

On the Long-run Aggregate and Distributional Effects of the 2021 Czech Tax Reform

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Summary. This study analyzes the long-run aggregate and distributional consequences of a labor income tax reform in the Czech Republic using a rich quantitative macroeconomic model with heterogeneous agents, a novelty in the context of the Czech Republic. While the reform also introduced changes in taxation of self-employed, we focus on the changes in taxation of employees.

The tax reform launched as part of the stimulus package during the COVID-19 pandemic, effective from January 1, 2021, abolished the concept of the “super-gross wage” and reduced marginal tax rates for middle income individuals, and increased the personal and child tax allowances. We study two main scenarios that differ in terms of how the tax cut will eventually be financed. In the first scenario, the tax cut is financed by a decrease in government expenditure, while in the second scenario it is financed by a decrease in transfers.

In both scenarios, the reform has a stimulative effect on the economy. Since after the tax reform agents face lower labor income taxes, they increase their labor supply. They also save more. In the long run, this implies higher levels of capital and output, as well as private consumption. The reform also reduces most earnings and wealth inequality measures in both scenarios. However, the specific details of the effects of the reform differ across the two scenarios. We also briefly discuss the possibility of debt financing. Debt financing would imply yet different implications of the reform.

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Policy Recommendations. Motivated by our findings, we put forth three main recommendations for fiscal policy, which are formulated so that fiscal policy avoids unnecessary risks associated with future tax reforms (or policy changes more generally).

- Recommendation 1. To eliminate the risk of future tax cuts without explicit plans of their long-run financing: Tax cuts should be accompanied by concrete plans in terms of how they will be financed in the long run. Otherwise, they generate unnecessary uncertainty and risk in the economy.
- Recommendation 2. To eliminate the risk of implementing policy changes with negative aggregate consequences: Tax reforms should be implemented only once their aggregate consequences have been properly understood. This can be done using models like the one presented in this study or other methods.
- Recommendation 3. To eliminate the risk of implementing policy changes with negative distributional consequences: Tax reforms should be implemented only once their long-run distributional have been analyzed. The model presented in this study is indeed a natural candidate for studying the distributional effects of tax reforms.

I Introduction

This study analyzes the aggregate and distributional impact of a labor income tax reform in the Czech Republic, where we focus on changes in taxation of employees. The tax reform launched as part of the stimulus package during the COVID-19 pandemic, was effective from January 1, 2021, represented a fundamental structural change to the country’s labor income taxation system. The main changes were the abolishment of the concept of the “super-gross wage”, which reduced marginal tax rates for middle incomes, and an increase in the personal and child tax allowances, which affected most low income individuals.

We analyze the distributional effects using a rich quantitative model with heterogeneous agents, based on Kina et al. (2024). In the model, individuals ex-ante differ in their skill level (skilled and unskilled) and face idiosyncratic wage risk. We characterize changes in the equilibrium allocation resulting from the policy change, depending on assumptions about how the tax reform might be financed. As our benchmark, we consider the case when a decrease in government expenditure is used to finance the tax cut and alternatively, we consider a decrease in transfers (an increase in lump-sum taxes).

While there have been estimates of the budgetary costs of the Czech tax reform (Kalíšková et al. (2020) and Kalíšková et al. (2023)), to the best of our knowledge, this study is the first one to analyze the effects of the reform using a state-of-the-art dynamic macroeconomic model with heterogeneous agents.

II Model

In this section, we describe the main components of the model. The model consists of individuals of measure one, a representative firm, and a government.

Agents. Individuals are ex-ante heterogeneous in their skill type: They are either skilled ($i = s$) or unskilled ($i = u$). Skilled individuals work in skilled occupations earning wage $w_{s,t}$ per efficiency labor unit in time t , whereas unskilled individuals work in unskilled occupations earning wage $w_{u,t}$ per efficiency labor unit. We assume that the mass of individuals working in a particular occupation in time t is fixed and denoted by $\pi_{i,t}$, where $i \in \{u, s\}$. Quantitatively, we characterize the skilled individuals to correspond to those who have attained at least a bachelor's degree or its equivalent at the time of entering the labor market.¹

Within each skill group, individuals face idiosyncratic labor productivity shock $z_{i,t}$. The productivity shock follows a type-specific Markov chain with states denoted by $Z_i = \{z_{i,1}, \dots, z_{i,I}\}$ and transitions denoted by $\Pi_i(z|z')$, where $\{1, \dots, I\}$ are the possible productivity shocks that worker of type i can face. The productivity shock for individuals is drawn from the stationary distribution associated with the Markov chain.

Our assumptions imply that an individual of skill type i earns $w_{i,t} \cdot z_{i,t}$ per unit of her time in period t .

Preferences. Agents have an additively separable utility function over consumption and labor:

$$u(c) - v(l) = \frac{c^{1-\sigma}}{1-\sigma} - \phi \frac{l^{1+\gamma}}{1+\gamma},$$

where σ denotes the coefficient of relative risk aversion and γ controls the Frisch elasticity of labor supply. Additionally, agents discount utility across periods by $\beta_i \in (0, 1)$.

