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ORIGINAL SCIENTIFIC PAPER

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RECEIVED: APRIL 2017

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REVISED: JULY 2017

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ACCEPTED: JULY 2017

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DOI: 10.1515/ngoe-2017-0014

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UDK: 331.2:336.22(497.5)

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JEL: C22, H24, H71

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**Citation:** Palić, I., Dumičić, K., & Grofelnik, B. (2017). Analysis of Personal Income Taxation Determinants in Croatia in Long Run: Evidence from Cointegration Analysis. *Naše gospodarstvo/Our Economy*, 63(3), 12-18. DOI: 10.1515/ngoe-2017-0014

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NAŠE GOSPODARSTVO  
OUR ECONOMY

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Vol. 63 | No. 3 | 2017

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pp. 12–18

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# Analysis of Personal Income Taxation Determinants in Croatia in Long Run: Evidence from Cointegration Analysis

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## Abstract

Personal income taxation remains an ongoing issue in Croatia. It is used as an important instrument of income redistribution. Moreover, it directly affects purchasing power of the working population. Numerous changes have been made in this type of taxation since the establishment of Croatian tax system. The aim of this paper is to analyse possible determinants of personal income taxation in Croatia. After offering brief insight into public finance theory regarding personal income taxation, the structure of personal income taxation in Croatia is explained. The empirical analysis of the determinants of personal income taxation in Croatia is conducted using cointegration analysis. Economic conditions, average monthly wage, and number of taxpayers are used as determinants of personal income tax used in this research. The cointegration analysis is conducted using monthly data from January 2008 to February 2016. The results of the research show a statistically significant negative impact of economic conditions and statistically significant positive impact of average monthly wage and number of taxpayers on personal income taxation in long run, what is in line with economic and public finance theory.

**Keywords:** personal income taxation determinants, economic conditions, wages, number of taxpayers, johansen cointegration approach, Croatia

## Introduction

The income taxation has been one of the most important questions of economic policy since the establishment of tax system in Republic of Croatia in 1994. The Croatian tax system has passed through numerous changes throughout years. Most of the changes were made in the field of personal income taxation, which is determined by the Income Tax Act and income tax ordinance. From 1994 to 2012, the Income Tax Act has changed 13 times (Šimović, 2012). There are two main concepts of income taxation: consumption and income concept. The consumption

concept is based on taxation of income, which is used for consumption. Parts of income used for saving and investments, such as dividends and interests, are excluded from taxation. On the other hand, income concept includes all types of income in the process of taxation. In Croatia, the hybrid concept, which includes both income and consumption concept characteristics, is mostly used (Šimović, 2012).

Personal income tax is used as the most important instrument of redistribution of income among households in economy (Egger et al., 2012). Public finance theory considers that progressive taxation of income ensures rightful distribution of tax burden. One of the most important roles of the government is to ensure social welfare, which is higher when resources are more equally distributed. On the other hand, redistributive taxes and transfers can cause a decrease in individuals' incentives to work, save, and earn income. Therefore, it is necessary for the government to find an optimal tax system to ensure social welfare and encourage individuals to work (Diamond & Saez, 2011).

In Croatia, Urban (2006) analysed the progressivity of personal income tax using a Gini concentration coefficient. However, prior to this research, the determinants of personal income taxation are not analysed in Croatia using econometric analysis. This research contributes to the existing literature due to the fact that it offers analysis of the determinants of personal income taxation in Croatia in the long run.

