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SELECTION OF RELEVANT VARIABLES IDENTIFY- ING THE RELATIONSHIP BETWEEN THE GENERAL GOVERNMENT SECTOR SIZE AND THE ECONOMY

The article is dedicated to research on relations between size of general government sector and the economy. The aim of this article is determination of the most important values that are used to identify relations between size of the sector and the economy, as well as determination of how frequently they appear in relation to pair of the variables that are being researched. In exploration of relations between the variables that describe size of general government sector and the economy, the authors used methodology that bases on Bayes networks. The object of the analyses was the economies of EU member states and their public finances systems. The period that was selected for the research has covered the years 2000–2013 (inclusive). In order to describe economies, the authors selected 18 variables, whereas to describe general government sector 15 variables. All variables were sourced from databases of Eurostat, OECD and World Bank. Among economy's measures and general government sector's measures, there were also some benchmarks found as standard ones (classical ones) as well as measures proposed by the authors, which were not used in the scientific descriptions that were dedicated to researches on sizes of general government sector. Ipso facto, this article fits in the discussion on, general government sector and optimization of its size, and at the same time it provides starting point for further research on sector's size and its influence on economy.

Keywords: General government sector, general government sector size, economy, economic policy, public finance, relationship between the general government sector size and the economy

1. INTRODUCTION

The impact of the general government sector on the economy is a subject of continuous analyses. As part of the research on the relations linking the economy, there is a number of approaches that are often being based on analogous variables, but lead to entirely different conclusions. An example that confirms the above statement is the results of research on the impact of public spending on the economy, as well as stimulus and de-

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stimulus impact of taxes on economic activity and the macroeconomic situation of country⁴. In both cases, the conducted research has frequently provided different results. This fact means that the question of dependences on the line "general government sector - economy" was still not sufficiently explored and explained. The topic of selection of variables that describe sizes of general government sector is still open. There are also constant studies on the methodology aimed for identifying and explaining the relation between the size of government and/or general government sector and its impact on the economy. Finally, a newer approach also abounds way of standardization and combination of input variables that are being compared (presenting the size of the general government sector) and outcome variables (i.e. parameters that describe the economy).

Considering the above, the purpose of this article was to typify the most important variables designed to identify the relations between the size of the general government sector and the economy. The realization of research objective has started with the analysis of the research approaches that were used in the past to describe the size of the central government and the general government sector. The conducted study has shown two patterns. First of all, there is vastly more frequent research on the impact of the size of the central government on the economy, rather than its impact on the size of the whole general government sector. Secondly, the dominant approach in defining the size of the central government and the size of the general government sector, is the use of measures based on income and public expenditure of the general government sector, which are expressed in relative values and absolute values, taking into account their internal structure (ie. the components of public revenues and expenditures), and a reference to the nominal and real ratios. This article assumes that due to the fact that the central government, according to ESA2010, is part of the general government sector, the measurements used to measure and extended by other components of the industry (referred in ESA2010), can be used to measure the size of the entire general government sector.

According to the results of the analyses, total public (general government) spending (expenditure / outlays), as a measure of the size of the central government (and hence to that also general government sector) appears in the literature continuously over the few past decades. The measure was used inter alia by Cameron⁵, Saunders⁶, as well as Bairam⁷ and

⁴ T. Skica, *Efektywność wydatkowania publicznego w Polsce*, Zeszyty Naukowe Politechniki Koszalińskiej 2011, No 14, pp. 115–129; T. Skica, *Ocena wpływu rozmiarów sektora finansów publicznych w Polsce na efektywność wydatkowania publicznego*, Acta Universitatis Nicolai Copernici 2014, Vol. 45(2), pp. 253–273; A. Alesina, S. Ardagna, *Large Changes in Fiscal Policy: Taxes Versus Spending*, NBER Working Paper, 2009, No. 15438, pp. 1–37; B.W. Poulson, J.G. Kaplan, *State Income Taxes and Economic Growth*, "Cato Journal" 2008, Vol. 28(1), pp. 53–71; R.B. Koester, R.C. Kormendi, *Taxation, aggregate activity and economic growth: Crosscountry evidence on some supply-side hypotheses*, "Economic Inquiry" 1989, Vol. 27, pp. 367–386; J. Agell, T. Lindh, H. Ohlsson, *Growth and the public sector: A critical review essay*, "European Journal of Political Economy" 1997, Vol. 13, pp. 33–52; J. Slemrod, *What do cross-country studies teach about government involvement, prosperity, and economic growth?*, "Brookings Papers on Economic Activity" 1995, Issue 2, pp. 373–431; A.B. Atkinson, *The welfare state and economic performance*, "National Tax Journal" 1995, Vol. 48, pp. 171–198; W. Easterly, S. Rebelo, *Fiscal policy and economic growth: An empirical investigation*, Journal of Monetary Economics" 1993, Vol. 32(3), pp. 417–458; C.J. Katz, V.A. Mahler, M.G. Franz, *The impact of taxes on growth and distribution in developed capitalist countries: A cross-national study*, "American Political Science Review" 1983, Vol. 77(4), pp. 871–886.

⁵ D.R. Cameron, *The Expansion of the Public Economy: A Comparative Analysis*. American Political Science Review 1978, 72, pp. 1243–1261.

⁶ P. Saunders, *Public Expenditure and Economic Performance in OECD Countries*. Paper presented at the Conference on Social Policy and the Economy: The Future of the Welfare State, University of Bath, June, 1984.

Conte & Darrat⁸. It also finds its application in a bit later studies of following authors: Hansson & Henrekson⁹ and Gwartney et al.¹⁰. The measure can be also found in current studies that are dedicated to measurement of central government and general government sector. These studies were conducted by, among others, Chobanov & Mladenova¹¹, de Witte & Moesen¹², as well as Colombier¹³, Afonso & Furceri¹⁴ and Bergh & Karlsson¹⁵ and Bergh & Henrekson¹⁶.

In addition to nominal value of public spending that is commonly used to measure the size of the general government sector, in the literature there are quite frequent appearances of measures of sector taken by using relative measures, i.e. share of nominal government expenditure in nominal GNP ratios (or GDP ratios). The measure appeared in studies of Marlow¹⁷, Barth & Bradley¹⁸, Peden & Bradley¹⁹, as well as in studies of Carlstrom & Gokhale²⁰, Engen & Skinner²¹ and Yavas²². The measure was also used by Fölster & Henrekson²³, Dar & Amirkhalkhali²⁴, as well as by Afonso et al.²⁵. Share of government

⁷ E. Bairam, *Government expenditure and economic growth : reflections on Professor Ram's approach, a new framework and some evidence from New Zealand time-series data*, Keio economic studies" 1988, Vol. 25. 1, pp. 59–66.

⁸ M.A. Conte, A.F. Darrat, *Economic growth and the expanding public sector: A reexamination*, Review of Economics and Statistics" 1988, 70, pp. 322–330.

⁹ P. Hansson, M. Henrekson, *A new framework for testing the effect of government spending on growth and productivity*, Public Choice" 1994, Vol. 81(3–4), pp. 381–401.

¹⁰ J. Gwartney, R. Holcombe, R. Lawson, *The scope of government and the wealth of nations*, Cato Journal" 1998, Vol. 18 No. 2, pp. 163–190.

¹¹ D. Chobanov, A. Mladenova, *What Is the Optimum Size of Government*, Institute for Market Economics, Bulgaria 2009.

¹² K. De Witte, W. Moesen, *Sizing the government*, "Public Choice" 2010, Vol. 145(1), pp. 39–55.

¹³ C. Colombier, *Growth Effects of Fiscal Policies: An Application of Robust Modified M-Estimator*, "Applied Economics" 2009, 41(7), pp. 899–912.

¹⁴ A. Afonso, D. Furceri, *Government Size, Composition, Volatility and Economic Growth*, "European Journal of Political Economy" 2010, 26(4), pp. 517–532.

¹⁵ A. Bergh, M. Karlsson, *Government Size and Growth: Accounting for Economic Freedom and Globalization*, Public Choice" 2010, 142(1–2), pp. 195–213.

¹⁶ A. Bergh, M. Henrekson, *Government Size and Growth: A Survey and Interpretation of the Evidence*, IFN Working Paper 2011, No. 858, 2011.

¹⁷ M.L. Marlow, *Private sector shrinkage and the growth of industrialized economies*, Public Choice 1986, Vol. 49(2), 143–154; M.L. Marlow, *Private sector shrinkage and the growth of industrialized economies: Reply*, Public Choice" 1988, Vol. 58(3), pp. 285–294.

¹⁸ J.R. Barth, M. Bradley, *The impact of government spending on economic activity*, Mimeo. The National Chamber Foundation, Washington 1988.

¹⁹ E.A. Peden, M.D. Bradley, *Government size, productivity and economic growth: The post war experience*, Public Choice 1989, Vol. 61(3), pp. 229–245.

²⁰ C. Carlstrom, J. Gokhale, *Government consumption, taxation, and economic activity*, Federal Reserve Bank of Cleveland, "Economic Review" 1991, 3rd Quarter, pp. 28–45.

²¹ E.M. Engen, J. Skinner, *Fiscal policy and economic growth*, Working Paper no 4223 NBER, Cambridge 1992.

²² A. Yavas, *Does too much government investment retard economic development of a country*, "Journal of Economic Studies" 1998, 25(4), pp. 296–308.

²³ S. Fölster, F. Henrekson, *Growth effects of government expenditure and taxation in rich countries*, European Economic Review" 2001, Vol. 45(8), pp. 1501–1520.

