Macroeconomic effects of demographic transition, mobilization of the labor force potential and labor productivity

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Abstract The aim of this study is to quantitatively assess the potential medium- and long-term macroeconomic effects of improved mobilization of labor force potential, as outlined in the recommendations of the Productivity report 2023. The study focuses on five areas: (i) productivity, (ii) skills and education, (iii) effective labor supply of women (iv) labor market participation of older persons and (v) migration. Benchmarking approach based on labor market and demographic indicators across EU member states is used to identify the potential impact of reforms in Austria. Simulations with the FISK-OLG model show the potential impact of closing the gaps to the EU countries. The quantitative analysis is complemented by a discussion of the structural determinants and possible policy approaches.

The study yields the following key findings. First, sustaining economic growth in Austria at levels comparable to the past 30 years will be challenging in an aging society. Productivity growth would need to significantly increase to counterbalance the effects of a shrinking labor force (relative to total population). Second, utilizing the labor market potentials could bring significant improvements in long-run economic outcomes. Closing the distance to median EU country in terms of educational attainment, effective labor supply of women, and labor market participation of older workers would elevate GDP per capita by about 7%, closing the gap to top performers by about 14% by 2070. Third, there are substantial differences between the reform areas. In the long run, productivity growth and human capital are the most important drivers of economic performance. Therefore, improvements in educational attainment yield significant improvements, although these improvements manifest with a considerable delay. In contrast, increasing the effective labor input of women and older persons has a more immediate positive impact in the short to medium term, with labor input of women holding particularly high potential based on comparisons with other EU member states. Fourth, there are complementarities between reforms across various reform areas.

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1. Introduction

Demographic change will be a limiting factor for Austria's economic growth in the coming decades. According to population projections by the Austrian statistical office, the working-age population (ages 20 to 64) is expected to shrink by around 6% between 2024 and 2060, with the sharpest decline occurring between 2025 and 2035 (main variant, Statistics Austria, 2023a). In contrast, the population aged 65 and over is projected to grow substantially, from approximately 1.84 million in 2024 to around 2.87 million in 2060, a 56% increase. Consequently, the ratio of the working-age population to those aged 65 and over will decrease. While there are currently three individuals aged 20 to 64 for every person aged 65 and over in 2024, this ratio is expected to fall to 2.2 by 2035 and further to 1.8 by 2060. These demographic shifts will constrain economic growth and place a considerable burden on Austria's public finances (for overview see Peneder et al., 2023).

At the same time, Austria has latent potential that could increase the effective labor supply and help mitigate the economic consequences of demographic change. This includes the unemployed, as well as parts of the non-employed and underemployed persons. In 2022, there were around 156,000 persons in “potential labor force” - persons who wish to work but are either not actively searching or are not immediately available to start a job. Additionally, there were more than 100,000 part-time workers who wished to work more hours (Angel et al., 2023). Moreover, another important factor in mitigating the consequences of demographic change is the productivity of the labor force. Productivity is influenced by available capital and production technologies, allocative efficiency of the economy, as well as the qualifications and health of the workforce, among other factors.

The Productivity report 2023 (Produktivitätsrat, 2023) highlights the important role that better mobilization of labor force potential and increasing productivity play in the future development of Austria’s economic performance. The report makes several recommendations for unlocking labor force potential by increasing labor market participation, working hours, and improving the qualifications and skills of the population. Specifically, the report addresses the following dimensions: improving health status, adjusting qualifications and skills to reduce labor market skill mismatch, enhancing childcare and long-term care services to boost labor market participation among individuals with care responsibilities, implementing measures to increase labor market participation among older people, and promoting labor mobility. These areas all influence individual labor market opportunities and life quality, but also impact the total amount of labor supply in Austria.

The aim of this study is to quantitatively assess the potential medium- and long-term macroeconomic effects of improved mobilization of labor force potential, as outlined in the recommendations of the Productivity report 2023. The study focuses on five areas: (i) productivity, (ii) skills and education, (iii) effective labor supply of women, (iv) labor market participation of older persons and (v) migration. I employ a benchmarking approach based on labor market and demographic indicators across EU member states to identify the potential impact of reforms in Austria. The study identifies the gaps to the median and best performing countries and use these as inputs for model simulations. Rather than analyzing specific measures, the model simulations focus on quantifying the potential impact of closing the gaps, while the modelling of the catching up process remains highly stylized. The quantitative analysis is complemented by a discussion of the structural determinants and possible policy approaches.

The medium and long-term macroeconomic effects are evaluated using the FISK-OLG model (Schuster, 2021). The model encompasses a wide range of economic channels through which reforms influence the economic outcomes and provides a standardized framework for analyzing various scenarios. In this way, the model allows to quantify the impact of reforms on a large number of variables and differentiates the effects on various socio-demographic groups. This comprehensive approach can help to prioritize the reforms based on their expected effects, highlight the complementarities between reforms, and inform the design of policy measures aimed at increasing labor supply and labor productivity.

The study yields the following key findings. First, sustaining economic growth in Austria at levels comparable to the past 30 years will be challenging in an aging society. Productivity growth would need to significantly increase to counterbalance the effects of a shrinking labor force (relative to total

population). Second, utilizing the labor market potentials could bring significant improvements in long-run economic outcomes. Closing the distance to median country in terms of educational attainment, effective labor supply of women, and labor market participation of older workers would elevate GDP per capita by about 7%, closing the gap to top performers by about 14%. Third, while based on stylized scenarios, the model results underscore important differences between the reform areas. In the long run, productivity growth and human capital are the most important drivers of economic performance. Therefore, improvements in educational attainment yield significant improvements, albeit after a long initial period of negative impact before the gains of the reforms start to realize. In contrast, improving the effective labor input of women and older persons brings positive impact in short and medium run, with labor input of women holding especially big potential based on comparisons with other EU member states.

Finally, the reform areas should not be viewed as alternatives, as each dimension offers untapped potential, and their effects are complementary. Simultaneously closing the gap to the median country (or the top three countries) in terms of educational attainment, labor supply of women, and labor market participation of older workers leads to long-term effects that exceed the combined impacts of the three reforms implemented in isolation. Furthermore, fully closing the gap to the top performers in these three dimensions is the only scenario under the baseline assumptions on technological progress and migration in which average GDP per capita growth between 2023 and 2070 matches the average growth rate observed between 1993 and 2023. This finding highlights the necessity of ambitious reform goals across all discussed areas to enhance the prospects for economic growth.

The study is organized as follows: Section 2 introduces the FISK OLG model and outlines the methodology. Section 3 describes the alternative scenarios for each reform area, discusses the main simulation results and outlines the key determinants and possible policy approaches. Section 4 summarizes the findings. Detailed simulation results and sensitivity analysis are reported in the annex.

2. Methodology

2.1 Model description

This section gives a brief overview of the **FISK OLG model**, for a comprehensive model description see Schuster (2021). The FISK OLG model is a numerical overlapping generations (OLG) model of the Auerbach-Kotlikoff type for Austria. The model is tailored for quantifying medium and long-run macroeconomic effects of demographic change and structural reforms. At the core of the modelling approach, households and firms make economic decisions to maximize their welfare (i.e. the decisions are micro founded). Because these agents take into account that their economic choices influence their future outcomes, the model is dynamic and forward-looking. Importantly, while policymakers cannot directly impose economic decisions on households and firms, they can influence these decisions through incentives and shaping the economic environment. The model is solved in general equilibrium, i.e., prices are the result of the interaction between households, firms, government, and the rest of the world in product and factor markets. The model is designed and calibrated to capture the economic environment and institutional features specific to Austria. In order to address policy questions, particular emphasis is put on a detailed modeling of government sector, including revenues and expenditures.

As demographic change is an important determinant of future economic developments, the model places particular emphasis on a detailed representation of the **population structure**. The population is differentiated along the following dimensions: age (yearly cohorts), highest attained level of education (low, medium, high), and ability to save/access to credit markets (consumption-smoothing "Ricardian" households and hand-to-mouth consumers with zero savings). Persons age by exactly one year each year but they cannot change their savings type or educational attainment over time. The demographic module encompasses the information on the number of persons and the vital rates (fertility, mortality, and net migration) by demographic group and also accounts for gender differences and family status.

In the economic part of the model, each cell is populated by a representative unisex household. The representative households make decisions along the following margins: consumption, labor market participation and retirement, and hours supply. Therefore, age- and education-specific profiles of participation, income, consumption, etc. by cohort are model outcomes. Aggregating these model outcomes across demographic groups yields the macroeconomic aggregates of the household sector. The only source of uncertainty for an individual agent is time of death, which follows a stochastic process. In other respects, households have perfect foresight, i.e. future events are expected by agents with certainty. However, the modelling framework can also be used to analyze the effects of unanticipated shocks.

Firms make forward-looking decisions concerning investment, labor demand, and prices. They use the production factors labor, private capital, and public capital as inputs and turn them into outputs. The labor-augmenting technological process that determines the firm productivity is assumed to be exogenous.

The government affects the economy by altering agents' resource constraints (via taxes and transfers) and by participating in product markets (via public consumption and public investment). Moreover, the government issues debt, which is held by domestic and foreign asset holders. Particular emphasis is put on capturing government revenues and expenditures. Most of the taxes are proportional, with the exception of a progressive income tax, which is based on non-linear tax functions. Part of the government expenditures is demography-related and modeled in most cases by using age-skill-specific unit cost profiles. Special attention is given to the representation of the pension system. Pensions are based on individual income histories and are subject to different pension system regimes (the old systems differentiating between private sector employees and civil servants and the new harmonized pension account system).

Austria is modelled as a small open economy, trading both goods and assets with the rest of the world. The demand for goods is allocated between domestic and imported goods following the Armington assumption. The demand for different types of assets is based on a portfolio optimization problem of households. The domestic and foreign assets (both firm shares and government debt) are imperfect substitutes. Therefore, the assets can yield different returns without causing arbitrage.

In contrast to many comparable models, the model does not treat a (current) base year or base period as a steady state. The model is fitted to the historical time series with an initial steady state dating many generations in the past. This allows to capture important non-stationarities as observed in the data. Examples of such dynamic developments are the non-stationary relationships between the current population structure and the current vital rates, or between the current primary balance and the current debt level. Furthermore, this approach ensures that future trends, such as population ageing, are already included in agents' expectations. In addition, the approach allows to analyze historical reforms, such as pension reforms, with gradual yet long-lasting consequences.

The model is calibrated to reflect the economic and demographic development of Austria up to 2023, incorporating information from the medium-term economic forecast up to 2028 and the long-term demographic forecast up to 2080. In order to adapt the model to historical developments, a consistent data set has been constructed specifically for the FISK OLG model, including data back to 1954 and integrating variables from different sources. The macroeconomic data are mainly taken from the System of National Accounts (SNA), where data according to the national accounts concepts ESA 2010, ESA 1995 and SNA1968 (Statistics Austria, 1985) are linked together. Most income and expenditure categories of the SNA are explicitly modelled. Past and projected demographic trends are fitted to various demographic indicators published by Statistics Austria. Micro data are used to calibrate the education and age profiles of various labor market, income and wealth indicators. Model elasticities are calibrated in line with the macroeconomic literature. A detailed technical documentation of the model is available in Schuster (2021).

2.2 Benchmarking and construction of scenarios

The core of the analysis is the comparison of various reform scenarios for the development of effective labor supply with the baseline scenario (no-policy-change). In order to identify the potential impact of reforms in Austria, I employ a benchmarking approach based on labor market and demographic indicators across EU member states. The data source for the construction of the indicators is Labor Force Survey published by the Eurostat (2024 release).

For each indicator, I identify the gaps between Austria and the median country, resp. between Austria and average of three best performing countries which are referred to as *median* and *TOP 3* values, respectively, throughout the study. I map these benchmark values into model variables and simulate the alternative scenarios. In the case of migration, there is no clear benchmark in the sense of "optimal" migration rate, therefore I analyze an ad hoc alternative migration scenario. Closing the gaps to median and best performing countries is in most cases a very ambitious goal, requiring a number of complementary policy measures and not attainable in short or even medium run. Rather than analyzing specific measures, the model simulations focus on quantifying the potential impact of successful reforms.

For better comparability, all scenarios are implemented in consistent manner. Unless stated otherwise, each "reform" is introduced as an unexpected but credible shock in the year 2025. The magnitude of the shock gradually increases until it reaches full strength in 2029 and remains constant thereafter. It is important to note that the full implementation of the reform over five years does not mean that the economic effects are fully realized within this time frame, most obvious example being education. The model simulations are presented up to the year 2070, in accordance with the Ageing Report (European Commission, 2024). The results are calculated for the economy as a whole and broken down by demographic groups. The model allows for the analysis of a wide range of variables related to economic performance (GDP, investment, consumption, productivity, etc.), labor markets (employment, unemployment, etc.), and public finances (covering public debt and deficit, public revenue, and expenditure by category), of which only a fraction is presented in this study.

The essential step in constructing the scenarios is to map the changes in structural indicators into model variables in a meaningful way. I use two different strategies. First, I map the indicators directly to permanent exogenous shocks to educational attainment, age-specific average hours per worker, labor market participation rates, and net migration flows to compute the main results. Once an exogenous shock is introduced, all endogenous variables gradually adjust as households and firms adapt to the new conditions and reevaluate their economic decisions. This process leads to general equilibrium effects, which may either dampen or amplify the direct effects of the underlying shock.

Second, to compare the impact of policy interventions on the labor market participation of older workers, I introduce shocks to selected policy parameters that influence the effective labor supply indirectly. Higher labor force participation among older persons may be achieved through reforms in various areas, such as the pension system, tax system or by improving the overall health status of the population. The model provides a consistent framework for comparing the effects of different policy interventions on labor supply.

Despite all the advantages, most of the scenarios in this study are stylized and should not be interpreted as assessing concrete policy measures. First, mapping specific measures into model variables requires a detailed assessment of their macroeconomic effects, which can vary significantly between measures. Moreover, empirical estimates are often available only at the microeconomic level, making it challenging to translate them into model variables. Finally, the model simulations do not fully account for the costs of the respective reforms. In general, excessively high costs of reforms could offset their positive effects. The results of the model simulations quantify the potential macroeconomic effects while fully acknowledging that these outcomes might be difficult to achieve in practice.

