Furgasė, J., & Miceikienė, A. (2025). Robot tax versus labour tax: Funding the future of public finance. *Journal of International Studies, 17*(1), 81-98. doi:10.14254/2071-8330.2025/18-1/5

Journal of International Studies

Centre of Sociological Research

Scientific Papers

Robot tax versus labour tax: Funding the future of public finance

Jevgenija Furgasė
Vytautas Magnus University, Kaunas, Lithuania
jevgenija.furgase@vdu.lt
ORCID 0000-0001-6445-3314

Astrida Miceikienė
Vytautas Magnus University, Kaunas, Lithuania
astrida.miceikienė@vdu.lt
ORCID 0000-0003-1432-7971

Abstract. Accelerating technological progress is a potential threat to employment. In this context, the reduction of taxes on labour income can be used as an effective measure to maintain employment, but it will inevitably decrease tax revenues. Various solutions are being considered to compensate for the loss of tax revenue, including the taxation of automated capital income (e.g., robots). This paper presents an analysis of the effectiveness of this tax as an alternative to labour income tax in the context of technological progress. The study employs a general equilibrium model that has been calibrated to the European Union economy. The model is used to examine a range of policy scenarios that involve a combination of reduced labour income tax rates with a tax on robots at different rates (5%, 10%, and 20%). The modelling results show that robot taxation, while attractive in theory, is inefficient in practice, as it hinders technological progress and economic growth. The findings confirm that a robot tax: (1) leads to lower employment levels than a reduction in labour taxes alone; (2) has a negative impact on economic growth, especially at high levels of automation; and (3) does not generate sufficient revenue to compensate for the reduction in labour taxes. It is, therefore, evident that alternative ways of ensuring fiscal sustainability in an automated economy must be identified.

Received: March, 2024
1st Revision: February, 2025
Accepted: March, 2025

DOI: 10.14254/2071-8330.2025/18-1/5

Keywords: robot tax, labour income tax, technological progress, employment, public finance

JEL Classification: H25, O33, E62

1. INTRODUCTION

In the 21st century, the world is going through a period of fundamental change driven by rapid technological progress. Artificial intelligence and automation are changing the manner in which we communicate and organise production, as well as the structure of the labour market. Unfortunately, these developments are not entirely positive, as there is a significant risk of structural unemployment due to the declining demand for low- and middle-skilled workers.

In this context, cuts in labour income taxes could be an appropriate means of mitigating the negative effects of technological progress on employment. Lower labour income taxes would encourage firms to create new jobs and help retain existing ones, which would, in turn, stimulate economic activity and employment.

Nevertheless, reduction in labour income taxes will inevitably have a negative impact on overall tax revenues. Given that labour taxes represent a significant share of total tax revenue, their reduction would put considerable pressure on public finances at a time when the need to finance retraining and social protection is increasing.

In order to compensate for the loss of tax revenue, alternative sources of taxation must be sought. One of the measures under discussion is the so-called "robot tax", which could theoretically provide an alternative to labour income taxes. The rationale for such a tax is simple: if a robot replaces human labour, the value it creates should be taxed in a way similar to how human labour income is taxed.

However, the question arises as to whether such a tax could truly be an appropriate tool to compensate for the loss of tax revenue due to labour income tax cuts. As the following literature review will show, there is a significant research gap in this area: namely, a lack of cross-cutting studies examining the interaction between labour income tax cuts and the introduction of robot taxes. To address this gap, we employ a general equilibrium model to systematically analyse the impact of these tax reforms on employment and other macroeconomic variables.

The aim of the study is to assess the combination of the reduction of labour income taxes and the introduction of the robot tax and its impact on employment, tax revenues, and broader macroeconomic indicators. The study contributes to the literature on tax system reform in the context of technological progress by providing an empirical analysis of the interaction between labour income taxation and robot taxation, examining their combined effects on employment, fiscal sustainability, and economic performance.

The paper is structured in three main parts. The first part reviews the academic literature on the macroeconomic impact of labour income tax cuts and the implementation of robot taxation. The second part presents the methodology of the study based on a general equilibrium model. The third part presents the modelling results and their implications for employment and other macroeconomic indicators.

The scope of this study is limited to an analysis of the taxation of labour income and automated capital income (robots) in the context of the European Union. Other forms of taxation, such as consumption or environmental taxes, and other economic regions are not considered.

2. LITERATURE REVIEW

In the 21st century, technological progress has reached unprecedented levels and fundamentally transformed the entire economic structure, including the labour market (Di Battista et al., 2023). Automation and artificial intelligence have the potential to transform up to 60% of jobs in developed economies (Manyika et al., 2017), and by 2030, artificial intelligence could automate up to 300 million jobs globally (Bangash et al., 2024). In China alone, it is projected that by 2049, AI could replace up to 278 million jobs, representing 35.8% of its current workforce (Zhou et al., 2019).

Technological progress has a complex impact on employment, with both positive and negative consequences. In terms of positive effects, technology is creating new jobs in high-tech sectors, particularly in IT, data analytics, and digital marketing (Piva and Vivarelli, 2018). In addition, the introduction of new technologies improves the quality of work by reducing routine tasks and increasing the need for human skills (Juliana, 2023; Turja, 2024). However, technological progress also has negative consequences. Automation and artificial intelligence reduce the number of jobs, especially in low-skilled and traditional industries (Piva and Vivarelli, 2018; Emara, 2024; Yarovenko et al., 2024). Unemployment may increase temporarily during the transition period while the labour market adjusts to the new conditions (Feldmann, 2013). The structure of employment is also changing, with an increasing demand for high-skilled workers and a decreasing number of low- and medium-skilled jobs (Mishchuk et al., 2024).

These changes in the labour market, driven by technological advances, exert dual pressures on public finances: on the one hand, they can reduce tax revenues and on the other, they can increase government spending. Prisecaru (2017) points out that technological developments reduce the demand for lower- and middle-skilled workers, which in turn will increase structural unemployment and, consequently, reduce tax revenues. And if there is no investment in retraining these workers, unemployment and social inequality will increase (Owoeye, 2024). These developments—rising structural unemployment, increasing demand for funds to retrain workers, finance education reform, and support vulnerable groups—pose serious challenges to current tax systems.

In this context, reducing taxes on labour income could be an appropriate instrument to mitigate the negative employment effects of technological progress (Furgase and Miceikiene, 2024; Swiderska et al., 2024). Reducing labour income taxes would help slow down job losses and create new employment opportunities (Pierrard, 2004; Heijdra and Ligthar, 2009). Jacquinot et al. (2018), assessing the impact of labour income tax cuts in the euro area, found that such measures would have a stimulative effect on the domestic economy and employment. Moreover, coordinated labour income tax cuts could boost economic activity and employment across the euro area. Bielecki and Stähler (2022) find that reducing the labour income tax burden generates positive macroeconomic effects and increases aggregate welfare. Wang (2023) argues that lower labour taxes would stimulate employment growth by encouraging firms to hire more workers, which can be particularly effective in creating a more stable economic environment. However, Rossi (2020) stresses that the effectiveness of labour income tax cuts should be reinforced by additional measures to foster innovation and human capital development, as sustainable economic growth depends not only on labour costs but also on the wider economic environment.