## Literature Review on Determinants of Personal Income Taxation

Personal income taxation is widely researched in economic literature due to great significance of tax revenues on government policies and overall economy. Castro and Ramirez (2014) concluded that determinants of tax revenues in OECD differ among high-income and middle-income countries. High-income countries with high GDP per capita, low share of FDI, and robust industrial sector have higher tax revenues. Also, lagged values of tax revenues are strong determinants of current tax revenues. On the contrary, tax revenues of middle-income countries depend less on their lagged values and the role of economic, institutional, social, and structural factors are more significant determinants of tax revenues. Aamir et al. (2011) analysed the impact of indirect and direct taxes on total tax revenue in Pakistan and India. They concluded that indirect taxes have a greater impact on total tax revenues in Pakistan, while in India direct taxes have a higher impact. Velaj and Prendi (2014) conducted regression analysis in order to determine what impacts tax revenues in Albania. They considered several variables: GDP, inflation, income tax, unemployment and imports. Their analysis has

shown positive correlation between tax revenues and with GDP growth, inflation and imports, while unemployment has shown negative correlation. Addison and Levin (2012) researched the determinants of tax revenue performance in sub-Saharan Africa, including the tax base, structural factors, and foreign aid and conflict, which are considered in the econometric analysis. Karagoz (2013) used regression analysis in order to investigate determinants of tax revenues in Turkey. Mentioned research showed that agricultural and industrial share in GDP, foreign debt stock, monetization rate and urbanization rate have a significant impact on total tax revenues. Aloo (2012) defined determinants of tax revenues in Kenya. The research demonstrated a positive correlation between tax revenues and changes in oil prices and exchange rates and negative correlation of tax revenues with GDP. Ivanitskaya and Tregub (2013) concluded that personal income tax revenue in the UK has a positive relationship with the number of taxpayers and inflation measured by the retail price index. Their research also showed a significant relationship between personal income tax revenue and oil prices, which can be positive or negative. On the other hand, research has shown that there is no correlation between personal income tax revenue and GDP growth.

## Personal Income Taxation in Croatia

Progressive income taxation is used in Croatia. It is based on division of income into three tax bases, and each base is taxed with different tax rate. Tax bases and tax rates are presented in Table 1.

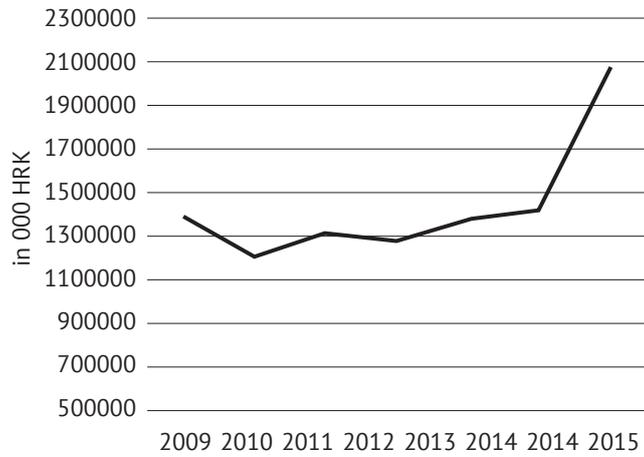
**Table 1.** Personal Income Taxation Structure in Croatia in HRK

| Tax base             | Tax rate |
|----------------------|----------|
| < 2.200,00           | 12%      |
| 2.200,00 - 13.000,00 | 25%      |
| > 13.000,00          | 40%      |

Source: Ministry of Finance, Croatia: Tax Administration, 2016

A taxpayer is defined as a person who acquires an income. It is possible to distinguish six sources of income, which can be taxed according to the Income Tax Act: income from employment, income from independent personal activities (self-employment), income from property and property rights, income from capital, income from insurance, and other income. The total amount of income that the taxpayer obtains in Republic of Croatia can be calculated as sum of all types of taxable incomes reduced for personal allowance (Ministry of Finance, Croatia: Tax Administration, 2016). The personal allowance plays a crucial role in progressivity of personal income tax. Since 1994 the amount of personal

**Figure 1.** Yearly Personal Income Tax Revenue (in thousand HRK) in Republic of Croatia



Source: Croatian Ministry of Finance State Budget, 2016

allowance has grown faster than average incomes and in that way it decreased the progressivity of personal income tax (Urban, 2006). Since 2009 until 2014, personal income tax revenues in Croatia have slightly increased. Furthermore, from 2014 until 2015 personal income tax revenues made a huge jump, which is shown in Figure 1.