²⁴ A.A. Dar, S. Amirkhalkhali, *Government size, factor accumulation, and economic growth: evidence form OECD countries*, "Journal of Policy Modelling" 2002, Vol. 24, pp. 679–692.

nominal expenditure in nominal GNP ratios (or GDP ratios), constitutes measure used also in the studies of Dilrukshini²⁶, Scully²⁷ and Bose et al.²⁸ It was similarly often referred by Ramayandi²⁹, Kustepeli³⁰, as well as Yuk³¹. The measure was also mentioned in the studies on central government and general government sector by Jiranyakul & Brahmasrene³², Magazzino & Forte³³, as well as by Ruta et al.³⁴ and di Liddo et al.³⁵ Modified aspect of the measure mentioned above, which included realative measures in the place of public spending given in nominal values (i.e., real government expenditure to real GDP), are used in studies of inter alia Peltzman³⁶ and Marlow³⁷.

An alternative to presented above measures of the size of the central government and the general government sector, which refer to the overall level of public spending given in both relative and absolute terms, is the analysis of government and consumer spending sector made on the basis of the ratio share of government consumption in GDP expenditure. The measure was used in the studies of inter alia Landau³⁸ and Ram³⁹. It can be also found in the studies of following authors: Barth & Bradley⁴⁰, Grier & Tullock⁴¹, and

²⁵ A. Afonso, L. Schuknecht, V. Tanzi, *Public Sector Efficiency: An International Comparison*, Public Choice 2005, 123(3-4), pp. 321-347.

²⁶ W.A. Dilrukshini, *Public Expenditure and Economic Growth: Cointegration Analysis and Causality Testing*, Staff Studies Central of Sri Lanka, 2002, Vol. 34(1), pp. 51-68.

²⁷ G.W. Scully, *Economic Freedom, Government Policy and the Trade-Off Between Equity and Economic Growth*, Public Choice, 2002, Vol. 113(1-2), pp. 77-96.

²⁸ N. Bose, M.E. Haque, D.R. Osborn, *Public Expenditure and Growth in Developing Countries: Education is the Key*, Centre for Growth and Business Cycle Research Discussion Paper Series from Economics, The University of Manchester, Discussion Paper Series No. 030, 2003.

²⁹ A. Ramayandi, *Economic Growth And Government Size In Indonesia: Some Lessons For The Local Authorities*, Working Paper in Economics and Development Studies, Department of Economics Padjadjaran University, 2003, No. 200302.

³⁰ Y. Kustepeli, *The Relationship Between Government Size and Economic Growth: Evidence From a Panel Data Analysis*, Dokuz Eylül University-Faculty of Business-Department of Economics Discussion Paper Series", 2005, No. 05/06, November-December.

³¹ W. Yuk, *Government size and economic growth: Time-series evidence for the United Kingdom 1830-1993*, Econometrics Working Paper EWP0501, 2005, Department of Economics, University of Victoria, pp. 1-22.

³² K. Jiranyakul, T. Brahmasrene, *The Relationship Between Government Expenditure and Economic Growth in Thailand*, "Journal of Economics and Economic Education Research" 2007, Vol.8(1), pp. 93-103.

³³ C. Magazzino, F. Forte, *Optimal size of government and economic growth in EU-27*, MPRA Paper 26669, University Library of Munich, Germany 2010.

³⁴ A. Ruta, S. Estrin, T. Mickiewicz, *Size matters: entrepreneurial entry and government*, Small Bus Econ, 2012, 39, pp. 119-139.

³⁵ G. Di Liddo, C. Magazzino, F. Porcelli, *Decentralization, growth and optimal government size in the Italian regional framework. A BARS curve approach*, CREI Working Paper, No. 1/2015.

³⁶ S. Peltzman, *The Growth of Government*, "The Journal of Law and Economics", October 1980, pp. 209-87.

³⁷ M.L. Marlow, *Private sector shrinkage and the growth of industrialized economies*, Public Choice 1986, Vol. 49(2), 143-154; M.L. Marlow, *Private sector shrinkage and the growth of industrialized economies: Reply*, Public Choice 1988, Vol. 58(3), pp. 285-294.

³⁸ D. Landau, *Government Expenditure and Economic Growth: A Cross-Country Study*, "Southern Economic Journal", January 1983, 49, pp. 783-792.

³⁹ A. Ram, *Association Government Size and Economic Growth: A New Framework and Some Evidence from Cross-Section and Time-Series Data*, "The American Economic Review", Vol. 76, No. 1 (Mar., 1986), pp. 191-203.

⁴⁰ J.R. Barth, M. Bradley, *The impact of government spending on economic activity*, Mimeo. The National Chamber Foundation, Washington 1988.

Carlstrom & Gokhale⁴² and Levine & Renelt⁴³. The level of consumer spending as the measure of sector was also used by Lin⁴⁴ and Guseh⁴⁵, as well as Vedder & Gallaway⁴⁶, Bose et al.⁴⁷ and Ramayandi⁴⁸. Finally, general government sector scale of consumption constitutes the exponent of its size in the studies of Gunalp & Dincer⁴⁹ and Chobanov & Mladenova⁵⁰.

A kind of “modification” of the presented above ratio, is its recognition in real terms using ratios of real government consumption expenditure to real GDP used, among others, by Summers & Heston⁵¹, Barro⁵², as well as by Easterly & Rebelo⁵³, Sheehey⁵⁴ and Dar & Amirkhalkhali⁵⁵. Consumer spending as a measure of central government and general government sector are also given per capita ratio and recognized as a measure, which is called real government consumption expenditure to real GDP per capita⁵⁶. Measures related to consumer spending, as a ratio of the size of the general government sector, are share of government consumption expenditure in total consumption expenditures used by Afonso & Jalles⁵⁷ and growth rate of government consumption expenditure in GDP that

⁴¹ K. Grier, G. Tullock, *An empirical analysis of cross-national economic growth 1951–1980*, “Journal of Monetary Economics” 1989, 24, pp. 48–69.

⁴² C. Carlstrom, J. Gokhale, *Government consumption, taxation, and economic activity*, Federal Reserve Bank of Cleveland, “Economic Review” 1991, 3rd Quarter, pp. 28–45.

⁴³ R. Levine, D. Renelt, *A sensitivity analysis of cross-country growth regressions*, “American Economic Review” 1992, 82(4), pp. 942–963.

⁴⁴ S.A.Y. Lin, *Government spending and economic growth*, Applied Economic” 1994, Vol. 26, pp. 83–94.

⁴⁵ J.S. Guseh, *Government size and economic growth in developing countries: a political-economy framework*, Journal of Macroeconomics” 1997, Vol. 19(1), pp. 175–192.

⁴⁶ R.K. Vedder, L.E. Gallaway, *Government size and Economic growth*, “Paper prepared for the Joint Economic Committee of the US Congress” 1998, pp.1–15.

⁴⁷ N. Bose, M.E. Haque, D.R. Osborn, *Public Expenditure and Growth in Developing Countries: Education is the Key*, Centre for Growth and Business Cycle Research Discussion Paper Series from Economics 2003, The University of Manchester, Discussion Paper Series No. 030.

⁴⁸ A. Ramayandi, *Economic Growth And Government Size In Indonesia: Some Lessons For The Local Authorities*, Working Paper in Economics and Development Studies, Department of Economics Padjadjaran University, No. 2003/02.

⁴⁹ B. Gunalp, O. Dincer, *The Optimal Government Size in Transition Countries*. Department of Economics, Working Paper Series, Hacettepe University Beytepe, Ankara and Department of Commerce, Massey University, Auckland 2005.

⁵⁰ D. Chobanov, A. Mladenova, *What Is the Optimum Size of Government*, Institute for Market Economics, Bulgaria 2009.

⁵¹ R. Summers, A. Heston, *Improved International Comparisons of Real Product and its Composition: 1950–80*, “Review of Income and Wealth” 1984, June 1984, 30, pp. 207–262.

⁵² R.J. Barro, *A cross-country study of growth, saving, and government*, Working paper 1989, no 2855 NBER, Cambridge, MA; R.J. Barro, *Economic growth in a cross section of countries*, Quarterly Journal of Economics” 1991, Vol. 106(2), pp. 407–444.

⁵³ W. Easterly, S. Rebelo, *Fiscal policy and economic growth: An empirical investigation*, Journal of Monetary Economics” 1993, Vol. 32(3), pp. 417–458.

⁵⁴ E. Sheehey, *The Effect of Government Size on Economic Growth*, Eastern Economic Journal” 1993, Vol. 19, issue 3, pp. 321–328.

⁵⁵ A.A. Dar, S. Amirkhalkhali, *Government size, factor accumulation, and economic growth: evidence from OECD countries* Journal of Policy Modelling” 2002, Vol. 24, pp. 679–692.

⁵⁶ D. Josheski, D. Lazarov, C. Koteski (2011), *Analysis of the optimal size of the government consumption*, Unpublished (http://mpira.ub.uni-muenchen.de/32983/1/MPRA_paper_32983.pdf).

⁵⁷ A. Afonso, J. Jalles, *Economic Performance and Government Size*, Working Paper no. 21, DE UECE.

appears *inter alia* in studies of Ram⁵⁸ and Guseh⁵⁹. Finally, it should be noted that in addition to the classic comparison of public spending to GDP (including current expenditure), in the literature there are perceived attempts to modify this-way-understand ratio of the general government sector. For instance Korpi⁶⁰ and Alexander⁶¹, in place of the consumer spending that are referred in standard way to GDP, decided to use such measures as government final consumption, current disbursements of government, or total outlays of government include current disbursements plus gross capital formation.

Literature suggests also that size of central government and general government sector in economy is expressed by the scale of sector's investment spending. Measures that present such recognition of the issue being studied are *inter alia*: share of government investment in GDP Expenditure applied by Barth & Bradley⁶², Easterly & Rebelo⁶³, Illarionov & Pivovarov⁶⁴, and Ramayandi⁶⁵, Gross real public investment is real GDP, as well as total consolidated public investment and public investment by general government to GDP, which were used in the studies of Easterly & Rebelo⁶⁶.

