TAX CHANGES EFFECTS ON THE CZECH ECONOMY

Zlatica Konôpková[1]

Abstract

Today, economies are struggling with the consequences and uncertainty caused by the pandemic of novel coronavirus. Economic subjects turn their attention to the government and ask for help. Government budgets will face a real challenge in the next years, due to current high demand for the spending and expected decline in income. This paper investigates the current condition of public finances in the Czech Republic and the possible effects on economy by decreasing direct taxes on labor and capital. Simple DSGE model of small and closed economy with 3 sectors is calibrated using data from 2018 and stochastic analysis is performed. It is shown that economy is more sensitive to the shocks on labor than on capital income taxes. Results support the tax reform of decreasing labor taxes for which Czechia is waiting for long time.

Keywords

Tax Reduction, The Czech Republic, DSGE, Labour, Capital

I. Introduction

At the end of the previous millennium, the world economy experienced a period of boom and relative stability. However, since 2000 it has faced many challenges and tests. The first decade brought fluctuations caused by bubbles in the stock and mortgage markets, which eventually resulted in a global financial and economic crisis associated with a multi-percent economic downturn. During the second decade, a slow recovery of the world economy has started eventually turning into relatively long period of continuous growth. However, predictions of the recession have begun to emerge, but no one expected the cause that actually triggered the current decline in growth.

Nowadays, economies are struggling with the consequences and uncertainty caused by the pandemic of novel coronavirus. Restrictive measures have forced a reduction in economic activity, with some sectors literally shutting down to zero. The epidemic of such a large scale highlights the crucial role of the state, which has not only put in place measures against the spread of the virus, but also has made proposals to address the economic impact. Economic subjects turn their attention to the government and ask for help and compensation for limiting their activities. The role of the state is thus strengthened again at the expense of the market. Government budgets will face a real challenge in the next years. In addition to current high demand for the spending and expected decline in income, in developed countries, we have been experiencing a trend of population aging, which implies increase in the spending on the social and health.

In this paper, we will examine the effects of the fiscal policy on the economy by using the simple Dynamic Stochastic General Equilibrium Model (DSGE). This has been a key macroeconomic modelling approach in last years, used for research of different economic topics. Just to mention some recent works, Alves (2018) developed DSGE model to examine the impacts of different types of tax. Kim & Kim (2018) used DSGE model to study welfare implications of a simple operational tax policy rule for different type of taxes. Algozhina (2012) introduced DSGE model for joint fiscal and monetary interactions, investigating the changes in public investment and consumption. Nowadays, all important economic institutions, for

[1]Masaryk University, Faculty of Economics and Administration, Lipová 41a, 602 00 Brno, Czech Republic, E-mail: zlatica.konopkova@mail.muni.cz.

example central banks or ministry of finance, are creating their own models. It is also a case for the Czech Republic. Ministry of Finance is developing their own model called Hubert in order to evaluate the situation in economy, prepare policy and make decision, for details check Štork (2011).

The paper is inspired by work of Costa Junior and Sampaio (2014) and follows standard practice in DSGE modelling presented by Galí (2008). The authors investigated and evaluated tax reduction policies of the productive sector in Brazilian economy. According to OECD (2010), the direct taxes have the greatest negative effect on the economy. Reducing them might result in positive (stabilizing) effect on the economy. It was also confirmed by Mamatzakis (2005), that shift from direct to indirect taxation can invoke an economic growth without changes on revenue side, which was then the main fiscal policy trend in the recent years. One of the promised tax reforms of the actual Czech government was to reduce direct labor taxes, but it has not been implemented yet. The aim of this paper is to examine the current condition of public finances and the possible effects of decreasing direct taxes on labor and capital in the Czech Republic. Due to the availability of data, the simulation and impulse response functions have starting point in 2018.