Technology. There is a representative firm with a Cobb-Douglas production function given by:

$$F(K_t, L_s, L_u) = K^\theta (\kappa L_s^\varepsilon + (1 - \kappa) L_u^\varepsilon)^{\frac{1-\theta}{\varepsilon}} \quad (1)$$

where θ is the standard Cobb-Douglas parameter that determines the income share of capital, κ ensures that skilled labor is more productive than unskilled labor, and ε regu-

¹Using US data, researchers typically define a skilled person as a person with at least 16 years of education or a bachelor's degree. These definitions are consistent between the USA, where getting a bachelor's degree requires 16 years of education (12 years to finish high school + 4 years of bachelor's) and the Czech Republic (13 + 3). We exclude 'konzervatoře ukončené absolutoriem' and 'vyšší odborné (titul DiS.)' from the skilled in the Czech Republic because they correspond more to non-bachelor programs such as 2-year community colleges in the USA. Also, these degrees are not considered university education in the Czech Republic.

lates the extent to which skilled and unskilled labor can be substituted for one another. K, L_s , and L_u refer to the aggregate levels of capital, effective skilled labor supply and unskilled labor supply, respectively. Capital depreciates at rate δ . In each period, the firm rents capital and hires the two types of labor to maximize profits.

Government. The government uses piecewise linear tax function to tax labor income, which is discussed in detail in section III. Furthermore, the government uses constant taxes on capital income and consumption given by τ_k and τ_c respectively. The government uses taxes to finance their expenditure $\{G_t\}_{t=0}^\infty$, debt (repayment) $\{B_t\}_{t=0}^\infty$ and lump-sum transfers $\{Tr_t\}_{t=0}^\infty$.

Asset Market Structure. Government debt B is the only financial asset in the economy. The return on government debt in period t is R_t . In addition, individuals also save through capital. The non-arbitrage condition ensures that the return on these assets is the same, i.e., $R_t = 1 + (r_t - \delta)(1 - \tau_k)$, where r_t is the rental rate of capital. We denote individuals' total asset holdings with $a \in \mathcal{A} = [0, \infty)$.

Individual's Problem. In period t , individual of skill type i with productivity shock $z_{i,t}$ and asset level $a_{i,t}$ chooses consumption $c_{i,t}$, labor supply $l_{i,t}$ and savings $a_{i,t+1}$ to solve:

$$\begin{aligned} V_{i,t}(z_{i,t}, a_{i,t}) = & \max_{(c_{i,t}, l_{i,t}, a_{i,t+1}) \geq 0} u(c_{i,t}, l_{i,t}) + \beta_i \sum_{z_i \in \mathcal{Z}_i} \Pi_i(z_{i,t+1} | z_{i,t}) V_{i,t+1}(z_{i,t+1}, a_{i,t+1}) \\ \text{s.t. } & (1 + \tau_c)c_{i,t} + a_{i,t+1} \leq y_{i,t} - T_t(y_{i,t}) + R_t a_{i,t} + Tr_t \\ & c_{i,t}, a_{i,t+1} \geq 0 \text{ and } l_{i,t} \in (0, 1), \end{aligned} \tag{2}$$

where $V_{i,t}(z_{i,t}, a_{i,t})$ denotes the value function, $y_{i,t}$ is pre-tax labor income $y_{i,t} = w_{i,t} z_{i,t} l_{i,t}$, Tr_t is the lump-sum transfer in period t , and $T_t(y_{i,t})$ is the labor income tax function in period t described in section III.

Steady State Competitive Equilibrium. In the quantitative analysis, we focus on long-run implications of the reform, comparing steady states before and after the reform. In a steady state, prices, aggregate allocations and government policies are constant. As is common in the literature, we call such an equilibrium stationary recursive competitive equilibrium (SRCE).

III Czech Tax Reform

The 2020 tax reform changed the taxation of employee and self-employed earnings, starting from 2021. In this study, we focus only on the tax reform of employees.

Before 2021 (Baseline). Let y be the pre-tax labor income. The tax paid is:

$$T(y) = (\tau_{SSE} + \tau_{SSR}) \min\{y, \bar{y}\} + \max\{0, T_I(y + \tau_{SSR} \min\{y, \bar{y}\} - D) - C\},$$

where the social insurance tax is a linear function with a cap at a maximum social insurance base $\bar{y}$ (“maximální vyměřovací základ”), and τ_{SSE} and τ_{SSR} are social insurance tax rates paid by employee and employer (includes social security, health and unemployment insurance taxes).

The income tax function T_I is applied to the “super-gross income” $y + \tau_{SSR} \min\{y, \bar{y}\}$ after subtracting tax deductions D , and is given by (where y is pre-tax labor income):

$$T_I(y) = \begin{cases} \tau_1 y & \text{if } y \leq \bar{y} \\ \tau_1 \bar{y} + \tau_2 (y - \bar{y}) & \text{if } y \geq \bar{y}. \end{cases} \quad (3)$$

The second tax rate τ_2 , which applies to high income earners, has been in place since 2013, and was called “solidarity surcharge”. Finally, C is the tax discount. We abstract from some of the finer details of the tax system like the tax bonus. In 2020, the tax rates were as follows: $\tau_{SSE} = 0.065$, $\tau_{SSR} = 0.248$, $\tau_1 = 0.15$, $\tau_2 = 0.22$.

The tax function has two changes in its slope: first at $\bar{y}_0$ given by:

$$\bar{y}_0 = \frac{C + \tau_1 D}{\tau_1 (1 + \tau_{SSR})}, \quad (4)$$

since no income tax is paid below that level, and, second, at $\bar{y}$, since income is taxed at a higher rate above that level, but at the same time no social security tax is paid. In what follows it is assumed that $\bar{y}_0 \leq \bar{y}$, which is consistent with the data.

$$T(y) = \begin{cases} (\tau_{SSE} + \tau_{SSR})y & \text{if } y \leq \bar{y}_0 \\ (\tau_{SSE} + \tau_{SSR})y + \tau_1(1 + \tau_{SSR})(y - \bar{y}_0) & \text{if } \bar{y}_0 \leq y \leq \bar{y} \\ \tau_2(y - \bar{y}) + (\tau_{SSE} + \tau_{SSR})\bar{y} + \tau_1(1 + \tau_{SSR})(\bar{y} - \bar{y}_0) & \text{if } y \geq \bar{y} \end{cases} \quad (5)$$

The income tax threshold in 2020 was $\bar{y} = 1672080$ CZK, 4 times the average annual salary.² The marginal tax rates were therefore 0.313 in the first bracket, 0.500 in the second bracket, and 0.22 in the third bracket.

