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An application of dynamic models in evaluating relationship between direct taxes and investment in OECD countries

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Abstract: *The article researches the direct tax effect on investment share in thirty-five OECD countries for the period from 1996 to 2016 year. The goal of this research is to determine how direct taxes influence on investment level measured by the share in the gross domestic product. The empirical analysis enables the implementation of fundamental econometric procedures as well as different dynamic panel models in order to measure effect of direct taxes. Results of Hausman show that PMG model is appropriate for measuring the effect of tax revenue growth, personal income tax, corporate income tax and property tax on investment share in selected countries. The model results reflect significant effect of tax revenue growth, personal income tax and property tax in the long term, while corporate tax is not significant for investment share in OECD countries. However, direct taxes do not have significant impact on investment share in the short-term, except tax revenue growth has positive effect on the investment in observed period.*

Keywords: *direct taxes, investment, dynamic modelling, OECD countries*

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Primena dinamičkih modela u procenjivanju odnosa između direktnih poreza i investicija u OECD zemljama

Apstrakt: Rad istražuje uticaj direktnih poreza na učešće investicija u bruto domaćem proizvodu trideset pet zemalja OECD-a za vremenski period od 1996 do 2016 godine. Cilj ovog istraživanja je utvrditi kako direktni porezi utiču na nivo investicija mereno učešćem u bruto domaćem proizvodu. Empirijska analiza omogućava primenu osnovnih ekonometrijskih procedura, kao i dinamičke panel modele kako bi se izmerili efekti direktnih poreza. Rezultati Hausman testa pokazuju da je PMG model odgovorajući za merenje uticaja rasta poreskih prihoda, poreza na dohodak građana, poreza na dobit preduzeća i poreza na imovinu na učešće investicija u odabranim zemljama. Rezultati modela odražavaju značajan efekat rasta poreskih prihoda, poreza na dohodak građana i poreza na imovinu u dugom roku, dok porez na dobit preduzeća nije značajan za učešće investicija u zemljama OECD-a. Međutim, direktni porezi nemaju značajan uticaj na učešće investicija u kratkom roku, osim rasta poreskih prihoda koji ima pozitivan efekat na investicije u posmatranom periodu.

Ključne reči: direktni porezi, investicije, dinamičko modeliranje, OECD zemlje

1. Introduction

Capital is becoming increasingly mobile among countries and in order to respond to the rising trend of capital movements, states seek to attract and keep capital within their own jurisdictions (Devereux & Griffith, 2003). Investors have the aim of achieving the greatest possible profits, especially in terms of the long-term investments, but the stability and continuity of their activity are also essential (Kersan-Škabić, 2015). Over the last two decades there has been a trend of abolishing trade barriers and capital flows liberalization in the world, which has contributed to the rise of importance of foreign direct investment, as well as corporate taxation. Foreign direct investment has a significant role in stimulating growth and corporate income tax has become inseparable component for multinational companies (Sapienza, 2010). Tax differences affect international trade as well as optimal allocation of resources in the world (Hristu-Varsakelis et al. 2011). Taxes are relevant to all investors and their capital, because their stability and predictability determine the capital movement. Firms pay corporate income taxes (Miao, 2019) where Paun (2019) highlighted that countries need to develop tax system that will allow them to stimulate investments and generate

growth. Likewise, Alinaghi (2015) and Andrašić et al. (2018) point out tax significance for economic growth and gives a contribution to economic efficiency and fair income distribution. According to endogenous growth model, tax rates affect the long-run growth rate (Cheng & Pu, 2017). Quantitative analysis of taxes is essential in order to reveal which determinants affect it and determine strategies to generate tax revenue and finance public expenditure (Castaneda Rodriguez, 2018). Accordingly, Loganathan et al. (2017) determined that tax revenues still have a key role in stimulation and sustainability of the country's economic performance. Kalaš et al. (2020) found significant effect of taxes on economic growth with special focus to indirect taxes in the Republic of Serbia. However, direct taxes have greater share in the GDP of developed economies, where personal income tax and corporate income tax enable higher level of revenues compared to less developed economies.

The construction of this paper is determined in four segments. The first two segments imply introduction and literature review which covers previous papers and studies about corporate tax and investment. The third segment chapter includes a methodological framework and econometric preconditions for properly determined panel models. The fourth segment refers to the analysis of direct taxes and investment share in OECD countries for the period from 1996 to 2016. The five segment refers to empirical results of different dynamic panel models that have estimated which tax forms are essential for the investment share in the gross domestic product. The last segment covers the results and discussion with suggestions for further analysis.