However, cuts in labour income taxes will undoubtedly have a negative impact on overall government tax revenues. This would put pressure on public finances at a time when their need is particularly acute, both because of the need to support the growing number of socially vulnerable groups and the need to finance an education system to help workers adapt to the challenges of technological progress. Labour taxes account for a significant share of total tax revenue—the average labour tax wedge in the EU in 2023 was 41.56% (OECD, 2024). Therefore, in order to compensate for the loss of tax revenue, it would be appropriate to look for alternatives, either by increasing other taxes or by introducing new taxes.

To compensate for the loss of tax revenue, alternative sources of taxation must be sought. Recently, there has been an active debate in the academic literature on the so-called 'robot tax,' which could be an alternative to labour income taxes. This is particularly important as automation reduces the traditional tax base based on human labour (Abbott and Bogenschneider, 2018). Robotic taxation could also help reduce income and wealth inequality by redistributing income from capital owners to workers who have lost their jobs (Damijan et al., 2021).

Robot tax, at first glance, this seems to be a logical solution—if a robot replaces human labour, the value it creates should be taxed in a similar way to human labour income, and the resulting tax revenue will be used to finance public services (Bottone, 2018; Zhang, 2019; Damijan et al., 2021).

In practice, however, the implementation of a robot tax faces several serious challenges:

- *slowing down technological progress:* taxing robots can slow down technological progress and innovation by increasing the cost of firms' investments in automation (Damijan et al., 2021; Oberson, 2021; Kedziora, 2022);

- *inhibiting economic growth:* taxing robots effectively becomes a tax on innovation, which would reduce productivity and slow economic growth (Abbott, 2020; Bendel, 2019);

- *difficult implementation:* setting up and administering a robot tax system is a complex process that can lead to economic distortions and administrative difficulties (Englisch, 2018);

- *international competition:* without a coordinated international effort, countries introducing the tax will lose competitiveness, leading to a loss of tax revenue (Englisch, 2018; Damijan et al., 2021).

There are also doubts about the long-term effects of the tax—while a robot tax may improve economic welfare in the short term, it may not have a positive impact on long-term economic growth (Gasteiger and Prettner, 2022). Furthermore, the tax does not comply with basic tax principles: - a robot tax would score poorly on Adam Smith's principles of good taxation, such as proportionality, clarity, convenience, and cost-effectiveness (Damijan et al., 2021).

A review of research in the field of robot taxation reveals complex and often contradictory views. Abbott and Bogenschneider (2018) have proposed a balanced approach to the relationship between robots and labour, introducing an 'automation tax' that aims to align the taxation of robots and human labour. Mazur (2018) analysed the adaptation of the tax system to the challenges posed by robotization. While the study showed that a tax on robots could compensate for reduced labour tax revenues and reduce inequality, it was also found that such taxation could hamper innovation and productivity growth.

Acemoglu et al. (2020) provided practical solutions for how the tax system could promote beneficial technological progress. They proposed a differentiated 'automation tax' that would apply only to technological solutions that replace people without adding significant value while not taxing productivity-enhancing and job-creating technologies. Such an approach would encourage companies to opt for automation solutions that benefit both the economy and workers.
Gasteiger and Prettner (2022), modelling the impact of a robot tax on the capital-labour ratio, find that while it may improve welfare in the short run, it hinders technological progress and economic growth in the long run. The researchers also highlighted the need for international coordination regarding the introduction of the robot tax. Guerreiro et al. (2022), analysing the long-term effects of a robot tax, proposed a regression model in which the tax rate decreases with the age of the robot (e.g., 7% in the first decade, 3% in the second). According to the researchers, such a system could be more effective in reducing labour inequality and redistributing income.

Thuemmel (2023) used a quantitative approach to optimise the robot tax and modelled its impact on the labour market and welfare. The results showed that the optimal robot tax should be modest: 1.8% per year in markets where workers find it difficult to retrain and 0.86% where retraining is possible. Costinot and Werning (2023) developed a theoretical framework for technology regulation and taxation by proposing three optimal tax formulas that accounted for the impact of robots on wages. Their study found that in order to maintain productivity growth and reduce inequality, the tax on robots should be modest (1-3.7%), while emphasising the importance of reconciling technology regulation and labour market policy.

Taken together, these studies show that while robot taxation seems in theory an attractive solution to the fiscal challenges posed by automation, its practical implementation faces significant hurdles. The results suggest that robot taxes should be introduced with caution to avoid holding back useful technological progress. However, the complexity of the implementation and administration of such taxes, together with the potential negative impact on innovation and economic growth, raises serious doubts about their appropriateness as a policy tool to address the challenges of automation.

Despite extensive research on the impact of robot taxation and automation on the labour market, a significant gap remains in the current academic literature: there is a lack of analysis that examines the interaction between labour income tax cuts and the introduction of a robot tax. Most studies analyse robot taxation as a stand-alone fiscal instrument, without sufficiently assessing its interaction with other tax policy measures or its broader macroeconomic implications. Moreover, while the theoretical foundations of robot taxation have been developed, there is a lack of empirical evidence on its effectiveness as a compensatory mechanism for reduced labour taxation.

This study seeks to fill these gaps by testing three main hypotheses raised by the literature review:

H1: The introduction of a robot tax alongside labour tax reduction leads to lower employment levels compared to scenarios with labour tax reduction alone, with this negative effect intensifying as the robot tax rate increases;

H2: Robot taxation adversely affects economic growth and productivity indicators, with the magnitude of this negative effect increasing with tax rates and automation levels;

H3: Tax revenues generated from robot taxation fail to offset the revenue losses from labour tax reduction due to their adverse impact on investment and economic growth.

By testing these hypotheses using a general equilibrium model, this study contributes to both the theoretical understanding and practical policy solutions to robot taxation. The study provides empirical evidence for policymakers seeking to balance technological progress with fiscal sustainability and employment stability. Moreover, it sheds light on the complex interactions between different tax instruments in an increasingly automated economy, helping to bridge the gap between theoretical tax policy proposals and the challenges of their practical implementation.

3. METHODOLOGICAL APPROACH

The study applies a general equilibrium model to assess the taxation of automated capital income (robots) as an alternative to the taxation of labour income in the context of technological progress. The detailed structure of the model, the calibration of the parameters with empirical data from the European Union, and the modelling process are presented in Furgas and Miceikiene (2024), and this study therefore presents only the main elements and innovations of the model that are relevant to the problem at hand.

The economy is modelled as an interaction between three main agents: households, firms, and government. The model makes a clear distinction between traditional and automated capital, which allows for an analysis of the impact of differential taxation on these two forms of capital in the CES production function:

$$Y_t = K_t^a[\mu D_t^v + (1-\mu)L_t^v]^{\frac{1-a}{v}} \tag{1}$$

*where Y is output, K_t is traditional capital, D_t is automated capital, L_t represents labour, a - c*apital share, *μ is a distribution parameter determining the share of automated jobs in the production process, and v is the substitution parameter between labour force and automated capital.*

The model classifies traditional capital as physical capital that complements human labour (e.g., tools, equipment, infrastructure) and automated capital as technology that can replace human labour (e.g., robots, artificial intelligence systems, automated production processes).

Technological progress in this model is defined through the μ parameter, which refers to the share of automated jobs. Automated jobs and human labour coexist only at $0 < \mu < 1$, where $\mu = 0$ refers to traditional (human) labour alone and $\mu = 1$ to full automation of jobs.