²Sources: <https://www.mpsv.cz/socialni-pojisteni-v-roce-2020>. In nominal terms, the average annual salary used in the tax code for 2020 was 418020 CZK.

The average total discount C , as well as the average tax deductions D can differ for low income and high income individuals, because of differences in family composition, amounts of mortgage payments, and so on.³ For people with taxable income below 50000 CZK (for whom the tax discount is most relevant), the tax discount and tax deduction in 2020 were 26830 CZK and 974 CZK.⁴ Based on those numbers, the initial threshold was 0.345 of the average annual salary using Equation (4).

The parameters values of the baseline tax functions are summarized in Table 1.

Table 1: Labor Income Tax Parameters

Parameter	Symbol	Baseline	Reform	Source
Social insurance tax rate paid by employee	τ_{SSE}	0.065	0.065	MPSV
Social insurance tax rate paid by employer	τ_{SSR}	0.248	0.248	MPSV
Marginal tax rate	τ_1	0.15	0.15	MPSV
Solidarity Surcharge	τ_2	0.22	0.23	MPSV
Tax discount	C	0.0642	0.0703	FS
Tax deduction	D	0.0023	0.0024	FS
Income tax threshold 1	$\bar{y}_0$	$0.345\bar{Y}$	$0.471\bar{Y}$	
Income tax threshold 2	$\bar{y}$	$4\bar{Y}$	$4\bar{Y}$	MPSV

This table reports the parameters of the labor income tax functions in baseline and post-reform. $\bar{Y}$ denotes average income. MPSV stands for Ministry of Labour and Social Affairs of the Czech Republic (Ministerstvo práce a sociálních věcí ČR). FS stands for Financial Administration (Finanční správa).

2021 and after (Reform). In 2021, the super-gross concept was abolished, and the tax function replaced by the following formula:

$$T(y) = (\tau_{SSE} + \tau_{SSR}) \min\{y, \bar{y}_1\} + \max\{0, T_I(y - D) - C\},$$

The function T_I is still given by (3), although the parameters are different. For 2021, the tax rates are $\tau_{SSE} = 0.065$, $\tau_{SSR} = 0.248$, $\tau_1 = 0.15$, $\tau_2 = 0.23$. We again consolidate the tax function. The first threshold $\bar{y}_0$ increases to:

$$\bar{y}_0 = \frac{C + \tau_1 D}{\tau_1}, \quad (6)$$

³Aggregate data by income level are available from <https://www.financnisprava.cz/cs/dane/analyzy-a-statistiky/danova-statistika>.

⁴For the full population, the basic tax discount for 2020 was 24840 CZK. Additional discounts reflect the number of children, non-working spouse and other items. Based on <https://www.financnisprava.cz/cs/dane/analyzy-a-statistiky/udaje-z-danovych-priznani>, the average total discount over all taxpayers was 34037 CZK. The average tax deduction D across all population was 11031 CZK. The tax deduction especially is thus very different for low income individuals. For the full sample, in terms of the average annual salary, the average tax deduction was 0.0264 of the average annual salary and the initial threshold is $\bar{y}_0 = 0.456$ using Equation (4), almost one half of the average annual salary.

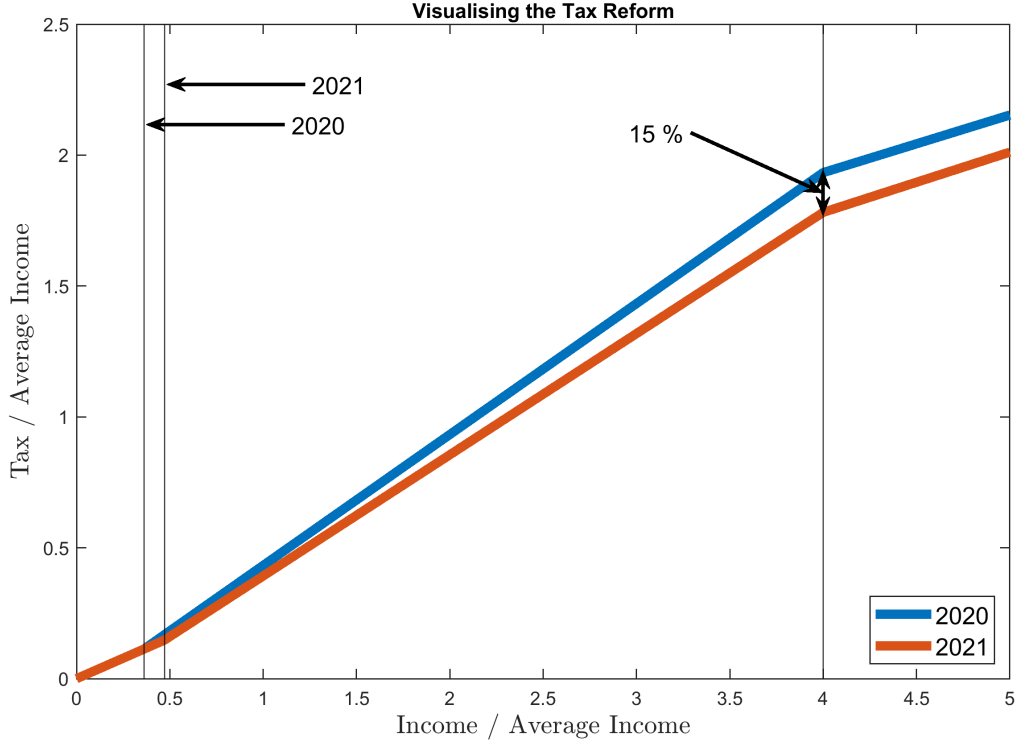


Figure 1: Tax Function in Baseline vs Reform

This figure displays the change in labor income tax from 2020 to 2021.