The division into consumer and investment spending, as a measure of the size of the central government and general government sector, complement the disaggregated measures of government expenditures (government provision of goods and services, defense, education, subsidies to industries, etc.) used in the studies of Friedland & Sanders⁶⁷ and Levine & Renelt⁶⁸, but also in studies of Easterly & Rebelo⁶⁹, Hansson & Henrekson⁷⁰ or Lin⁷¹. This measure, as the exponent of the size of central government and because of

⁵⁸ R. Ram, *Association Government Size and Economic Growth: A New Framework and Some Evidence from Cross-Section and Time-Series Data*, "The American Economic Review" 2011, Vol. 76, No. 1 (Mar., 1986), pp. 191–203.

⁵⁹ J.S. Guseh, *Government size and economic growth in developing countries: a political-economy framework*, "Journal of Macroeconomics" 1997, Vol. 19(1), pp. 175–192.

⁶⁰ W. Korpi, *Economic Growth and the Welfare State: Leaky Bucket or Irrigation System?*, "European Sociological Review" 1985, Vol. 1, No. 2 (Sep., 1985), pp. 97–118.

⁶¹ W.R.J. Alexander, *Growth: Some combined cross-sectional and time series evidence from OECD countries*, *Applied Economics* 1990, 22, pp. 1197–1204.

⁶² J.R. Barth, M. Bradley, *The impact of government spending on economic activity*, Mimeo. The National Chamber Foundation, D.C. Washington 1988.

⁶³ W. Easterly, S. Rebelo, *Fiscal policy and economic growth: An empirical investigation*, "Journal of Monetary Economics" 1993, Vol. 32(3), pp. 417–458.

⁶⁴ A. Illarionov, N. Pivovarov, *Size of the State and Economic Growth*, *Voprosy Ekonomiki* (Issues of Economy) 2002, Vol. 9, pp. 18–45.

⁶⁵ A. Ramayandi, *Economic Growth And Government Size In Indonesia: Some Lessons For The Local Authorities*, Working Paper in Economics and Development Studies 2003, Department of Economics Padjadjaran University, No. 200302.

⁶⁶ W. Easterly, S. Rebelo, *Fiscal policy and economic growth: An empirical investigation*, "Journal of Monetary Economics" 1993, Vol. 32(3), pp. 417–458.

⁶⁷ R. Friedland, J. Sanders, *The Politics of Economic Growth in Market Economies*. Unpublished manuscript, Department of Sociology, University of California, Santa Barbara 1983.

⁶⁸ R. Levine, D. Renelt, *A sensitivity analysis of cross-country growth regressions*, "American Economic Review" 1992, 82(4), pp. 942–963.

⁶⁹ W. Easterly, S. Rebelo, *Fiscal policy and economic growth: An empirical investigation*, "Journal of Monetary Economics" 1993, Vol. 32(3), pp. 417–458.

⁷⁰ P. Hansson, M. Henrekson, *A new framework for testing the effect of government spending on growth and productivity*, *Public Choice* 1994, Vol. 81(3–4), pp. 381–401.

⁷¹ S.A.Y. Lin, *Government spending and economic growth*, "Applied Economics" 2001, Vol. 26, pp. 83–94.

that also general government sector, was also used by Heitger⁷², Vedder & Gallaway⁷³, and finally the Romero-Avila & Strauch⁷⁴.

A measure which, due to the reference to public expenditure structure corresponds with presented above approach to measure the size of the central government and general government sector, is the ratio called level of public transfer payments (including social security expenditure), used among others in the studies of authors such as Friedland & Sanders⁷⁵, Korpi⁷⁶ as well as by Barth & Bradley⁷⁷, Easterly & Rebelo⁷⁸ or Henrekson & Hansson⁷⁹. The last of the measures based on public spending and related to its configurations of presented parameters describing general government sector, is measure called expenditure shares computed as the average of (government investment + current disbursements of government) to GDP. It was used in the studies of Folster & Henrekson⁸⁰.

In addition to review of presented above measures of the size of the central government and general government sector based on public expenditure, there is equally important place in the literature for measures based on public revenues. The most general category of income-based measures are the ratios based on the total underlying values of public revenues related to GDP or GNP. This type of measure is share of government revenue in GNP used by Robinson⁸¹ and Korpi⁸². Due to its general character, the more beneficial should be ration called disaggregated measures of government revenue that includes structure of public revenues components. This measure was applied by, among others, Romero-Avila & Strauch⁸³. The consequence of breaking the total pool of public revenues into its sub-parts, was to use to measure a size of central government and the general government sector some measures, which are based on taxes as a main component of public revenue. An example of such measure is the ratio called the total tax revenue

⁷² B. Heitger, *The Scope of Government and Its Impact on Economic Growth in OECD Countries*, Kiel Working Paper 2001, No. 1034, pp. 1–36.

⁷³ R.K. Vedder, L.E. Gallaway, *Government size and Economic growth*, Paper prepared for the Joint Economic Committee of the US Congress 1998, pp. 1–15.

⁷⁴ D. Romero-Avila, R. Strauch, *Public Finances and Long-Term Growth in Europe: Evidence from a Panel Data Analysis*, "European Journal of Political Economy" 2008, 24(1), pp. 172–191.

⁷⁵ R. Friedland, J. Sanders, *The Politics of Economic Growth in Market Economies*, Unpublished manuscript, Department of Sociology, University of California, Santa Barbara 1983.

⁷⁶ W. Korpi, *Economic Growth and the Welfare State: Leaky Bucket or Irrigation System?*, "European Sociological Review" 1985, Vol. 1, No. 2 (Sep., 1985), pp. 97–118.

⁷⁷ J.R. Barth, M. Bradley, *The impact of government spending on economic activity*, Mimeo. The National Chamber Foundation, Washington 1988.

⁷⁸ W. Easterly, S. Rebelo, *Fiscal policy and economic growth: An empirical investigation*, "Journal of Monetary Economics" 1993, Vol. 32(3), pp. 417–458.

⁷⁹ P. Hansson, M. Henrekson, *A new framework for testing the effect of government spending on growth and productivity*, *Public Choice* 1994, Vol. 81(3–4), pp. 381–401.

⁸⁰ S. Fölster, F. Henrekson, *Growth effects of government expenditure and taxation in rich countries*, "European Economic Review" 2001, Vol. 45(8), pp. 1501–1520.

⁸¹ R. Robinson, *Dependency, Government Revenue, and Economic Growth, 1955–70*, *Studies in Comparative International Development*, 1977, 12, pp. 3–28.

⁸² W. Korpi, *Economic Growth and the Welfare State: Leaky Bucket or Irrigation System?*, "European Sociological Review" 1985, Vol. 1, No. 2 (Sep., 1985), pp. 97–118.

⁸³ D. Romero-Avila, R. Strauch, *Public Finances and Long-Term Growth in Europe: Evidence from a Panel Data Analysis*, "European Journal of Political Economy" 2008, 24(1), pp. 172–191.

that was used, among others, by Agell et al.⁸⁴, and Colombier⁸⁵ as well as Afonso & Furceri⁸⁶, Bergh & Karlsson⁸⁷ and Bergh & Henrekson⁸⁸. This measure, however, give the value of tax revenue in nominal terms, which reduces the amount of information resulting from the values presented this way. A slightly different measure based on taxes is ratio of taxation to GDP. Presented measure shows the ratio of tax burden to GDP. Because of that it is not considered as a measure of tax revenues, but the scale of tax burdening economy. This indicator is used in the studies by, among others, Rabushka⁸⁹ as well as Kormendi & Koester⁹⁰, and Folster & Henrekson⁹¹, and Chobanov & Mladenova⁹². Approximate measures of the fiscal burden are development of presented relative measures. The first of these is the ratio called average tax rates (total tax revenue divided by GDP), used among others by Engen & Skinner⁹³ and Agell et al.⁹⁴ The second measure is a parameter called tax shares, which is computed as the average of (total direct taxes + social security contributions received by government + Indirect taxes) to GDP, and which was used in study of inter alia Folster & Henrekson⁹⁵. Complement to measures that base on tax revenue and tax rates is the ratio called the government fiscal surplus ratio to GDP, which is used in, among others, studies of Levine & Zervos⁹⁶.

The natural consequence of expressing the size of the central government and the general government sector detachable from the revenue side and the expenditure side, is a reference of these comparisons' results to the figures of sector that take into account the information load carried out separately by both sides of the public finance system (revenue and expenditure sides). The ratio that opens above group of measures that are used for measurement of size of the central government and general government sector, is ratio based on results of entire budget and entire sector. To these measures we can include

⁸⁴ J. Agell, H. Ohlsson, P. Thoursie Skogman, *Growth Effects of Government Expenditure and Taxation in Rich Countries: A Comment*, "European Economic Review" 2006, 50(1), pp. 211–219.

⁸⁵ C. Colombier, *Growth Effects of Fiscal Policies: An Application of Robust Modified M-Estimator*, "Applied Economics" 2009, 41(7), pp. 899–912.

⁸⁶ A. Afonso, D. Furceri, *Government Size, Composition, Volatility and Economic Growth*, "European Journal of Political Economy" 2010, 26(4), pp. 517–532.

⁸⁷ A. Bergh, M. Karlsson, *Government Size and Growth: Accounting for Economic Freedom and Globalization*, "Public Choice" 2010, 142(1–2), pp. 195–213.

⁸⁸ A. Bergh, M. Henrekson, *Government Size and Growth: A Survey and Interpretation of the Evidence*, "IFN Working Paper" 2011, No. 858.

⁸⁹ A. Rabushka, *Taxation and Liberty in the Third World*, Paper presented at the Liberty Fund Symposium, September 1985, pp. 26–29.

⁹⁰ R.B. Koester, R.C. Kormendi, *Taxation, aggregate activity and economic growth: Crosscountry evidence on some supply-side hypotheses*, *Economic Inquiry* 1989, Vol. 27, pp. 367–386.