The parameter for the share of automated jobs (μ) in the model has been calibrated in the range [0.1; 0.5], based on the most recent research. Estimates of automation potential vary considerably in the scientific literature. Frey and Osborne (2013) predicted that 47% of jobs in the US could be automated by 2050, while Arntz et al. (2016) found that only 9% of jobs in OECD countries are fully automated. Manyika et al. (2017) estimate that 30% of jobs could be automated by 2030 and 50% by 2050. Smit et al. (2020), in a medium scenario, predict 22% of jobs to be automated by 2030. Lassébie and Quintini (2022) report that on average, 28% of jobs in OECD countries are at high risk of automation, and that this growing estimate is attributed to the rapid development of artificial intelligence technologies. Therefore, the range [0.1; 0.5] chosen in the model reflects both the current level of automation and its potential in the near future.

The main novelty of the model in this study is the introduction of different tax rates for labour and automated capital income, which allows us to study the tax policy scenario at different levels of automation.

Tax revenue in the model consists of taxes on labour and automated capital income:

$$T_t = t_t^l W_t L_t + t_t^a (R_{d,t} - \delta_d) D_t \tag{2}$$

where t_t^l *represents the labour income tax rate,* W_t *is the wages,* t_t^a *represents the automated capital income tax rate,* R *– is the rate of return on automated capital,* δ_d *- is the automated capital depreciation rate.*

The study identifies the income tax on automated capital with the so-called 'robot tax' because it covers a wide range of technological solutions that can replace human labour. This definition is in line with the modern view of automation, where a "robot" is no longer just a physical machine but encompasses a wide range of advanced technologies, including artificial intelligence systems, automated production processes, and software that can perform tasks previously carried out by humans. Furthermore, the model's approach of taxing automated capital based on the return generated by this capital is in line with other research (Prettner and Strulik, 2020; Gasteiger and Prettner, 2022; Guerreiro et al., 2022) on the methodology for the valuation of robot taxes.

The study develops five scenarios that analyse the introduction of an automated capital income (robot) tax at different levels combined with a reduction of the tax burden on labour income (Table 1).

Table 1

Modeling scenarios

Scenario	BS	A	B	C	D
Labour income tax rate, (%)	41,56	39,02	39,02	39,02	39,02
Automated capital income tax rate, (%)	-	-	5	10	20

Source: own compilation

The Baseline Scenario (BS) reflects the current situation in the EU, where the average tax burden on labour income is 41.56% (OECD, 2024), and there is no taxation of automated capital. In the other scenarios, the labour income tax burden is reduced to the first quartile (Q1) level of 39.02% (Furgase and Miceikiene, 2024). This level of labour income tax cuts is chosen to ensure a gradual transformation of the tax system, reflecting the actual practice in EU countries and being more politically and economically feasible than a drastic reduction to the lowest rate of 34.31%. Scenario A shows the impact of a reduction in labour taxation without other changes to the tax system.

Scenario B applies a 5% automated capital income tax, which is in line with the optimal rate identified by Guerreiro et al. (2022). Scenario C introduces a 10% rate as an intermediate value, while Scenario D applies a 20% rate, which is close to the EU average gross capital income tax rate for 2023 (19.55%) (Tax Foundation, 2023). The study drops the modelling of lower (1-2%) automated capital income tax rates because, as the results will show, such rates do not generate significant tax revenue, and their administrative costs may exceed the revenue collected. Rates above 20% are also not analysed, as this would lead to significant risks of production displacement and loss of competitiveness (Damijan et al., 2021).

The scenario model assesses the impact of different tax policy scenarios by comparing them with each other and with the baseline model. The study analyses the transition of the economy from one steady state to another as the level of automation (parameter μ) changes. The main macroeconomic indicators assessed are employment (L), tax revenue (T), output (Y), consumption (C), investment (I), and traditional and automated capital (K+D).

For the interpretation of the modelling results, it is assumed that technological progress develops sequentially and that the parameter for the share of automated jobs (μ) varies in the interval [0.1; 0.5]. This interval can be divided into three periods:

- Short-term period ($\mu \in [0.1; 0.25]$) - according to studies by Manyika et al. (2017), Smit et al. (2020), and Lassébie and Quintini (2022), economies will reach this level of automation by 2030.
- Medium-term period ($\mu \in (0.25; 0.40]$) - this phase is characterised by significant automation of work processes and active interaction between labour and technology.
- Long-term period ($\mu \in (0.40; 0.50]$) - according to Frey and Osborne (2013) and Manyika et al. (2017), this phase reflects the advanced digital economy, where automated capital is becoming the dominant factor of production, and a large part of the routine tasks and a part of the complex tasks are automated.

Values of $\mu > 0.50$ are not analysed due to the excessive uncertainty in assessing the economic and social consequences of this level of automation.

The modelling results allow us to observe the adaptation of the economy to changes in tax policy, the reactions of economic agents to tax modifications, and the impact of these changes on the economy with increasing levels of automation.

The methodological limitations of the study are related to the fact that the model only analyses steady states without taking into account transition dynamics, does not take into account possible economic shocks and unexpected changes, and makes standard assumptions about rational economic agents and perfect information. Despite these limitations, the model provides information on the long-run implications of tax policy changes at different levels of automation and allows for the identification of appropriate tax reform strategies to support employment and fiscal sustainability in a context of technological progress.

4. CONDUCTING RESEARCH AND RESULTS

Employment effects of reducing labour income tax and introducing an automated capital income tax

To investigate the economic impact of reducing labour income taxes and introducing an automated (robotic) capital income tax, several tax reform scenarios were modelled. First, hypothesis H1 is tested, which states that the introduction of an automated capital income tax combined with a reduction in labour income taxes leads to a lower level of employment than in scenarios where only labour income taxes are reduced, and that this negative effect increases with the increase in the automated capital income tax rate (Figure 1).