and the tax function change as follows:

$$T(y) = \begin{cases} (\tau_{SSE} + \tau_{SSR})y & \text{if } y \leq \bar{y}_0 \\ (\tau_{SSE} + \tau_{SSR})y + \tau_1(y - \bar{y}_0) & \text{if } \bar{y}_0 \leq y \leq \bar{y} \\ \tau_2(y - \bar{y}) + (\tau_{SSE} + \tau_{SSR})\bar{y} + \tau_1(\bar{y} - \bar{y}_0) & \text{if } y \geq \bar{y} \end{cases} \quad (7)$$

The tax threshold is $\bar{y}_1 = \bar{y}_2 = 1701168$, again 4 times the average annual salary.⁵ The marginal tax rate in the first bracket is unchanged at 0.313, decreases to 0.463 in the second bracket, and increases to 0.23 in the third bracket.

Similar to before the reform, we compute the tax discount C and tax deduction D considering only taxable income below 50000 CZK. We find that the tax discount and tax deduction increased to 29872 CZK and 998 CZK on average. In terms of the average annual salary, they are 0.0703 and 0.0024 respectively, and the initial threshold decreases to 0.471 using Equation (6).⁶

⁵Sources: <https://www.mpsv.cz/socialni-pojisteni-v-roce-2021>, <http://zpravy.ckait.cz/vydani/2022-01/dan-z-prijmu-za-rok-2021>. In nominal terms, the average annual salary for 2021 was 425292 CZK.

⁶For the full population, the basic tax discount C for 2021 was increased to 27840 CZK. There was a further increase to 30840 CZK in 2022, which we abstract from. The average total discount C over all

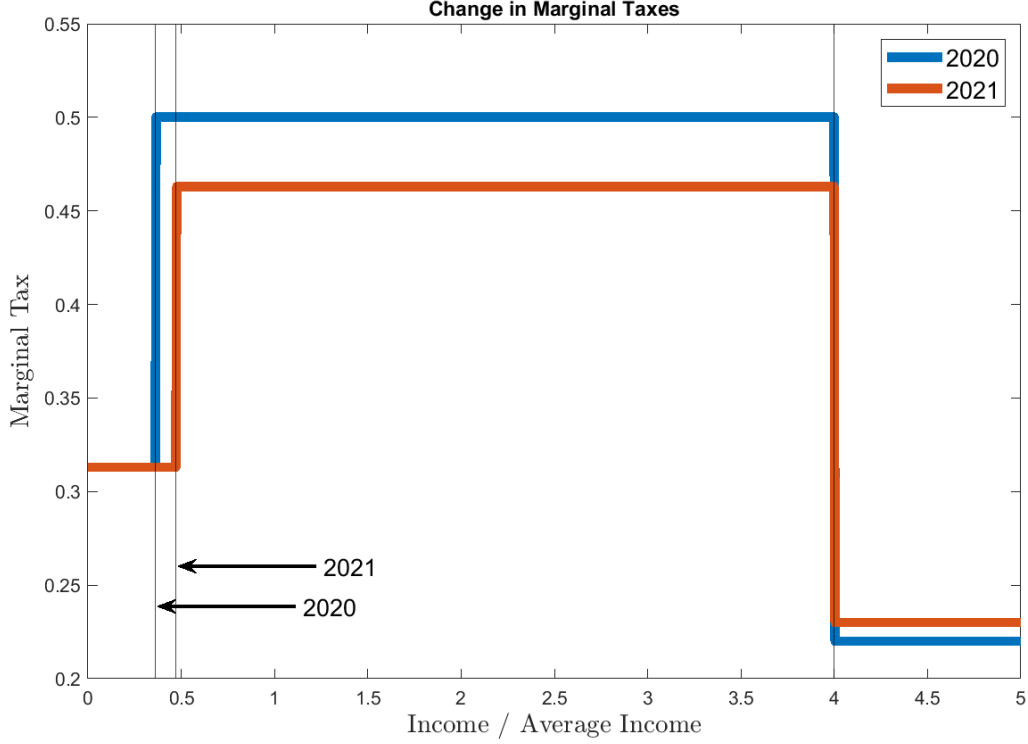


Figure 2: Marginal Tax in Baseline vs Reform

This figure displays the change in labor income tax from 2020 to 2021.

Figure 1 visualizes the changes in the labor income tax as a function of income for parameter values specified in Table 1 and figure 2 shows the change in marginal tax. We discuss the quantitative changes in the tax code in the next section.

The parameters values of the post-reform tax functions are summarized in Table 1.

IV Calibration

This section describes the calibration of our model to Czech data. One period in the model corresponds to one year in the data. Using the data or the literature, we first fix a number of parameter values without having to solve the model (external calibration), as summarized in Table 2. Subsequently, we jointly calibrate the remaining parameters such that the stationary recursive competitive equilibrium of the model matches the Czech economy in 2020 (internal calibration). Internally calibrated parameters and targets are specified in Table 3.

taxpayers (including an increased deduction for children) was 38093 CZK, and the average tax deduction D was 11975 CZK. In terms of the average annual salary, the basic discount, average total discount, and average tax deduction were 0.0655, 0.0896 and 0.0282 of the average annual salary. This increases the initial threshold to 0.626 of the average annual salary using Equation (6).