2. Literature review

The question of corporate taxation effect on investment is one of the central issues of the economic development whereby Brusov et al. (2015) point out correlation between tax rate change and investment efficiency, while Ćurčić et al. (2020) highlighted that efficiency of collecting tax revenues is related to the tax relief. Further, Brockmeyer (2014) noticed bidirectional causality between investment and tax policy runs, where tax reforms motivated by slow investment. The importance of this tax form is considerably higher in developing countries where observed countries use corporate taxation to attract foreign capital (Abramovsky et al. 2014). Tax policy is one of the instruments that can use to attract foreign capital. Taxes affect investment, saving and consumption, whereby any change in tax structure can have positive or negative implications for a decision of an individual or a state in terms of these components (Desai et al. 2004). When defining tax forms,

governments consider the expectations of their effects on investment and economic activity, including foreign investments. Dobbins and Jacob (2016) argued that impact of taxes on corporate investment is a main component for government strategies in order to boost economy. Yanikkaya and Karaboga (2017) argue that countries with better macroeconomic environment and effective government have effectively investment incentives. Sok-Gee et al. (2018) found that high corporate tax countries benefit more from higher quality country governance. Mourmans (2016) emphasizes that countries often observe what other countries are doing with corporate income tax and this represents the most influential factor in deciding about the rate and level of this tax form. Loretz (2007) states that country size affects the effective tax rates at bilateral level confirming that any form of economic integration reduces tax burden. A stable share of revenues from this tax in the gross domestic product is observed, but also a decrease in the total tax revenues share (Devereux et al. 2002). Analyzing corporate tax in Ireland, Confrey and Fitzgerald (2011) pointed out that a tax rate reduction causes lower tax revenues as well as an increase in the country attractiveness from the point of attracting foreign capital. Djankov et al. (2010) examined the tax rates effect on eighty-five countries in 2004 and confirmed that tax significantly affects to the total investment, FDI and economic activity. The increase of corporate tax form by 10% has negative implications for the total investment share in the GDP by 2%. Corporate tax affects the investor's behavior in the context where high taxes make investments more difficult, while low tax rates encourage investors to invest their capital. Ohrn (2018) estimated that 1% reduction in the corporate tax rate is 64% effective at stimulating corporate investment. Vartia (2008) notices that taxes have an adverse impact on industry-level investment in terms of corporate taxes reduce investment. Brebler (2012) defines a negative nexus between corporate tax and investment in terms of lower taxes stimulate higher investment which is confirmed by previous studies of (Becker, 2009; Feld & Heckemeyer, 2008; Schratzenstaleer et al. 2005). Governments should stimulate investment to accelerate growth where a positive relationship between these variables (Anghelache et al. 2019). Kalaš et al. (2020) confirmed unidirectional causality between total investment and tax revenues in the European Union for the period 2006-2018. Their findings identified positive effect of investment level to the tax revenues in EU countries for the observed period. The empirical findings of Janský & Palanský (2019) indicate that OECD countries lose the least tax revenues while middle-income countries and low-income countries lose the most tax revenues relative to their GDP and total tax revenues.

3. Research methodology

The study implies annual data obtained from database of OECD and IMF for thirty-five OECD countries. This research includes panel data estimation of the effect of direct tax forms such as personal income tax, corporate income tax and property tax on investment share in OECD countries for the period 1996-2016. Likewise, the analysis includes tax revenue growth, as well as, main macroeconomic variables such as gross domestic product, unemployment, inflation and government expenditure.

Table 1. Variable selection

| Variable | Notation | Calculation | Source |
|------------------------|----------|-------------|-----------------------------|
| Investment | INV | % of GDP | International Monetary Fund |
| Tax revenue growth | TRgr | Annual rate | OECD |
| Personal income tax | PIT | % of GDP | OECD |
| Corporate income tax | CIT | % of GDP | OECD |
| Property tax | TOP | % of GDP | OECD |
| Gross domestic product | GDP | Annual rate | IMF |
| Unemployment | UNM | Annual rate | IMF |
| Inflation | INF | Annual rate | IMF |
| Government expenditure | GE | % of GDP | IMF |

Source: Authors' illustration

Dynamic panel model implies that current value of the variable depends of their previous value. It can be presented as:

$$Y_{it} = \mu + \gamma Y_{i,t-1} + \beta_1 X_{it1} + \beta_2 X_{it2} + \dots + \beta_k X_{itk} + \alpha_i + \varepsilon_{it}; i = 1, \dots, N, t = 1, \dots, T.$$

where error relations are independent and equally distributed random variables with mean 0 and variance 0 and variance σ^2 . As it can be noticed, correlations between dependent variables Y_{it} and random effect α_i is identified regardless of that α_i represents fixed effect or random error.