2.3 Related literature

The empirical literature on quantifying the potential impacts of economic policies predominantly relies on reduced-form regression analyses to examine the effects of individual policy interventions. This

approach typically estimates the impact on selected variables such as productivity, employment, investment, or business dynamics. The empirical estimates are often available only at the microeconomic level and provide limited information on macroeconomic effects of reforms. Moreover, the estimated effects are usually backward-looking and identification of indirect effects is challenging. However, empirically linking policy measures to specific economic variables can also be used to translate the effects of reforms into shocks, which can serve as inputs for model analysis (see, for example, Égert and Gal, 2017). Nevertheless, the microeconomic focus of empirical estimates poses an ongoing challenge for the analysis of macroeconomic effects of reforms.

This study relies on model-based analysis, which is a valuable tool for quantifying the potential impacts of economic reforms, particularly given the identification challenges faced by empirical estimates. The strength of model-based analysis lies in its ability to capture macroeconomic dynamics, including various transmission channels and feedback effects. Importantly, the macroeconomic effects of policy measures can differ significantly from their impacts on specific households, firms, or sectors. Ignoring the feedback mechanisms can lead to underestimating or overestimating the effects of reforms, thereby distorting policy decisions (Gersbach, 2004). However, even in model-based analysis, studies typically quantify the potential impact of only one or a few policy interventions and rely on empirical estimates of the specific policy measures.

Two recent studies are closely related to the approach of this study in that they analyze the effects of a number of structural reforms, including labor supply and education, within a comprehensive dynamic modeling framework. Pfeiffer et al. (2024) use a benchmarking approach to estimate the potential impact of reforms for all EU Member States. Their simpler modeling framework lacks a number of transmission channels and Austria-specific factors and does not allow to differentiate between demographic groups. While the experiments are not directly comparable, the resulting effects of reforms in education and labor market participation of older workers are roughly in line with this study. IMF (2024) presents an analysis of labor-supply related reforms with an overlapping generations model specifically calibrated to Austria. Instead of comparisons to international benchmarks, the study focuses on explicit transmission channels and relies on econometric estimates of the reforms' effects. The study finds that lowering the pension replacement rate to the EU27 average would increase labor force participation and boost GDP per capita by 0.4 percent in the long run. For female labor input, the study estimates that increasing childcare availability and reducing social disapproval of mothers working could increase female labor input by around 5 percent in the long run. Both estimates are roughly in line with the labor input potentials identified in this study. To summarize, the methodological approach in this study and its results are in line with recent publications in the economic literature.

3. Simulations

3.1 Baseline scenario

The baseline scenario depicts the expected trajectory of the Austrian economy under the assumption of no policy changes. In other words, only the legal situation in force or legislative changes already enacted at the time of the analysis are considered. However, the baseline scenario reflects the expected future developments. It follows the available economic forecasts up to the year 2028 and incorporates long-run developments such as demographic trends and technological progress. As in many economic models, a fiscal instrument is used to ensure a stable path for government debt, forming an exception to the no-policy-change assumption.

The simulation results in this study rely on several key assumptions about future developments, which are characterized by a high level of uncertainty. Similar to other economic models, the most critical assumptions are (a) the future trajectory of productivity growth, particularly the contribution of technological progress, and (b) the future path of government debt and the fiscal policies that future governments will adopt to meet their fiscal targets. These assumptions affect the baseline scenario and all alternative scenarios discussed in the following sections. However, the primary focus of analyzing the macroeconomic effects of the reforms is on the differences between the baseline and alternative

scenarios, which are generally less sensitive to these assumptions. The robustness checks with respect to various model assumptions are provided in the annex.

3.1.1 Assumptions about the development of public finance

The model assumes a moderately restrictive scenario for the development of public finances. Given the elevated level of government debt, Austria will face pressure to reduce its deficits in the coming years. However, since it is uncertain how effectively future governments will comply with the reformed EU fiscal rules and given that recent forecasts are expecting the debt-to-GDP ratio to stay elevated until 2028, I assume a less restrictive path. From 2028 onwards, the baseline specification assumes that the government debt-to-GDP ratio will remain constant, with public spending ensuring a stable level of public services and public investment over time. Any excess public expenditure is assumed to be financed through a lump-sum tax paid by all households regardless of their decisions. This compromise approach avoids overly optimistic assumptions about future government debt reduction while reflecting the increasing need to cover public expenditure through higher revenues. Several risks are associated with these assumptions: First, fiscal instruments used by governments to increase revenues, such as taxes on labor and capital income, are often more distortive to economic activity then a lump-sum tax. Second, governments might be pushed to consolidate at a faster pace, potentially cutting on public spending. Third, they might need to increase public expenditures in some areas, for example on defense or mitigating the effects of climate change.

3.1.2 Assumptions about productivity growth

The baseline scenario assumes that in the long run, the *unexplained* part of total factor productivity (TFP) will grow at the average rate of the previous 30 years, between 1993 and 2023. The unexplained part of TFP refers to the *standard* TFP residual adjusted for the estimated contributions of labor force composition and public infrastructure, see Textbox 1 for details. Since the contributions of the two *explained* components are projected to decrease, the assumption implies that overall TFP and labor productivity will grow slower compared to the previous 30 years. In the baseline specification, (standard) TFP is projected to grow by 0.60% p.a. between 2023 and 2070 (compared to 0.74% p.a. from 1993 to 2023) and labor productivity is projected to grow by 0.88% p.a. between 2023 and 2070 (compared to 1.27% p.a. between 1993 and 2023).

Productivity growth in Austria, similarly to many other developed countries, has steadily declined since the 1960s and 1970s. There is an ongoing debate in economic literature about whether and to what extent the sluggish productivity growth observed after the global financial crisis will return to pre-crisis levels in the future. In a comprehensive review, Goldin et al. (2024) conclude that a significant portion of the productivity slowdown following the financial crisis is due to long-lasting secular trends. Therefore, it is plausible to expect that the average growth rate of the unexplained part of TFP will remain at a level between the pre- and post-financial crisis periods. In fact, the period from 1993 to 2023, which forms the basis for the productivity growth assumption, includes about the same number of years from both before and after the financial crisis. The productivity growth in the baseline scenario is somewhat lower but comparable to other recent studies. The 2024 Ageing Report assumes the average labor productivity growth for Austria between 2022 and 2070 of 1.2% p.a., based on convergence trajectories which are set as consensus among EU member states (European Commission, 2024). In a long-run model of the Austrian economy (A-LMM 2.0), Kaniovski et al. (2024) feature average labor productivity of 1.1% p.a. between 2022 and 2075.

Textbox 1: **Productivity growth and its components**

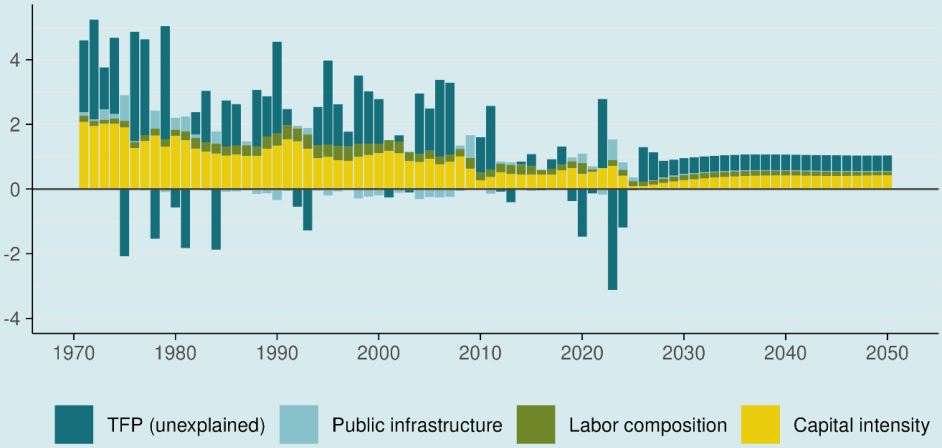
Labor productivity (LP) in this study is defined as real GDP per hour worked. As usual in the literature, the growth rate of labor productivity can be decomposed into contributions from capital intensity (capital per hour worked) and **total factor productivity** (TFP). Capital intensity in the model is endogenous, as investment decisions depend on available production technology and other factors affecting expected returns. The **standard TFP** measure used in this study captures the joint efficiency of both labor input (hours worked) and private capital. Theoretically, with perfect measurement of inputs and outputs and perfectly competitive markets, TFP approximates technological progress. In practice, TFP is measured as a residual that includes technological progress along with various measurement and composition effects, such as labor composition and factor utilization (see also Molnárová, 2023). Therefore, the FISK OLG model further decomposes TFP into contributions from several factors.

TFP growth in the FISK OLG model explicitly accounts for labor composition (with respect to skill level and age of the workforce) and for contribution of public infrastructure. Subtracting the contributions of these factors gives the residual that I refer to as the **unexplained part of TFP** growth, although in general other factors could be accounted for. The advantage of the two components is that they reflect long-term exogenous developments that can be projected into the future with some level of certainty. In contrast, the unexplained part of TFP includes technological progress and other factors which are highly uncertain. Long-term demographic trends imply a positive contribution of labor composition in the upcoming decades, although its contribution has been declining since the 1990s. The positive contribution of public infrastructure investments is typically concentrated around economic downturns and has only a small growth effect over longer horizons (Figure 1).

To summarize, capital intensity is an endogenous model variable, data and model projections are used to predict the development of the two contributing factors labor composition and public infrastructure, and the future development of unexplained part of TFP is treated as an assumption.

Figure 1: **Decomposition of labor productivity growth in Austria 1970 – 2050**

Contributions to growth rate in percentual points.



Source: PROD, simulations with FISK-OLG model. Note: Historical decomposition from 1970 to 2023, projections 2024 onwards.

3.1.3 Economic growth, demographic change, and productivity

This section presents the baseline scenario together with alternative scenarios with different rates of technological progress and with constant population structure, which illustrate the role of productivity growth and demographic transition in Austria's long-term economic development. Table 1 and Figure 2 show the long-run development of real GDP per capita, private consumption per capita and TFP for

these scenarios. All scenarios are calibrated to match the development of Austria up to 2023 and include the information from the mid-term economic forecasts up to 2028. Detailed simulation results, sensitivity analysis and overview of main assumptions for all scenarios are reported in the annex.

In the baseline scenario, the average per capita GDP growth between 2023 and 2030 is 0.78% (0.87% p.a. between 2030 and 2070), almost a third lower than average over the previous 30 years (1.2% between 1993 and 2023). In terms of private consumption per capita, the difference is substantial as well: 1.0% p.a. (2023-2030) and 0.67% (2030-2070) compared to 1.4% in the previous 30 years. The declining growth profile of consumption per capita in the future is a consequence of the demographic change. As the society ages, a larger portion of resources is used for providing public services and transfers, such as health care and long-term care.

Without population ageing, the economic development in the coming decades would be substantially more favorable. Figure 2 shows the hypothetical scenario in which the age structure of the Austrian population is held constant from 2024 onwards. This is implemented through adjusting the migration flows with migrant population that perfectly mirrors the corresponding Austrian cohorts. In this scenario, the amount of hours worked is about 5.5% higher by 2040 (10% higher by 2070) due to the higher share of persons in working age on total population. As a consequence, GDP per capita grows at around 1% p.a. and is about 3.6% higher by 2040 (10% higher by 2070) compared to the baseline. The difference is even more pronounced for private consumption per capita (increase of 7% by 2040 and 17% by 2070). Again, the stronger effect on private consumption is due to higher public spending in the older society.

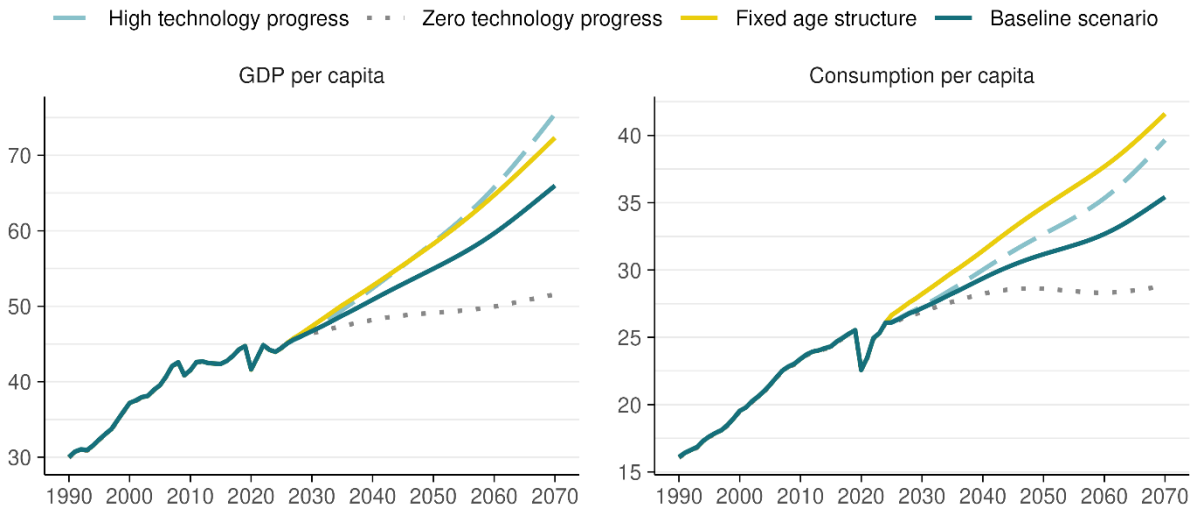
Table 1: **Baseline scenario, demographic change, and productivity growth**

	GDP per capita (real)			TFP (standard)			TFP (unexplained part)		
	1993–2023	2023–2030	2030–2070	1993–2023	2023–2030	2030–2070	1993–2023	2023–2030	2030–2070
Baseline scenario	1.20	0.78	0.87	0.74	0.51	0.61	0.49	0.31	**0.49**
High technology progress	1.20	0.83	**1.20**	0.74	0.58	0.85	0.49	0.39	0.75
Zero technology progress	1.20	0.68	0.26	0.74	0.39	0.16	0.49	0.17	**0.00**
Fixed age structure	1.20	0.98	1.06	0.74	0.52	0.62	0.49	0.31	**0.49**

Source: PROD, simulations with FISK-OLG model. Note: The highlighted value shows the underlying assumption for each scenario.