Preferences and Demographics. Following Kina et al. (2024), we set $\gamma = \sigma = 1$. We internally calibrate ϕ to match the aggregate labor supply of $1/3$, which is common in the macroeconomic literature. We assume that the discount rates of skilled and unskilled are equal i.e., $\beta_s = \beta_u = \beta$ and internally calibrate β , as explained below.

We define skilled individuals as those with at least a bachelors’ degree or its equivalent. Using data from Table A1.1 in OECD (2020), we calculate the fraction of skilled agents π_s to be 0.241 in 2019.⁷ We focus on the percentage of adults with a given level of education as the highest level attained between the ages of 25 and 64.

Technology. Following Havranek et al. (2024), we set the elasticity of substitution between skilled and unskilled labor to 3, which implies that $\varepsilon = 0.67$ in Equation (1). We set $\theta = 0.4438$ to match the labor share of output of 55.62%.⁸ We set depreciation rate to 0.096 to match the investment to output ratio of 0.27.⁹ These exogenously set parameters are listed in Table 2. We internally calibrate κ as explained below.

Table 2: Benchmark Parameters

Parameter	Symbol	Value	Source
Capital’s share of output	θ	0.4438	UN Global SDG Database
Elasticity of substitution between L_s and L_u	ε	0.67	Havranek et al. (2024)
Depreciation rate of capital	δ	0.096	AMECO
Relative risk aversion parameter	σ	1	
Inverse Frisch elasticity	γ	1	
Relative supply of skilled workers	π_s	0.241	OECD
Linear tax rate on capital income	τ_k	0.3115	Taxes in Europe Database
Linear tax rate on consumption	τ_c	0.195	Taxes and Customs Union
Government consumption	G/Y	0.196	OECD
Government debt	B/Y	0.378	OECD

This table reports the benchmark parameters that we take directly from the literature or the data. OECD stands for the Organisation for Economic Co-operation and Development (OECD, 2020). AMECO stands for Annual Macro-economic Database of the European Commission. UN Global SDG Database stands for United Nation Global Sustainable Development Goal Database. Taxes in Europe Database is from the European Commission. Taxes and Customs Union database is from the European Commission, based on the Eurostat data.

Government. We set government debt as a share of GDP to 37.8% and government expenditure as a share of GDP to 19.6% (as reported by the OECD in 2019). We set the capital income tax as a combination of corporate income tax of 19% and personal

⁷In calculating the share of skilled agents, short cycle tertiary education is excluded. Short-cycle tertiary education (SCTE) refers to the types of programmes typically offered by community colleges and similar educational institutions, of at least two years duration, and predominantly vocationally oriented.

⁸Labor share of output is an average from 2016 to 2020 and is calculated using data from UN Global SDG Database.

⁹The investment to output ratio is an average from 2005 to 2020 and is calculated using data from AMECO.

taxation of capital income 15%, resulting in a capital income tax of 31.15% $(1 - (1 - 0.19) * (1 - 0.15))$.¹⁰ We set the consumption tax at 19.5% in 2020 using data from the Taxes and Customs Union database from the European Commission.

Wage Risk. We follow Castaneda et al. (2003) in setting up and calibrating wage risk in the model. As proposed by that paper, we assume the existence of a superstar individual productivity state. This allows us to overcome the limitation of this class of models and their inability of match earnings and wealth inequality simultaneously, especially at the top end of the corresponding distribution, when assuming Gaussian individual labor productivity.

For each skill type i , productivity, z can either be a normal or superstar state. In the normal state, z follows a skill-type specific AR(1) process: $\log z_{t+1} = \rho_i \log z_t + \epsilon_{i,t}$, which we approximate by the finite Markov chain using the Rouwenhorst method described in Kopecky and Suen (2010). Productivity transits to superstar state with probability p_i from any normal state, at any given time t . In the superstar state, productivity is e_i times larger than the average productivity across normal states. q_i is the probability of remaining at the superstar state. When agents return to the normal state, they draw a new labor market ability from the ergodic distribution associated with the AR(1) process. The productivity process introduces ten parameters to be calibrated, together with the persistence parameter, ρ_i , and variance of the shocks, $var(\epsilon_i)$.

Table 3: Calibration: Aggregate Moments

Parameter	Symbol	Value	Target	Source
<i>Technology</i>				
Production parameter	κ	0.5171	Skill premium = 1.5309	SILC
<i>Common parameters</i>				
Discount factor	β	0.9751	Capital to output ratio = 2.81	AMECO
Disutility of labor	ϕ	4.1747	Labor supply = 1/3	Standard

This table reports the calibration procedure for parameters that target aggregate moments. Model generated target moments are not reported as the match is almost perfect. The production function parameter κ controls income shares of the skilled and unskilled labor in the model. AMECO stands for Annual Macro-economic Database of the European Commission. SILC stands for the Statistics on Income and Living Conditions of the Czech Statistical Office.