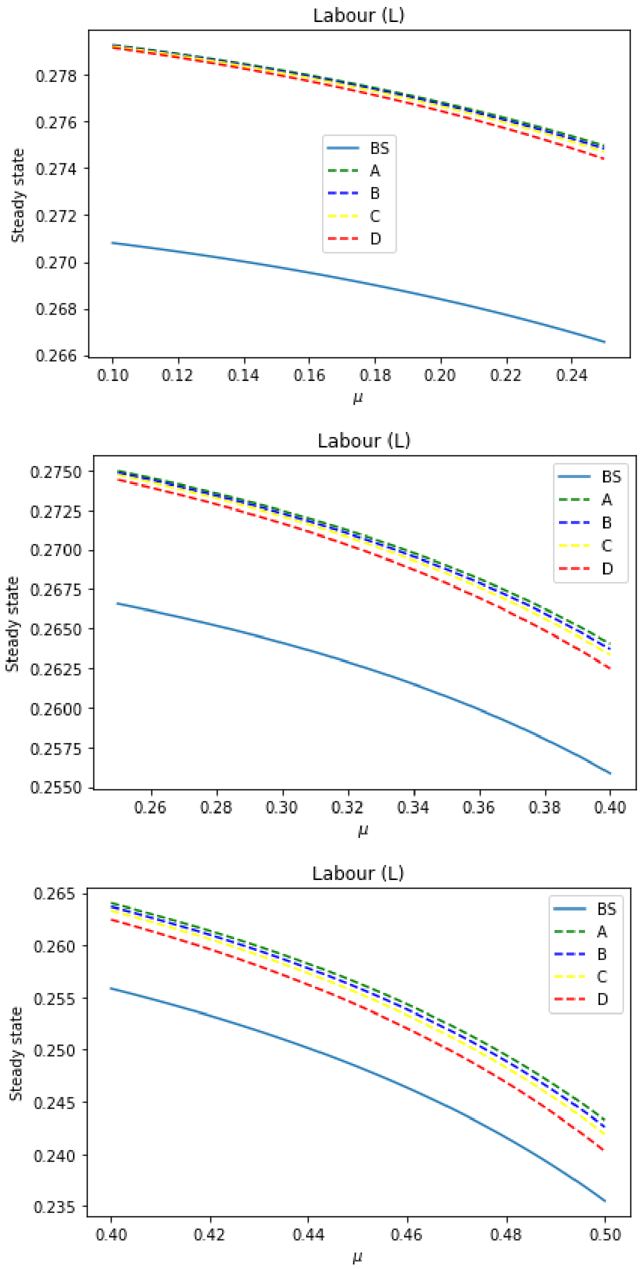

Figure 1. Dynamics of employment

(BS – baseline model, A – labour income tax reduction scenario, B – labour income tax reduction and automated capital income tax 5% scenario, C – labour income tax reduction and automated capital income tax 10% scenario, D – labour income tax reduction and automated capital income tax 20% scenario, μ – share of automated jobs parameter)

Source: own evaluation.

The analysis of the data shows that in the baseline model (BS), as the share of automated jobs (parameter μ) increases, employment (L) initially decreases very slightly. However, once a certain threshold (μ~0.2) is reached, the decrease becomes more pronounced. This trend shows that as automation gains momentum, labour demand decreases more rapidly. This reflects structural changes in the labour market, where the number of traditional jobs is declining due to the expansion of automation.

Looking at the employment dynamics in Scenario A, the employment level (L) is higher than in the baseline model over the entire range of automation analysed. This difference is particularly pronounced at lower levels of automation ($\mu < 0.25$), where employment in Scenario A remains higher than in the baseline model. This result confirms that a reduced labour tax burden potentially slows down the pace of job automation, giving the labour market more time to adapt to technological change.

In the short run ($\mu \in [0.1; 0.25]$), the introduction of an automated capital income tax (scenarios B, C, and D) slightly reduces the positive impact of the labour tax cut, while employment remains significantly higher than in the baseline model. This suggests that in the early stage of automation, labour income tax cuts are effective in boosting employment, even with automated capital income taxation.

The results for the medium term ($\mu \in (0.25; 0.40]$) show an increasing gap between the scenarios. The scenarios with higher taxes on automated capital income (especially scenario D) show lower employment growth. This is explained by the fact that higher taxes on automated capital income start to dampen investment in technological progress, which has a negative impact on the overall productivity of the economy and job creation.

In the long run ($\mu \in (0.40; 0.50]$), we observe an even more pronounced divergence between the scenarios, where higher taxes on the income of automated capital (scenarios C and D) significantly reduce the positive effect of reducing taxes on labour income. At this stage, the taxation of automated capital income becomes particularly problematic as it hinders technological progress and reduces the competitiveness of firms, which in turn has a negative impact on employment.

Thus, these modelling results support Hypothesis H1: the introduction of an automated capital income tax combined with a reduction in labour income taxes does indeed lead to a lower level of employment compared to a reduction in labour income taxes alone, and this negative effect increases as the rate of the automated capital income tax increases. This is particularly pronounced in the long run, when higher rates of automatic capital income taxes significantly reduce the positive employment effect of labour income tax cuts.

Macroeconomic impact of the reduction of labour income tax and the introduction of an automated capital income tax

In order to assess the broader economic impact of automated taxation of capital income, the second hypothesis (H2) is further analysed, which states that the taxation of robots has a negative impact on economic growth and productivity performance, and that this negative effect is amplified at higher levels of automation and higher tax rates, thus counteracting the positive economic impact of a reduction in labour income tax. To test the hypothesis, we analyse the main macroeconomic indicators: total production (Y), consumption (C), investment (I), and total capital growth consisting of traditional and automated capital (K+D) (Figure 2, Figure 3, Figure 4).

The analysis of the results of the baseline model shows that output (Y) increases over the whole range of values of the parameter μ. This increase becomes particularly pronounced at higher levels of automation ($\mu > 0.4$), confirming that increasing automation leads to higher productivity in spite of declining employment.Consumption (C) grows with increasing levels of automation, but at a slower rate compared to the overall growth of output, particularly at higher levels of automation. This may be due to the fact that automation, while increasing the productivity of the economy, reduces the share of labour income in the overall income structure, which limits consumption growth. This difference between fast-growing production and slower-growing consumption may be a reflection of the direction of income inequality. The investment (I) curve shows an upward trend, especially when the level of automation reaches higher values, reflecting an increasing propensity to invest in expanding production. The increase in total conventional and automated capital (K+D) is also significant, indicating that, despite automation, the need for conventional capital goods and infrastructure persists and that high-tech capital is growing alongside.

In the analysis of scenario A, the production (Y) curve is higher than in the baseline model over the whole range of the parameter μ, although this positive difference remains relatively small. This suggests that the reduction in labour costs and the increase in employment are both positive for overall economic growth. The level of consumption (C) remains higher than in the baseline model over the entire μ-parameter range, due to an increase in households' disposable incomes, suggesting a lasting positive impact on households' welfare. The curves for investment (I) and total capital (K+D) show that the fall in labour costs does not dampen the propensity of firms to invest in capital, both traditional and automated, and does not lead to a capital substitution effect but rather boosts the overall development of the economy.

These results in Scenario A confirm the multiplier effect of reducing the tax burden on labour income: the initial reduction in labour income taxes triggers a chain of positive economic effects through increased consumption, investment, and production. It is particularly important to note that these positive effects not only persist but, in some cases, even increase with the level of automation, demonstrating the sustainability of labour tax reduction policies in the context of technological progress.

When analysing the short-run ($\mu \in [0.1; 0.25]$) results, all scenarios show better economic dynamics than the baseline model, but with significant differences between them (Figure 2).