The econometric analysis includes Pooled Mean Group (PMG), Mean Group (MG) and Dynamic Fixed Effects (DFE). Bearing in mind that research covers a large number of countries, as well as a period of more than twenty years, these models are suitable for panel regression analysis. Through the set of models, it will be determined the direct tax impact on investment from the aspect of share in the GDP. Mean Group model includes the assessment of individual regression and average values for each observation unit. Based on Pesaran and Smith (1995), the model is defined as follows:

$$Y_{it} = \beta_i + \beta_i' x_{it} + c_{it} + \mu_{it}$$

where β_i is a free member, β_i' is a regression parameter, x_{it} matrix of explained variables and c_{it} is a linear trend with regression parameter. On the other hand, the PMG model starts from the equality of the long-term coefficients and assumptions about the short-term coefficients variation and variance of errors.

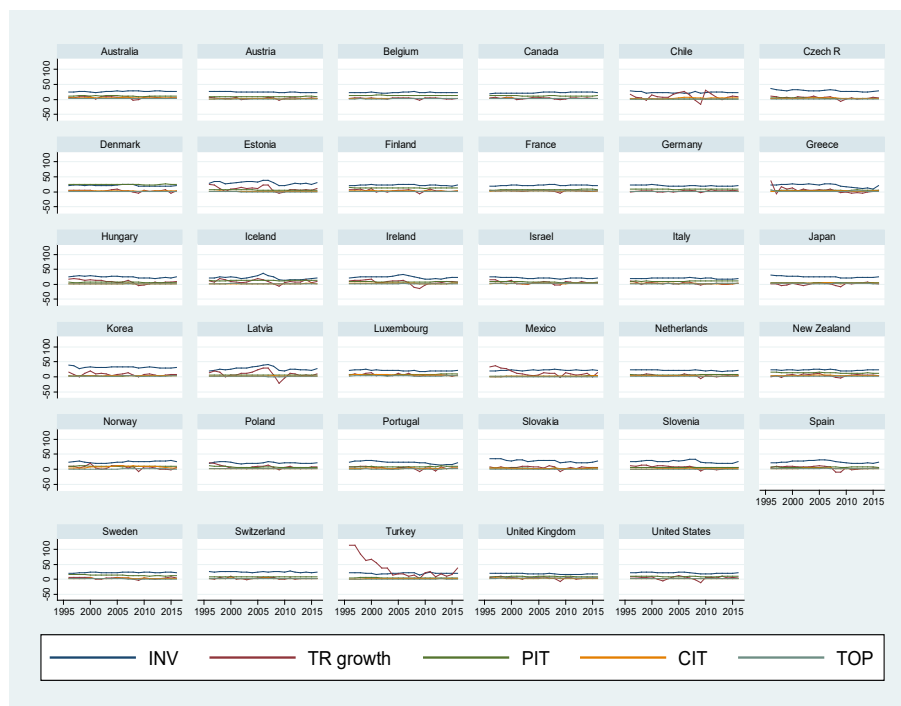
$$y_{it} = \sum_{j=1}^p \lambda_{ij} y_{i,t-j} + \sum_{j=0}^q \delta_{ij}' x_{i,t-j} + \mu_i + u_{it}$$

where λ_{ij} is a coefficient with dependent variable with delay δ_{ij}' , $k \times 1$ is a vector of heterogeneous regression parameters, while individual effects are denoted by μ_i . Also, the DFE model is included which presupposes the homogeneity of the short-term and the long-term coefficients.

4. Empirical Analysis and Results

This chapter covers descriptive analysis, panel specification and dynamic modelling of effects of direct tax forms on investment share in OECD countries during the observed period. First, there is a descriptive statistics of explanatory variables. First, research includes trend and level of investment share in the gross domestic product as well as direct taxes for the observed period. After analyzing their movement, it is possible to measure and estimate their effect on investment share which is identified as a dependent variable.

Figure 1. Investment share and direct taxes



Source: Authors' calculation

It is noticeable that investments share in the GDP ranges between 22-24% which is encouraging fact since the share of this indicator should be about 20% of GDP. This tendency was identified in Scandinavian countries as well as Spain, Switzerland, Mexico and Hungary. However, it is far higher compared to Germany, Luxembourg, United States, France, Netherlands and Poland whose levels did not exceed 22%. The average investment share of GDP is 23.45%, where Korea has the greater share of investment with 31.88% which is for example 10% more than the United Kingdom or the United States during the observed period (Andrašić et al. 2018). The average tax revenue growth is 6.63%, while personal income tax represents one of the most generous tax forms in OECD countries including social security contributions and tax on goods. The mean share of corporate income tax is 2.99% while the property tax share of GDP is 1.78%. Analyzing by

economies, Denmark and Norway have the greatest share of personal income tax of 24.5% and corporate income tax of 8.4% of GDP. Further, the property tax share of GDP is the greatest in the United Kingdom with 3.8%, Canada 3.6%, France 3.1%, while this tax form is extremely lower in Austria, Czech Republic, Estonia, Germany, Hungary, Mexico, Slovakia and Turkey where mean share ranged from 0.5% to 0.9% (Andrašić et al. 2018).