Figure 2: **Baseline scenario, demographic change, and productivity growth**

Real GDP per capita (left) and private consumption per capita (right), in 1000 Euros (2015).



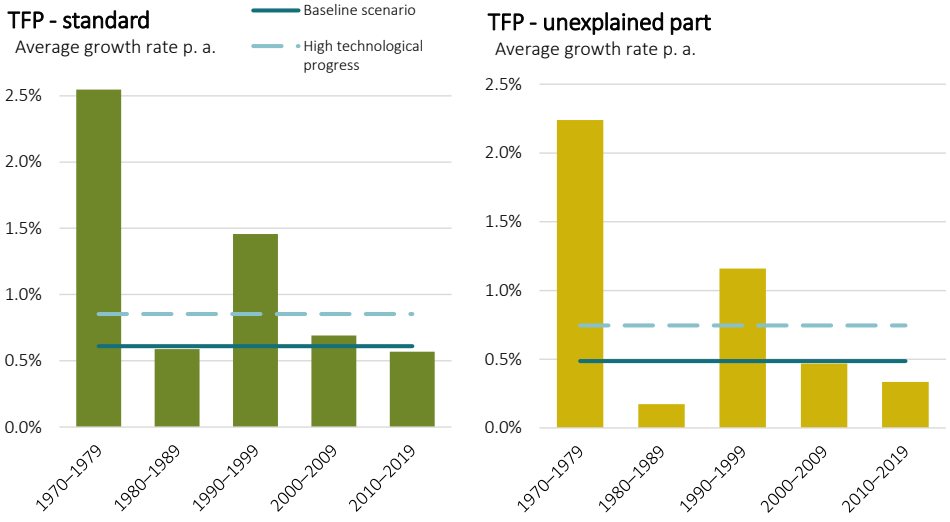
Source: PROD, simulations with FISK-OLG model.

Population ageing negatively influences economic performance through several channels included in the model: Firstly, in an ageing society, the share of active working-age population on total population shrinks. Secondly, workers individual productivity depends on their age and cohort. The increasing share of older workers reaching retirement age shifts the weights towards young inexperienced workers, with negative effect on estimated aggregate productivity growth. Thirdly, the age composition of the population affects labor productivity growth through its effects on private investment. Not included in the model are further effects of the demographic composition on technological progress through innovation, entrepreneurial activity, etc. (see Karahan et al., 2024; Liang et al., 2018).

Substantially faster technological progress could bring the economic growth to its past levels and close to the scenario with fixed population structure, but it will be difficult to achieve. To illustrate this, Figure 2 also shows the alternative scenario with a higher rate of technological progress. As in the baseline scenario, the economy follows the forecasted path until 2028. Starting from 2029, the high-growth scenario is constructed such that the growth rate of GDP per capita matches the average over the period from 1993 to 2023. This requires a substantially higher growth of the unexplained part of TFP, corresponding to a TFP growth of 0.8% p.a. and labor productivity growth of 1.2% p.a. between 2023 and 2070. Although not targeted, these values closely align with the assumptions in the 2024 Ageing Report for Austria. However, Figure 3 shows that these rates of TFP growth and its unexplained component are higher than the values experienced in the recent decades. Achieving these growth rates in the coming decades can be considered a major challenge for Austria and for many other developed countries.

Lastly, Figure 2 also shows the scenario with no technological progress after 2028 (zero growth of unexplained part of TFP). Even in this scenario, GDP per capita continues to grow due to other long-term developments. The most important contributors are improvements of human capital and higher capital intensity, driven by the increase in relative price of labor compared to capital. Overall, GDP per capita in this scenario grows at around 0.3% p.a. over the period of 2023-2070.

Figure 3: **Total factor productivity growth – historical development and model assumptions**



Source: PROD, simulations with FISK-OLG model. Note: Horizontal lines depict average growth rates 2030–2070 for alternative scenarios.

Table 2: **GDP per capita effects in alternative scenarios**

	2030	2040	2070
	Difference to baseline (in %)		
Alternative assumptions: technology, demography			
High technology progress	0.34	2.99	14.43
Zero technology progress	-0.59	-5.27	-21.86
Fixed age structure	1.39	3.64	9.63
Reforms based on EU benchmarks			
Education EU median	-0.14	-0.67	2.49
Education EU TOP 3	-0.29	-1.01	4.66
Women EU median	1.64	2.27	3.17
Women EU TOP 3	3.13	4.20	5.53
Older workers EU median	0.47	0.30	0.23
Older workers EU TOP 3	1.11	0.99	1.03
Combination education, women, older: EU median	2.28	2.30	7.34
Combination education, women, older: EU TOP 3	4.68	5.15	13.96
Reforms without EU benchmarks			
High migration	-0.16	-0.21	0.94
Education: fixed low-skill share	0.01	-0.09	-1.20
Older workers: reduced pension insurance contr.	0.03	0.03	0.04
Older workers: higher retirement age	-0.02	0.45	2.72

Source: PROD, simulations with FISK-OLG model.

3.2 Educational attainment

Higher qualifications influence labor market opportunities and expected lifetime earnings of individuals, but also contribute to overall productivity and economic development. Empirical research consistently shows that individuals with higher levels of educational attainment experience higher employment chances, higher wages and lower unemployment rates than those with lower levels of educational attainment (OECD, 2022). This is attributed to the advanced skills and specialized knowledge acquired through higher education, which increase employability and job market competitiveness (Oreopoulos and Petronijevic, 2013; Autor et al., 2020). Moreover, higher education has important signaling value and facilitates access to professional networks and career services, enhancing job placement prospects (Spence, 2002; Tholen et al., 2013).

Beyond immediate labor market advantages, higher education significantly contributes to long-term career growth, is positively correlated with access to employer-sponsored benefits, and more opportunities for professional development and career (OECD, 2022). The evolving nature of the labor market, particularly with the growing emphasis on technology and specialized skills, underscores the importance of higher education in fostering adaptability and continuous learning, crucial for sustaining productivity growth (Goldin and Katz, 2008; Autor, 2022).

This section analyzes the potential benefits of increasing the average educational attainment of the Austrian population, with a focus on younger cohorts. The simulations are based on the assumption that additional education enhances the productivity of individuals, which subsequently improves their labor market outcomes. Although the scenarios are constructed based on formal educational attainment, any productivity-increasing reforms, such as informal qualifications, certificates, quality improvements in education system, etc. would yield comparable effects, provided they have equivalent impact on productivity, labor market outcomes, and associated costs.

3.2.1 Country comparison and scenario construction

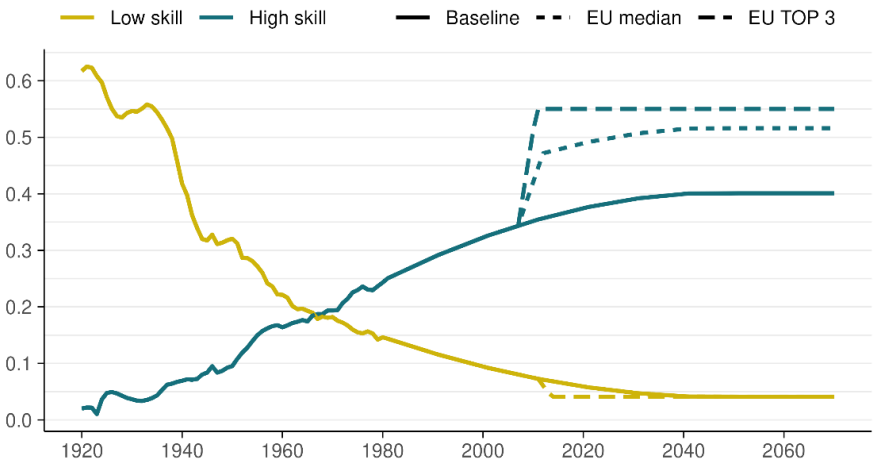
The average educational attainment in EU countries has been steadily increasing over time. According to the Labor Force Survey (Eurostat, 2024), the share of individuals aged 25 to 34 with at most lower secondary education (ISCED level 0-2) has decreased in both Austria and the EU since 2006, although Austria experienced a slight rebound in 2016 and 2017. In 2023, Austria was close to the EU median at 10%, which is below the EU average of 14.5% but above the average of the top three performing countries, which stood at 4.6%. Simultaneously, the share of individuals aged 25 to 34 with a bachelor's degree or higher (ISCED level 6-8) has increased in both Austria and the EU. Due to changes in classification, comparable data series are only available from 2014 onwards. Despite growing from 21% in 2014 to 28% in 2023, Austria still lags behind the EU, where the median was 39.6% and the mean is 38.5% in 2023. For the three countries with the highest share of individuals with at least bachelor's degree in this age group—Lithuania, the Netherlands, and Ireland—the average share in 2023 was 55.0%.

The FISK-OLG model integrates more detailed Austrian data and projects an increase in average educational attainment even in the baseline scenario. In the model, individuals are assigned to one of three skill groups at birth: low (ISCED 0–2), medium (ISCED 3–5), or high (ISCED 6–8). The average educational attainment increases with each successive birth cohort (see Figure 4). Various model parameters are calibrated to match demographic and labor-market characteristics for each cohort and skill group, including skill-dependent mortality rates, labor market participation, unemployment, and wages. The share of the population in each skill group is exogenously given for each cohort. Alternative scenarios are modelled as exogenous shocks to the shares.

In the two alternative scenarios, the educational attainment of young cohorts is adjusted upwards to catch up with the EU median, resp. TOP 3 countries according to the LFS (Figure 4). In the median scenario, the share of low-educated individuals stays the same as in the baseline, converging to about 5%. The share of individuals with high education is assumed to increase by additional 12 percentage points compared to the baseline trajectory, with a gradual increase in number of additional students between 2025 and 2029. In the TOP 3 scenario, the share of individuals with low education is assumed to converge to the same level as in the baseline, but at a faster pace, closing the gap between Austria and TOP 3 by 2029. The share of individuals with high education is assumed to reach the TOP 3 level of 55% (value in 2023), with a gradual increase in number of new students between 2025 and 2029 and staying constant afterwards. Finally, the additional education take-up starting from year 2025 is translated to corresponding birth cohorts (2007 for high skill and 2011 for low-skill group).

Figure 4: **Education composition by year of birth: baseline and alternative scenarios**

Share of population with high education (ISCED 6-8) and low education (ISCED 0-2) according to birth cohort.



Source: PROD, simulations with FISK-OLG model.

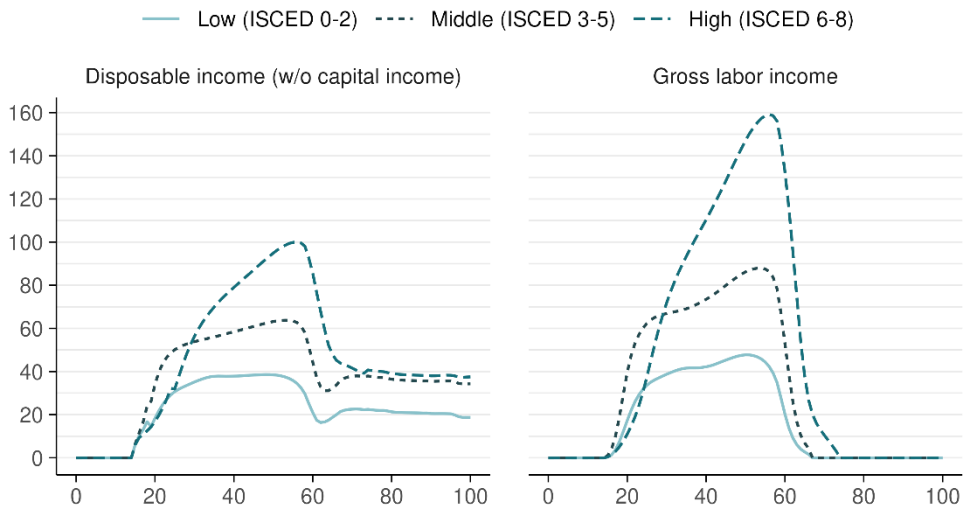
3.2.2 Individual effects

Higher educational attainment in the model influences labor market opportunities and expected life-time earnings of individuals. Figure 5 shows the model results for expected lifetime earnings of persons with low, middle and high education attainment for the cohort born in 2010. The combination of higher participation rates in both prime age and older age, lower unemployment risk and higher wages leads to large differences in gross labor earnings between the groups, which grow with age (right panel). Although these differences are somehow muted by the progressive system of taxes and transfers, the disposable income of persons with high educational attainment is on average about twice as high as the disposable income of persons with low education attainment (left panel).

In the baseline calibration, the elasticity of substitution between labor inputs of different skill groups is set very high. Therefore, increasing the supply of high-skilled workers does not affect the skill premium or relative labor productivity. Sensitivity analysis shows that reducing the elasticity of substitution within reasonable limits reduces the long-run impact of educational reforms, but the impact is moderate (see Annex 6.2).

Figure 5: **Expected life-time earnings by educational attainment and age**

Birth cohort 2010. Relative to maximum disposable income of persons with high education.



Source: PROD, simulations with FISK-OLG model. Note: Baseline scenario. Normalized such that maximum disposable income of persons with high education equals 100.

3.2.3 Macroeconomic effects

Improving the average educational attainment of young cohorts brings positive macroeconomic effects, but with a significant time lag (Figure 6). In terms of GDP per capita, the EU median scenario is 0.67% below the baseline in 2040 (1.0% in the TOP 3 scenario) and 2.5% above the baseline in 2070 (4.7% in the TOP 3 scenario). On the other hand, the reform improves the labor market outcomes of those actively participating in the labor market. In the EU median scenario, the unemployment rate is 0.06 p.p. lower in 2040 (0.16 p.p. in the TOP 3 scenario) and 0.13 p.p. lower in 2070 (0.23 p.p. in the TOP 3 scenario).