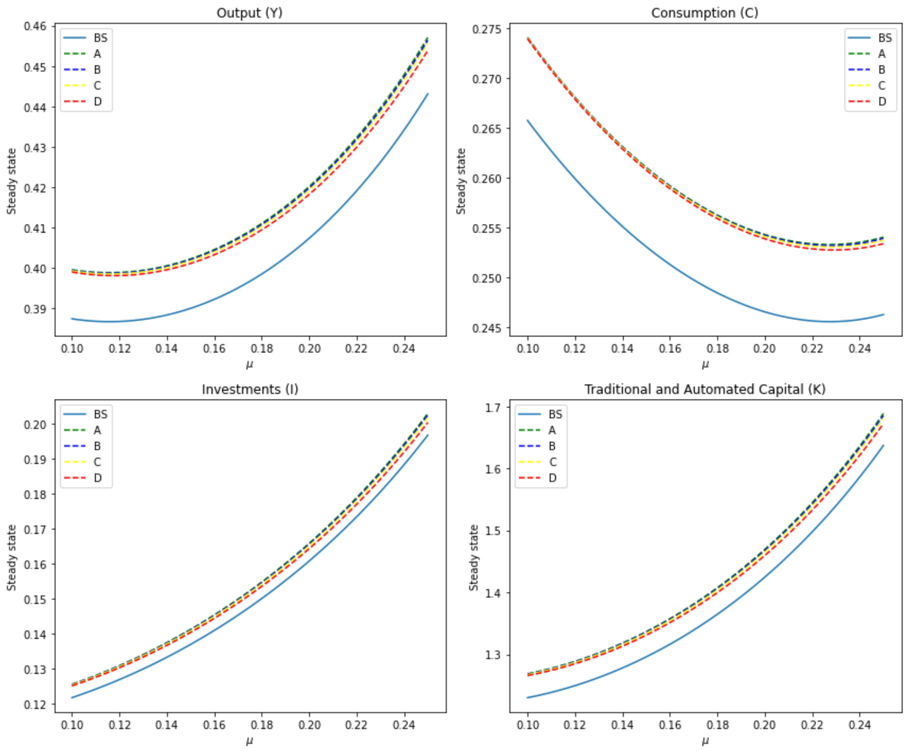

Figure 2. Dynamics of other macroeconomic indicators over the short term

(BS – baseline model, A – labour income tax reduction scenario, B – labour income tax reduction and automated capital income tax 5% scenario, C – labour income tax reduction and automated capital income tax 10% scenario, D – labour income tax reduction and automated capital income tax 20% scenario, μ – share of automated jobs parameter)

Source: own evaluation.

Scenario A, which only reduces labour income tax, shows the best results for all macroeconomic indicators. The differences between Scenario A and the scenarios with automated income taxes (B, C, D) increase as the rate of the automated capital income tax increases. The taxation of automated capital income, especially at higher rates, starts to inhibit investment (I) in technological development at an early stage, which is also reflected in slower capital growth (K+D). This dampening of investment becomes a key factor limiting potential growth. In the early stages of automation, firms are still in the early stages of adopting new technologies, so higher taxation can slow down technological progress and reduce overall economic efficiency.

A medium-term (μ ∈ (0.25; 0.40]) analysis reveals sharp differences between the scenarios and an increasing negative impact of automated capital income taxation (Figure 3).

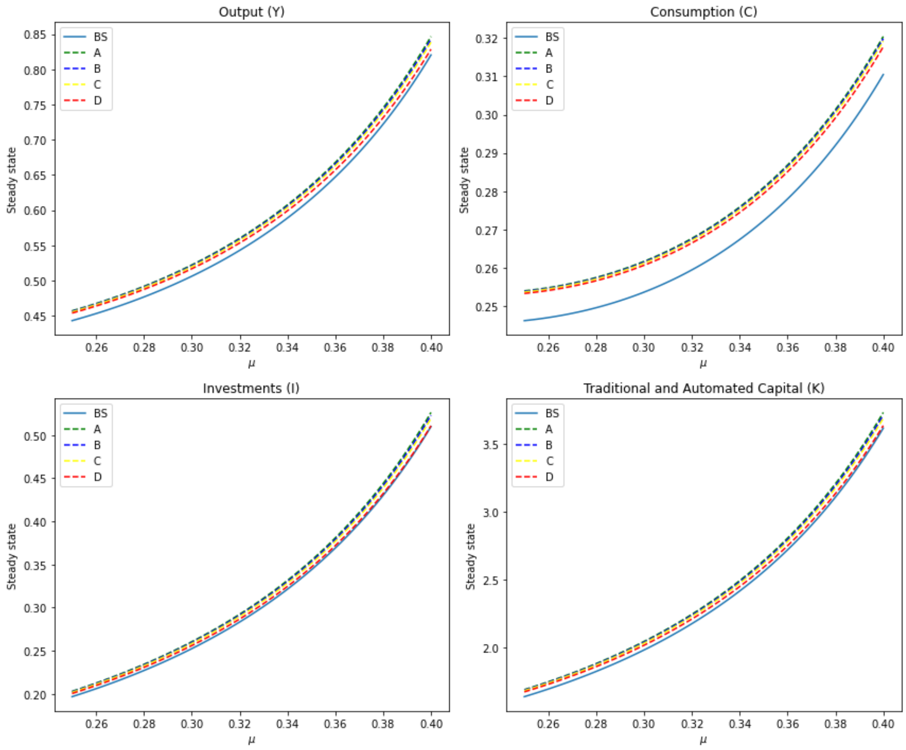

Figure 3. Dynamics of other macroeconomic indicators over the medium term

(BS – baseline model, A – labour income tax reduction scenario, B – labour income tax reduction and automated capital income tax 5% scenario, C – labour income tax reduction and automated capital income tax 10% scenario, D – labour income tax reduction and automated capital income tax 20% scenario, μ – share of automated jobs parameter)

Source: own evaluation.

While all alternative scenarios still outperform the baseline model, the gap between scenario A and the scenarios with an automatic capital income tax (B, C, and D) becomes more pronounced. At this stage, the growth (Y) and consumption (C) curves clearly show that higher rates of an automatic capital income tax start to dampen the positive effect of labour income tax cuts significantly. This is particularly noticeable in Scenario D, where growth rates are significantly slower than in Scenario A. The slowdown in the growth of investment (I) and total capital (K+D) in the scenarios with higher taxes on automated capital income suggests that firms are starting to limit technological development. These results can be explained by the fact that automation is becoming an increasingly important driver of economic growth in the medium term. Companies are more actively adopting new technologies to increase productivity and competitiveness.

Therefore, taxation of automated capital income has a more negative impact at this stage, not only by directly increasing the cost of investment but also by reducing the ability of firms to modernise production. In addition, slower technological renewal starts to have a negative impact on labour productivity, which in turn limits wage growth and consumption, despite the reduction in labour income taxes.

In the long run (μ ∈ (0.40; 0.50]), the negative impact of automated capital income taxation on the economy becomes particularly pronounced (Figure 4).

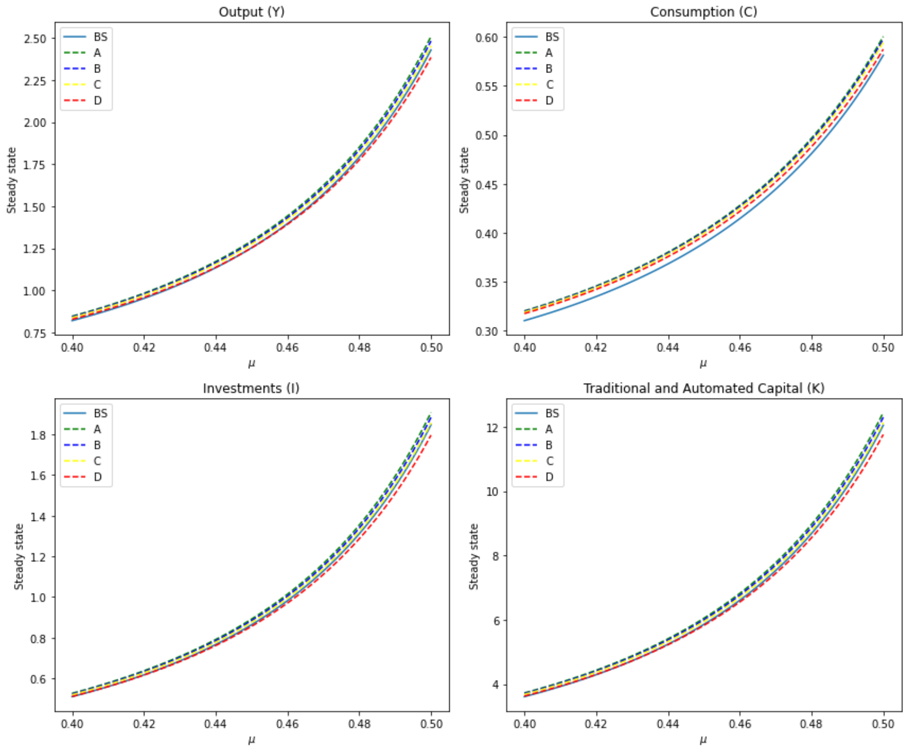

Figure 4. Dynamics of other macroeconomic indicators over the long term

(BS – baseline model, A – labour income tax reduction scenario, B – labour income tax reduction and automated capital income tax 5% scenario, C – labour income tax reduction and automated capital income tax 10% scenario, D – labour income tax reduction and automated capital income tax 20% scenario, μ – share of automated jobs parameter)

Source: own evaluation.