Table 2. Descriptive analysis

| Variable | INV | TRgr | PIT | CIT | TOP | GDP | UNM | INF | GE |
|----------|-------|-------|------|------|------|------------|-------|-------|-------|
| Mean | 23.45 | 6.63 | 7.77 | 2.99 | 1.78 | 2.53 | 7.74 | 3.64 | 41.62 |
| Std Dev. | 4.20 | 9.69 | 4.91 | 1.52 | 1.04 | 3.07 | 4.02 | 7.27 | 8.95 |
| Min | 9.83 | -22.2 | 0 | 0.6 | 0.2 | - 14.72 | 1.7 | -1.69 | 14.66 |
| Max | 41.54 | 114.4 | 26.8 | 12.6 | 7.3 | 11.9 | 27.47 | 85.65 | 65.29 |
| Obs | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 | 735 |

Source: Authors' calculation

Results from Table 2 manifest that TRgr, GE and INF have the greatest standard deviation, which is much more compared to other variables. Thus in 1997, Turkey had the record inflation rate of 85.65%, while on the other hand in the same year, Australia had the inflation rate of only 0.22%. Likewise, a wide range is recorded TRgr, where this variable was 111.4% in 1996 again in Turkey, while Latvia had the highest drop in tax revenue in 2009 where they dropped for 22.2%. The high standard deviation of GE is caused by an extremely high share of this variable in the GDP in Ireland 2010, while the lowest share is identified in Korea in 1997 with 14.66% (Andrašić et al. 2018). On the other hand, TOP has the smallest standard deviation with 1.04 in observed countries.

Table 3. Panel unit root test

| H ₀ : Panels contain unit roots | | | | |
|--|------------------|-------------------------|-------------------------|-----------------------|
| H _a : Panels are stationary | | | | |
| Variables | Number of panels | LLC test | Breitung test | HT test |
| INV | 35 | -7.3182*** (0.0000) | -4.0206*** (0.0000) | 0.7174*** (0.0000) |
| TRgr | 35 | -10.7752*** (0.0000) | -6.2250*** (0.0000) | 0.5883*** (0.0000) |
| PIT | 35 | -5.1969*** (0.0000) | -3.6548*** (0.0001) | 0.7633*** (0.0000) |
| CIT | 35 | -7.5359*** (0.0000) | -5.0528** (0.0000) | 0.6904*** (0.0000) |
| TOP | 35 | -7.5359*** (0.0000) | -3.1628*** (0.0008) | 0.3640*** (0.0000) |
| GDP | 35 | -10.2999*** (0.0000) | -10.0412*** (0.0000) | 0.3633*** (0.0000) |
| UNM | 35 | -9.8128*** (0.0000) | -3.4416** (0.0003) | 0.8065*** (0.0084) |
| INF | 35 | -7.4784*** (0.0000) | -3.3316*** (0.0004) | 0.7926*** (0.0015) |
| GE | 35 | -6.1453*** (0.0000) | -4.3005** (0.0000) | 0.6587*** (0.0000) |

Note: in parentheses are p-values. ***,** and * indicates rejecting the null hypothesis of non-stationary at 1%, 5% and 10% level, respectively

Source: Andrašič et al. (2018)

The research includes panel unit root tests in order to investigate that panels contain unit roots or not. As it can be seen in Table 3, all variables are clearly stationary at levels so it can be rejected the null hypothesis.

Table 4. Test of autocorrelation and heteroscedasticity

| Wooldridge test | |
|------------------------------------|--------|
| H0: no first-order autocorrelation | |
| F (1, 34) | 2,208 |
| Prob > F | 0,1809 |
| White test | |
| H0: homoskedasticity | |
| Chi ² (9) | 15,44 |
| Prob > chi ² | 0,0794 |

Source: Authors' calculation

Model validity is detected by testing the potential autocorrelation and heteroskedasticity. As can be seen, the value of Wooldridge test shows the

absence of autocorrelation (value = 0.1809) which confirms the null hypothesis that there is no serial autocorrelation between exponential variables. Likewise, the White test confirms the null hypothesis of the existence of homoskedasticity (value = 0.0794).