⁹¹ S. Fölster, F. Henrekson, *Growth effects of government expenditure and taxation in rich countries*, "European Economic Review" 2001, Vol. 45(8), pp. 1501–1520.

⁹² D. Chobanov, A. Mladenova, *What Is the Optimum Size of Government*, Institute for Market Economics, Bulgaria 2009.

⁹³ E.M. Engen, J. Skinner, *Fiscal policy and economic growth*, Working Paper no 4223 NBER, Cambridge 1992.

⁹⁴ J. Agell, T. Lindh, H. Ohlsson, *Growth and the public sector: A critical review essay*, "European Journal of Political Economy" 1997, Vol. 13, pp. 33–52.

⁹⁵ S. Fölster, F. Henrekson, *op. cit.*, pp. 1501–1520.

⁹⁶ R. Levine, S.J. Zervos, *What we have learned about policy and growth from cross-country regressions*, *American Economic Review* 1993, 83(2), Papers and Proceedings, pp. 426–430.

share of the public budget in total output, which was used in the study of Bajo-Rubio⁹⁷, central government surplus (consolidated public sector surplus) to GDP, followed in the study by Easterly & Rebelo⁹⁸, as well as the central government deficit measure that was used in the article of Alexander⁹⁹ and government financial balance measure (ratio of government receipts minus outlays to GDP), used in the development of Dar & Amirkhalkhali¹⁰⁰. The ratio called the general government net lending corresponds with the ratios presented above. This indicator was applied, among others, in study of Chobanov & Mladenova¹⁰¹.

Presented above approaches to the measurement of the general government sector do not cover the issue of ratios and approaches to quantify of its size. The group of measures that has slightly different structure and describes the size of central government and the general government sector, are some ratios based on underlying assets held by the government and the sector (e.g. share of assets owned by government in total national assets and sale of state assets), as well as ratio based on the accumulation of capital (eg. gross fixed capital formation). The first of asset-backed measures was used inter alia in study of Illarionov & Pivovarova¹⁰². The second was used in study of Chobanov & Mladenova¹⁰³. The last of the ratios that base on assets was applied in the study of authors such as Alexander¹⁰⁴ or Easterly & Rebelo¹⁰⁵, but also in studies of Heitger¹⁰⁶ and Dar & Amirkhalkhali¹⁰⁷. Supplement of measures based on public funds and financial assets, are the ratios that relate to the number of people working in the sector, such as the general government sector employment and share of employees in the government sector in over-all employment. These measures were used in the study of, among others, Gupta et al.¹⁰⁸ and Illarionov & Pivovarova¹⁰⁹ or McTigue¹¹⁰ and Mitchell¹¹¹.

⁹⁷ O. Bajo-Rubio, *A further generalization of the Solow growth model: the role of the public sector*, "Economic Letters" 2000, Vol. 68(1), pp. 79–84.

⁹⁸ W. Easterly, S. Rebelo, *Fiscal policy and economic growth: An empirical investigation*, "Journal of Monetary Economics" 1993, Vol. 32(3), pp. 417–458.

⁹⁹ W.R.J. Alexander, *Growth: Some combined cross-sectional and time series evidence from OECD countries*, "Applied Economics" 1990, 22, pp. 1197–1204.

¹⁰⁰ A.A. Dar, S. Amirkhalkhali, *Government size, factor accumulation, and economic growth: evidence form OECD countries*, "Journal of Policy Modelling" 2002, Vol. 24, pp. 679–692.

¹⁰¹ D. Chobanov, A. Mladenova, *op. cit.*

¹⁰² A. Illarionov, N. Pivovarova, *Size of the State and Economic Growth*, *Voprosy Ekonomiki* (Issues of Economy) 2002, Vol. 9, pp. 18–45.

¹⁰³ D. Chobanov, A. Mladenova, *op. cit.*

¹⁰⁴ W.R.J. Alexander, *op. cit.*

¹⁰⁵ W. Easterly, S. Rebelo, *op. cit.*

¹⁰⁶ B. Heitger, *The Scope of Government and Its Impact on Economic Growth in OECD Countries*, Kiel Working Paper 2001, No. 1034, pp. 1–36.

¹⁰⁷ A.A. Dar, S. Amirkhalkhali, *Government size, factor accumulation, and economic growth: evidence form OECD countries*, *Journal of Policy Modelling* 2002, Vol. 24, pp. 679–692.

¹⁰⁸ S. Gupta, L. Leruth, L. de Mello, S. Chakravarti, *Transition Economies: How Appropriate Is the Size and Scope of Government?*, *International Monetary Fund Working Paper* 2001, WP/01/05, pp. 1–44.

¹⁰⁹ A. Illarionov, N. Pivovarova, *Size of the State and Economic Growth*, "Voprosy Ekonomiki (Issues of Economy)" 2002, Vol. 9, pp. 18–45.

¹¹⁰ M. McTigue, *Rolling Back Government: Lessons from New Zealand*, April 2004, Vol. 33, No 4, reprinted by permission from Imprimis, the National speech digest of Hillsdale College (www.hillsdale.edu).

Review of presented approaches to measure the size of the central government and the general government sector demonstrates a number of research efforts to develop a set of variables that allow to describe a size of general government sector in the best way. This article and its research objective is part of a discussion on exploring ratios of the size of the general government sector. An integral part of the article is also the attempt to identify the relationship between the size of the general government sector and the economy, which constitutes an additional aspect of the research work adopted by the authors of this study.

2. DATA AND METHODS

2.1. Data collection

The starting point for the preparation of this article was the selection of variables available to describe the size of the general government sector and the economy. The object of analysis was the economies of the EU Member States and their public finance systems. For these studies, it was admitted to cover a period of 13 years and to take into account the years from 2000 to 2013 (inclusive), with the exception of data from the year 2001. This year due to the large number of missing data were eliminated from the analysis. Basing on literature review and research experience of authors, there were 18 variables selected to describe the economy (see Table 1) and 15 variables selected in order to describe general government sector (see Table 2). The collected data were quantitative in nature and took into account the values given in both relative and absolute terms. The source of statistical data was the databases of Eurostat, OECD and World Bank. Among the ratios of the economy and the general government sector, there were also included measures considered as both standard (classic) and measures proposed by the authors, which have not been used in studies dedicated to research on the size of the general government sector and the economy. Their selection was purposeful and corresponded to specificity of the topic being examined. Thus, the article brings added value in the form of test variables, which analysis have not been conducted in studies dedicated to the above topics.

¹¹¹ D.J. Mitchell, *The Impact of Government Spending on Economic Growth*, The Heritage Foundation, March 31, 2005, No. 1831.

Table 1. Variables describing the economy

No	Name	Unit
1	External balance of goods and services	Million Euro
2	Gross Domestic Product in current prices (per inhabitant)	GDP per inhabitant
3	Production in industry – dynamic	Percentage change compared to same period in previous year
4	Balance of the current account	Million Euro
5	Potential output of total economy	Million Euro
6	Harmonised Indices of Consumer Prices (HICPs)	Annual average rate of change
7	Inward FDI flows	Million USD
8	FDI (Foreign direct investment)	Million USD
9	Real effective exchange rate	Index 1999 = 100
10	Human Development Index – HDI	Value from 0 to 1
11	Outward FDI flows	Million USD
12	Growth rates of GDP (percent)	Percentage change
13	Gross capital formation (% GDP)	% GDP
14	Gross Domestic Product in current prices (per inhabitant) - dynamic	Percentage change
15	Activity rate	in %
16	Retail sales – dynamic	Index of turnover – Total 2010 = 100
17	Potential output of total economy - dynamic	Annual average rate of growth - percentage
18	Unemployment rate	in %

Source: Own work.

Table 2. Variable describing size of general government sector

No	Name	Unit
1	General Government gross capital formation (% GDP)	% GDP
2	Government consolidated gross debt (% GDP)	% GDP
3	Public sector employment	Number of people
4	Total General Government Expenditure (euro per inhabitant)	euro per inhabitant
5	Total General Government Revenue (euro per inhabitant)	euro per inhabitant
6	Net lending/ borrowing	Million Euro
7	Total General Government Expenditure (% GDP)	% GDP
8	Central government deficit (% GDP)	% GDP
9	General Government Sector Output (% GDP)	% GDP

Table 2 (contd). Variable describing size of general government sector

No	Name	Unit
10	Gross value added or General Government total value-added	basic (current) prices
11	The ratio of total taxes to GDP	% GDP
12	Final consumption expenditure	% GDP
13	General government deficit (% GDP)	% GDP
14	Total General Government Revenue (% GDP)	% GDP
15	General government Gross fixed capital formation (% GDP)	% GDP

Source: Own work.

The data were incomplete (missing attribute values), noisy (containing errors) and unnormalized. Therefore, in order to prepare the data for the analysis a preprocessing was necessary. The data preprocessing included three steps: (i) data cleaning to remove incompleteness and noise (ii) data reduction i.e. discretization (iii) data integration. The data was characterized by a large number of missing attributes/cases. For this reason, it was assumed that for further research the attributes/cases, in which the number of missing values is less than 1/3 of the total number, were selected. Then, single missing values were completed using advanced methods based on generalized additive models and the method of k-nearest neighbors.

The data describing numerical attributes were discretized. Two methods of discretization process were used: equal-width, where the interval range of values is constant and equal-frequency, where frequency of instances in the range is constant. For further analysis the following numbers of discretization intervals were selected: 4, 6 and 8. Moreover the interval labels were used to replace actual data values.

In order to assess the impact of the general government sector on the economy the data integration was required. The data was collected in the form of decision tables¹¹² i.e. tables of 2a type (consisting of any number of descriptive attributes (variables from general government sector size) and only one dependent attribute (called decision from economy domain) located in the rightmost column. There were 224 decision tables for examining the relationship between general government sector size and the economy, which were prepared for each discretization interval respectively.