While all scenarios show strong growth due to high levels of automation, the differences between scenarios become even more pronounced and the negative impact of automated capital income taxes even stronger. The growth trajectories of output (Y) show that the scenarios with higher automated capital income taxes (especially C and D) lag significantly behind Scenario A. This gap becomes even more pronounced at higher values of μ, confirming that the impact of automated capital income taxation increases with technological progress. The growth curves for investment (I) and total capital (K+D) show a similar trend, with higher taxes on automated capital income significantly discouraging investment in technological development. Consumption (C) grows in all scenarios as a result of overall economic growth, but the scenarios with higher taxes on automated capital income show slower consumption growth. This suggests that the taxation of automated capital income not only directly discourages investment and production but also indirectly reduces household welfare through slower wage growth.

These results support Hypothesis H2: taxation of automated capital income does have a negative impact on economic growth and productivity performance, and this negative effect is amplified as the level of automation and the tax rate increase. In the long run, taxes on automated capital income significantly reduce the positive tax-reducing effect of labour income taxes, especially in a context of higher technological development, where automation becomes a key driver of economic growth.

The impact on tax revenues of the reduction of labour income tax and the introduction of an automated capital income tax

The third hypothesis (H3), which states that the revenue generated by automated capital income taxation is insufficient to compensate for the loss of tax revenue due to labour tax cuts, even at high levels of automation, is examined next. In order to confirm or refute this hypothesis, we analyse the dynamics of tax revenue collection by looking at total tax revenue collection (T) and by analysing separately the collection of labour income taxes (Tl) and automated capital income taxes (Ta) (Figure 5, Figure 6, Figure 7).

In the short run (μ ∈ [0.1; 0.25]), the dynamics of tax revenue reveal the fiscal cost of reducing labour income taxes (Figure 5).

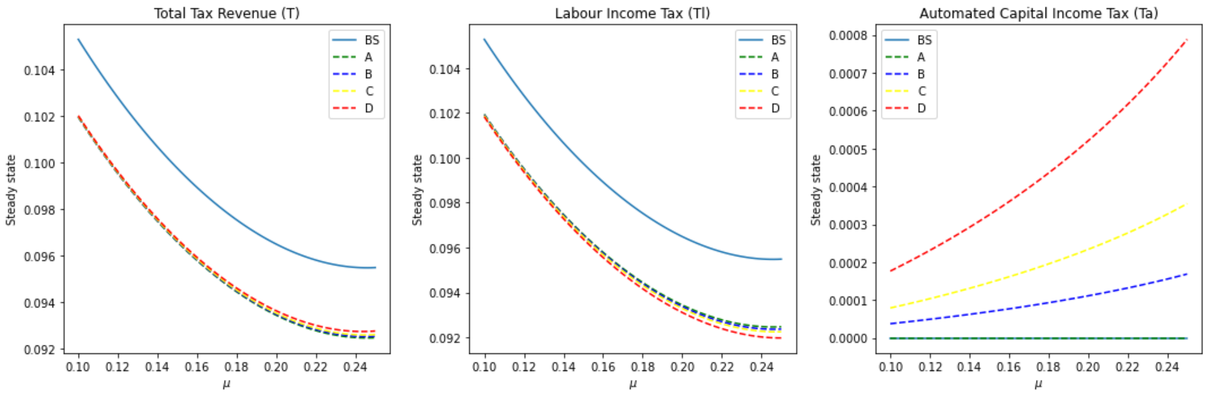

Figure 5. Tax revenue dynamics over the short term

(BS – baseline model, A – labour income tax reduction scenario, B – labour income tax reduction and automated capital income tax 5% scenario, C – labour income tax reduction and automated capital income tax 10% scenario, D – labour income tax reduction and automated capital income tax 20% scenario, μ – share of automated jobs parameter)

Source: own evaluation.

Total tax revenue (T) in all alternative scenarios is lower than in the baseline model, and the differences between the scenarios with different tax rates on automated capital income are minimal. The collection of labour income taxes (Tl) decreases in all scenarios due to the reduced tax rate, and this decrease is similar in all alternative scenarios. The revenue generated by automated capital income taxes (Ta), even at the highest rate of 20% (Scenario D), is relatively low and does not compensate for the loss of labour income taxes. This is explained by the fact that in the early stage of automation, the income base of automated capital is limited, so that even higher rates do not generate significant revenues. In addition, higher income taxes on automated capital start to inhibit investment in automation already at an early stage, which further limits the potential tax revenue from this source.

In the medium term (μ ∈ (0.25; 0.40]), the total tax revenue (T) in all alternative scenarios remains lower than in the baseline model, but the gap between the scenarios starts to narrow, especially at higher values of μ (Figure 6). There is an increase in tax revenue in all scenarios, driven by the increase in economic productivity due to automation.

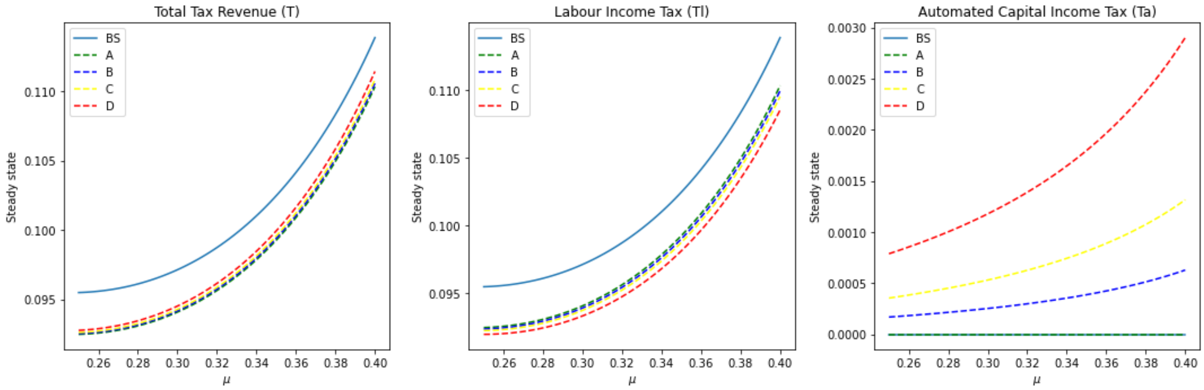

Figure 6. Tax revenue dynamics over the medium term

(BS – baseline model, A – labour income tax reduction scenario, B – labour income tax reduction and automated capital income tax 5% scenario, C – labour income tax reduction and automated capital income tax 10% scenario, D – labour income tax reduction and automated capital income tax 20% scenario, μ – share of automated jobs parameter)

Source: own evaluation.