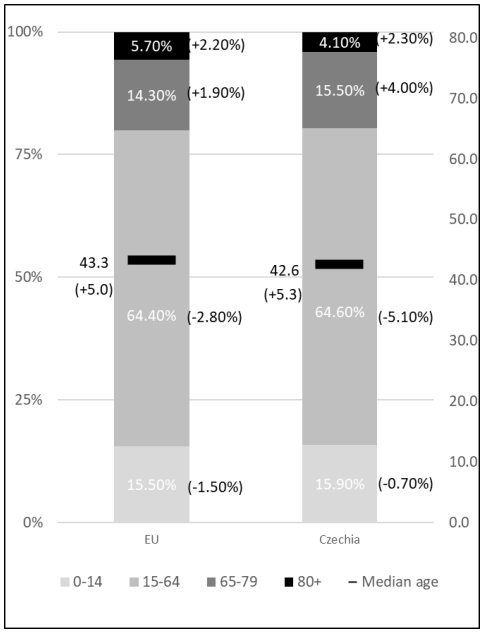
The next section of paper addresses the current trends in the Czech Republic and the European Union, political and economic union of which Czechia is a member. The third section introduces individual components of DSGE model used by Costa Junior and Sampaio (2014). Next part presents the calibrated values of parameters used for the simulation and obtained from other DSGE works in literature. Finally, the responses of economic variables on negative shocks in labor and capital income taxes are discussed.

II. Recent trends

The third millennium is characterized by the continuing globalization of the world economy and the deepening of the specialization of individual countries in areas in which they have a competitive advantage. Developed economies face various challenges, one of which is clearly unfavorable demographic developments. The problem of an aging population brings increased demands on future spending and puts pressure on the consolidation of public finances.

Figure 1 shows the structure of population in the European Union (EU) and the Czech Republic together with median age. Over the last 20 years, the proportion of people over 65 in the population of the EU has increased by 4.1 percentage points, and currently represents 20.0% of the population. On the contrary, the share of the population under 65 is decreasing, for children under 14 it is by 1.5 percentage points to a value of about 15%. The working group (15-64) has fallen by 2 percentage points over the last 20 years to a current value of around 64.5%. The development of the Czech population is very similar, almost copies the composition in the European Union. Although the median age is lower, the rate of change over the last 20 years is more intense. Unfortunately, population models do not predict a change in the trend in the future, so governments will have to cope with this structural change and prepare effective reforms of the social, health and pension systems.

Figure 1 Population structure in 2019 and change from 2000



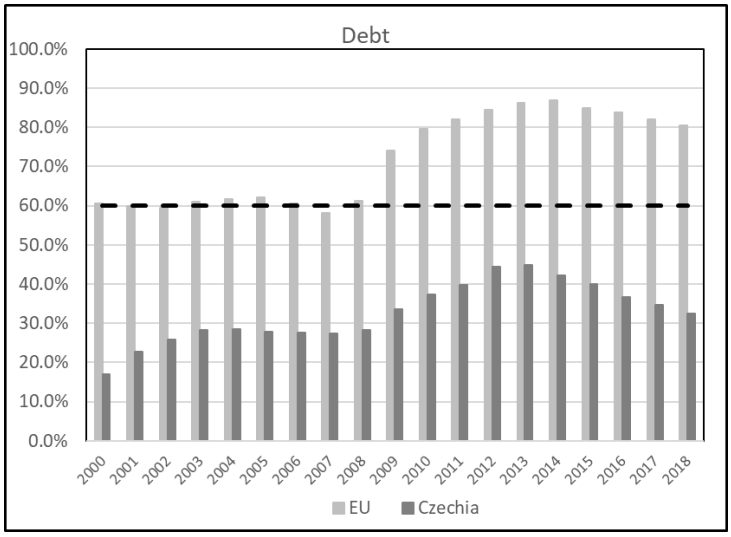
Source: Author's construction, Eurostat (2020c)

Public finances have still not fully recovered and not cleared all the debts created due to the last global financial crisis. The governments were intervening with their fiscal instruments in an effort to stabilize the economy. The crisis has brought us not only the decline in the performance of economies, but probably also changes of a long-term nature. It is still questionable how much the measures taken by governments, whether positive or negative, have changed the nature of the economy.

The European Union achieved the deepest drop in GDP in 2009 by almost 5 percentage points in response to the crisis. A small economic recovery took place in the following period, but the EU fell into recession again after 2 years. The reason was the debt crisis of the members caused by issues of Greece. The crisis development of GDP growth in Czechia was similar, but with its openness as a small economy a bit more intense. For more detailed data see Eurostat(2020b).

Crisis revealed the weak condition of European public finances, Figure 2 and 3 display their development. After 2008, the debt to GDP ratio of its members increased significantly reaching maximum value of 87% in 2015. Thanks to economic growth, it has been declining in the last years, but only very slowly, and the difference compared to the pre-crisis period is still around 20 percentage points. The development in the Czech Republic was similar, but with lower values of this ratio. In the pre-crisis period, it was kept below 30%, to which it is gradually returning from a crisis maximum of 45%. The issue of public debt sustainability is addressed by a number of research papers, it remains questionable what size of debt can cause problems for countries and also whether the absolute size of debt or relative size to GDP will play a key role in the outcome.