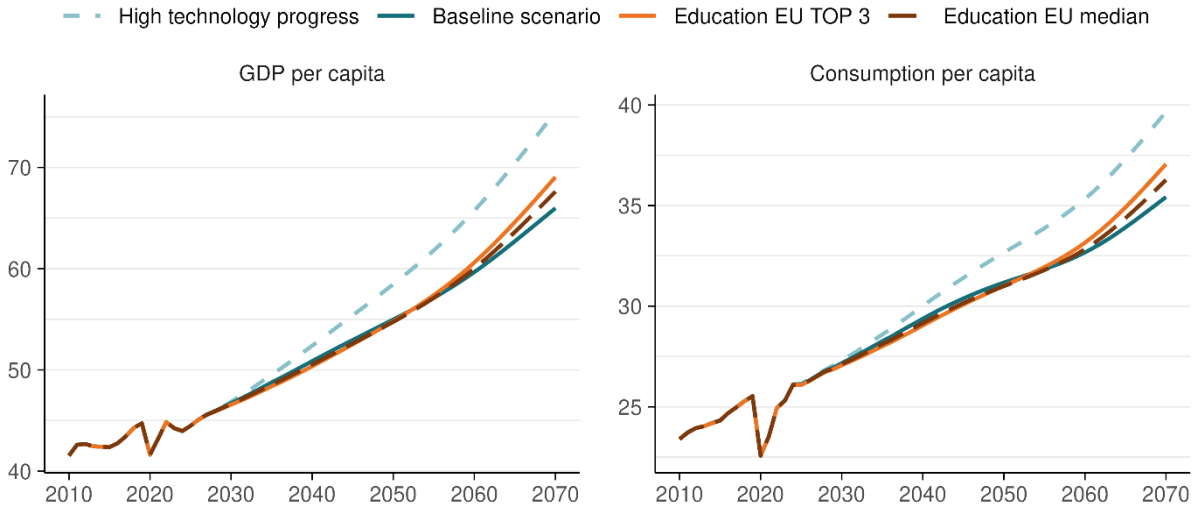
In the initial years of the reform, economic output per capita is lower in the two scenarios with higher average educational attainment than in the baseline, as the additional years of education reduce the available labor supply (Figure 7, left panel). The initial increase in labor productivity growth (Figure 7, right panel) is also a mere artefact of the lower labor supply, as the supply of low- and medium-skilled workers in the young cohorts declines. However, as the first cohorts of high school and upper secondary school graduates enter the labor market and gain experience, they start to contribute to labor

productivity growth. From around 2040 onwards, labor productivity growth starts to rise above the baseline. As a consequence of the higher labor productivity growth, output per capita growth also increases. Eventually, but only after 2050, the level of GDP per capita catches up with the baseline scenario and continues to grow at a faster pace (Figure 6).

Due to their delayed effects, reforms aimed at increasing of the qualification levels of young cohorts have very different effects across generations (Figure 8). For individuals directly influenced by the reform, the improved labor market outcomes significantly boost their lifetime disposable income. However, an average person experiences the reform's effects only indirectly through changes in labor market, earnings, and public finances. Changes in education structure of the population impact public finances in several ways: they influence education expenditure, transfers and demand for public services, and tax revenues. Without debt financing, changes in public expenditures and revenues in the model directly lead to adjustments in (lump sum) taxes.

Figure 6: **Education: output and consumption in alternative scenarios**

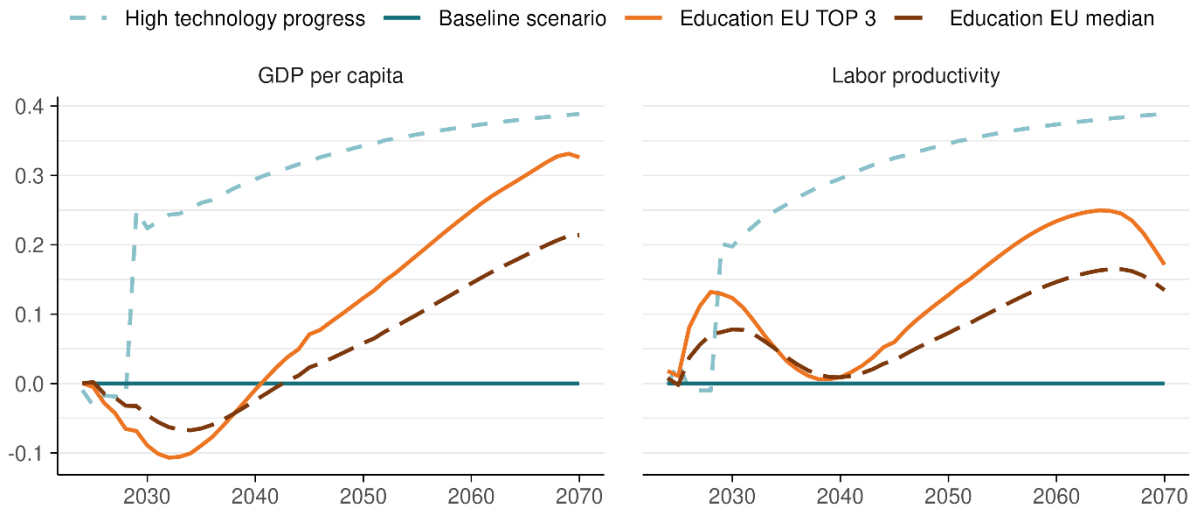
Real GDP per capita (left) and private consumption per capita (right), in 1000 Euros (2015).



Source: PROD, simulations with FISK-OLG model.

Figure 7: **Education: growth rate differentials of output and productivity in alternative scenarios**

Growth rates of real GDP per capita (left) and labor productivity (right), difference to baseline scenario in percentage points.



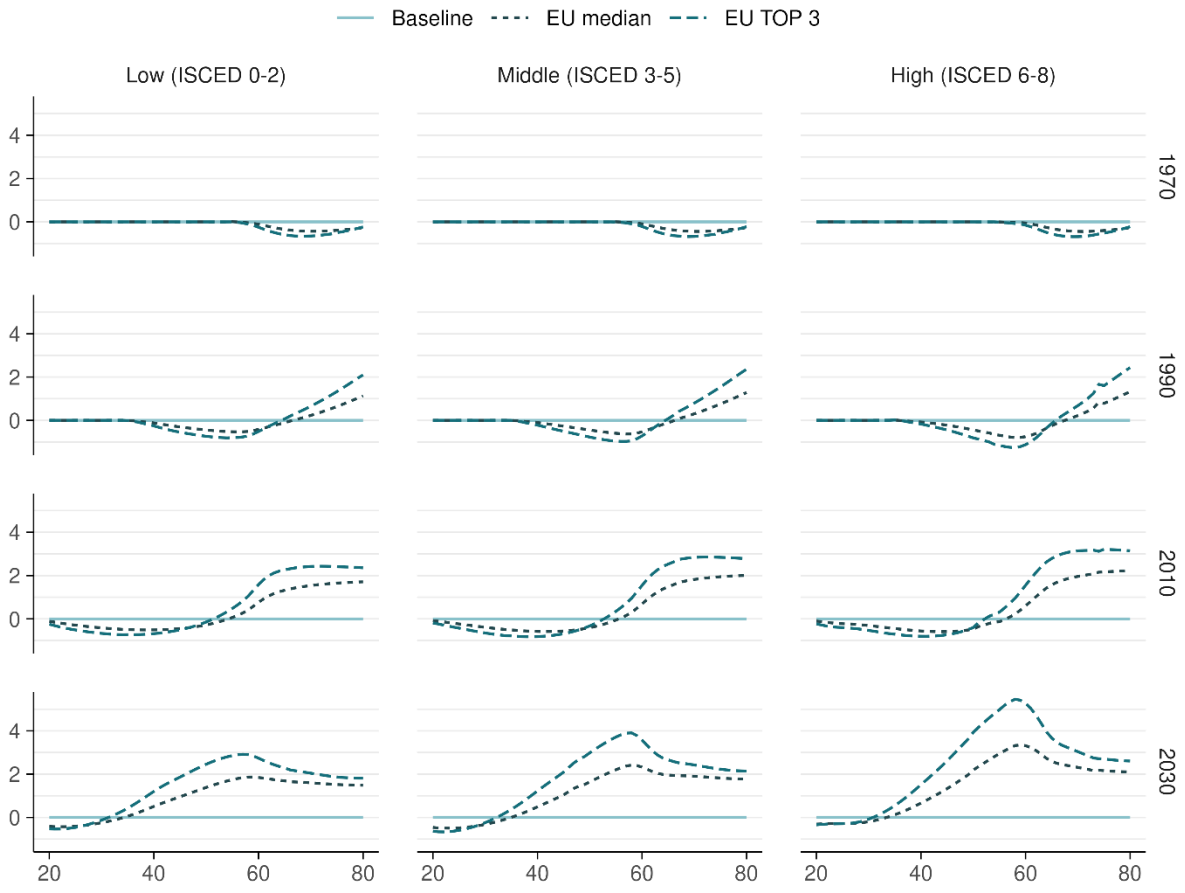
Source: PROD, simulations with FISK-OLG model.

For the cohort born in 1970, the overall effect of the reform on disposable income is negative. In comparison, the cohort born in 1990 lives long enough to benefit from the positive effects, but primarily during retirement, and thus mainly through transfers and the tax channel. In contrast, the generation born in 2030 benefits from the reform throughout most of their adult life via both the tax and earnings channels.

Lastly, notice that the baseline scenario assumes that the average educational attainment of the Austrian population will continue to rise, with an increase in the share of highly skilled individuals and a decrease in the share of low-skilled ones. However, achieving these improvements is also challenging. Notably, Austria experienced a slight rebound in the share of low-skilled individuals in 2016 and 2017. By 2023, this share has returned to its 2015 level, but future development is uncertain. To highlight the importance of further improvements, I compute an additional scenario in which the share of low-skilled population remains constant from 2023 onwards. In the long run, such scenario leads to significant macroeconomic losses compared to the baseline, both at individual and macroeconomic level. GDP per capita is about 0.1% lower in 2040 and 1.2% lower in 2070.

Figure 8: **Effects of education reform on disposable income by education attainment and cohort**

In percentage points of maximum disposable income of persons with high education.



Source: PROD, simulations with FISK-OLG model.

3.2.4 Discussion

Reducing the number of people without upper secondary education and lowering early school dropout rates in Austria requires comprehensive strategies addressing both educational and socio-economic factors. Austria has low intergenerational educational mobility compared to other EU countries, with school choice and access to higher education heavily influenced by family background. Adults from

households where parents only completed compulsory schooling or less have a 31% chance of not finishing upper secondary education, compared to just 2% for those whose parents have tertiary education. PISA results also reflect a strong relationship to parental education (Förstner and Königs, 2020).

Three major risk factors for children's school performance at the primary level are low parental education, low parental occupational status, and mother tongue other than German. The percentage of students in at least one of these risk categories rose from 23% in 2013 to 28% in 2018 (BMBWF, 2021). With a higher incidence of these risk factors among people with a migration background, Austria's education system faces an increasing challenge. Early intervention programs, such as high quality early childhood education and care, are vital for reducing future dropout risks (Melhuish et al., 2015). Enhancing primary and secondary education quality through improved teacher training, curriculum development, and strengthening support for at-risk students can maintain engagement and improve performance (European Commission, 2022; Schleicher, 2018). Further socio-economic measures such as income supplements and accessible childcare can alleviate external pressures and support higher secondary education completion rates (OECD, 2019).

Significantly increasing the tertiary-education attainment in Austria requires comprehensive strategies to improve access. Ensuring smooth transition paths from various types of secondary education, supplemented by support measures, is essential. Reducing financial barriers is also important to enhance inclusivity and ensure affordability for students from all socio-economic backgrounds (OECD, 2022). This can be achieved through enhanced student financial aid programs, such as grants and income-contingent loan schemes. Successful models for the latter exist for example in the UK, the Netherlands and the Nordic countries and can be justified by the positive effect of higher education on lifetime earnings. Additionally, targeted outreach and support services for underrepresented groups, such as students from lower socio-economic backgrounds and first-generation migrants, can help diversify the university population and increase overall enrollment (European Commission, 2022). Importantly, the capacity of tertiary education institutions should be adjusted to accommodate the increasing number of students without a negative effect on quality. The additional resources should be viewed in the context long-run macroeconomic benefits of higher educational attainment. Furthermore, the OECD emphasizes the importance of diversifying tertiary education institutions and programs. Besides promoting short-cycle tertiary programs this includes increasing the availability of part-time and online learning options to accommodate non-traditional students, such as working adults and those with family responsibilities (OECD, 2023).

3.3 Labor force potential of women

The labor input of Austrian women in prime age (between 25 and 54 years) is relatively low compared to most EU countries, and the gender gap in labor supply is substantial, indicating potential for increasing labor supply. Particularly, economically active Austrian women often work fewer hours, with a high part-time employment rate especially among women with children. This section analyzes the potential gains from increasing female labor input in Austria. The model analysis is supplemented by a discussion on the determinants of the gender gap in labor supply and outlines relevant policy approaches.