2.2. Methods

The main goal of our research was to identify the most significant factors defining the relationship between general government sector and economy. To achieve this goal we used an effective method from machine learning based on Bayesian network. Therefore a brief introduction to the mentioned learning model seems necessary.

Bayesian networks¹¹³ are graphical representation of probabilistic relationships among a set of random variables $X=\{X_1,...,X_n\}$. Each variable X_i (node in graph) contains finite

¹¹² Z. Pawlak, *Rough Sets*, Intern J Comp Inf Sci 1982, 11, pp. 341–356.

¹¹³ F.V. Jensen, *Bayesian Networks and Decision Graphs*, Springer-Verlag, New York 2001.

set of mutually exclusive states (values) x_1, \dots, x_n . The nodes and arcs form a directed, acyclic graph (DAG). The set of directed connections (arcs) in the network defines a hierarchy of nodes. If there exists an arc going out from node X_i to node X_j , then we say that X_i is a parent of X_j or X_j is a child of X_i . The intuitive meaning of an arc in the network corresponds to the statement that X_i has a direct influence on X_j . Each node is annotated with a conditional probability distribution (CPD) that represents $p(X_i | Pa(X_i))$, where $Pa(X_i)$ denotes the parents of X_i in DAG. The pair (DAG, CPD) describes the joint distribution $p(X_1, \dots, X_n)$. An unique joint probability distribution over X from DAG is expressed by the following relationship:

$$p(X_1, \dots, X_n) = \prod_i p(X_i | Pa(X_i)) \quad (1)$$

Bayesian networks are based on the assumption of independence of nodes, so the network structure is essential for specifying the intransitive dependencies and provides information about the formation of probability distribution. Bayesian networks can be constructed manually or learned from data. With the increasing availability of data, learning is evidently a more feasible alternative for developing a Bayesian network. The Bayesian network learning problem can be categorized as 1) a parameter-learning problem when the structure is known, and 2) a structure-learning problem when the structure is unknown. Our research focused on the latter issue. Among various methods of structure learning¹¹⁴, the greedy search provides a way to obtain a good model in a reasonable time frame as compared to other methods. For a fixed amount of computational time, a greedy search with random restarts produces better models than either simulated annealing or best-first search does¹¹⁵. In our research, Bayesian belief networks are developed with the help of a heuristic algorithm using the Bayesian function of network structure to distribution matching as a scoring function, named K2¹¹⁶.

¹¹⁴ G.F. Cooper, E. Herskovitz, *A Bayesian Method for the Induction of probabilistic networks from data*, Mach Learn 1992, 9, pp. 309–347; A.L. de Santana, C.R. Frances, C.A. Rocha, S.V. Carvalho, N.L. Vijaykumar, L.P. Rego, J.C. Costa, *Strategies for Improving the Modeling and interpretability of Bayesian networks*, Data and Knowledge Engineering, 2007, 63(1), pp. 91–107; F. Liu, F. Tian, Q. Zhu, *An Improved Greedy Bayesian Network Learning Algorithm on Limited Data*, Lecture Notes in Computer Science, 2007a, Part I, 4668, pp. 49–57; F. Liu, Q. Zhu, *The Max-relevance and Minredundancy Greedy Bayesian Network Learning Algorithm*, Lecture Notes in Computer Science, 2007, Part I, 4527, pp. 346–356; W. Lam, F. Bacchus, *Using Causal Information and Local Measures to Learn Bayesian Networks* [in:] Proceedings of the Ninth Conference on Uncertainty in Artificial Intelligence, D. Heckerman, A. Mamdani (eds.), Morgan Kaufmann, 1993, pp. 243–250; W. Lam, F. Bacchus, *Learning Bayesian Belief Networks: an Approach Based on the MDL Principle*, Computational Intelligence, 1994, 10(3), pp. 269–293; D.M. Chickering, D. Heckerman, C. Meek, *A Bayesian Approach to Learning Bayesian Networks with Local Structure*, Technical report MSR-TR-97-07, Microsoft Research 1997b; H. Steck, *On the Use of Skeletons when Learning in Bayesian Networks* [in:] Proceedings of the Sixteenth Conference on Uncertainty in Artificial Intelligence, C. Boutilier, M. Goldszmidt (eds.), Morgan Kaufmann, 2000, pp. 558–565; E. Faulkner, *K2GA: Heuristically Guided Evolution of Bayesian Network Structures from Data*, in Proceedings of the IEEE Symposium on Computational Intelligence and Data Mining, IEEE, 2007, pp. 18–25; F. Sahin, A. Devasia, *Distributed Particle Swarm Optimization for Structural Bayesian Network Learning* [in:] Swarm Intelligence: Focus on Ant and Particle Swarm Optimization, F.T.S. Chan, M.K. Tiwari (eds.), I-Tech Education and Publishing, Chapter 27, Vienna, Austria 2007, pp. 505–532.

¹¹⁵ D.M. Chickering, *Optimal Structure Identification with Greedy Search*, Journal of Machine Learning Research” 2002, 3, pp. 507–55.

¹¹⁶ F.V. Jensen, *op. cit.*

Our experience with this method shows that it is robust – it finds informative features in data sets. It has been successfully used in various applications of medicine¹¹⁷.

Initially, the set of classifiers (learning model) for 4, 6 and 8 discretization intervals in the form of bayesian network was built. The BeliefSEEKER system¹¹⁸ was used for this purpose. The classifiers in the form of bayesian networks were obtained by applying the greedy algorithm K2 maintaining constant value of Dirichlet parameter ($\alpha = 50$), established during previously performed analysis of data sets. Then the learning models were tested using 10-fold- cross-validation. Ten-fold cross validation is commonly accepted as a standard way of validating classifiers. In this technique all cases are randomly reordered, and then a set of all cases is divided into ten mutually disjoint subsets of approximately equal size. For each subset, all remaining cases are used for training, i.e., for network construction, while the subset is used for testing. This approach allowed to obtain the best learning models (in form of networks) and also allowed studying the importance of attributes used for the description of the general government sector size.

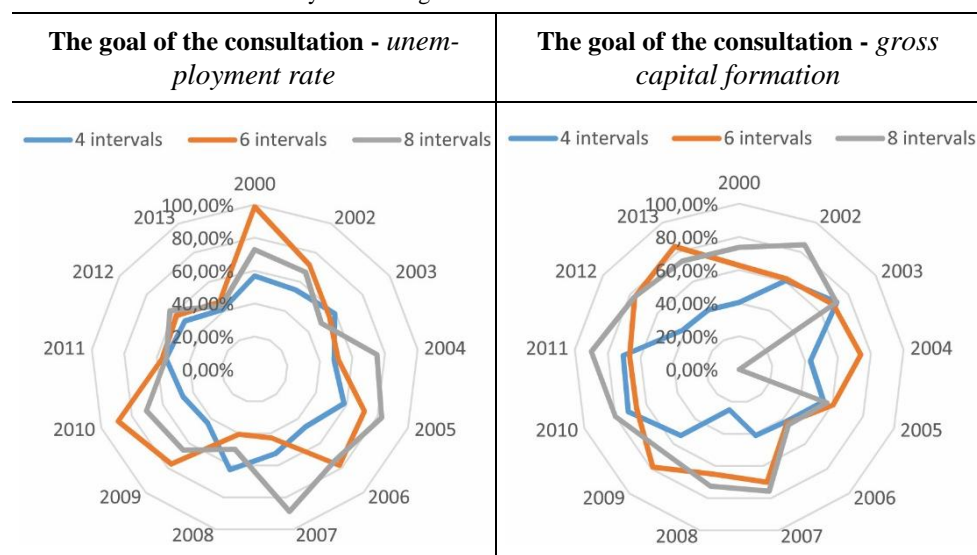
3. RESULTS AND DISCUSSION

Evaluation of the classification effectiveness of the generated Bayesian networks indicates that the obtained learning models are characterized by a high classification efficiency for 4 discretization intervals. Due to the large number of evaluated classifiers, as mentioned above, only selected results (for *unemployment rate* and *gross capital formation*), were presented in Table 3.

¹¹⁷ J.W. Grzymała-Busse, Z.S. Hippe, T. Mroczek, W. Paja, A. Buciński, *A Preliminary Attempt to Validation of Glasgow Outcome Scale for Describing Severe Brain Damages* [in:] Z.S. Hippe, J.L. Kulikowski (eds.), *Human-Computer Systems Interaction Backgrounds and Applications*, Springer-Verlag, Berlin/Heidelberg 2009, pp. 173–182; T. Mroczek, J.W. Grzymała-Busse, Z.S. Hippe, *A New Machine Learning Tool for Mining Brain Stroke Data*, in *Proceedings of 3rd IEEE International Conference on Human System Interaction (HSI'2010)*, Rzeszow 2010, 13–15.05.2010, pp. 246–250; T. Mroczek, K. Pancerz, J. Warchol, *Belief Networks in Classification of Laryngopathies Based on Speech Spectrum Analysis*, “Lecture Notes in Artificial Intelligence” 2012, 7414, pp. 222–231.

¹¹⁸ T. Mroczek, *Bayesian Network* [in:] Z.S. Hippe, J.W. Grzymała-Busse (eds.), *Selected methods data mining. Analysis of the inconsistency data*, Springer –Verlag 2011, pp.55–75 and 85–99.

Table 3. Classification accuracy of learning models obtained for various discretization intervals



Source: Own work.

Analysis of the best learning models (for 4 discretization intervals) allowed finding the most important attributes describing size of the general government sector. The selected variables describe by far the largest extent the relationship between the size of the general government sector and the economy. Due to this, selected variables are the set of indicators that allow you to combine information about the scale of the sector and its potential impact on the economy. The most important attributes in Bayesian networks are the attributes having direct influence on the dependent variable. The frequency of attribute occurrences in networks is presented in Table 4.