Figure 2 Development of debt (% of GDP)



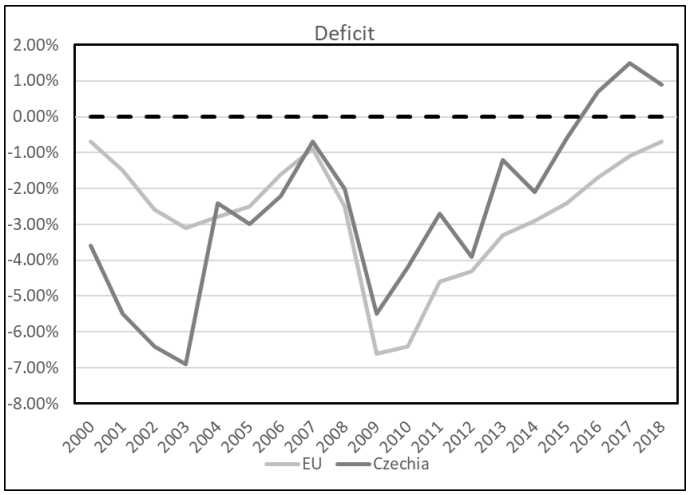
Source: Author's construction, Eurostat (2020a)

The origin of debt crisis is tightly connected to the yearly government performance. We can see on Figure 3 that in the pre-crisis period, a several percent public budget deficit was the standard, even in the years of the greatest expansion. In 2003, the average deficit of the EU countries was 3.1% and the surplus budget was recorded by only 4 members.

In response to these developments, in 2012 the European countries signed the Treaty on Stability, Coordination and Governance in Economic and Monetary Union, also known as the Fiscal Compact. The agreement strengthens the text of the Stability and Growth Pact, introduces a mandatory balanced budget rule and moves members closer to fiscal integration. In 2019, already 16 EU member states experienced budget surplus including Czechia, which signed the Treaty only that year after its initial refusal.

Considering the trends described above, consolidation of the public sector is the second key task for the government to be done, right after fighting the current crisis. The number of observed unfavorable situations creates considerable pressure on economic policy options to stabilize the economy. Given the consequences of the last global stagnation 10 years ago, justified doubts have arisen whether classic tools can help the economy.

Figure 3 Development of deficit (% of GDP)



Source: Author's construction, Eurostat (2020a)

III. Methodology and data

The model is designed for the environment of small and closed economy with three sectors: households, firms and government (authority) and the equilibrium condition in the goods market holds the truth.

$$Y_t = C_t + I_t + G_t \tag{1}$$

Households

Two types of representative agents – active (Ricardian) and inactive (non-Ricardian households) workers with the fixed split – creates the whole sector of Households. Aggregate consumption C_t of individuals can be then expressed as

$$C_t = (1 - \omega)C_{R,t} + \omega C_{NR,t}, \tag{2}$$

where $C_{R,t}$ $(C_{NR,t})$ represents the consumption of Ricardian (non-Ricardian) households.

Active workers are taxpayers, contributors to the pension system, and also savers. This type of households maximizes intertemporal utility function by choosing the consumption, savings, investments and leisure. Household's saving can be made in form of investment into capital goods I_t or purchase of bond issued by government B_{t+1} with the rate of return R_t^B. Every household must pay taxes on consumption τ_c, on labor income τ_l, on capital income τ_k and also social security contributions τ_p. ϕ_t^c and ϕ_t^l are the stochastic components of the taxes. Households receive wages W_t for labor, return from capital R_t and payments from the bonds B_t that matured after one period.

The budget constraint of the household is

$$P_t(1 + \tau_c)\left(C_{R,t} + I_t\right) + \frac{B_{t+1}}{R_t^B} = W_t L_t \left(1 - \frac{\tau_l}{\phi_t^l} - \tau_p\right) + R_t K_t \left(1 - \frac{\tau_k}{\phi_t^k}\right) + B_t. \tag{3}$$

Let E_t be the expectation operator, $\beta \in (0,1)$ the intertemporal discount factor, L_t the labor, S_t^C, S_t^L the shocks on intertemporal consumption and labor supply, ψ marginal disutility of labor and σ the coefficient of relative risk aversion, then the maximization problem of Ricardian household is

$$\max E_t \sum_{t=0}^{\infty} \beta^t S_t^C \left[\frac{C_{R,t}^{\sigma}}{1-\sigma} - S_t^L \frac{L_t^{1+\psi}}{1+\psi}\right] \tag{4}$$