Table 5. Dynamic modelling of tax effect on investment share (PMG)

| Δ INV | Coef. | Std. Err. | Z | P> z | [95% Conf. Interval] | |
|-------------------|-----------|-----------|-------|-------|----------------------|---------|
| Long-term | | | | | | |
| TRgr | 1,5187 | 0,3759 | 4,04 | 0,000 | 0,7819 | 2,2554 |
| PIT | -2,6887 | 0,7425 | -3,62 | 0,000 | -4,1440 | -1,2333 |
| CIT | 1,105815 | 0,5338 | 2,07 | 0,138 | 0,0596 | 2,1520 |
| TOP | 3,5779 | 1,8259 | 1,96 | 0,040 | -0,0007 | 7,1567 |
| GDP | 2,3898 | 0,5382 | 4,44 | 0,000 | 1,3350 | 3,4447 |
| UNM | 0,0255 | 0,1179 | 0,22 | 0,828 | -0,2055 | 0,2567 |
| INF | -2,4872 | 0,6358 | -3,91 | 0,000 | -3,7334 | -1,2410 |
| GE | 0,1281 | 0,1937 | 0,66 | 0,508 | -0,2515 | 0,5078 |
| Short-term | | | | | | |
| ECT | -0,1139 | 0,01898 | -0,60 | 0,548 | -0,0486 | 0,2058 |
| Δ TRgr | 0,0435 | 0,0249 | 1,74 | 0,001 | -0,005 | 0,0925 |
| Δ PIT | 0,2986 | 0,2548 | 1,17 | 0,241 | -0,2001 | 0,7979 |
| Δ CIT | 0,2881 | 0,2406 | 1,20 | 0,231 | -1,8345 | 0,7598 |
| Δ TOP | -1,8837 | 1,0588 | -0,83 | 0,404 | -2,9589 | 1,1914 |
| Δ GDP | 0,1114 | 0,0546 | 2,04 | 0,041 | 0,0043 | 0,2184 |
| Δ UNM | -0,5966 | 0,1229 | -4,85 | 0,000 | -0,8375 | -0,3557 |
| Δ INF | 0,1745 | 0,0621 | 2,81 | 0,005 | 0,0528 | 0,2962 |
| Δ GE | -0,0779 | 0,0577 | -1,35 | 0,177 | -0,1911 | 0,0353 |
| C | 0,3408 | 0,4244 | 0,80 | 0,422 | -0,4911 | 1,1728 |
| Number of obs | 700 | | | | | |
| Number of groups | 35 | | | | | |
| Log Likelihood | -773,1705 | | | | | |

Source: Authors' calculation

Table 5 reflects the effect of direct taxes on investment share by the PMG model. Tax revenue growth, personal income tax and property tax have a significant impact on investments in observed countries in the long-term. TRgr and TOP positively affect investment share in the GDP, while at the same time model has identified the negative impact of PIT. The results show that the TRgr and TOP enhances investment share by 1.57% and 3.58% in the gross domestic product. Also, an increase of PIT by 1% declines investment share by 2.69% in GDP. Regarding the short-term effects, only TRgr is significant, while the change of other tax forms does not have a significant impact on investment.

Table 6. Dynamic modelling of tax effect on investment share (MG)

| Δ INV | Coef. | Std. Err. | Z | P> z | [95% Conf. Interval] | |
|-------------------|----------|-----------|-------|-------|----------------------|---------|
| Long-term | | | | | | |
| TRgr | 0,1246 | 0,3287 | 0,38 | 0,705 | -0,5198 | 0,7690 |
| PIT | -12,0252 | 9,3482 | -1,29 | 0,198 | -30,3473 | 6,2968 |
| CIT | -1,5919 | 2,9847 | -0,53 | 0,594 | -7,4418 | 4,2580 |
| TOP | 6,9509 | 7,6623 | 0,91 | 0,364 | -8,0669 | 21,9688 |
| GDP | -0,1766 | 0,7176 | -0,25 | 0,806 | -1,5831 | 1,2299 |
| UNM | -0,0889 | 0,6890 | -0,13 | 0,897 | -1,4393 | 1,2616 |
| INF | 0,5810 | 0,8723 | 0,67 | 0,505 | -1,1288 | 2,2908 |
| GE | -0,7901 | 0,4119 | -1,92 | 0,055 | -1,5975 | 0,0173 |
| Short-term | | | | | | |
| ECT | 0,7751 | 0,1392 | 5,57 | 0,000 | 0,5023 | 1,0479 |
| Δ TRgr | -0,0099 | 0,0681 | -0,15 | 0,884 | -0,1435 | 0,1236 |
| Δ PIT | 1,0911 | 0,7205 | 1,51 | 0,130 | -0,3211 | 2,5033 |
| Δ CIT | -0,1657 | 0,9460 | -0,18 | 0,861 | -2,0199 | 1,6885 |
| Δ TOP | -1,0399 | 2,4782 | -0,42 | 0,675 | -5,8972 | 3,8173 |
| Δ GDP | 0,1273 | 0,0819 | 1,55 | 0,120 | -0,0332 | 0,2878 |
| Δ UNM | -0,2127 | 0,3019 | -0,70 | 0,481 | -0,8044 | 0,3790 |
| Δ INF | 0,2256 | 0,1609 | 1,38 | 0,167 | -0,0928 | 0,5379 |
| Δ GE | 0,0820 | 0,1272 | 0,65 | 0,519 | -0,1673 | 0,3314 |
| C | -7,8317 | 14,7239 | -0,53 | 0,595 | -36,6900 | 21,0266 |