The significance of the most relevant attributes was also confirmed during the analysis of learning models for 6 and 8 discretization intervals. It turned out that attributes indicated as the most important (from a classification point of view) for the best learning models had also a major role during building the learning models for 6 and 8 discretization intervals.

The Table 4 presents occurrences of the most significant attributes in Bayesian networks describing relation of general government sector with the economy. In accordance to the results of undertaken calculation of variable describing general government sector, which in the period of 2000-2013 was the most frequently indicated in the rules describing economy, was a parameter called total general government revenue (euro per inhabitant). In entire period under consideration, this parameter occurred 66 times in rules that show relation of sector with variables describing economies of examined EU countries. Second parameter in terms of frequency (61 cases) in the rules describing the relationship of the sector and the economy, was the variable called total general government expenditure

(euro per inhabitant). Third place was taken by ratio net lending / borrowing (million euros), which appeared in the 46 rules and proved a relation between size of the general government sector and the economy.

Next position were taken by the flowing variables: public sector employment (number of people) – 36 occurrences, total general government expenditure (% GDP) – 35 occurrences, central government deficit (% GDP) – 33 occurrences and general government deficit (% GDP) – 30 occurrences in rules describing relation of general government sector with economy. Following ratios noted less than 30 occurrences in rules describing examined dependence: ratio of total taxes to GDP (% GDP) – 28 occurrences and total general government revenue (% GDP) – 24 occurrences. Some of the measures performed in the research even worse: government consolidated gross debt (% GDP) – 19 occurrences in rules, final consumption expenditure (% GDP) – 16 occurrences in rules, and finally general government gross fixed capital formation (% GDP) – which similarly to the previous ratio proved 16 interdependences between size of the general government sector and the economy. From the other hand, the ratios that had decisively worst performance in comparisons, were the variables describing size of sector as general government sector output (% GDP), general government gross capital formation (% GDP) and gross value added (general government total value-added) (basic (current) prices). In the case of the first of them, it was only 13 instances in the rules describing the relation of the general government sector and the economy, and for two consecutive with only 12 identified interdependences.

Next dimension of benchmarking is to draw attention to the scale of the relations identified in relation to a single variable describing the size of the general government sector in cross-section of each year under examination. The variable describing the size of the sector, which was found in cross-section of individual years under examination as the most frequent one, was the parameter called net lending / borrowing (million euros), which in the years 2010 and 2013 occurred in 13 rules. The second variable in this ranking was total general government expenditure (euro per inhabitant), which in 2011 occurred in 11 rules defining the relation between the size of the sector and the economy. In third place of ranking, the authors listed *ex aequo* variables: total general government revenue (euro per inhabitant) and the general government deficit (% GDP), which respectively in 2010 and 2013 had 10 occurrences in the rules describing the relationship the size of the general government sector and the economy. Three variables noted 9 occurrences in the rules, i.e. public sector employment (number of people) in 2004, the central government deficit (% GDP) in 2012, and total general government revenue (% of GDP) in 2002. In the case of other variables describing the size of the general government sector and its relation with the economy, the frequency of occurrences in the rules did not exceed 5 cases.

In the next stage of research based on the results obtained by using Bayesian network, it was found which of variables describing the size of general government sector and the economy were correlated and also in how many years this relation was noted. Presentation of research findings is shown in Table 5. According to its content, the variables describing size of general government sector, which had strongest relation to variables describing the economy, were following ratios: total general government expenditure (euro per inhabitant) and total general government revenue (euro per inhabitant). First of mentioned had 11-years lasting relation with the variables describing economy – Gross Domestic Product in current prices (per inhabitant). Second measure confirmed relation with variable FDI

(foreign direct investment) (Million USD) for 11 years, and with variable Gross Domestic Product in current prices (per inhabitant) for 10 years.

The broadest scale of relations between variable describing general government sector and the variables describing the economy was characterized by two ratios. The first of these is public sector employment (number of people), and the second is the net lending / borrowing (million euros). Both variables occurred respectively in 17 out of the 18 variables describing the economy. Parameter public sector employment showed no relationship only with variable retail sales – dynamic (index of turnover – total 2010 = 100). In turn, the parameter net lending / borrowing kept “neutrality” only in relation to a variable called production in industry – dynamic (percentage change compared to same period in previous year).

Next group of variables describing general government sector, which was found with very extended scale of relations with economy, was composed with three ratios: total general government expenditure (euro per inhabitant), total general government revenue (euro per inhabitant), as well as the ratio of total taxes to GDP (% GDP). Invoked variables showed relations with 16 parameters describing economy. First of invoked variables did not show any relations only with ratio retail sales – dynamic (index of turnover – total 2010 = 100) and ratio real effective exchange rate (index 1999 = 100). Second variable describing general government sector was left with no relation with variables for economy as: potential output of total economy (million euro) and unemployment rate (in %). On the other hand, last of invoked variables describing general government sector had not relation with ratio for economy as activity rate (in %) and retail sales – dynamic (index of turnover – total 2010 = 100).

The last group of variables, in terms of scale of relations with the economy and which describe the general government sector, was composed from two ratios: the general government deficit (% GDP) and total general government revenue (% of GDP). Both variables did not show an association with only three parameters describing the economy. First of them was neutral towards variables as: production in industry – dynamic (percentage change compared to same period in previous year), gross domestic product in current prices (per inhabitant) – dynamic (percentage change) and potential output of total economy – dynamic (annual average rate of growth – percentage). From the other hand, second variable have not occurred in the rules describing economy in reference to following variables: production in industry – dynamic (percentage change compared to same period in previous year), balance of the current account (million euro), as well as activity rate (in %).

The worst in comparisons on scale of the relations between the variable describing the general government sector and the variables describing the economy, was the ratio of general government gross capital formation (% of GDP), which is not found in 11 rules clarifying the relationship of sector with the economy. On the following positions in the ranking, there were listed following variables: the general government sector output (% GDP) – no relation to the 8 variables for the economy, as well as gross value added (the general government total value-added) (basic (current) prices), final consumption Expenditure (% of GDP) and general government gross fixed capital formation (% of GDP) – which did not appear in the 7 rules explaining the relation to the economy.

4. CONCLUSION

The research has found a number of regularities. Firstly, conducted analyzes allowed to build a ranking of variables describing the size of the general government sector according to the maximum number of occurrences in the rules describing the economy (see Table 6). Variables describing size of general government sector that occurred in the largest number of rules explaining relation of sector and the economy were: total general government revenue (euro per inhabitant) and total general government expenditure (euro per inhabitant). First of mentioned variables occurred in 66 rules and second in 61 rules. On the next places of the ranking, there were: net lending/ borrowing (million euro) – 46 occurrences in rules, public sector employment (number of people) – 36 occurrences in rules and total general government expenditure (% GDP) – 35 occurrences in rules describing relation with the economy. Variables describing size of general government sector, that were characterized by the smallest number of occurrences in the rules describing relation with the economy were: general government sector output (% GDP) – 13 occurrences, as well as general government gross capital formation (% GDP) and gross value added (general government total value-added) (basic (current) prices) – 12 occurrences. Secondly, the research allowed to create ranking of variables describing the size of the general government sector basing on the number of relationships identified in relation to a single variable describing the size of the general government sector with variable describing the economy (see Table 7). Largest number of relations with the variables describing economy had the variable called net lending/ borrowing (million euro) – 13 occurrences. On the next places, there were variables total general government expenditure (euro per inhabitant) – 11 occurrences and *ex aequo* two variables total general government revenue (euro per inhabitant) and general government deficit (% GDP) – 10 occurrences. Without any doubts, the worst score was obtained by two variables, i.e. gross value added (general government total value-added) (basic (current) prices) and general government gross capital formation (% GDP). Referring to the first of them, it occurred only 3 times in the conducted research and when comes to second of them, it had only 2 occurrences in the rules explaining relations of size of general government sector and the economy.

Thirdly, as a result of research, it was found which of the variables describing the size of the general government sector and the variables describing the economy in the period showed the highest frequency of relations measured by the number of years, where relations between variables were identified (see Table 8). According to results of research, the variable total general government revenue (euro per inhabitant) describing size of general government sector has decisively highest frequency of relations with variable FDI (foreign direct investment) (million USD) describing economy, whereas variable total general government expenditure (euro per inhabitant), was found the most frequent relation with parameter Gross Domestic Product in current prices (per inhabitant) describing the economy. In both cases, the relation was identified in 11 out of 13 years of examined years. The relations with variable FDI (foreign direct investment) (million USD) describing economy, was also exhibited by a variable called public sector employment (number of people), where the identified relation was found in 9 examined years. Remaining, the most frequent variables occurring in rules that describe size of general government sector were corresponding with other (than mentioned above), variables describing economy. In case of variable net lending/borrowing (million euro), the one was the variable activity rate (in %), and describing it relation was noted in 8 years from examined period. In 8 out of 13