In order to explain the reason of presented movements in personal income tax revenues, it is necessary to define determinants of personal income tax.

## Empirical Analysis of Determinants of Personal Income Tax in Croatia

### Data and Model

The impact of three possible determinants on personal income tax revenues is examined in this research, namely,

economic conditions, average monthly wage, and number of taxpayers, in the period from January 2008 to February 2016. Monthly data on volume indices of industrial production, 2010 = 100 are used to approximate the output because information related to output is published on a quarterly basis. The aim of approximation is preserving degrees of freedom and reliability of econometric analysis.

Regarding the data on personal income tax revenues, data are derived from the Croatian Ministry of Finance State Budget (2016). An average gross monthly wage is derived from Central Bureau of Statistics of Republic of Croatia (2016). Personal tax revenues, average monthly wage, and industrial production indices are deflated using a consumer price index 2010=100, available at Croatian National Bank (2016) and defined in real terms. Data on number of taxpayers are approximated by number of employed persons and provided by Central Bureau of Statistics of Republic of Croatia (2016).

The descriptive statistical measures of real personal income tax revenues (denoted by *PIT*), real volume indices of industrial production (2010=100), denoted by *Y*, real average gross monthly wages in HRK, denoted by *W* and number of taxpayers denoted by *N*, in period from January 2008 to February 2016 are given in Table 2.

The provided descriptive statistical measures point to the fact that variable *PIT* exhibits the highest variability among these four variables, what is shown by the highest coefficient of variation of 56.488%. Therefore, due to high variability of personal income taxation, the analysis of its determinants gains in importance. The kurtosis and skewness are also the most distant from zero for variable *PIT*, pointing to leptokurtic and negatively skewed data distribution.

Prior to conducting econometric analysis, all variables are transformed into logarithmic values and seasonally adjusted using X-13 ARIMA SEATS adjustment method (see US Census Bureau, 2016). Therefore, seasonally adjusted logarithmic values of economic conditions (denoted by *LY\_SA*),

**Table 2.** Descriptive Statistical Analysis of Selected Variables from January 2008 to February 2016

|                          | PIT      | Y      | W        | N        |
|--------------------------|----------|--------|----------|----------|
| Mean                     | 120084.5 | 95.214 | 7573.674 | 1403892  |
| Median                   | 136645.8 | 93.238 | 7548.063 | 1386615  |
| Standard Deviation       | 67834.4  | 11.292 | 202.856  | 73833.15 |
| Kurtosis                 | 2.538    | -0.284 | -0.571   | -0.769   |
| Skewness                 | -1.547   | 0.549  | 0.297    | 0.619    |
| Coefficient of variation | 56.488   | 11.859 | 2.678    | 5.259    |

Source: Authors' calculation

average monthly wage (denoted by  $LW_{SA}$ ), and number of taxpayers (denoted by  $LN_{SA}$ ) and personal income tax revenues (denoted by  $LPIT_{SA}$ ) in the long run are used in empirical analysis.

First, in order to test the stationarity of selected variables, the ADF unit root test is conducted. The results of the test are shown in Table 3.

All variables are shown to be non-stationary in levels but stationary in first differences at 1% significance. In other words, all selected time series are integrated of order (1) at 1% significance. According to Enders (2015), if a linear combination of non-stationary variables is stationary, the variables are cointegrated. Thus, the Johansen cointegration approach is used to examine the impact of  $LY_{SA}$ ,  $LW_{SA}$  and  $LN_{SA}$  on  $LPIT_{SA}$ . The Johansen approach is used for determining the number of cointegrating relations. The basis of the Johansen procedure is the estimation of the vector error correction (VEC) model. If variables are cointegrated, the long run relationship between non-stationary variables exists (Enders, 2015). The Johansen procedure uses the maximum eigenvalue test and trace test for determining the number of cointegrating relations (Bahovec, Erjavec, 2009).