3.3.1 Country comparison and scenario construction

Labor market participation and employment rates of prime-age Austrian women are close to the EU median, but employed women in Austria tend to work fewer hours. This is reflected in the indicator *employment rate in full-time equivalents (FTE)*, which accounts for both the extensive margin (employment) and the intensive margin (hours per worker) of labor supply. According to the Labor Force Survey (Eurostat 2024), female labor input measured as employment rate in FTE is in the lowest quartile amongst the EU countries in each age group (Figure 9, left panel). The overall employment rate in FTE in 2023 was 66% for prime age women in Austria and 77% in median EU country. On the other hand, employment rate in FTE of prime-age men in Austria (84%) is close to the EU median of 86% (Figure 9,

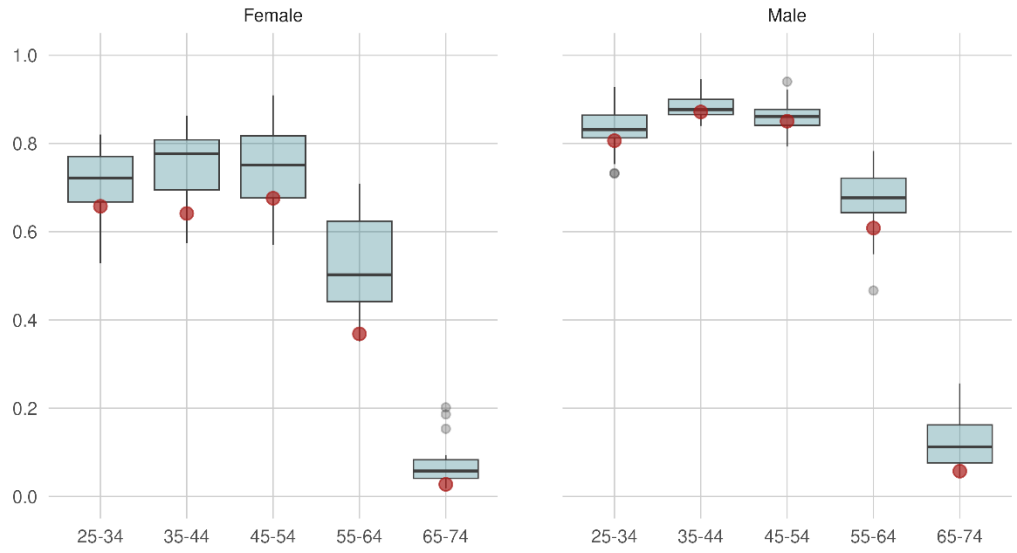
right panel). This significant gender gap is largely attributable to the high share of part-time work among Austrian women, with 51% of employed women aged 25 to 54 years working part-time.

There are several empirical observations worth noticing in this context. First, the low relative labor input of women in Austria persists across age groups and is not confined to the period when women typically have young children. Second, the gap in employment measured in full-time equivalents (FTE) compared to other EU countries is most pronounced among women with university degrees, while Austria performs somewhat above the median for low-skilled women (conditional on age group, see Figure 18 in the annex). In most EU countries, the average gender gap in labor supply decreases with education level. In Austria, this pattern is evident in the 25-34 age group but disappears for women over 35, suggesting a link with motherhood. Lastly, while there are differences in female labor supply participation based on migration background, these differences do not explain the low female labor supply in Austria. Specifically, labor input of non-EU born women in prime age is on average lower than of general population, even when conditioning on education and age group. However, the data does not allow to control for number of kids or other factors. Restricting the comparison to the group of native-born Austrian women without migration background leads to labor input gaps of the same magnitude, with below median performance for all age groups.

The FISK-OLG model incorporates more granular Austrian data and features slightly increasing average labor input per worker due to the cohort and wage effects already in the baseline scenario. In the two alternative scenarios, the labor supply in each skill group and each 10-year age group is adjusted upwards to offset the difference in female labor input to EU median, resp. TOP 3 countries. The increase in labor input is modelled as exogenously given increase in average hours per employed person. No direct costs of the reform are considered. The shock phases in gradually between 2025 and 2029 and stay constant afterwards.

Figure 9: **Employment rates in full time equivalents by gender and age group, 2023**

Distribution across EU member states (boxplot) and Austria (red dot)



Source: Labor Force Survey, Eurostat (2024), PROD calculations and figure. Interpretation: employment rate in full-time equivalents is defined as employment rate weighted by work intensity of employed persons. For example, an employed person working 40% of usual full-time hours is counted as 0.4 employed persons. A rate of 0.6 means the same labor quantity as 60% of persons in a given demographic group working full-time.

3.3.2 Macroeconomic effects

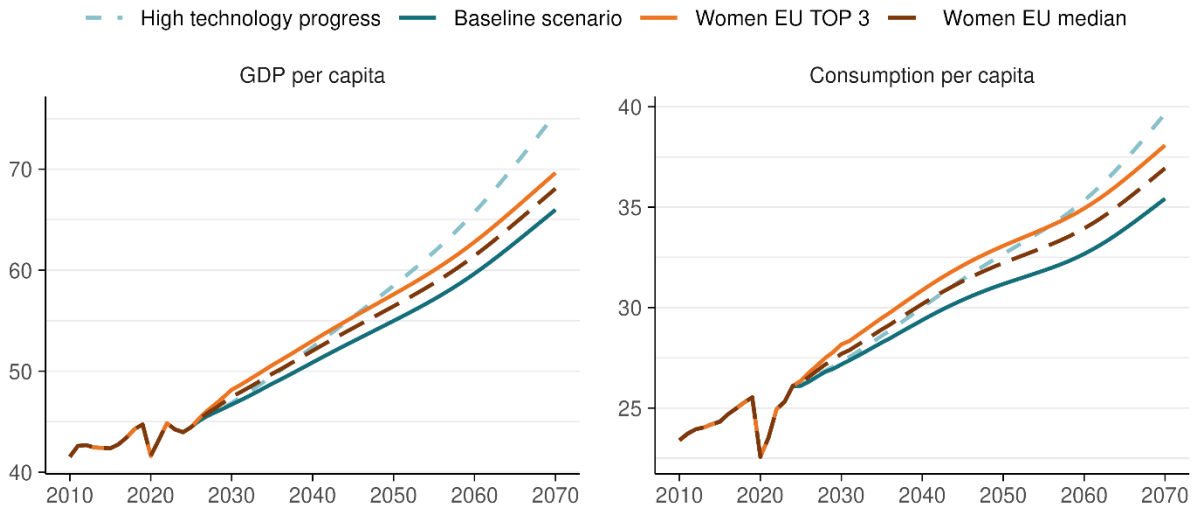
Increasing female labor input could bring large economic effects in the coming decades. While the potential for labor supply growth is limited and the growth effect diminishes after the initial period, the overall level effects remain substantial in the long run. In terms of GDP per capita, the EU median scenario projects a 2.3% increase above the baseline by 2040 (4.2% for the TOP 3 scenario) and a 3.2% increase by 2070 (5.5% for the TOP 3 scenario), see Figure 10. Since the labor input gap of Austrian women increases with education, catching up to EU median and TOP 3 means that also measured aggregate TFP increases. In the medium to long run, aggregate labor productivity increases as well and significantly contributes to output growth. Change in output thus surpasses the change in worked hours, which is 2.4% in EU median scenario and 4.5% in TOP 3 scenario by 2070.

In the medium run, alternative scenarios for female labor input can to a large extent offset the effects of population aging discussed in section 3.1.3. In terms of output per capita, the EU median scenario offsets nearly two-thirds of the impact of population aging by 2040, leaving a remaining gap of 1.4 percentage points compared to the scenario with fixed age structure. In the TOP 3 scenario, the effects of population aging are more than fully offset, with GDP per capita in 2040 projected to be 0.6 percentage points higher than in the fixed age structure scenario.

Examining the effects of the reform across demographic groups reveals that for all affected groups the benefits are distributed throughout the entire prime age period, with their magnitude increasing with age (Figure 11). Since the alternative scenarios assume no direct costs associated with the reform, the effects are positive for all groups. However, the direct labor income effects dominate the various indirect effects. The direct effects are most pronounced in the high education group, where the increase in labor input is also the greatest. The distribution of effects over lifetime underscores the importance of focusing on entire career paths rather than limiting the discussion to interventions with limited time span, such as childcare for very young children.

Figure 10: **Labor input of women: output and consumption in alternative scenarios**

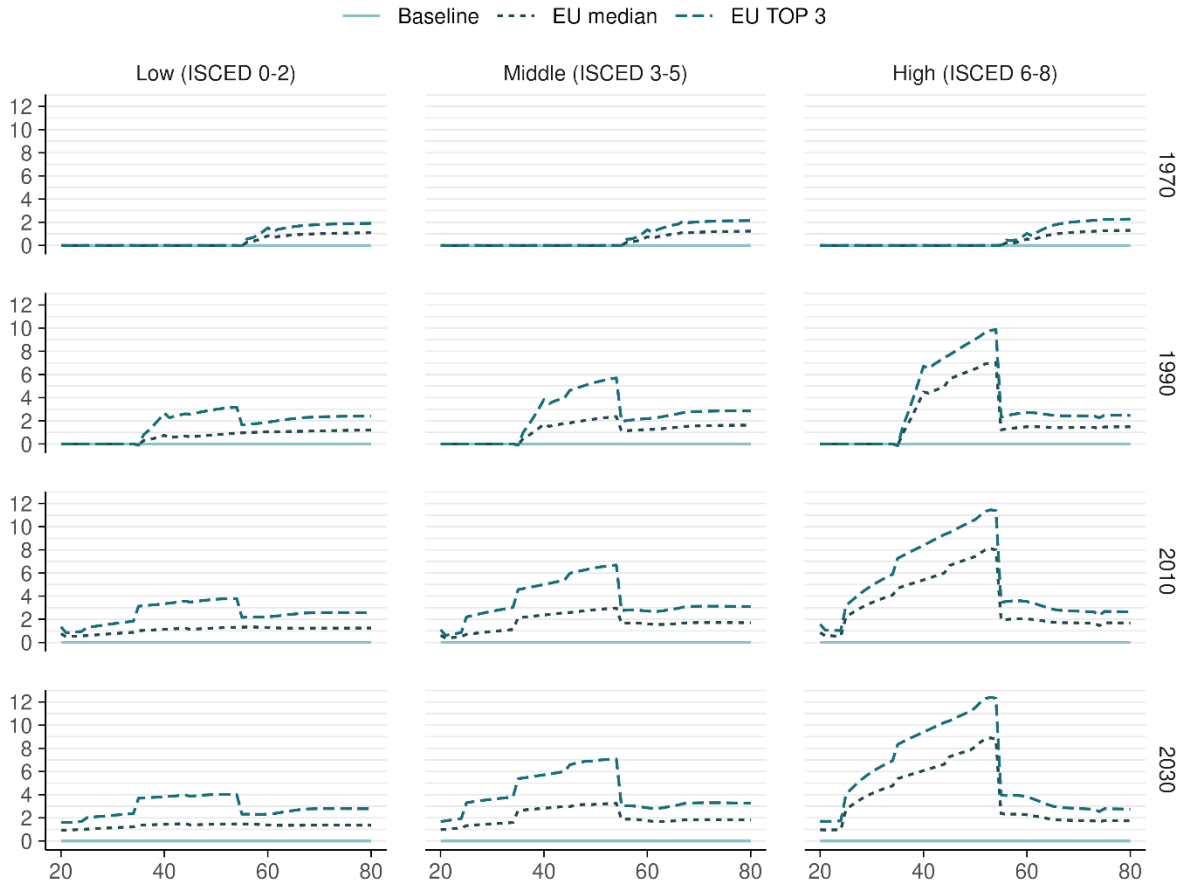
Real GDP per capita (left) and private consumption per capita (right), in 1000 Euros (2015)



Source: PROD, simulations with FISK-OLG model.

Figure 11: **Effects of higher labor input of women on disposable income by education attainment and cohort**

In percentage points of maximum disposable income of persons with high education



Source: PROD, simulations with FISK-OLG model.

3.3.3 Discussion: gender gap in labor input and child penalty

Parenthood affects men and women differently, with a significant disparity in labor market outcomes. A useful concept for measuring the effects of parenthood is *child penalty*. Child penalty quantifies the impact of parenthood as difference between average labor market outcomes such as employment or labor income of individuals after the birth of the first child to those of comparable individuals who remains childless. In terms of labor income, child penalty[1] is very high for Austrian women with labor income dropping by 90% in the first year, 60% by the fifth year, and 50% even ten years after the birth of the first child (Kleven et al., 2019). In contrast, men in Austria, as in most countries, generally experience no child penalty. A major portion of the gender gap in labor market outcomes in Austria can be attributed to the child penalty experienced by women. According to Kleven et al. (2022), around 80% of the gender income gap in 2017 was due to the child penalty for mothers, accounting for 33 percentage points out of a 42% income gap. Furthermore, the effect of the child penalty has remained largely unchanged since the 1950s, unlike the residual gender gap which has decreased over time. In terms of employment, the child penalty for Austrian women also accounts for virtually the entire gender gap (Child Penalty Atlas, Kleven et al., 2023).

[1] The labor income-based child penalty includes the effects of parenthood on quantity of labor input (employment and hours per employed person) and effects on hourly wage.

The relatively low labor input of women in Austria can, in addition to the effects of motherhood, also be attributed to the higher share of part-time work among women without children. In 2023, 69% of employed prime-age women with children in Austria worked part-time, compared to the EU average of 32% (LFS, Eurostat, 2024). For Austrian women without children, the part-time rate was much lower at 35%, but still higher than the EU average of 20%. For men without children, the part-time rate was 12% (EU 7.3%). For both men and women, part-time work can be a result of various factors other than childcare, for example care responsibilities for other family members and housework, health reasons, inability to find a full-time job, or preference to work part-time. Overall, the contribution of part-time work of women without children to the female labor input gap between Austria and the EU is smaller than the effect of the child penalty.

The country-level estimates of gender gap and child penalty do not control for number of children, which is a natural factor to be considered in this context. Despite its intuitive role, the relationship between fertility rate and female labor supply at country level is not straightforward. Cross-sectional studies for developed countries have found that the correlation used to be negative until the 1980s and then weakened or even turned positive ever since (Ahn and Mira, 2002; Rindfuss et al., 2003; Matysiak and Vignoli, 2006). This positive correlation cannot be interpreted as causal and is likely driven by other explaining factors such as social norms and institutional background (Kögel, 2004; Engelhardt and Prskawetz, 2004). Even though the academic discussion is not conclusive, it is unlikely that number of children per woman is explaining the differences in female labor input between the EU countries. Several European countries with the lowest female effective employment rate also have some of the lowest fertility rates over the last 10 years, notably Spain, Italy, and Greece. For Austria, total fertility rate of 1.47 children per woman is below EU27 average of 1.53 per woman (10-year averages from 2013 to 2022, Eurostat definition).