The capital in economy is characterized by law of motion

$$K_{t+1} = (1 - \delta)K_t + I_t. \tag{5}$$

Shocks presented to the model follow the rules of movement

$$\log S_t^C = (1 - \rho_{sc}) \log S_{ss}^C + \rho_{sc}\, S_{t-1}^C + \epsilon_{sc,t} \tag{6}$$

$$\log S_t^L = (1 - \rho_{sl}) \log S_{ss}^L + \rho_{sl}\, S_{t-1}^L + \epsilon_{sl,t} \tag{7}$$

$$\log \phi_t^l = (1 - \rho_l) \log \phi_{ss}^l + \rho_l\, \phi_{t-1}^l + \epsilon_{l,t} \tag{8}$$

$$\log \phi_t^k = (1 - \rho_k) \log \phi_{ss}^k + \rho_k\, \phi_{t-1}^k + \epsilon_{k,t} \tag{9}$$

where $\epsilon_{i,t}$ are exogenous shocks and ρ_i are autoregressive components.

Inactive workers are the retired ones and are not allowed to make savings. They are limited by the value *PEN* of the benefits received from government and do not maximize their intertemporal utility function,

$$PEN = (1 + \tau_c) P_t C_{NR,t}. \quad (10)$$

Firms

The final good of economy Y_t is created in two stages of the Firms sector, where $Y_{j,t}$ is the intermediate product and φ is the elasticity of substitution between intermediate goods. Following technology is used

$$Y_t = \left(\int_0^1 Y_{j,t}^{\frac{\varphi-1}{\varphi}} dj \right)^{\frac{\varphi}{\varphi-1}}, \quad (11)$$

Firstly, there is *wholesale sector* representing number of firms that produce different intermediate goods and face monopoly competition. With the share of capital α and the productivity A_t, wholesalers determine the quantities of production factors to minimize costs taking their prices as given

$$\min_{L_{j,t} K_{j,t}} W_t L_{j,t} + R_t K_{j,t}, \quad (12)$$

subject to the technology

$$Y_{j,t} = A_t K_{j,t}^{\alpha} L_{j,t}^{1-\alpha}. \quad (13)$$

Let $\epsilon_{A,t}$ be exogenous shock and ρ_A autoregressive component, the law of motion is

$$\log A_t = (1 - \rho_A) \log A_{ss} + \rho_A \log A_{t-1} + \epsilon_{A,t} \quad (14)$$

The firms maximize the profit by subsequently determining the optimal price of the good and the quantity

$$\max_{P_{j,t}} P_t Y_t - W_t L_{j,t} + R_t K_{j,t}. \quad (15)$$

Second stage of production is done by *retail industry*, a single firm in perfect competition aggregating the intermediate goods into a single good consumed by agents in economy. Subject to the technology (11), the firm maximize its profit taking the prices of goods from wholesalers as given

$$\max_{Y_{j,t}} P_t Y_t - \int_0^1 P_{j,t} Y_{j,t} dj \quad (16)$$

Prices in economy are subject to change in line with Calvo (1983). Only a randomly selected fraction $(1 - \theta)$ of wholesalers is able to set the optimal price $P_{j,t}^*$ in every period. The remaining part θ of firms can use the price from previous period $P_{j,t-1}$. The overall price level in economy is hence equal to

$$P_t = \left[\theta P_{t-1}^{1-\varphi} + (1 - \theta) P_t^{*1-\varphi} \right]^{\frac{1}{1-\varphi}} \quad (17)$$

Government

Government is the third sector in model. It acts as fiscal and monetary authority and also takes care of social security system. Only simple *social system* with no capitalization is considered, so the pension balance BAL_t is equal to difference of revenues and expenses

$$BAL_t = \tau_p W_t L_t - PEN \quad (18)$$

Fiscal authority needs to finance purchases of goods and services. Resources are accumulated from taxes and issued bonds, which allow financing of spending on debt.