Source: Authors' calculation

Table 6 reflects an analysis of the effect of direct taxes on investment share through the MG model. The results of the model imply a significant impact of TRgr in the long-term, while tax revenue growth of 1% increases investment share by 0.12% in the GDP. On the other hand, PIT, CIT and TOP are not significant for the investment share in the short-term. Also, PIT and CIT have negative impact in the long-term compared to TOP. In the short-term this tax has positive implications for the investment share in observed countries.

Table 7. Dynamic modelling of tax effect on investment share (DFE)

| Δ INV | Coef. | Std. Err. | Z | P> z | [95% Conf. Interval] | |
|-------------------|---------|-----------|-------|-------|----------------------|---------|
| Long-term | | | | | | |
| TRgr | 0,3926 | 0,1237 | -3,17 | 0,002 | -0,6350 | -0,1502 |
| PIT | 0,2407 | 0,3749 | 0,64 | 0,521 | -0,4940 | 0,9756 |
| CIT | -0,4708 | 0,4221 | -1,12 | 0,265 | -1,2981 | 0,3565 |
| TOP | 0,0480 | 1,1637 | 0,04 | 0,967 | -2,2327 | 2,3288 |
| GDP | 0,0451 | 0,2113 | 0,21 | 0,831 | -0,3689 | 0,4592 |
| UNM | -0,8093 | 0,1532 | -5,28 | 0,000 | -1,1095 | -0,5091 |
| INF | 0,3824 | 0,1373 | 2,78 | 0,005 | 0,1132 | 0,6516 |
| GE | -0,0009 | 0,1304 | -0,01 | 0,994 | -0,2565 | 0,2545 |
| Short-term | | | | | | |
| ECT | 0,2188 | 0,0305 | 7,17 | 0,000 | 0,1590 | 0,2786 |

| | | | | | | |
|-------|---------|--------|-------|-------|---------|---------|
| ΔTRgr | 0,0039 | 0,0167 | 0,24 | 0,813 | -0,2879 | 0.0367 |
| Δ PIT | 0,0675 | 0,1301 | 0,52 | 0,604 | -0,1876 | 0.3225 |
| Δ CIT | -0,3077 | 0,1458 | -2,11 | 0,135 | -0,5934 | -0.0219 |
| Δ TOP | -0,1244 | 0,2316 | -0,54 | 0,591 | -0,5782 | 0.3295 |
| Δ GDP | 0,1802 | 0,0318 | 5,67 | 0,000 | 0,1179 | 0.2426 |
| Δ UNM | -0,5019 | 0,0561 | -8,94 | 0,000 | -0,6120 | -0.3919 |
| Δ INF | 0,0903 | 0,0271 | 3,33 | 0,001 | 0,0371 | 0.1435 |
| Δ GE | -0,0622 | 0,0313 | -1,99 | 0,047 | -0,1235 | -0.0009 |
| C | -6,5780 | 1,4979 | -4,39 | 0,000 | -9,5138 | -3.6423 |

Source: Authors' calculation

Table 7 reflects the effect of direct taxes on the investment share measured by the dynamic model of fixed effects. In regard to the impact on the long-term, there is a statistical significance of tax revenue growth. As with the results of the MG model it can see the identical effect of PIT, CIT, TOP in terms of significance. In particular, PIT and TOP positively affect the investment share in the GDP in the long-term, but without statistical significance. Also, CIT negatively affects to the the investment share in the short-term as well as long-term. TRgr of 1% contributes to significant investment share increase by 0.39% in the GDP in the long-term.

Table 8. Comparative review of dynamic panel models

| Variable | PMG | MG | DFE |
|---------------------|---------------------------|---------------------------|---------------------------|
| TRgr | | | |
| Long-term effect | +/significant | <i>+/not significant</i> | <i>+/significant</i> |
| Short-term effect | +/significant | <i>-/not significant</i> | <i>+/not significant</i> |
| PIT | | | |
| Long-term effect | -/ significant | <i>-/not significant</i> | <i>+/not significant</i> |
| Short-term effect | +/not significant | <i>+/not significant</i> | <i>+/not significant</i> |
| CIT | | | |
| Long-term effect | +/ not significant | <i>-/ not significant</i> | <i>-/ not significant</i> |
| Short-term effect | +/ not significant | <i>-/ not significant</i> | <i>-/ not significant</i> |
| TOP | | | |
| Long-term effect | +/significant | <i>+/ not significant</i> | <i>+/ not significant</i> |
| Short-term effect | -/ not significant | <i>-/ not significant</i> | <i>-/not significant</i> |
| Hausman test | 1,96 0,9821 | | |

Source: Authors' illustration

Based on the results from table 8 the PMG model is an appropriate model in the empirical analysis of direct taxes effect on the investments in OECD countries. This model shows a significant effect of tax revenue growth, personal income tax and property tax in the long-term, while their change does not significantly affect investment in the short-term. Corporate income is not significant variable for investment share in the observed period.