The collection of labour income taxes (Tl) is starting to increase significantly, despite the reduced rate, due to rising labour productivity and correspondingly rising labour income. However, this growth does not compensate for the loss of revenue due to the reduced tax rate, so that labour income tax collections remain lower than in the baseline model. Revenues from taxes on automated capital income (Ta) grow faster in the medium term, especially in Scenario D, due to the growing automated capital income base. However, even at this stage, automated capital income taxes do not generate sufficient revenues to compensate for the loss of labour income tax revenues. In addition, higher taxes on automated capital income start to put a greater brake on investment in automation, which limits the potential growth of tax revenues in the long term.

In the long run ($\mu \in (0.40; 0.50]$), the dynamics of tax revenues reveal a complex situation (Figure 7). Although Scenario D eventually almost reaches the level of total tax revenue (T) in the baseline model, this result has to be interpreted with caution, taking into account the broader economic context.

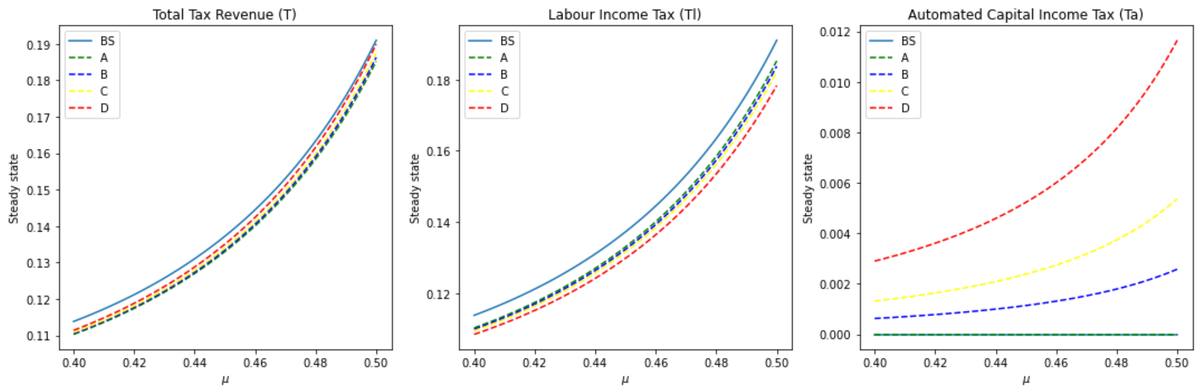

Figure 7. Tax revenue dynamics over the long term

(BS – baseline model, A – labour income tax reduction scenario, B – labour income tax reduction and automated capital income tax 5% scenario, C – labour income tax reduction and automated capital income tax 10% scenario, D – labour income tax reduction and automated capital income tax 20% scenario, μ – share of automated jobs parameter). *Source*: own evaluation.

The collection of labour income taxes (Tl) in all alternative scenarios remains lower than in the baseline model due to the reduced rate. Meanwhile, revenues from automated capital income taxes (Ta) show an exponential increase, especially in scenario D, due to a significant increase in the automated capital income tax base under high levels of automation. However, this apparent fiscal "success" in Scenario D comes at a significant cost: as discussed above, a high tax on automated capital income significantly discourages investment, reduces output, and reduces overall economic efficiency. In fact, higher tax revenue collection is achieved at the expense of economic growth and productivity, which in the long run may lead to even higher tax revenue losses due to reduced economic activity.

These results support Hypothesis H3: while high income taxes on automated capital can theoretically compensate for the loss of labour income tax revenues, this is achieved by creating significant damage to overall economic development. Therefore, the taxation of automated capital income cannot be considered an effective fiscal policy instrument, as its alleged effectiveness is achieved at the excessive cost of holding back economic growth.

To summarise, the modelling results lead to a policy dilemma: while tax cuts on labour income are effective in stimulating employment and overall economic growth, they create significant pressure on public finances. The modelling results show that in the short term, reduced tax revenues may limit the government's ability to finance essential public services and retraining programs—precisely at a time when these investments become particularly important in a context of rapid technological progress. However, an income tax on automated capital is not an appropriate solution to these problems, as it not only does not generate sufficient revenue to compensate for the reduction in labour income taxes but also hampers technological progress and economic development. In order to ensure long-term fiscal sustainability, it is necessary to combine this policy of reducing labour taxation with other reforms of the tax system, such as a review of other existing taxes, in order to strike the optimal balance between employment promotion and the sustainability of public finance. In order to ensure long-term fiscal sustainability, it is necessary to combine the policy of reducing labour taxation with other reforms of the tax system, seeking an optimal balance between employment promotion and sustainability of public finances.

5. CONCLUSIONS

This study aimed to assess the effectiveness of automated (robotic) taxation of capital income as an alternative to labour income taxes in the context of technological progress. Using a general equilibrium model calibrated for the EU economy, three hypotheses were tested to analyse the interaction between labour tax cuts and automated capital income taxation and their impact on employment, growth, and tax revenues.

The modelling results confirmed all three hypotheses. First, the introduction of an automated capital income tax combined with a reduction in labour income taxes is found to lead to lower employment levels compared to scenarios with only labour income tax cuts. This negative effect is amplified as the rate of the automated capital income tax increases, especially in the long run when automation becomes more widespread. Even a low, automated capital income tax rate of 5% starts to reduce the positive employment effects of labour income tax cuts.

Second, the analysis reveals that the taxation of automated capital income has a broader negative impact on economic growth and productivity. While all alternative scenarios outperformed the baseline model in the short run, the scenarios with higher tax rates on automated capital income showed significantly slower growth in output, consumption, and investment, especially as the level of automation increases. This confirms that taxing automated capital income does not only fail to solve employment problems but also hampers economic development.

Thirdly, the study shows that the taxation of automated capital income is not an effective means of generating tax revenue as a substitute for labour income taxes. Even with high rates and advanced levels of automation, revenues from automated capital income taxes do not compensate for the reduction in labour income tax revenues. Moreover, the overall fiscal effect is even less favourable when the negative impact on growth and investment is taken into account.

These results lead to a clear conclusion: taxation of automated capital income is not an appropriate solution to address labour market challenges and the fiscal consequences of technological progress. Instead of introducing automated (robotic) taxes on capital income, policymakers should consider alternative ways to ensure fiscal sustainability while supporting employment in an increasingly automated economy. This could include a gradual reduction of labour income taxes, combined with a broader reform of the tax system and greater investment in labour adaptation programs.

Further research should focus on three main aspects to better balance tax revenue adequacy with technological progress and employment support. First, the sensitivity of different skill groups to tax changes in the context of automation needs to be further explored in terms of their adaptability to technological change. Secondly, alternative sources of tax revenue need to be analysed, especially in the context of the changing structure of the economy and new business models in the digital economy. Thirdly, it is important to assess the interaction of tax reform with other policy measures such as education reform or active labour market policies. Such an integrated approach would lead to a tax system that is not only fiscally sustainable but also promotes technological progress, economic growth, and the well-being of society as a whole.

REFERENCES

Abbott, R., & Bogenschneider, B. (2018). Should robots pay taxes: Tax policy in the age of automation. *Harv. L. and Pol'y Rev.*, 12, 145.

Acemoglu, D., Manera, A., & Restrepo, P. (2020). Taxes, automation, and the future of labor. Research Brief.