Internal Calibration. In addition to the ten parameters of the productivity process, we have three more parameters to be determined: share of skilled labor κ , labor disutility parameter ϕ and discount factor β . We jointly calibrate these 13 parameters to match selected moments in the data. Even though we perform joint calibration, we can consider

¹⁰Corporate income tax was 19% for 2020. Czech Republic does not have a capital gains tax but there is withholding tax on dividends, interests from government bonds, interest from corporate bonds, interest from special savings accounts and interest from deposits of 15% in 2020. We use the tax data from Taxes in Europe Database v4 from the European Commission.

the two sets of parameters separately. First, the three parameters κ , ϕ and β are chosen to match three aggregate moments. κ and β are calibrated to target (i) the skill premium w_s/w_u of 1.5309, where w_s and w_u are average wages for skilled and unskilled workers in the period 2016-2020, and (ii) the capital to output ratio of 2.81.¹¹ We calibrate ϕ such that the aggregate labor supply in steady state equals 1/3 as commonly assumed in the macro literature. The calibrated parameters, along with their targets are summarized in Table 3.

Second, for the ten productivity parameters that describe the individual wage risk processes, we calibrate them to match ten distributional targets, namely, two Gini coefficients of earnings and assets, top 1% share in the earnings and wealth distribution, top 1% share in the earnings of skilled and unskilled workers, log pre-tax earnings standard deviation of skilled and unskilled workers, and autocorrelation of log pre-tax earnings of skilled and unskilled workers. We report the model’s ability to match calibration targets in Panel A and the calibrated parameter values in Panel B of Table 4.

Aa Table 4 shows, our calibration procedure matches the selected distributional moments really well. This is not surprising given that the calibration procedure targets those moments. Below we provide further validation of our calibration by comparing the baseline calibrated model to a number of non-targeted moments from the data.

Model Fit. Following Dyrda and Pedroni (2022), we consider a number of non-targeted moments to validate our calibration, focusing on cross-sectional moments of the earnings and wealth distributions.

We report shares of each earnings quintile (for the skilled, unskilled and overall), both in the model and in the data, in Table 5. In addition, we find (not reported in the table) that the earnings Gini for the skilled is 0.2960 in the data and 0.3104 in the model, while for the unskilled these numbers are 0.2616 (data) and 0.2918 (model). We conclude that the model reproduces well the degree of earnings inequality present in the data. Importantly, the model matches well the inequality both in the whole population as well as in the subgroups we specify in our model (skilled and unskilled).

Table 6 reports non-targeted moments of the wealth distribution (this data is not available for the skilled and unskilled separately). We find that the model reproduces the degree of wealth inequality remarkably well. This suggests that our model is a good laboratory to study the effects of tax changes, not only when it comes to macroeconomic effects but also when it comes to the reform’s distributional impact.

¹¹The skill premium is computed using SILC (Statistics on Income and Living Conditions of the Czech Statistical Office). The capital to output ratio is an average from 2005 to 2020 and is calculated using data from AMECO.

Table 4: Calibration: Distributional Moments

Panel A: Moments	Data	Model
Log earnings autocorrelation - skilled	0.7929	0.7941
Log earnings autocorrelation - unskilled	0.7862	0.7846
Log earnings standard deviation - skilled	0.5905	0.5856
Log earnings standard deviation - unskilled	0.5355	0.5226
Earnings Top 1%'s share	0.0466	0.0493
Earnings Top 1%'s share - skilled	0.0477	0.0613
Earnings Top 1%'s share - unskilled	0.0377	0.0323
Earnings Gini	0.2917	0.3217
Wealth Gini	0.7343	0.7321
Wealth Top 1%'s share	0.2598	0.2552
Panel B: Parameters	Symbol	Value
Normal state persistence (skilled)	ρ_s	0.7203
Normal state volatility of shocks (skilled)	$var(\varepsilon_s)$	0.0320
Transit into superstar state (skilled)	p_s	0.0002
Remain in superstar state (skilled)	q_s	0.0044
Productivity superstar state (skilled)	e_s	28.6889
Normal state persistence (unskilled)	ρ_u	0.7956
Normal state volatility of shocks (unskilled)	$var(\varepsilon_u)$	0.0343
Transit into superstar state (unskilled)	p_u	0.0001
Remain in superstar state (unskilled)	q_u	0.0100
Productivity superstar state (unskilled)	e_u	22.8717

This table reports calibration results regarding the wage risk parameters. The model's ability to match calibration targets are reported in Panel A and the calibrated parameter values are reported in Panel B. Log earnings autocorrelation is autocorrelation of log pre-tax labor earnings and log earnings standard deviation is standard deviation of log pre-tax labor earnings. Earning top 1% share is top 1% percentile share of log pre-tax labor earnings and earnings Gini is the Gini coefficient of log pre-tax labor earnings. These data moments correspond to the 2005-2020 Czech economy and are taken calculated using SILC. Wealth Gini and top 1% share are from 2020 taken from WID, where WID stands for World Inequality Database.

V Results

The Two Scenarios. We first discuss the two main scenarios we consider. In the initial pre-reform steady state (SRCE), we ensure that the level of government debt, spending, taxes and transfers is such that the government budget constraint clears. Given that we fix the remaining variables (either directly by the tax function or by matching targets in the data) we are left with one free variable to clear the government budget, namely lump-sum transfers Tr . We set transfers residually so that the government budget constraint clears in the pre-reform equilibrium. To compute the new post-reform steady state (with the new labor tax function), we need to make assumptions that would guarantee government budget constraint clearing as well. In other words, we need to make assumptions about how the tax cut will be financed in the long run.

1. Scenario 1. In the first scenario, we assume that after the tax reform, the *level* of transfers Tr and government debt B remains constant. To ensure that the government can finance this expenditure with different taxes, we assume that government

Table 5: Non-Targeted Moments: Earnings Quintiles

	1 st	2 nd	3 rd	4 th	5 th
Data	8.04%	13.97%	17.9%	22.63%	37.47%
Model	7.84%	11.72%	17.77%	22.01%	40.66%
Skilled					
Data	8.3%	13.93%	17.27%	22.14%	38.36%
Model	7.47%	13.34%	17.24%	23.82%	38.13%
Unskilled					
Data	8.62%	14.71%	18.66%	23.16%	34.86%
Model	8.72%	12.65%	17.43%	23.85%	37.35%

This table reports the fit of the model with respect to non-targeted moments of the earnings distribution. All data moments correspond to 2005-2020 Czech Republic economy and are calculated using data from SILC.