analyzed years, the authors identified also relation of variables central government deficit (% GDP) and real effective exchange rate (Index 1999 = 100). When comes to variable total general government expenditure (% GDP), it corresponded with Gross Domestic Product in current prices (per inhabitant) - dynamic (percentage change), when total general government revenue (% GDP) showed relationship with potential output of total economy - dynamic (annual average rate of growth - percentage). Identified relations, similarly to previous pair of variables, occurred in 7 years from examined period. Three variables describing size of general government sector were the worst in ranking prepared by basing on mentioned criteria: final consumption expenditure (% GDP), general government gross fixed capital formation (% GDP) and general government gross capital formation (% GDP). Variable called final consumption expenditure (% GDP), occurred in the rules describing economy by the parameters as: FDI (Foreign direct investment) (Million USD) and Harmonized Indices of Consumer Prices (HICPs) (Annual average rate of change). On the other hand, variable called general government gross fixed capital formation (% GDP) showed relation with three variables describing the economy. These included unemployment rate (in %), potential output of total economy - dynamic (annual average rate of growth - percentage) and gross capital formation (% GDP). All dependences mentioned above occurred in 3 out of 13 years of examination period. The last of the variables, i.e. general government gross capital formation (% GDP) describing size of general government sector, was even worst. It corresponded with three variables describing the economy: unemployment rate (in %), gross capital formation (% GDP) and harmonized indices of consumer prices (HICPs) (annual average rate of change). The relation between mentioned variables describing size of general government sector and the economy was noted in only 2 out of 4. The study helped to build the ranking of variables describing the size of the general government sector by the number of variables describing economy in relation to which, identified measures of sector have shown the interdependency (see Table 9). The variables determining size of the general government sector, which showed the relationship with 17 out of 18 variables of the economy were: public sector employment (number of people) and net lending / borrowing (million euros). Equally high score was found in relation to the three other variables describing the size of the sector, i.e. total general government expenditure (euro per inhabitant), total general government revenue (euro per inhabitant) and the ratio of total taxes to GDP (% of GDP). In relation to each of them, the authors have found interdependences with 16 variables describing the economy of the EU countries under investigation. In contrast, the least in this ranking came out the following ratios of the size of the general government sector: gross value added (the general government total value-added) (basic (current) prices), final consumption expenditure (% of GDP) and general government gross fixed capital formation (% of GDP). They showed association with 11 out of 18 variables describing the economy. Ever worse score was obtained by the variables general government sector output (% GDP) – showing a relationship with a 10 variables describing the economy, and eventually the general government gross capital formation (% of GDP) – corresponding only with 7 variables describing the economy of the EU countries under examination.

Developed classifications enabled to create collection presenting collectively ranking positions of variables describing size of the general government sector based on each of the four criteria listed in Tables 6, 7, 8 and 9. On this basis, the authors determined the average position in ranking for each variable describing the sector. In the next step, the variables specifying size of general government sector were put in order by the criteria of

average ranking position occupied by each of variable. It was assumed that the higher ranking position of the variable is, the better it fits to explain interdependences occurring between the size of the general government sector and the economy (see Table 10). According to prepared ranking, three variables that simultaneously obtained the highest position were total general government expenditure (euro per inhabitant), as well as total general government revenue (euro per inhabitant) and net lending/borrowing (million euro). Second place was taken by the variable called public sector employment (number of people), and third place went to central government deficit (% GDP). Next group was formed from four variables that were listed on fourth place, i.e. variables, which fit in smaller degree to explain relation between size of the sector and the economy. The variables inside the group were general government deficit (% GDP), total general government expenditure (% GDP), total general government revenue (% GDP) and variable the ratio of total taxes to GDP (% GDP). On fifth place, there were *ex aequo* government consolidated gross debt (% GDP) and general government sector output (% GDP). Variables, that were ranked on sixth place, and because of that were qualified to explain the relation between the general government sector and economy in the second smallest degree were: final consumption expenditure (% GDP), and in next order gross value added (general government total value-added) (basic (current) prices) and general government gross fixed capital formation (% GDP). Last, seventh place was taken by the variable called general government gross capital formation (% GDP), what proved that it has the weakest relation between size of the general government sector and the economy.

Received findings constitute the basis for further research focusing on two research problems. The first of these will be to investigate the relationship between the variables describing the size of the general government sector and the variables describing the economy, using decision rules. Indicated decision rules are “if-then” rules that describe certain characteristics of combination between values of condition attributes and decision attributes. Among the various decision rule generation methods we have chosen the LEM2 algorithm¹¹⁹ for further analysis. Second research problem, to which authors will dedicate separate paper is to improve the efficiency of learning models classification that describe relations between size of general government sector and the economy. The average effectiveness of analyzed learning models classification was 63,31%. We expect to improve the quality of classification by merging data for each dependent attribute (from economy domain). Until now the learning models were generated for each year separately. Consequently, it could lead to the dispersion of information hidden in the data. In order to eliminate this problem the data will be grouped by years for each of the dependent variable.

¹¹⁹ J.W. Grzymala-Busse, *LEERS – A system for learning from examples based on rough sets* [in:] R. Slowinski (ed.), *Intelligent Decision Support. Handbook of Applications and Advances of the Rough Set Theory*, Kluwer Academic Publishers, Dordrecht, Boston, London 1992.

Table 4. Occurrences of the most significant attributes in Bayesian networks describing the relationship of the general government sector size and the economy

Parameters describing the relationship of general government sector size and the economy	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
General Government gross capital formation (% GDP)	2	1	2	-	1	1	2	-	-	-	1	2	-
Government consolidated gross debt (% GDP)	1	1	2	1	5	1	4	-	-	1	1	-	2
Public sector employment (Number of people)	6	6	1	9	6	1	6	1	-	-	-	-	-
Total General Government Expenditure (Euro per inhabitant)	6	3	5	6	6	2	8	2	1	3	11	4	4
Total General Government Revenue (Euro per inhabitant)	8	8	8	10	4	1	5	3	1	5	5	3	5
Net lending/ borrowing (Million Euro)	4	2	3	2	-	-	-	-	-	13	2	7	13
Total General Government Expenditure (% GDP)	4	4	5	5	1	-	4	-	-	2	1	5	4
Central government deficit (% GDP)	5	4	2	1	-	-	-	-	1	3	4	9	4
General Government Sector Output (% GDP)	3	4	3	1	-	2	-	-	-	-	-	-	-
Gross value added (General Government total value-added) (Basic (current) prices)	2	1	1	-	3	1	-	1	-	1	-	-	2
The ratio of total taxes to GDP (% GDP)	3	5	2	2	3	1	3	-	-	3	4	2	-
Final consumption expenditure (% GDP)	1	1	1	-	-	-	-	-	-	4	2	4	3
General government deficit (% GDP)	3	2	1	1	-	-	1	-	-	6	1	5	10
Total General Government Revenue (% GDP)	-	9	3	4	-	-	1	-	-	3	1	1	2
General government gross fixed capital formation (% GDP)	-	-	2	4	-	1	2	1	-	2	-	2	2

Source: Own work.

Table 5. Juxtaposition presenting relation between variables that describe size of general government sector and particular variables describing economy in analyzed period 2000–2013 (number in bracket states for number of years in analyzed period, where the relation between the variables was identified)

	External balance of goods and services (Million euro)	Gross Domestic Product in current prices (per inhabitant)	Production in industry – dynamic (% change compared to same period in previous year)	Balance of the current account (Million euro)	Potential output of total economy (Million euro)	Harmonized Indices of Consumer Prices (HICPs) (Annual average rate of change)	Inward FDI flows (Million USD)	FDI (Foreign direct investment) (Million USD)	Real effective exchange rate (Index 1999 = 100)	Human Development Index – HDI (Value from 0 to 1)	Outward FDI flows (Million USD)	Growth rates of GDP (Percentage change)	Gross capital formation (% GDP)	Gross Domestic Product in current prices (per inhabitant) - dynamic (% change)	Activity rate (in %)	Retail sales - dynamic (Index of turnover – Total 2010 = 100)	Potential output of total economy dynamic (Annual average rate of growth percentage)	Unemployment rate (in %)
General Government gross capital formation (% GDP)	-	1	-	-	1	2	-	-	-	-	-	-	2	-	-	1	1	2
Government consolidated gross debt (% GDP)	1	-	1	2	1	-	1	1	1	2	-	2	4	4	-	3	2	1
Public sector employment (Number of people)	5	2	8	8	2	2	8	9	4	1	8	1	2	3	8	-	3	7
Total General Government Expenditure (Euro per inhabitant)	5	11	1	8	2	2	7	4	-	6	1	2	4	4	4	-	2	1

Table 5 (contd). Juxtaposition presenting relation between variables that describe size of general government sector and particular variables describing economy in analyzed period 2000-2013 (number in bracket states for number of years in analyzed period, where the relation between the variables was identified)

Total General Government Revenue (Euro per inhabitant)	9	10	4	8	-	3	9	11	2	5	10	3	2	5	4	3	2	-
Net lending/ borrowing (Million Euro)	6	2	-	4	3	5	2	4	6	2	1	6	5	3	8	4	4	7
Total General Government Expenditure (% GDP)	2	2	1	-	4	6	2	1	1	-	-	6	4	7	-	4	4	2
Central government deficit (% GDP)	5	1	-	4	3	3	1	3	8	-	1	3	-	3	3	4	-	1
General Government Sector Output (% GDP)	-	-	6	3	-	-	4	3	3	-	2	2	-	-	1	3	-	1
Gross value added (General Government total value-added) (Basic prices)	-	-	1	-	2	-	-	1	2	-	1	5	-	1	1	1	1	1
The ratio of total taxes to GDP (% GDP)	1	1	5	1	3	2	1	2	1	2	2	2	1	1	-	-	6	2
Final consumption expenditure (% GDP)	1	-	-	-	-	3	2	3	-	1	1	-	1	2	1	2	1	-
General government deficit (% GDP)	6	2	-	4	2	4	1	4	5	1	1	2	2	-	6	1	-	2
Total General Government Revenue (% GDP)	6	2	-	-	1	5	1	2	3	1	1	5	4	5	-	1	7	1
General government gross fixed capital formation (% GDP)	-	1	1	2	2	2	1	-	-	-	-	1	3	-	-	1	3	3

Source: Own work.