The tax revenue TAX_t is equal to

$$TAX_t = \tau_c P_l (C_t + I_t) + \frac{\tau_l}{\phi_t^l} W_t L_t + \frac{\tau_k}{\phi_l^k} R_t K_t, \quad (19)$$

and the public debt is given as

$$\frac{B_{t+1}}{R_t^B} - B_t = P_t G_t - BAL_t - TAX_t, \quad (20)$$

The government's spending is sensitive relatively to the size of public debt with sensitivity coefficient χ

$$G_t - G_{ss} = \chi (B_t - B_{ss}), \quad (21)$$

where $G_{ss,}\ B_{ss}$ are steady-state levels.

Monetary authority controls the interest rate using simple Taylor rule (1993) with the goal of output growth and price stability. Let a, b be respective sensitivity coefficients, π_t inflation rate and $Y_{ss,}\ R_{ss}^B, \pi_{ss}$ steady-state levels, then the rule is

$$R_t^B = a(Y_t - Y_{ss}) + b(\pi_t - \pi_{ss}) + R_{ss}^B, \quad (22)$$

IV. Calibration

Before performing stochastic analysis, it is needed to assign values to structural parameters, see Table 1. The individual values are obtained from economic literature, other DSGE works or calculated from statistics available for Czech economy in 2018.

Table 1 Calibrated parameters

Parameter	Value	Description	Source
σ	2.0	relative risk aversion coefficient	Němec (2013)
ψ	3.0	marginal disutility of labor	Němec (2013)
τ_c	0.201	implicit tax rate on consumption	European Commission (2020)
τ_k	0.192	implicit tax rate on capital income	European Commission (2020)
τ_l	0.406	implicit tax rate on labor income	European Commission (2020)
τ_p	0.110	social security contributions	European Commission (2020)
χ	0.1	sensitivity of gov. spending to debt	Costa Jr. and Sampaio (2014)
ω	0.2726	pension beneficiaries	ČSSZ (2020)
PEN	0.124	benefit payments	Eurostat (2020d)
θ	0.6	price stickiness index	Němec (2013)
φ	6.0	elasticity of subst. btw. interm. goods	Costa Jr. and Sampaio (2014)

Source: Author's construction

V. Results

Stochastic simulation was performed for negative exogenous unit shocks in the labor and capital income tax rates generated for 50 periods. Overall, we can conclude the shock presented in the tax rate on labor income is more effective, highly influence the economy comparing to the shock in the tax rate on capital income. Table 2 presents the variance decomposition of the errors of the simulated endogenous variables in relation to presented exogenous shocks. Tax reduction in labor income affected all macroeconomic variables more intensively than reduction

in capital income. Lower tax increases the disposable income of households and motivates them to work more as it makes the leisure time more expensive. Their work injects the economy, creates more output, which support the consumption and investment.

Table 2: Variance Decomposition (in percent)

	Y	Welfare	C	I	K	L	TAX	B	G
$\epsilon_{l,t}$	98.42	97.14	96.23	95.67	95.79	98.87	93.65	93.4	93.4
$\epsilon_{k,t}$	1.58	2.86	3.77	4.33	4.21	1.03	6.35	6.6	6.6