Table 9. Dynamic modelling of tax effect on investment share by OECD countries (PMG)

| Country | Δ TRgr | Δ PIT | Δ CIT | Δ TOP | Δ GDP | Δ UNM | Δ INF | Δ GE |
|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Australia | 0.0171 | 0.7684* | 0.9125 | 0.4978 | 0.1182 | -2.402** | -0.644** | 0.0299 |
| Austria | 0.2709** | -0.1790 | -1.696** | 1.2504 | -0.245** | 0.0071 | 0.3228 | -0.1284 |
| Belgium | -0.2121* | 0.1732 | 0.8051 | 1.7261* | 0.2598* | -0.4871 | 0.6649** | -0.0045 |
| Canada | 0.0888 | 0.1687 | 0.2236 | 0.1543 | 0.2260 | -0.9263 | -0.4159 | -0.3007 |
| Chile | -0.0747* | -0.5411 | -0.2746 | 5.345 | 0.6327** | -0.883** | 0.4009* | 0.2278 |
| Czech R. | -0.0041 | 0.5980 | -0.0527 | 3.8815 | 0.1247 | 0.0974 | 0.2987 | -0.0480 |
| Denmark | 0.0810 | -0.6623* | -0.0117 | -1.411 | 0.0628 | -1.818** | -0.4290 | 0.0633 |
| Estonia | 0.1558 | 4.3527** | -0.6597 | -21.778 | -0.0148 | -0.2749 | -0.883 | -0.7834 |
| Finland | 0.2554** | 0.3706 | -1.589** | 6.4589* | -0.0430 | -0.6239 | 0.2254 | -0.537** |
| France | 0.0181 | 0.3089 | 0.0848 | -1.5149 | 0.0042 | -0.0948 | 0.2842 | -0.0643 |
| Germany | -0.0173 | 0.5529 | 0.1351 | -4.4361 | 0.0569 | 0.2853 | 0.4801* | 0.1926 |
| Greece | 0.0737 | 1.3258 | -0.2186 | 0.2749 | 0.5831** | -1.144** | 0.0530 | -0.1953 |
| Hungary | -0.0575 | 0.7547 | -0.1794 | -7.0214* | 0.6057** | -0.6015 | 0.2522 | 0.0475 |
| Iceland | 0.4203** | 0.2786 | 0.5612 | -8.260** | 0.1143 | -1.4546 | 0.6279** | -0.2194 |
| Ireland | 0.0536 | -0.2722 | 0.9978 | 1.2569 | -0.1514 | -0.2414 | -0.1934 | -0.0818 |
| Israel | -0.0218 | 0.1761 | 0.1537 | -0.2833 | -0.0136 | -0.1733 | 0.0725 | 0.2664 |
| Italy | 0.0069 | 0.1847 | 0.3951* | -0.3589* | 0.1206** | -0.931** | 0.0036 | -0.450** |
| Japan | -0.1007 | 0.5505 | -0.2257 | -2.0411 | -0.1243 | 1.0467 | 0.3785* | -0.0656 |
| Korea | 0.2416* | -2.0853 | -0.0051 | 1.5303 | 0.5126** | -2.060** | 1.2220** | 0.7482 |
| Latvia | -0.2344* | 1.1362 | 4.6286** | 12.762** | 0.3311 | 0.7669** | 0.2613* | -0.4535* |
| Luxembourg | -0.009 | 1.2735 | -0.6375 | -0.4328 | 0.0299 | -0.8344 | 0.2032 | 0.221 |
| Mexico | -0.118** | 1.0718 | -1.6529* | -9.0664 | 0.115 | -0.7887 | 0.0839 | 0.0513 |
| Netherlands | -0.6298 | 0.0619 | 1.8015** | -0.9806 | 0.1328 | -0.625** | -0.0645 | 0.1702 |
| New Zealand | 0.1006 | 0.0448 | 0.5792 | 1.2440 | -0.0035 | -1.165** | -0.1759 | -0.0550 |
| Norway | 0.0830 | 2.4209 | -1.2180* | -13.5056 | 0.1824 | -0.7348 | 0.6907* | 0.5677* |
| Poland | 0.3523** | 1.9982** | 4.6653** | -1.9626 | 0.8139** | -0.497** | 0.2201** | 0.2123 |
| Portugal | 0.0789 | -1.0900 | 1.8925 | -5.9625 | 0.1231 | -1.212** | 0.0279 | 0.0023 |
| Slovakia | 0.0597 | 3.8845 | -1.1289 | 8.9989 | 0.2926 | 0.2179 | -0.1354 | -0.0994 |
| Slovenia | -0.1948 | -0.6875 | 0.2574 | 7.2547 | 0.1962 | -1.3249 | 0.5592* | 0.2562 |
| Spain | 0.9093* | -0.4379 | -0.1696 | 4.2685** | -0.585** | -0.1715 | -0.1486 | -0.4319 |
| Sweden | -0.4973 | -0.1951 | -0.1088 | -4.864** | 0.1019* | -0.1109 | -0.1482 | -0.127** |
| Switzerland | 0.2299 | -4.2375* | 1.6263 | -1.7918 | -0.951** | -0.7390 | 0.5880 | -0.9455 |
| Turkey | -0.0026 | -1.1318 | 1.6373 | -0.0815 | 0.1995 | -0.7978* | 0.1069 | -0.4066 |
| United Kingdom | 0.0059 | 0.2840 | -0.2413 | -0.4734 | 0.1694 | 0.1035 | 0.1416 | -0.2955 |
| United States | -0.0056 | -0.916** | -1.2568 | -1.5479 | -0.1119 | -0.3082 | 0.3453** | -0.1472 |