### The results of cointegration analysis

Prior to model estimation, on the basis of the lowest value of Akaike information criteria, the model in which the constant is present only in cointegrating equation, and the trend is not present in the cointegrating equation nor in vector error correction model, is selected for the analysis. This model is used when analysed data does not contain a trend. The constant is present only in the cointegrating equation, which means that variables cointegrate around the constant. This model is often used in analysis of financial variables (Bahovec, Erjavec, 2009). The selected lag number in model is  $k=6$ .

Trace and maximum eigenvalue tests are conducted in order to assess the number of cointegrating relations. These tests are carried out until the first time the null hypothesis cannot be rejected (Enders, 2015). Results of both tests are presented in Table 4.

At 5% significance, results of the trace test, as well as maximum eigenvalue test, show that one cointegrating relation exists in the model. The decision is made by comparing empirical test statistics and critical values of the tests. A detailed explanation of both tests is given in Bahovec and Erjavec (2009).

**Table 3.** ADF Unit Root Test T-Test Statistics for Selected Variables in Levels and First Differences

| Variable           | None    | Intercept | Intercept and Trend |
|--------------------|---------|-----------|---------------------|
| $LPIT_{SA}$        | -0.424  | -3.011    | -3.742              |
| $LY_{SA}$          | -0.726  | -0.472    | -1.782              |
| $LW_{SA}$          | -1.584  | -2.616    | -1.074              |
| $LN_{SA}$          | 0.784   | 0.627     | 0.906               |
| $\Delta LPIT_{SA}$ | -8.763* | -8.747*   | -8.736*             |
| $\Delta LY_{SA}$   | -8.331* | -8.383*   | -8.359*             |
| $\Delta LW_{SA}$   | -6.119* | -6.340*   | -6.947*             |
| $\Delta LN_{SA}$   | -5.073* | -5.072*   | -5.178*             |

Note: \*denotes the stationarity of time series at 1% significance  
Source: Authors' calculation (EViews 8)

**Table 4.** Determining the Number of Cointegrating Relations

| Hypothesized Number of Cointegrating Equations | Eigenvalue | Trace Statistic | 0.05 Critical Value (Trace Statistic) | Max-eigen Statistic | 0.05 Critical Value (max-eigen statistic) |
|--|------------|-----------------|---------------------------------------|---------------------|---|
| 0*   | 0.3168     | 67.039          | 54.079                                | 37.337              | 28.588                                    |
| 1  | 0.1326     | 29.701          | 35.193                                | 13.946              | 22.299                                    |
| 2  | 0.1138     | 15.756          | 20.262                                | 11.836              | 15.892                                    |
| 3  | 0.0392     | 3.920           | 9.166                                 | 3.920               | 9.165                                     |

Note: \*denotes rejection of null hypothesis at 5% significance  
Source: Authors' calculation

Since the existence of cointegrating relation is shown, the following long run equation is estimated (with *t*-statistics in parentheses):

$$PIT = -414.91 - 13.932Y + 25.34W + 18.69N$$

$$(-473) \quad (-5.40) \quad (2.90) \quad (3.97). \quad (1)$$

Based on Eq. (1), all the selected variables are significant in explaining personal income tax in the long run in Croatia. Moreover, the error correction term (ECT) equals -1.1343, with corresponding *t*-statistics equal to -4.182. The negative sign of ECT indicates that personal income tax returns to the long-run equilibrium, while its value provides information about the adjustment speed. Namely, 113.43% of disequilibrium is corrected in each month and personal income tax returns to the equilibrium level for less than one month.