Table 6: Non-Targeted Moments: Wealth Quintiles

	1 st	2 nd	3 rd	4 th	5 th
Data	-1.37%	2.43%	7.26%	16.39%	75.29%
Model	0.54%	3.40%	7.57%	13.56%	74.93%

This table reports the fit of the model with respect to non-targeted moments of the wealth distribution. All data moments correspond to 2005-2020 Czech Republic economy are calculated using data from WID (World Inequality Database).

spending G adjusts. Since taxes decrease, this generically implies that G will also decrease. This scenario can be interpreted as saying that the decline in government revenue will be transferred one-to-one to a decline in non-transfer spending G . In the model, government spending does not enter agents' utility or the production process. Therefore, one can also interpret the decline in G as a decline in tax revenue caused by the reform without additional effects resulting from a change in other government policies, purely focusing on the effect of the tax decline. In general, though, a decline in government spending G would be costly and this scenario does not capture these costs.

2. Scenario 2. In the second scenario, we assume that after the tax reform, the *level* of government spending G and government debt B is constant. To ensure that the government budget is cleared, we assume that government transfers Tr adjust. Since taxes decrease, this generically implies that Tr will also decrease. One way to interpret this scenario is that to finance the decline in tax revenue, the government has to decrease transfers (unemployment benefits, social security benefits, etc.). Indeed, the decline in transfers will have additional effects on agents and the economy. In particular, lower transfers will stimulate labor demand beyond the effect of the tax decline. An alternative interpretation of this scenario is that the decline in distortionary taxes is financed by an increase in lump-sum taxes (a decline in a

Table 7: Changes in Macroeconomic Variables due to the Reform

Variable	Scenario 1	Scenario 2
Y	1.99%	2.98%
K	2.01%	3.01%
I	2.01%	3.01%
C	5.00%	4.06%
ℓ	2.54%	3.58%
B	0	0
G	-6.23%	0
Tr	0	-5.64%

This table reports the effects of the tax reform on allocations. “Scenario 1” refers to the percentage change between the pre-reform and post-reform steady state under Scenario 1 and “Scenario 2” refers to the percentage change between the pre-reform and post-reform steady state under Scenario 2. Y denotes aggregate output, K denotes aggregate capital, I is aggregate investment, C denotes average (aggregate) consumption, ℓ denotes the average overall supply of labor (in hours), B denotes government debt, G denotes government expenditure, and Tr denotes transfers.

lump-sum transfer is equivalent to an increase in lump-sum taxes). Since lump-sum taxes are non-distortionary, this is the most favorable scenario from an efficiency point of view.

The model makes it possible to analyze other scenarios as well. One such scenario would be that the tax decline is initially financed by an increase government debt. However, increasing government debt indefinitely is not possible, and hence one would need to make additional assumptions as to when and how future fiscal consolidation would look. We therefore focus on Scenarios 1 and 2, which do not require additional assumptions.

However, if we allowed government debt to increase, the future decline in transfers or government spending would have to be even higher. Or, alternatively, taxes would have to increase beyond their current level to be able to service the higher debt. In this sense, the scenarios we consider are the most favorable in the sense that they minimize the risk of future tax increases. Our analysis points out that even in this case there is no free lunch: A current tax decline will be offset by a decline in transfers or government expenditure.

Macroeconomic Effects. We compare the main variables of interest between the calibrated equilibrium before the reform and after the reform, once the economy had enough time to converge to a new steady state. These results are thus to be interpreted as long-run implications of the reform.

As Table 7 indicates, the reform has substantial stimulative effect on the economy in both scenarios, increasing aggregate output, capital accumulation, investment and private consumption. This is not surprising since the reform decreases taxes which stimulates labor supply. We see that the tax cut is more effective if it is financed by a decrease

in transfers (Scenario 2). As we discussed earlier, a decrease in transfers is equivalent to an increase in lump-sum taxes, implying a shift from distortionary labor taxation to non-distortionary lump-sum taxes, which results in a larger stimulative effect.

What are the true dynamic effects of the tax reform? We do not know since we do not know how the government plans to finance it in the long run. This motivates our first policy recommendation: Tax cuts should be accompanied by clearly specified plans in terms of how they will be financed. Otherwise agents will be surprised by future policy changes which is costly. Following this general recommendation would avoid the risk of future tax cuts that would not be accompanied by proper plans of subsequent fiscal consolidation.

A number that has been widely discussed are the budgetary costs of the reform, which is the negative side of the reform. The IDEA Think Tank estimated the impact of the tax reform on tax collection to be about 2% of GDP (115 billion Czech Crowns, while the Czech nominal GDP in 2020 was 5828 billion Czech Crowns). The relevant comparison number in our model would be the decline in government spending in Scenario 1 or the decline in transfers in Scenario 2.

Our estimates are lower: To maintain government budget balance, government spending must decrease by 1.22% of GDP in Scenario 1. Why is our estimate lower? The reason is that we consider long-run implications in a fully structural general equilibrium model in which we take into account not only labor supply responses, but also the increase in capital accumulation and other indirect effects such as changes in tax revenue from capital and consumption taxes.