Source: Authors' calculation

Analyzing the effect of direct tax forms on investments by countries, the results of the PMG model manifest a significant impact of tax revenue growth in ten OECD economies. Tax revenue growth has a positive effect on the investment share in the GDP in Austria, Finland, Iceland, Korea, Poland and

Spain. On the other hand, investment share in the GDP significantly drops in Belgium, Chile, Latvia and Mexico due to the tax revenue growth. Tax revenue growth of 1% contributes to an intensive increase of 0.91% of investment in the GDP of Spain. The smallest change in the investment share of -0.7% was recorded in Chile, which implies that when tax revenues rise, investment share declines in the gross domestic product of this country. Personal income tax significantly affects to the investment share in the GDP of Australia, Denmark, Estonia, Poland, Switzerland and United States, where the positive effect of this tax form is only present in Australia and Poland. The greatest sensitivity of investments as a result of the tax form change was registered in Switzerland (-4.24%), while the smallest change was registered in Denmark (-0.66%). Corporate income tax negatively affects to the investment share in the GDP of Austria, Finland and Norway. The largest change in the investment share of GDP was registered in Poland (4.66%), while on the other hand, the smallest sensitivity was registered in Italy (0.39%). Property tax negatively affects the investment share in the gross domestic product of Hungary, Iceland, Italy and Sweden. Further, this tax enhances investment share in GDP of Belgium, Finland, Latvia and Spain. The largest change in the investment share of GDP was registered in Latvia (12.76%), while the smallest sensitivity was registered in Italy (0.36%).

5. Conclusions

This research has examined the direct taxes effect on investment share in thirty-five OECD countries from 1996-2016. The study implies pooled mean group model, mean group model and dynamic fixed effects model that has evaluated the impact of tax revenue growth, personal income tax, corporate income tax, property tax on the investment share in selected countries. Analyzing the taxes whose impact is significant for the investment share in OECD countries, it can be noticed that 1% increase of tax revenue growth raises investment share in the GDP for 0.04% in the short-term. Likewise, tax revenue growth raises investment share in the long-term where change is 1.52%. Further, 1% increase in property tax raises investment share in the GDP for 3.58% in the long-term, while this tax is not significant in the short-term. Also, personal income tax is significant for investment share in the long-term effect, while intensity is smaller than property tax. Finally, corporate income tax is not significant for investment share in the observed countries. The contribution of this research is a quantitative measurement of the direct tax effect on investment share and determines which tax form is essential for the investment in OECD countries. Also, this relationship has not sufficiently explored in previous empirical studies and this research enables informatical

support for the policy makers to define direct tax levels that are important for this macroeconomic variable. Considering that direct taxes have a various effect it is necessary to increase tax revenue growth and share of the property on tax of the gross domestic product. Furthermore, results have confirmed a reduction of personal income tax because this tax form has a negative impact on the investment share in OECD countries. The research has enabled a greater understanding of nexus between direct taxes and investment as well as the impact of personal income tax, corporate income tax and property tax. Accordingly, empirical analysis has given a specified direction to tax policy makers in defining tax structure in observed economies. This implies an appropriate tax structure and level which should be improving and accelerating the growth of selected countries.

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