Furthermore, model adequacy is also examined. First, the White heteroskedasticity test is conducted for testing the appropriateness of the model. The  $\chi^2$  test statistic equals 466.017, with a corresponding *p*-value of 0.8597, suggesting that the null hypothesis of homoscedasticity cannot be rejected at any reasonable significance level. Moreover, the LM test of autocorrelation is conducted. At 5% significance level, the null hypothesis of no autocorrelation of residuals cannot be rejected up to lag length  $k=12$ , so it can be concluded that there is no autocorrelation problem in the model. Concerning the stability of VEC model, the model with *r* cointegrating relations is stable if  $k-r$  roots are equal to unity and the remaining roots have modulus less than one, where *k* is the number of endogenous variables and *r* is the number of cointegrating relations. The stability of model is checked by calculating the inverse roots of characteristic AR polynomial using EViews 8. The AR roots calculation has shown that VEC specification imposes three unit roots and the remaining roots have a modulus less than one. Since there are four variables and one cointegrating relation, the existence of three unit roots indicates that the system is stable. Therefore, the VEC diagnostic tests show that the estimated model is adequate. For explanation of heteroskedasticity and autocorrelation tests as well as AR roots calculation, see Enders (2015).

The results of the research show a significant negative impact of economic conditions and a significant positive impact of average monthly wage and number of taxpayers

on personal income taxation, what is in line with economic and public finance theory. Results of the impact of economic conditions confirm the results of the empirical research of Aloo (2012). Velaj and Prendi (2014) showed the negative correlation between unemployment and tax revenues, which is in line with the estimated positive impact of number of taxpayers approximated by number of employed persons on personal income tax. The mentioned result is also in line with results of the research of Ivanitskaya and Tregub (2013).

## Conclusion

Determining the appropriate level of personal income taxation in the Republic of Croatia is one of the most difficult challenges the government has dealt with for decades. Therefore, this paper analyses determinants of personal income tax revenues in Croatia.

This research analyses the impact of three selected determinants on personal income tax revenues: economic conditions, average monthly wage, and number of taxpayers. Data used in analysis are collected on monthly basis and refers to the period from January 2008 until February 2016. Limitations of the empirical research are mostly related to approximation of data used in model. Personal income taxation is approximated by personal income tax revenues on the monthly basis. The long-run relationship among selected variables is analysed using the Johansen cointegration approach. The White heteroskedasticity test and autocorrelation tests have shown there is neither heteroskedasticity nor autocorrelation problem in the model, and the vector correction model is estimated.

The results of the research show a negative significant relationship between economic conditions and personal income tax revenues and positive significant relationship of average monthly wage and number of taxpayers with personal income tax revenues, which is in line with economic and public finance theory.

## Acknowledgments

This work has been supported by the Croatian Science Foundation under the project STRENGTHS no 9402.

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# Analiza determinant odmerjanja dohodnine na Hrvaškem na dolgi rok: izsledki kointegracijske analize

## Izveček

Na Hrvaškem je še vedno aktualno vprašanje o odmeri dohodnine. Uporablja se kot pomemben instrument prerazporeditve dohodka. Poleg tega neposredno vpliva na kupno moč delovnega prebivalstva. Od vzpostavitve hrvaškega davčnega sistema so bile pri tej vrsti obdavčitve uvedene številne spremembe. Namen tega prispevka je analizirati možne determinante odmerjanja dohodnine na Hrvaškem. Po kratkem vpogledu v teorijo javnih financ glede dohodnine je pojasnjena struktura dohodnine na Hrvaškem. Empirična analiza determinant odmerjanja dohodnine na Hrvaškem je bila opravljena s pomočjo kointegracijske analize. V tej raziskavi so kot dejavniki dohodnine uporabljene gospodarske razmere, povprečna mesečna plača in število davkoplačevalcev. Kointegracijska analiza se izvaja z uporabo mesečnih podatkov od januarja 2008 do februarja 2016. Rezultati raziskave kažejo na statistično pomemben negativen vpliv gospodarskih razmer in statistično pomemben pozitiven vpliv povprečne mesečne plače in števila davkoplačevalcev na dolgotrajno odmerjanje dohodnine, kar je v skladu z ekonomsko in javnofinančno teorijo.

**Ključne besede:** determinante dohodnine, ekonomske razmere, plače, število davkoplačevalcev, Johansenov kointegracijski pristop, Hrvaška