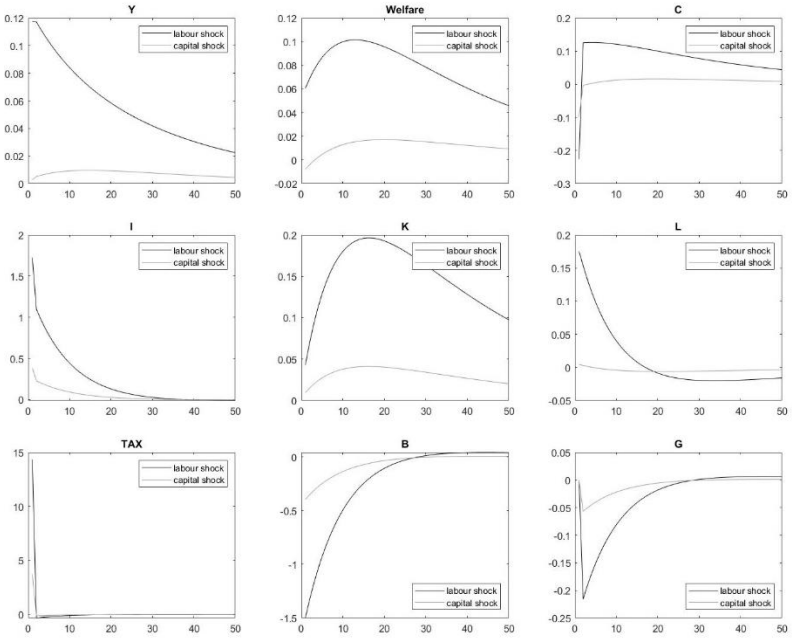
Source: Author's construction

Figure 4 shows the impulse responses of chosen economic variables to introduced shocks. All in all, we can briefly summarize that the reactions of variables are in line with expectations and positive, increasing *Welfare* in economy. As it was mentioned, the results are positive for the shock in labor income tax. Tax reduction in capital income tax is not able to invoke significant changes in economy. Despite the reduction policy, thanks to the changes in behaviour of economic subjects, *tax revenue* is not affected. The fall in *debt* is greater than the decline in *government spending*, which suggests that a reduction in indirect taxes can help the government in consolidating public finances for long term.

Consumption in economy is a composition of Ricardian and non-Ricardian households. Active workers increase their consumption thanks to direct substitution effect of the labor income tax decline. On the other hand, inactive workers are restricted by the payments from government and they are forced to reduce consumption due to a decline in government spending, which is reflected in a sharp downturn at the beginning of the simulation. In case of a capital income tax shock, the effect on consumption is not significant with a small initial decrease and then very little increase from the steady-state value. Non-Ricardian households are still limited by a fall in government spending, which creates the decline in consumption in the first few periods. The change in capital income tax also does not affect directly Ricardian households and their behaviour. They increase their consumption only after few periods of observing the positive affect of this reduction through the firms.

Investments respond positively to this type of shocks, again more intense to reduction in labor income tax. Thanks to bigger disposable income also investments are increased, which allows to create more capital and additionally support the economic growth. The positive change slowly vanishes due to diminishing marginal product of capital and displacement effect of the government spending which pushes investment out of the economy.

Figure 4 Impulse response function on shock in labor and capital income tax



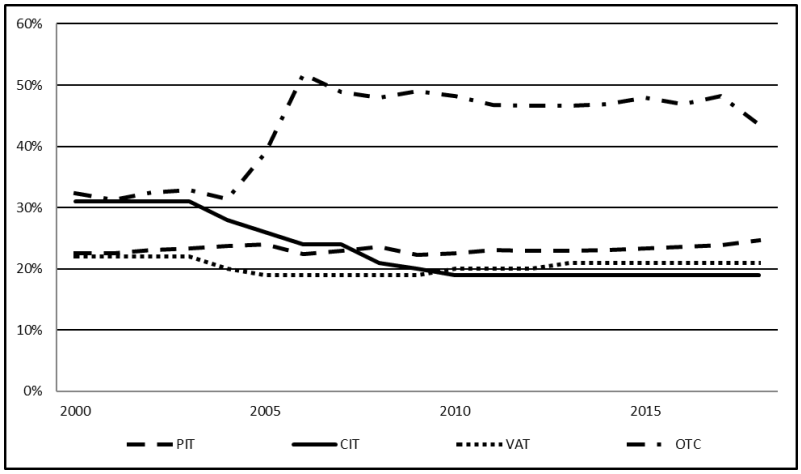
Source: Author's construction

VI. Conclusion and discussion

In this paper we discussed the current condition and development of public finances and examined the possible effects of decreasing direct taxes on labor and capital in the Czech Republic. Simple DSGE model of small and closed economy with 3 sectors was calibrated for data in 2018. Results of stochastic analysis support the trend of shift from direct to indirect taxes. Reduction of these taxes positively impacts the economy, especially when reducing taxes imposed on labor.

Reduction of income labor tax is one of the tax reforms promised by the actual Czech government. The tax system in Czechia is frequently changing. Initially, the reforms were needed to support transformation from centrally planned economy, then to meet the harmonisation criteria after joining the EU, but mostly in order to support economy. Figure 5 shows the important tax rates in the Czech Republic and their development in last 20 years. The governments were mostly focusing on indirect taxes – increasing excises (OTC) and keeping basic value added tax (VAT) quite stable. The other area of focus was the corporate income tax (CIT) with gradual decrease over time. Personal (labor) income tax (PIT) was left without significant reform – changing only +/- 1 percentage point around average value. As it was shown by our analysis, it is a big place for improvement as changes in labor income tax may invoke an economic growth.

Figure 5 Changes in tax rates over time



Source: Author's construction, OECD (2020)

Acknowledgements

Supported by funding of specific research at Faculty of Economics and Administration, project MUNI/A/0906/2019. This support is gratefully acknowledged.

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