Arntz, M., Gregory, T., & Zierahn, U. (2016). The risk of automation for jobs in OECD countries: A comparative analysis. OECD Social, Employment and Migration Working Papers, No. 189. OECD Publishing.

Bangash, S., Khan, I., Husnain, G., Irfan, M., & Iqbal, A. (2024). Revolutionizing healthcare with smarter AI: In-depth exploration of advancements, challenges, and future directions. *VFAST Transactions on Software Engineering*, 12(1). https://doi.org/10.21015/vtse.v12i1.1760

Bielecki, M., & Stähler, N. (2022). Labor tax reductions in Europe: The role of property taxation. *Macroeconomic Dynamics*, 26(2), 419-451.

Bottone, G. (2018). A tax on robots? Some food for thought. DF WP, (3).

Costinot, A., & Werning, I. (2023). Robots, trade, and luddism: A sufficient statistic approach to optimal technology regulation. *The Review of Economic Studies*, 90(5), 2261-2291.

Damijan, J., Damijan, S., & Vrh, N. (2021). Tax on robots: Whether and how much. GROWINPRO.

Di Battista, A., Grayling, S., Hasselaar, E., Leopold, T., Li, R., Rayner, M., & Zahidi, S. (2023). Future of jobs report 2023. World Economic Forum.

Emara, A. (2020). The impact of technological progress on employment in Egypt. *International Journal of Social Economics*. https://doi.org/10.1108/ijse-05-2020-0301

Englisch, J. (2018). Digitalisation and the future of national tax systems: Taxing robots? Labor: *Personnel Economics eJournal*. https://doi.org/10.2139/ssrn.3244670

Feldmann, H. (2013). Technological unemployment in industrial countries. *Journal of Evolutionary Economics*, 23, 1099-1126. https://doi.org/10.1007/S00191-013-0308-6

Frey, C. B., & Osborne, M. A. (2013). The future of employment: How susceptible are jobs to computerisation? Oxford Martin School Working Paper.

Furgasė, J., & Miceikienė, A. (2024). Reforming labour taxation: Addressing the employment effects of technological progress. *Management Theory and Studies for Rural Business and Infrastructure Development*, 46(4), 592-608.

Gasteiger, E., & Prettner, K. (2022). Automation, stagnation, and the implications of a robot tax. *Macroeconomic Dynamics*, 26(1), 218-249.

Guerreiro, J., Rebelo, S., & Teles, P. (2022). Should robots be taxed? *The Review of Economic Studies*, 89(1), 279-311.

Heijdra, B. J., & Ligthart, J. E. (2009). Labor tax reform, unemployment, and search. *International Tax and Public Finance*, 16, 82-104.

Juliana, J. (2023). Technological Advancement and its Impact on Workers. *International Journal For Multidisciplinary Research*, 5(6), 1-11. https://doi.org/10.36948/ijfmr.2023.v05i06.10014.

Jacquinot, P., Lozej, M., & Pisani, M. (2018). Labour tax reforms, cross-country coordination and the monetary policy stance in the euro area: A structural model-based approach. ECB Working Paper No. 2127.

Kedziora, D. (2022). Botsourcing, Roboshoring or Virtual Backoffice? Perspectives on Implementing Robotic Process Automation (RPA) and Artificial Intelligence (AI). *Human Technology*, 18(2), 92–97. https://doi.org/10.14254/1795-6889.2022.18-2.1

Lassébie, J., & Quintini, G. (2022). What skills and abilities can automation technologies replicate and what does it mean for workers? OECD Social, Employment and Migration Working Papers No. 266.

Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). A future that works: Automation, employment, and productivity. McKinsey Global Institute.

Mazur, O. (2018). Taxing the robots. *Pepp. L. Rev.*, 46, 277.

Mishchuk, H., Oliinyk, O., & Bilan, Y. (2024). Brain gain and country's resilience: A dependency analysis exemplified by OECD countries. Equilibrium. *Quarterly Journal of Economics and Economic Policy*, 19(2), 591-621

Oberson, X. (2021). Robot Taxes: The Rise of a New Taxpayer. *Bulletin for International Taxation*. https://doi.org/10.59403/1470y53.7

OECD. (2024). Taxing Wages 2024: Tax and Gender through the Lens of the Second Earner. OECD Publishing. https://doi.org/10.1787/dbcbac85-en

Owoeye, G. (2024). The influence of artificial intelligence on employment trends in the United States (US). *International Journal of Innovative Science and Research Technology*. https://doi.org/10.38124/ijisrt/ijisrt24jun328

Pierrard, O. (2004). Pourquoi faut-il cibler la réduction du coût du travail sur les très bas salaires? *Regards économiques*, 24, 1-12.

Piva, M., & Vivarelli, M. (2018). Technological change and employment: Is Europe ready for the challenge? *Eurasian Business Review*, 8, 13-32. https://doi.org/10.1007/S40821-017-0100-X

Prettner, K., & Strulik, H. (2020). Innovation, automation, and inequality: Policy challenges in the race against the machine. *Journal of Monetary Economics*, 116, 249-265.

Prisecaru, P. (2017). The challenges of the industry 4.0. *Global Economic Observer*, 5(1), 66-72.

Rossi, L. (2020). Employment and labor policies: The case of Italy. *International Journal of Business and Management*, 4(5), 1-10. https://doi.org/10.26666/rmp.ijbm.2020.5.1

Siderska, J., Alsqour, M., & Alsaqoor, S. (2023). Employees' attitudes towards implementing robotic process automation technology at service companies. *Human Technology*, 19(1), 23–40. https://doi.org/10.14254/1795-6889.2023.19-1.3

Smit, S., Tacke, T., Lund, S., Manyika, J., & Thiel, L. (2020). The future of work in Europe. McKinsey Global Institute.

Stehrer, R., Bykova, A., Jäger, K., Reiter, O., & Schwarzhappel, M. (2019). Industry level growth and productivity data with special focus on intangible assets. WIIW Statistical Report No. 8.

Tax Foundation. (2023). Capital gains tax rates in Europe 2023. Retrieved June 12, 2024, from https://taxfoundation.org/data/all/eu/capital-gains-tax-rates-in-europe-2023/

Thuemmel, U. (2023). Optimal taxation of robots. *Journal of the European Economic Association*, 21(3), 1154-1190.

Turja, T. (2024). Who sets the pace in robotisation? 'Working at a robotic pace' according to the justifying, criticising and problem-solving discourse frames. *Human Technology*, 20(2), 361–383. https://doi.org/10.14254/1795-6889.2024.20-2.6

Wang, S. (2023). Analysis of price effect and employment effect of government tax reduction. BCP Business & Management, 38, 2623-2629.

Yarovenko, H., Kuzior, A., Norek, T., & Lopatka, A. (2024). The future of artificial intelligence: Fear, hope or indifference?. *Human Technology*, 20(3), 611–639. https://doi.org/10.14254/1795-6889.2024.20-3.10

Zhang, P. (2019). Automation, wage inequality and implications of a robot tax. *International Review of Economics & Finance*. https://doi.org/10.1016/J.IREF.2018.10.013

Zhang, X., Palivos, T., & Liu, X. (2022). Aging and automation in economies with search frictions. *Journal of Population Economics*, 35(2), 621-642.

Zhou, G., Chu, G., Li, L., & Meng, L. (2019). The effect of artificial intelligence on China's labor market. *China Economic Journal*, 13(1), 24-41. https://doi.org/10.1080/17538963.2019.1681201