Discussions about public policies affecting female labor participation often focus on the accessible and affordable childcare, especially for children in pre-school age. In 2023, 90.4% of Austrian children above 3 years participated in formal childcare, higher than EU average of 89% (EU-SILC data). In the group of children below 3 years, it was 24.1%, below the EU average of 37.5% and below the Barcelona-goal of 33%. Moreover, there are substantial regional differences in the share of kids under 3 years attending childcare. In 2023/2024 it was only 20.8% in Styria and Upper Austria while in Vienna it was 46.2% (Statistics Austria, 2024a). In the context of prevalent part-time work, an important factor is the opening hours of early-childhood education and primary education facilities, which are often insufficient to be consistent with the full time employment of parents. Around 23% of all early-childhood education and care facilities have opening hours of less than 8 hours per day, 13.6% of the facilities are open 46 weeks per year or less. Moreover, school hours in primary schools are very short on average with insufficient care facilities after school. Around 51% of school children until age of 12 participate in education or formal childcare for more than 30 hours a week (EU-SILC data, 2024).

Women in Austria often mention childcare responsibilities as main reason why they do not work longer hours: 52% of women working less than 30 hours per week answered “housework, looking after children or other persons” as the main reason for working part-time, while only 6% of men chose the answer according to the 2019 EU-SILC survey. Among women with children under the age of 15, 84 percent report caring responsibilities as a reason for working part-time (Statistics Austria, 2023b). Among those with caring responsibilities, 73 percent do not seek (additional) care because they want to provide care themselves. However, 12 percent stated that the costs of care were too high, and a further 12 percent stated that they did not have access to suitable care services, amounting to almost 90,000 women with insufficient access to care. According to AMS survey, approximately 65,000 women in Austria would increase their working hours if they had more opportunities to look after children, suggesting better childcare availability should contribute to higher labor input.

The empirical evidence on the causal effect of improving access to childcare on female employment is mixed. The results from international studies are not easily transferable on Austria, as the effects

depend on social norms and other country-specific factors. Several studies have reported positive effects of improvements in childcare for Germany: a 10 percentage point increase in public childcare attendance of three to four year olds increased the probability of employment of affected mothers by 3.7 p.p. (Bauernschuster and Schlotter, 2015) and introduction of a legal childcare claim for children from 1 year old increased weekly working hours by 3% (Boll and Lagemann, 2019). Expanding the coverage rate of subsidized childcare for children up to three years by 1 percentage point increased the employment rate of mothers by roughly 0.2 percentage points (Müller and Wrohlich, 2020). For socio-economically disadvantaged mothers in Germany, support in accessing childcare services increases their employment (Hermes et al., 2023). This shows that these women, who often face a particularly high child penalty, do not necessarily have lower labor market participation due to norms or values, but that obstacles in the complex process of applying for childcare and a lack of information place a higher burden on them.

On the other hand, recent empirical study for Austria (Kleven et al., 2022) finds no impact of increasing formal childcare supply on income child penalty, suggesting that the low participation rate could be a consequence of norms and preferences and stressing the role of informal childcare as well. However, even if in the short run the improvement in access to childcare predominantly leads to substitution from informal to formal childcare, the long term labor supply effects might still occur, including the labor market input of grandparents. Frimmel et al. (2022) show that a first grandchild increases the probability of grandmother to leave the labor market by 9 percent. This effect is stronger when informal childcare is more valuable and when grandmothers live close to the grandchild.

While access to childcare might help explaining the lower labor market participation of parents, gender differences in child penalty can only be explained in combination with social norms. For example, studies typically find high correlations between various measures of approval rates and labor supply of women with kids at country level. In Austria, high share of mothers declare that they do not work or do not increase their working hours because they prefer to care for their children themselves. Halla et al. (2020) argue that conservative gender norms in Austria strongly affect the labor market participation decisions of women.

A major factor affecting the labor supply decisions are financial incentives. Two structural aspects affecting specifically female labor supply are gender wage gap and tax system. Austria's tax and social security contribution system favors part-time work: in a family earning an average wage, increasing hours from 50% to 100% of full-time employment for the second earner leads to almost 40% of additional earnings lost to either higher taxes or lower benefits. Effective participation tax rates are also relatively high, about 80% of earnings are lost to higher taxes, lower benefits and net childcare costs when a parent with young children takes up full-time employment and uses full-time institutional childcare, the third highest proportion in the OECD (OECD, 2024). Consequently, relatively more persons in Austria may decide to decrease their hours voluntarily, even without differences in preferences or social norms across countries. Moreover, gender wage gap combined with conservative social norms contributes to asymmetric split of the part-time work between couples. As an outcome, women are more likely than men to work part time, accepting lower income both in the short and long-run.

Child penalty of women in Austria is both larger and more persistent than in comparable countries, which is also reflected in the low labor market intensity of women over lifetime. Many women continue working part time long-term after their children grew up. For women with youngest child 12 years or older the part-time rate is 59% in Austria (28% EU average). Quantitatively, the direct effect of long time that women spend in part time is more important than short spans of maternity leave. Back of the

envelope calculation shows that if all women working part time increased their labor supply by approximately 3 hours, this would offset the effect of one additional year of maternity leave per child.[2]

However, the short-term child penalty and its persistence are likely to be linked. The negative labor supply shock after childbirth for women might lead to detachment from work and human capital depreciation, especially with longer leave durations (Kunze, 2016). Even if the human capital stays unaffected, employers might (mis-)perceive it as such. In both cases, this leads to further worsening of labor market outcomes of mothers, disincentivizing women from increasing their labor input or to spread paid and unpaid work more equally within family. In this context, improving of the uptake of early childcare may help to decrease the persistence of child penalty.

3.4 Labor force potential of persons over 55 years

The labor input of individuals aged 55 and above is relatively low in Austria compared to most EU countries, indicating potential for increasing labor supply. Beginning in 2024, the statutory retirement age for women started to gradually increase from 60 to 65 years, which is expected to boost the labor input of women within and close to this age group over the coming decade and reduce the average labor input gap of older workers to many EU countries. This section analyzes the potential gains from further increasing the labor input of older workers in Austria. The analysis is supplemented by a discussion on the selected policy approaches that influence the labor market participation among older people.

3.4.1 Country comparison and scenario construction

Labor market participation and employment rates for individuals aged 55 and above in Austria are relatively low compared to the EU median. Additionally, older workers in Austria tend to on average work fewer hours than their peers in other EU countries, resulting in a gap in effective labor supply. According to the Labor Force Survey (Eurostat 2024), the employment rate in FTE for both older men and women in Austria was low compared to most of the EU countries in 2023 (Figure 9). This gap is primarily attributable to lower participation and employment rates (extensive margin) and to a lesser extent to fewer hours worked per employed person (intensive margin).

The FISK-OLG model integrates ongoing trends and reforms in Austria's pension system, particularly the gradual increase in the statutory retirement age for women, into the baseline scenario. In two alternative scenarios, labor market participation rates for each skill group and each 10-year age cohort are adjusted upwards to align with the 2023 levels of employment rates (FTE) of the EU median and TOP 3 countries. However, to avoid unrealistically high participation rates for some cohorts and skill groups, these increases are capped at empirically plausible levels. Additionally, for certain cohorts and skill groups where the baseline scenario projects participation rates (eventually) above those of the EU median and TOP 3, the baseline projections are used. The increase in labor market participation rates is exogenously given and phases in gradually between 2025 and 2029. No direct costs of the reform are considered. The results for the median and TOP 3 scenarios are presented in section 3.4.2.

An obvious shortcoming of adjusting the labor input of older workers to align with the 2023 levels of the EU median and TOP 3 countries is that most other European countries are also undergoing reforms that will further increase the labor market participation of older people in the future. This is either due to planned discretionary increases in the coming years, or automatic increases based on linking the statutory retirement ages to increases in life expectancy (European Commission, 2024). However, constructing benchmarks that account for developments in all 27 EU member states is beyond the scope of this study. Therefore, the alternative scenarios presented in this section abstract from these developments and should be viewed as conservative estimates.

[2] This back-of-the-envelope estimate is based on a fertility rate of 1.47 children per woman, an average working week of 32 hours and a 51% share of women working part-time (of all employed women in age group 25-54 years).

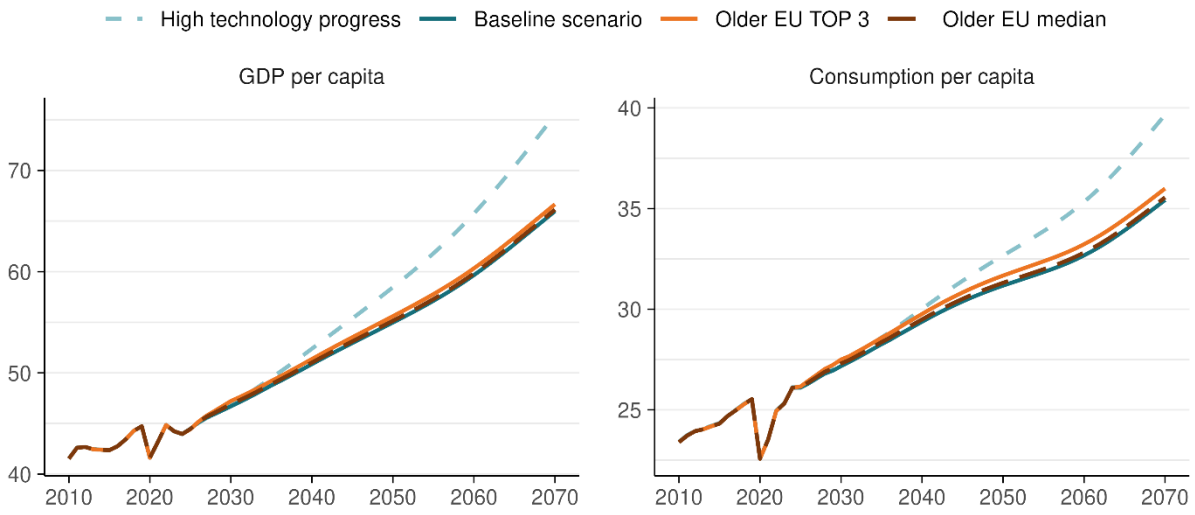
The analysis of the labor market potential of older persons is complemented with two additional scenarios. The scenarios reflect reform suggestions that have been actively discussed in policy debates in the recent years. The first scenario examines the impact of improving tax incentives for continued employment at older ages by reducing social security contributions for workers who have reached the statutory pension age. The second scenario considers the effects of linking the statutory retirement age to life expectancy. The results for the additional scenarios are presented in section 3.4.3.

3.4.2 Macroeconomic effects

Increasing labor supply participation of older workers to the level of EU median (or TOP 3 countries) could bring significant economic effects in the upcoming decades. However, since the gradual increase in labor marked participation is already projected in the baseline scenario, the effects are moderate and decrease over time. In terms of GDP per capita, the EU median scenario in 2040 is 0.30% above the baseline scenario (1.0% for TOP 3 scenario) and by 2070 it is 0.23% above the baseline scenario (1.0% for TOP 3 scenario), see left panel of Figure 12. These numbers roughly correspond with the change in hours worked. In the long run, consumption per capita increases slightly more strongly (Figure 12, right panel), while aggregate investment increases slightly less strongly than GDP.

Figure 12: **Labor input of persons over 55 years: output and consumption in alternative scenarios**

Real GDP per capita (left) and private consumption per capita (right), in 1000 Euros (2015).



Source: PROD, simulations with FISK-OLG model.

3.4.3 Model simulations for selected reforms affecting the labor supply of older persons

A further scenario examines the potential impact of improving tax incentives to encourage continued employment among older workers by **reducing social security contributions** for those who have reached the statutory pension age. Recent policy discussions have considered a proposal to eliminate the employee part of pension insurance contributions for individuals who have reached the statutory pension age, which currently accounts for 10.25% of gross income.

Fink et al. (2023) provide an in-depth analysis of the proposal at the microeconomic level and show that the impact of such reform varies across individuals according to their labor and pension income. For most workers—except those with very low labor income—a major portion of the reduction in pension insurance contributions would translate into an increase in net disposable income, thereby enhancing their labor market incentives. However, the authors also emphasize that both the microeconomic and macroeconomic outcomes of the reform would depend on the specific details of its implementation, which were not fully specified in the discussions.

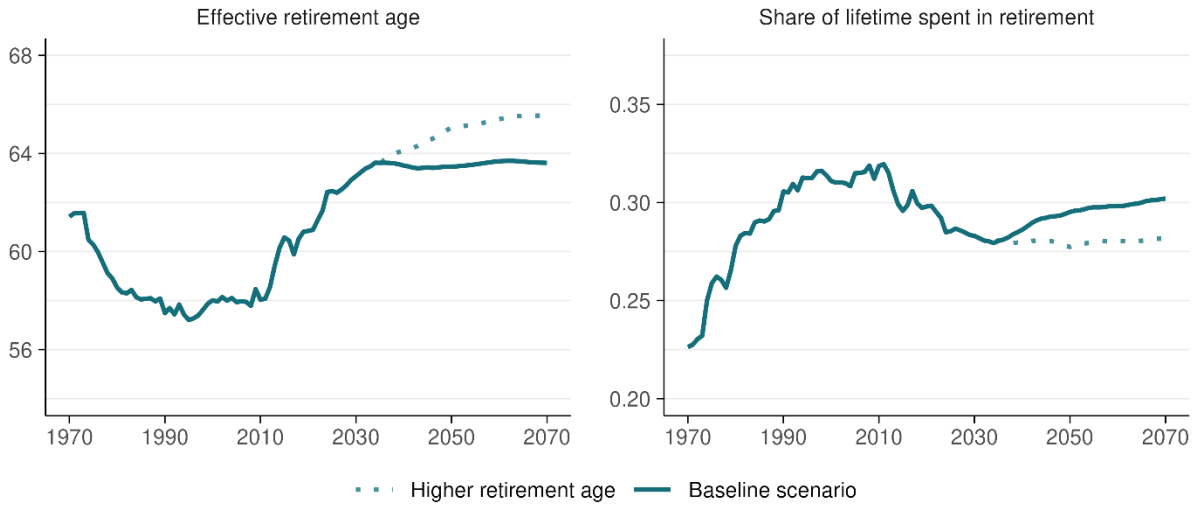
Using the FISK OLG model, I estimate the macroeconomic effects of the proposed reform in a simplified setting. First, I assume that the reform impacts individuals aged 65 and older. While the current statutory retirement age for women in Austria is below 65 years, it will gradually rise to 65 by 2033 to match the statutory retirement age of men. Therefore, 65 is the relevant age threshold to consider the effects of the reform in the long-term. Second, since the model does not explicitly account for the possibility of receiving both labor and pension income simultaneously, it slightly overestimates the reform's impact on disposable income for the affected groups, see Fink et al. (2023). However, this turns out not to be qualitatively important for the results.