Table 6. Ranking by maximum number of appearances of variable describing size of general government sector in the rules that describe economy in the period 2000–2013 (inclusive)

No	Name	Variable value
1	Total General Government Revenue (Euro per inhabitant)	66
2	Total General Government Expenditure (Euro per inhabitant)	61
3	Net lending/ borrowing (Million Euro)	46
4	Public sector employment (Number of people)	36
5	Total General Government Expenditure (% GDP)	35
6	Central government deficit (% GDP)	33
7	General government deficit (% GDP)	30
8	The ratio of total taxes to GDP (% GDP)	28
9	Total General Government Revenue (% GDP)	24
10	Government consolidated gross debt (% GDP)	19
11	Final consumption expenditure (% GDP)	16
	General government gross fixed capital formation (% GDP)	16
12	General Government Sector Output (% GDP)	13
13	General Government gross capital formation (% GDP)	12
	Gross value added (General Government total value-added) (Basic (current) prices)	12

Source: Own work.

Table 7. Ranking by number of identified relations in relations to single variable that describe size of general government sector with the variable describing economy in period 2000-2013 (inclusive)

No	Name	Variable value
1	Net lending/ borrowing (Million Euro)	13
2	Total General Government Expenditure (Euro per inhabitant)	11
3	Total General Government Revenue (Euro per inhabitant)	10
	General government deficit (% GDP)	10
	Central government deficit (% GDP)	9
4	Public sector employment (Number of people)	9
	Total General Government Revenue (% GDP)	9
	Total General Government Expenditure (% GDP)	5
5	The ratio of total taxes to GDP (% GDP)	5
	Government consolidated gross debt (% GDP)	5
	Final consumption expenditure (% GDP)	4
6	General government gross fixed capital formation (% GDP)	4
	General Government Sector Output (% GDP)	4
7	Gross value added (General Government total value-added) (Basic (current) prices)	3
8	General Government gross capital formation (% GDP)	2

Source: Own work.

Table 8. Ranking by number of years, where identified relation between variable describing size of general government sector and variable describing economy in period 2000–2013 (inclusive)

No	Name of variable describing size of general government sector	Name of variable describing economy	Number of years, where relation between variable describing size of general government sector and the economy was identified
1	Total General Government Expenditure (Euro per inhabitant)	Gross Domestic Product in current prices (per inhabitant)	11
	Total General Government Revenue (Euro per inhabitant)	FDI (Foreign direct investment) (Million USD)	11
2	Public sector employment (Number of people)	FDI (Foreign direct investment) (Million USD)	9
3	Net lending/ borrowing (Million Euro)	Activity rate (in %)	8
	Central government deficit (% GDP)	Real effective exchange rate (Index 1999 = 100)	8
4	Total General Government Revenue (% GDP)	Potential output of total economy - dynamic (Annual average rate of growth - percentage)	7
	Total General Government Expenditure (% GDP)	Gross Domestic Product in current prices (per inhabitant) - dynamic (Percentage change)	7
5	General Government Sector Output (% GDP)	Production in industry – dynamic (Percentage change compared to same period in previous year)	6
	The ratio of total taxes to GDP (% GDP)	Potential output of total economy - dynamic (Annual average rate of growth - percentage)	6
	General government deficit (% GDP)	Activity rate (in %)	6
		External balance of goods and services (Million euro)	6

Table 8 (contd). Ranking by number of years, where identified relation between variable describing size of general government sector and variable describing economy in period 2000-2013 (inclusive)

6	Gross value added (General Government total value-added) (Basic (current) prices)	Growth rates of GDP (Percentage change)	5
7	Government consolidated gross debt (% GDP)	Gross Domestic Product in current prices (per inhabitant) - dynamic (Percentage change)	4
		Gross capital formation (% GDP)	4
8	Final consumption expenditure (% GDP)	FDI (Foreign direct investment) (Million USD)	3
		Harmonised Indices of Consumer Prices (HICPs) (Annual average rate of change)	3
	General government gross fixed capital formation (% GDP)	Unemployment rate (in %)	3
		Potential output of total economy - dynamic (Annual average rate of growth - percentage)	3
		Gross capital formation (% GDP)	3
9	General Government gross capital formation (% GDP)	Unemployment rate (in %)	2
		Gross capital formation (% GDP)	2
		Harmonised Indices of Consumer Prices (HICPs) (Annual average rate of change)	2

Source: Own work.

Table 9. Ranking by number of appearances of variable describing size of general government sector in rules that describe relation between economy in the period 2000-2013 (inclusive)

No	Name	Number of appearances (Number of variables that describe the economy = 18)
1	Public sector employment (Number of people)	17
	Net lending/ borrowing (Million Euro)	17
2	Total General Government Expenditure (Euro per inhabitant)	16
	Total General Government Revenue (Euro per inhabitant)	16
	The ratio of total taxes to GDP (% GDP)	16
3	General government deficit (% GDP)	15
	Total General Government Revenue (% GDP)	15
	Government consolidated gross debt (% GDP)	14
4	Total General Government Expenditure (% GDP)	14
	Central government deficit (% GDP)	14
	Gross value added (General Government total value-added) (Basic (current) prices)	11
5	Final consumption expenditure (% GDP)	11
	General government gross fixed capital formation (% GDP)	11
6	General Government Sector Output (% GDP)	10
7	General Government gross capital formation (% GDP)	7

Source: Own work.

Table 10. Classification of variables describing size of general government sector that exhibits "strongest" relations with the variables describing economy by the criteria of average ranking position gained in the particular rankings

Name of variable describing size of general government sector	Ranking 1	Ranking 2	Ranking 3	Ranking 4	Average ranking position of variable	Variable describing size of general government sector that exhibits its strongest relation with the economy
Total General Government Expenditure (Euro per inhabitant)	2	2	1	2	2	1
Total General Government Revenue (Euro per inhabitant)	1	3	1	2	2	1
Net lending/borrowing (Million Euro)	3	1	3	1	2	1
Public sector employment (Number of people)	4	4	2	1	3	2
Central government deficit (% GDP)	6	4	3	4	4	3
Total General Government Expenditure (% GDP)	5	5	4	4	5	4
General government deficit (% GDP)	7	3	5	3	5	4
Total General Government Revenue (% GDP)	9	4	4	3	5	4
The ratio of total taxes to GDP (% GDP)	8	5	5	2	5	4
Government consolidated gross debt (% GDP)	10	5	7	4	7	5
General Government Sector Output (% GDP)	12	6	5	6	7	5
Final consumption expenditure (% GDP)	11	6	8	5	8	6
General government gross fixed capital formation (% GDP)	11	6	8	5	8	6

Table 10 (contd). Classification of variables describing size of general government sector that exhibits "strongest" relations with the variables describing economy by the criteria of average ranking position gained in the particular rankings

Gross value added (General Government total value-added) (Basic (current) prices)	13	7	6	5	8	6
General Government gross capital formation (% GDP)	13	8	9	7	9	7

Ranking 1. Ranking by maximum number of appearances of variable describing size of general government sector in the rules that describe economy in the period 2000-2013 (inclusive)

Ranking 2. Ranking by number of identified relations in relations to single variable that describe size of general government sector with the variable describing economy in period 2000-2013 (inclusive)

Ranking 3. Ranking by number of years, where identified relation between variable describing size of general government sector and variable describing economy in period 2000-2013 (inclusive)

Ranking 4. Ranking by number of appearances of variable describing size of general government sector in rules that describe relation between economy in the period 2000-2013 (inclusive)

Source: Own work.

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SELEKCJA ZMIENNYCH IDENTYFIKUJĄCYCH ZALEŻNOŚĆ MIĘDZY WIELKOŚCIĄ SEKTORA FINANSÓW PUBLICZNYCH I GOSPODARKI

Artykuł poświęcony został zbadaniu związków zachodzących pomiędzy rozmiarem sektora finansów publicznych (SFP) a gospodarką. Celem niniejszego artykułu jest zidentyfikowanie najważniejszych zmiennych służących zobrazowaniu związków zachodzących pomiędzy rozmiarem SFP i gospodarką oraz ustalenie częstotliwości ich występowania w relacji do badanych par zmiennych. Do odkrywania związków pomiędzy zmiennymi opisującymi rozmiary SFP oraz gospodarki wykorzystano metodologię bazującą na sieciach Bayesa. Analizie poddano gospodarki państw UE oraz ich systemy finansów publicznych. Okres przyjęty do badań obejmował roczniki od 2000 do 2013. Do opisu gospodarki wytypowano 18, a do opisu SFP 15 zmiennych, dla których źródłem były bazy Eurostat, OECD oraz Banku Światowego. Wśród miar gospodarki oraz SFP znalazły się zarówno miary

uznawane za standardowe (klasyczne), jak i mierniki zaproponowane przez autorów. Przeprowadzone badania pozwoliły zbudować ranking zmiennych opisujących rozmiary SFP według klasyfikacji opartej na maksymalnej liczbie ich wystąpień w regułach opisujących gospodarkę. Badanie umożliwiło także opracowanie rankingu zmiennych opisujących rozmiary SFP oparte na liczbie związków identyfikowanych w odniesieniu do pojedynczej zmiennej opisującej rozmiary SFP ze zmienną opisującą gospodarkę. W wyniku analiz ustalono, które ze zmiennych opisujących rozmiary SFP oraz zmiennych opisujących gospodarkę wykazywały w badanym okresie największą częstotliwość związków mierzoną liczbą lat, w których identyfikowano powiązania pomiędzy zmiennymi. Badanie pozwoliło zbudować ranking zmiennych opisujących rozmiary SFP według kryterium liczby zmiennych opisujących gospodarkę, w stosunku do których miary SFP wykazywały związek. Przeprowadzone ustalenia powodują, że artykuł wpisuje się w dyskusję nad SFP i optymalizacją jego rozmiaru, a jednocześnie stanowi punkt wyjścia dla dalszych badań nad jego wielkością oraz wpływem na gospodarkę.

Słowa kluczowe: Sektor finansów publicznych, wielkość sektora finansów publicznych, gospodarka, polityka gospodarcza, finanse publiczne, związki pomiędzy rozmiarem sektora finansów publicznych i gospodarką

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