In Scenario 2, we find that transfers must decrease by 1.05% to maintain government budget balance.¹² This decline is even smaller than in Scenario 1, because labor supply effects are now stronger: A decline in transfers (pure income effect) induces people to work more in Scenario 2 than in Scenario 1 (an increase in aggregate labor supply of 3.58% in Scenario 2 relative to 2.54% in Scenario 1).

Motivated by these findings, we provide a second policy recommendation: Tax cuts should be implemented only once their macroeconomic consequences are properly understood. This can be done using both static estimates as well as state-of-the-art micro-founded dynamic general equilibrium macroeconomic models, as we do in this study. This way, policy makers would avoid the risk of implementing policy reforms without properly understanding their macroeconomic consequences. More specifically, they could avoid implementing policies with negative long-run macroeconomic consequences.

Distributional Implications of the Reform. Tables 8 and 9 document the distributional implications of the reform. First, Table 8 reports our results at the level of

¹²Observe that in both scenarios, our results suggest that the Czech Republic is to the left of the peak of the Laffer curve: A decline in taxes, even though it has a stimulative effect, decreases tax revenue.

Table 8: Changes in Between Group Inequality due to the Reform

Variable	Scenario 1	Scenario 2
C_s	4.15%	3.50%
C_u	5.45%	4.35%
ℓ_s	1.54%	2.36%
ℓ_u	2.87%	3.99%
A_s	-0.15%	0.09%
A_u	3.86%	5.46%
w_s	0.19%	0.27%
w_u	-0.08%	-0.10%
skill premium	0.27%	0.37%

This table reports the effects of the tax reform on allocations. “Scenario 1” refers to the percentage change between the pre-reform and post-reform steady state under Scenario 1 and “Scenario 2” refers to the percentage change between the pre-reform and post-reform steady state under Scenario 2. C_s denotes the average skilled consumption, C_u denotes the average unskilled consumption, ℓ_s denotes the average supply of skilled labor, ℓ_u denotes the average supply of unskilled labor. A_s denotes the average skilled agents’ asset holdings and A_u denotes the average unskilled agents’ asset holdings. w_s denotes wages of skilled workers, w_u denotes wages of unskilled workers, skill premium is the ratio of wages of skilled workers to wages of unskilled workers.

population groups: skilled and unskilled. Starting from the stimulative labor supply effect, we find that it is larger in Scenario 2 than in Scenario 1, as we discussed in detail above. We also find that labor supply increases more for the unskilled, as they are more affected by the shift in the tax threshold $\bar{y}_0$, above which the labor tax is paid (on top of social security contributions) and the decline in taxation of middle incomes. This is, in fact, a common finding: Labor supply, consumption and asset accumulation increase more for the unskilled than for the skilled in both scenarios.

Second, Table 9 reports our results for distributional moments that were used to calibrate and validate the model in earlier parts of this study. We observe decreases in (pre-tax) earnings inequality as reported in Panel A of the table. They are likely to be associated by the shift in the tax threshold $\bar{y}_0$, which stimulates labor supply in the lowest quintile, as can be seen in Panel B of the table (the first quintile’s earnings share increases). As for wealth inequality, Panel A again suggests that the reform decreases wealth inequality. In Panel B, we see that this decline is caused by the increase in the share of the 3rd and 4th wealth quintile: The (upper) middle class gets richer relative to the rest of the economy. To the best of our knowledge, most of the cross-sectional effects that we analyze using our model were not known or discussed when the reform was introduced.

Our last policy recommendation thus is: Tax reforms should be implemented only when their possible distributional consequences are understood. Following this advice, the Czech Republic would avoid the risk of implementing policy reforms without properly

Table 9: Changes in Distributional Moments

	Scenario 1	Scenario 2
Panel A: Calibrated Moments		
Earnings autocorrelation - skilled	-0.88	-0.83
Earnings autocorrelation - unskilled	-0.16	-0.13
Earnings standard deviation - skilled	-1.41	-1.4
Earnings standard deviation - unskilled	-1.85	-1.87
Earnings Top 1%'s share	-0.07	-0.09
Earnings Top 1%'s share - skilled	-0.11	-0.14
Earnings Top 1%'s share - unskilled	-0.04	-0.04
Earnings Gini	-0.72	-0.76
Wealth Gini	-0.80	-1.12
Wealth Top 1%'s share	-0.74	-0.95
Panel B: Uncalibrated Moments		
Earning Quintiles		
1st	0.52	0.52
2nd	-0.01	0.02
3rd	-0.09	-0.09
4th	-0.10	-0.07
5th	-0.32	-0.38
Wealth Quintiles		
1st	-0.07	-0.06
2nd	-0.04	0.02
3rd	0.31	0.42
4th	0.87	1.01
5th	-1.06	-1.39

This table reports the changes (in percentage points) in the targeted and untargeted distributional moments.

understanding their cross-sectional consequences. In particular, policy makers could avoid implementing policies with negative cross-sectional consequences.

VI Conclusion

This paper studies the aggregate and distributional impact of a labor income tax cut in 2021 in the Czech Republic using a rich quantitative macroeconomic model with heterogeneous agents. We consider two scenarios with respect to how the tax cut will eventually be financed. In both scenarios, the reform has a stimulative effect on the economy. It increases labor supply, aggregate capital, output and private consumption. The reform also reduces inequality in earnings and wealth in both scenarios. However, the specific details of the effects of the reform differ across the two scenarios. We argue that this is an important issue: It is unclear what the implications of the reform will be (both on the aggregate and the distributional front), given that we do know how the reform will eventually be financed. Our policy recommendations go in this direction: Tax reforms (tax cuts) should be implemented only after their consequences and sources of financing are properly determined.

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