The labor supply effects of the reform crucially depend on the income elasticity of labor supply, which in turn depends on model parameters. The income elasticity in the FISK OLG model varies by workers' age and skill group. For prime-age workers, the ex post (Marshallian) elasticity is between 0.15 and 0.3, meaning that a 1% increase in net labor income leads to a labor input response of 0.15% to 0.3%. In line with the empirical economic literature, the elasticity increases for workers aged over 60, eventually rising above 1.0 for all skill groups, see for example Keane (2022).

Even with this stronger response of labor input among older workers, the overall effects of the reform predicted by the model are minor. The total hours worked are projected to increase by 0.03% by 2040 (0.05% by 2070) compared to the baseline scenario. In terms of GDP per capita, the effects are 0.03% and 0.04% by 2040 and 2070, respectively. This is about an order of magnitude smaller than the labor potential of older workers identified in the previous section and two orders of magnitude lower than the effect of population aging.

The second scenario examines the effects of linking the **retirement age** to life expectancy, a measure that has been repeatedly recommended to Austria by international institutions in the context of sustainability of the pension system, see e.g. OECD (2024). Model projections show that the effective retirement age in Austria will largely stagnate after 2033, when the statutory retirement age for women reaches 65 years (Figure 13, left panel). Beyond this point, the average relative share of lifetime spent in retirement will start increasing again due to the continued rise in life expectancy (Figure 13, right panel). To maintain a constant relative share from 2033 onwards, the effective retirement age would need to gradually rise by approximately two years, reaching 65.6 years by 2070.

Figure 13: **Effective retirement age and share of lifetime spent in retirement**



Source: PROD, simulations with FISK-OLG model.

Model simulations show that the labor supply effects of such reform would be substantial, with total hours worked increasing by 0.60% by 2040 and 3.3% by 2070 compared to the baseline scenario. In terms of GDP per capita, the projected increases are 0.45% by 2040 and 2.7% by 2070. Moreover, the reform would help alleviate the pressures on the public pension system (cf. European Commission, 2024; Fiskalrat, 2021).

3.4.4 Discussion

Pension systems and retirement policies influence the labor market participation of older workers by affecting financial incentives for early or delayed retirement. Austria recently implemented pension reforms, including the gradual increase of the statutory retirement age for women, in order to encourage extended work lives (OECD, 2024). The model simulations presented in section 3.4.3 show that policies further increasing the effective retirement age in line with the increasing life expectancy can have a substantial effect on labor supply in the long run. The statutory retirement age is linked to life expectancy in ten EU member states, including for example Sweden, Denmark, and Slovakia (European Commission, 2024). However, the effectiveness of such policies in increasing effective retirement age and labor input among older workers depends on several factors.

Good health is essential for longer work lives, yet the health status of the Austrian population lags behind the EU average according to some indicators, most prominently the Healthy Life Years (HLY) published by the Eurostat. Long-term strategies promoting preventive health care and healthy lifestyles are necessary to improve health outcomes. Better health not only enhances labor market participation but also increases productivity, leading to additional positive individual and macroeconomic effects, see for example Sharpe and Mobasher Fard (2022).

Lifelong learning, skill development and qualifications are also vital factors for longer working life. Although qualification is an important determinant of worker productivity and labor market outcomes, the motivation and possibilities to pursue additional qualifications decrease with a shorter remaining career duration (OECD, 2020; Bodnar und Nerlich, 2022). As careers extend and the proportion of older workers in the workforce grows, lifelong learning and requalification possibilities must be in focus to maintain and enhance labor productivity. In Austria, public programs aimed at re-employing older workers tend to focus on employment subsidies and job search skills, with less emphasis on qualification and skill development for those close to retirement (Frimmel, 2021). Moreover, employment services tailored specifically to the needs of older job seekers can contribute to their higher re-employability. For example, emphasis on competence-based skill matching may strongly benefit older workers by facilitating transitions to new professions that match their qualifications and health status.

Societal attitudes towards aging and older workers also play a significant role. Unemployment among older people in Austria is higher and more persistent than among prime-age workers, which could be further addressed by labor market policies and efforts to eliminate age discrimination (AMS, 2019, 2017). Fostering a positive perception of older workers and recognizing their contributions can enhance their labor market participation. Additionally, promoting flexible work arrangements, such as part-time work and remote work options, as well as creating age-appropriate working conditions, can improve employment retention among older workers (OECD, 2020).

3.5 Migration

In the medium and long term, the available labor supply also depends on migration. Migrants can help ease labor shortages and boost the country's innovation potential. By setting the right incentives, policy makers can encourage the immigration of workers with emphasis on qualification profiles in high demand. This section looks at the potential economic effects of attracting more (qualified) immigration. Since there are no clear international benchmarks in this context, this section discusses an ad hoc alternative migration scenario and examines its impact on the economy.

3.5.1 Country comparison and scenario construction

The baseline scenario follows the migration assumptions outlined in the population forecast published by Statistics Austria (2023a). The main variant of the population forecast expects average net migration surplus of around 32 thousand persons per year between 2025 and 2070. The long-term projections for international migration in the main variant are based on past developments and assume no major deviations from historical trends. However, forecasting international migration, especially over long periods, comes with significant uncertainty. There are notable risks in both directions. Geopolitical developments, such as unrests and wars, can lead to increased immigration to Austria, as seen in 2015 and 2022. On the other hand, it's uncertain to what extent Austria will be able to attract migrants, particularly given the aging populations and labor shortages across many European countries. Some of the most important countries of origin of skilled migration to Austria in recent decades, including those in Central, Eastern, and South-Eastern Europe, as well as Germany, are also facing labor shortages.

In recent decades, Austria has attracted skilled workers primarily from EU countries, but also from third countries (Statistics Austria, 2024b). However, in terms of skill composition of migration, Austria lags behind some other European countries. In particular, the average qualification of working-age migrants from new EU member states (EU13) and migrants from the developing countries was lower compared to France and Switzerland between 2004 and 2016 (Landesmann and Leitner, 2023). This was also reflected in the occupational structure of the migrant population, where migrants from these country groups were less likely to work in managerial and professional positions and more likely to be employed as manual workers. Although there is no clear benchmark in the sense of "optimal" migration rate, it is clear that public policies can influence both the volume and the skill composition of migration through targeted incentives (pull factors).

The alternative scenario presented in this section assumes an additional net migration of ten thousand persons per year. The age distribution of the migrants mirrors the composition of net migration to Austria in the baseline scenario, but the maximum age is capped at 55, beyond which net migration is typically small and negative. The skill composition of the additional migrants is assumed to match that of the Austrian population, with the majority falling into either the middle- or high-skill groups. The increase in immigration is expected to phase in gradually between 2025 and 2029 and to remain at the higher level thereafter. While there are no direct costs associated with the reform, the scenario accounts for the indirect costs and revenues resulting from the increased population size.

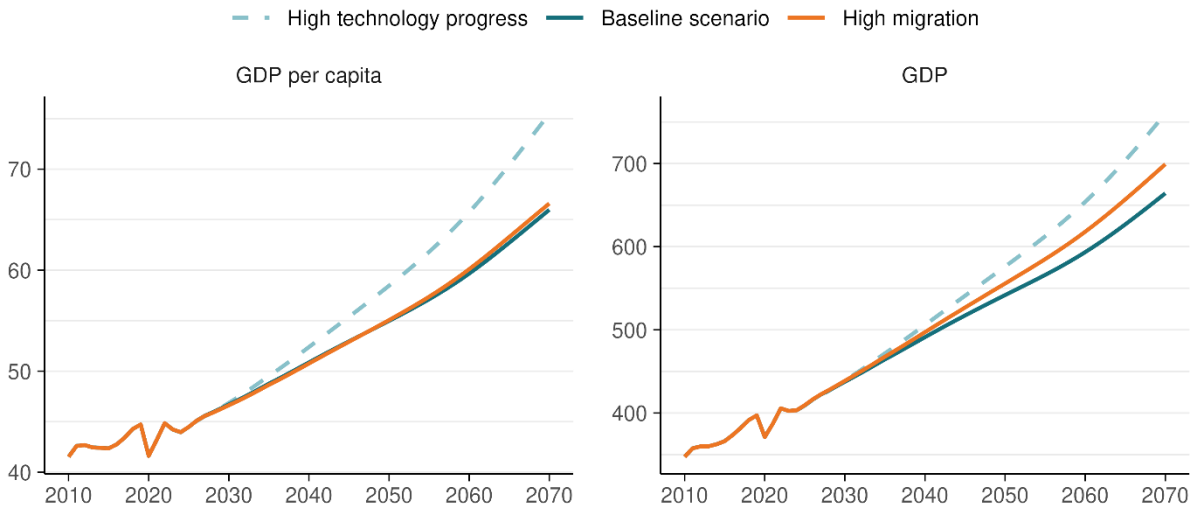
The alternative scenario with ten thousand additional net migrants is roughly in line with the projection of high migration variant of the population forecast, which anticipates an average annual net migration of around 43,000 people between 2025 and 2070 (Statistics Austria, 2023a). However, it is important to emphasize that the scenario discussed in this section examines the potential impact of actively attracting migrants through pull factors, rather than on the uncertainties stemming from geopolitical developments or humanitarian reasons, which influences the demographic composition of the migrant population. A more relevant comparison is therefore the inflow of workers through residence and work permits, particularly from non-EU countries. The historical peak for residence permits granted to qualified workers from outside the EU (under the red-white-red card and EU blue card schemes) was reached in 2022, with ca. 5,200 permits issued—a significant increase from 2017 level of ca. 2,200 persons (Rechnungshof, 2024).

3.5.2 Macroeconomic effects

Increasing net migration by ten thousand persons per year would expand the labor supply and could have significant economic impacts in the coming decades. Model simulations suggest that total hours worked would rise by 2.0% by 2040 and by 6.2% by 2070. The effects on real GDP would also be notable, with an expected increase of 1.2% by 2040 and 5.3% by 2070 (Figure 14, right panel). The decrease in labor productivity can be partly attributed to the different age structure of the migrant population and partly to a reduction in the capital intensity of the economy.

Figure 14: **Migration: output in alternative scenarios**

Real GDP per capita (left) in 1000 Euros and real GDP (right) in billion Euros (2015 prices).



Source: PROD, simulations with FISK-OLG model.

Unlike in the previous alternative scenarios, in the high migration scenario population size changes as well, affecting the denominator of GDP per capita. Initially, the impact of the growing population is stronger than the effect on output, leading to a 0.21% decrease in GDP per capita by 2040 compared to the baseline scenario. By 2070, the effect becomes positive, with GDP per capita rising 0.94% above the baseline (Figure 14, left panel). However, it is important to note that the model simulations do not account for the possibility of specifically targeting occupations in high demand. This could ease labor shortages and ultimately yield greater positive output effects within a shorter time frame.

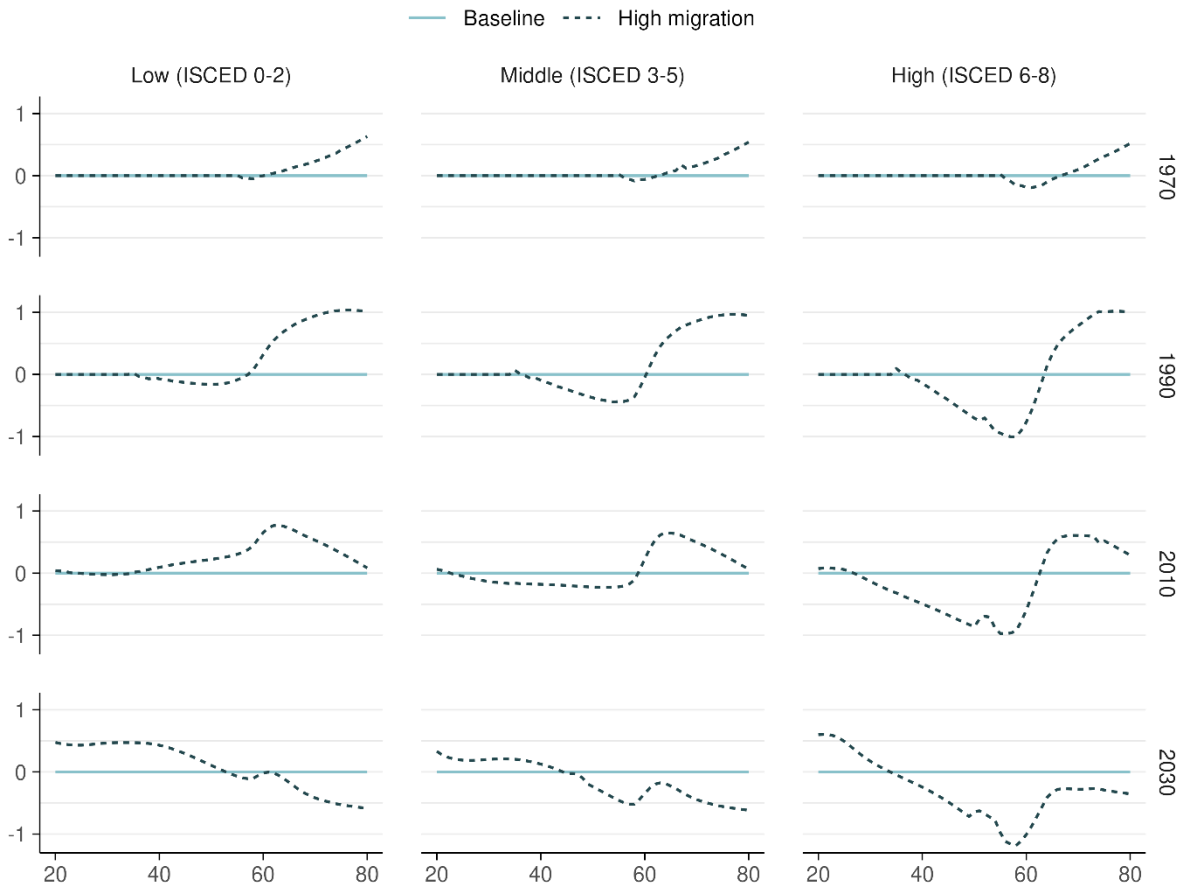
Examining the effects of higher migration on disposable income further reveals differentiated effects of the reform across demographic groups (Figure 15). While the reform increases labor supply across all three skill groups, the relative proportion of low-skilled workers within the additional migrant population is lower than in the overall population. This is primarily due to cohort effects and the younger age profile of the migrant population. As a result, the (small) negative impact of increased labor supply and decreased capital intensity on average labor income is observed only among medium- and high-skilled workers. Moreover, for cohorts born in 1970, 1990, and 2010, there is a positive indirect effect from the tax and transfer system, driven by improvements in public finance due to the influx of a comparatively young labor force. However, as the additional migrant population size and age distribution stabilizes, the positive indirect effect diminishes, and the overall effect becomes negative, as illustrated by the cohort born in 2030. This underscores the importance of complementing migration policies with measures that incentivize investment, including foreign investments.

3.5.3 Discussion

Austria is a developed country with a high standard of living, offering job opportunities, access to quality healthcare, education, and social services. The country's central location in Europe, combined with its high level of public safety and political stability, are further factors that increase its attractiveness for potential migrants. Austria's strong focus on innovation, research, and development, supported by a well-established infrastructure, further enhances the attractiveness for qualified labor force, such as for professionals in technology, engineering, and science.

Figure 15: **Effects of higher net migration on disposable income by education attainment and cohort**

In percentage points of maximum disposable income of persons with high education.



Source: PROD, simulations with FISK-OLG model.

Beyond economic and social determinants, immigration policies play an important role in attracting skilled migration. Programs that facilitate access to work visas, recognition of foreign qualifications, and pathways to permanent residency are essential for attracting qualified individuals from outside the EU. In a review of Austria's flagship programs for residence and work permits, the red-white-red card and the blue card, Rechnungshof (2024) identified several areas with potential for improvement. These include the system's low transparency and high complexity, which can be challenging for potential applicants to navigate, the lengthy and administratively burdensome decision-making process, and the system's lack of flexibility. Additionally, these programs are not well-suited to all occupational groups in which there are labor shortages.

4. Summary of the results

The model simulations presented in section 3 quantify the economic potentials associated with reforms in various areas. Using a benchmarking approach, I examine the improvements in the average educational attainment, the labor force potential of prime-age women and the labor force potential of people over 55. I also present results for different demographic and migration scenarios as well as various assumptions about the rate of technological progress.

The analysis of the scenarios yields a number of important findings. First, sustaining economic growth in Austria at levels comparable to the past 30 years will be challenging in an aging society. Productivity growth would need to significantly increase to counterbalance the effects of a shrinking labor force

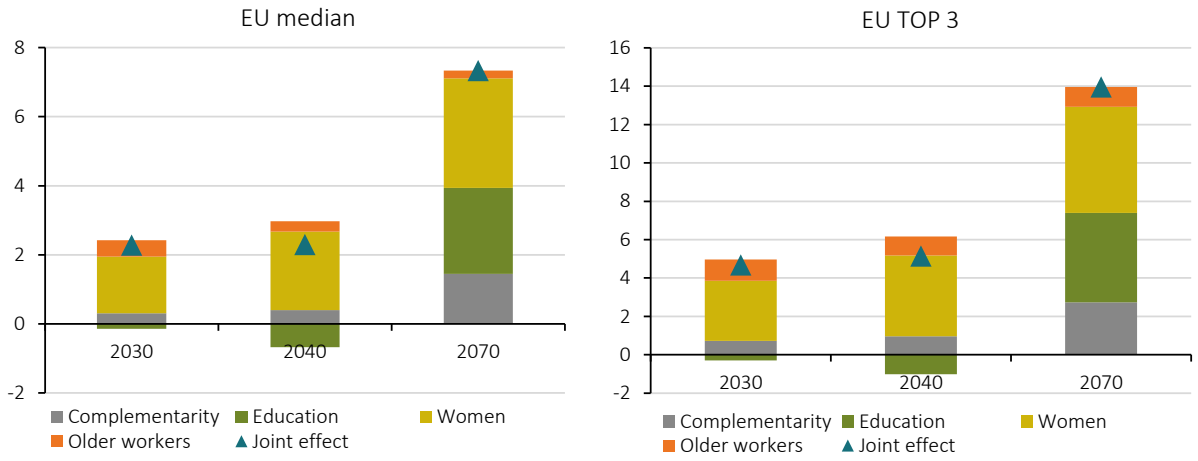
(relative to total population). Second, utilizing the labor market potentials could bring significant improvements in long-run economic outcomes (Table 2).

While based on stylized scenarios, the model results underscore important differences between the reform areas. In the long run, productivity growth and human capital are the most important drivers of economic performance. Therefore, improvements in educational attainment yield significant improvements, albeit after a long initial period of negative impact before the gains of the reforms start to realize. On the other hand, improving the effective labor input of women and older persons brings positive impact in short and medium run, with labor input of women holding especially big potential based on comparisons with other EU member states. However, the labor potential of women in Austria is spread across all age groups, and the high effects are conditional on increased labor supply for women of all ages. This highlights the importance of expanding the discussion from limited policies such as access to early childcare to comprehensive strategies and societal changes that include family policies, school system, health and long-term care system, social norms, and many others.

The reform areas should not be viewed as alternatives, as each dimension offers untapped potential, and their effects are complementary. The model simulations show that closing the gap to the median country simultaneously for educational attainment, labor supply of women, and labor market participation of older workers would elevate GDP per capita in 2070 by about 7% and closing the gap to top performers by about 14%. In both cases, these long-term effects exceed the combined impacts of the three reforms implemented in isolation (Figure 16). Furthermore, fully closing the gap to the top performers in these three dimensions is the only scenario under the baseline assumptions on technological progress and migration in which average GDP per capita growth between 2023 and 2070 matches the average growth rate observed between 1993 and 2023 (Figure 17). In other words, in order to achieve the same growth rates as in the period 1993 to 2023 with the use of latent labor market potentials, very ambitious reform goals would be necessary along not one, but all of the examined reform areas.

Figure 16: **Combination of alternative scenarios vs. individual effects: education, women, older workers**

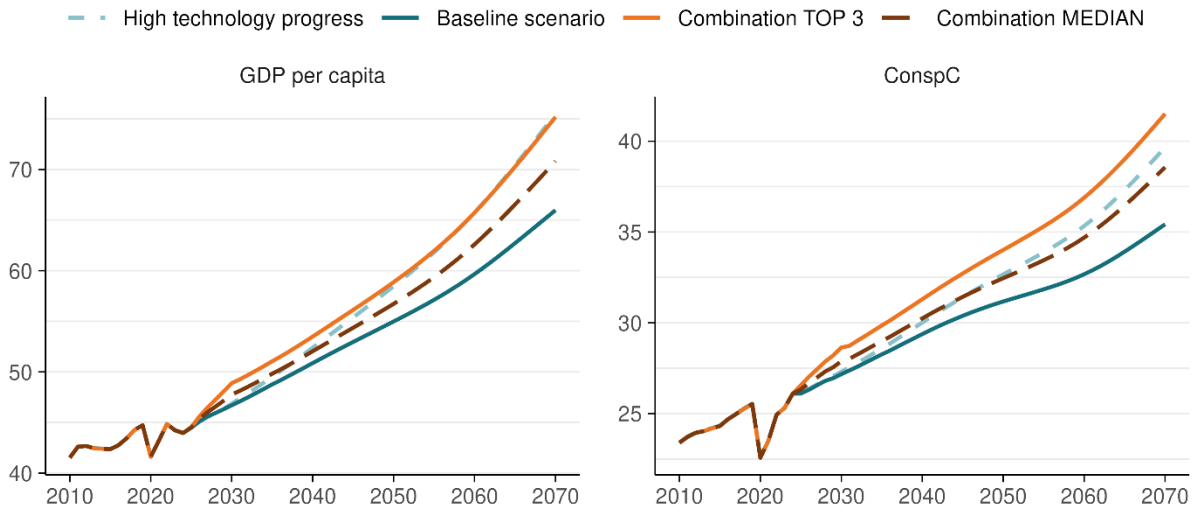
Effects on real GDP per capita, difference to baseline (in %).



Source: PROD, simulations with FISK-OLG model.

Figure 17: **Combination of alternative scenarios: education, women, older workers**

Real GDP per capita (left) and private consumption per capita (right), in 1000 Euros (2015).



Source: PROD, simulations with FISK-OLG model.

5. Literature

Ahn N., Mira P. (2002). A note on the changing relationship between fertility and female employment rates in developed countries. Journal of Population Economics, 15, 667–682.

AMS (2017). Weshalb die Arbeitslosigkeit bei Personen ab 50 Jahren weniger sinkt. Spezialthema zum Arbeitsmarkt 11/2017, AMS, Wien.

AMS (2019). Weshalb im konjunkturell so günstigen vergangenen Jahr die Arbeitslosenzahlen von älteren Menschen und von AkademikerInnen weniger deutlich zurückgingen oder diese aktuell sogar steigen. Spezialthema zum Arbeitsmarkt 06/2019, AMS, Wien.

Angel S., Bittschi B., Horvath T., Kogler M., Mahringer H. (2023). Aktivierbare Arbeitsmarktpotenziale und "Stille Reserven" in Österreich. WIFO, Wien.

Autor D. (2022). The Labor Market Impacts of Technological Change: From Unbridled Enthusiasm to Qualified Optimism to Vast Uncertainty. Working paper.

Autor D., Goldin C., Katz L. F. (2020). Extending the Race between Education and Technology. AEA Papers and Proceedings, 110, 347–351.

Bauernschuster S., Schlotter M. (2015). Public child care and mothers' labor supply—Evidence from two quasi-experiments. Journal of Public Economics, 123, 1–16.

BMBWF (Bundesministerium für Bildung, Wissenschaft und Forschung) (2021). Nationaler Bildungsbericht Österreich 2021. Wien.

Bodnar K., Nerlich C. (2022). The macroeconomic and fiscal impact of population ageing. European Central Bank Occassional Paper Series, 296.

Boll C., Lagemann A. (2019). Public Childcare and Maternal Employment — New Evidence for Germany. LABOUR, CEIS, 33(2), 212–239.

Égert B., Gal P. (2017). The quantification of structural reforms in OECD countries: A new framework. OECD Journal: Economic Studies, 2016/1.

Engelhardt H., Prskawetz A. (2004). On the Changing Correlation Between Fertility and Female Employment over Space and Time. European Journal of Population, 20, 35–62.

European Commission (2022). Education and training monitor 2022 – Austria. Directorate-General for Education, Youth, Sport and Culture, Publications Office of the European Union.

European Commission (2024). 2024 Ageing Report. Economic and Budgetary Projections for the EU Member States (2022-2070). Institutional Paper 279, Directorate-General for Economic and Financial Affairs, European Commission, Brussels.

Eurostat (2024). Labor Force Survey, 2024 release.

Fink M., Mayrhuber C., Rocha-Akis S. (2023). Abgabenbelastung bei Kombination von Pensions- und Erwerbseinkommen. WIFO-Monatsberichte, 8/2023, 539–551.

Fiskalrat (2021). Bericht über die fiskalische Nachhaltigkeit. Wien.

Frimmel W. (2021). Later retirement and the labor market re-integration of elderly unemployed workers. The Journal of the Economics of Ageing, 19, 100310.

Frimmel W., Halla M., Schmidpeter B., Winter-Ebmer R. (2022). Grandmothers' Labor Supply. Journal of Human Resources, 57(5), 1645-1689.

Förster M., Königs S. (2020). Promoting social mobility in Austria. OECD Social, Employment and Migration Working Papers, No. 251, OECD Publishing, Paris.

Gersbach H. (2004). Structural reforms and the macroeconomy: The role of general equilibrium effects. In: Solow R. (Ed.), Structural Reform and Economic Policy. Palgrave Macmillan UK, 9–22.

Goldin C., Katz L. F. (2008). The Race Between Education and Technology. Harvard University Press.

Goldin I., Koutroumpis P., Lafond F., Winkler J. (2024). Why Is Productivity Slowing Down? Journal of Economic Literature, 62(1), 196–268.

Halla M., Schmieder J., Weber A. (2020). Job Displacement, Family Dynamics, and Spousal Labor Supply. American Economic Journal: Applied Economics, 12(4), 253–287.

Hermes H., Lergetporer P., Mierisch F., Peter F., Wiederhold S. (2023). Discrimination on the Child Care Market: A Nationwide Field Experiment. CEPR Discussion Papers, 18113.

IMF (2024). Austria: Selected Issues. IMF Country Report No. 2024/108, IMF.

Kaniovski S., Url T., Hofer H., Ertl M. (2024). A Long-run Macroeconomic Model of the Austrian Economy (A-LMM 2.0) - New Results (2024). WIFO-Studie, Wien.

Karahan F., Pugsley B., Şahin A. (2024). Demographic Origins of the Start-up Deficit. American Economic Review, 114(7), 1986-2023.

Keane M. P. (2022). Recent research on labor supply: Implications for tax and transfer policy. Labour Economics, 77, 102026.

Kleven H., Landais C., Posch J., Steinhauer A., Zweimüller J. (2019). Child Penalties across Countries: Evidence and Explanations. AEA Papers and Proceedings, 109, 122-126.

Kleven H., Landais C., Posch J., Steinhauer A., Zweimüller J. (2022). Do Family Policies Reduce Gender Inequality? Evidence from 60 Years of Policy Experimentation. American Economic Journal: Economic Policy (Forthcoming).

Kleven H., Landais C., Leite-Mariante G. (2023). The Child Penalty Atlas. NBER Working Paper Series, 31649.

Kögel T. (2004). Did the Association between Fertility and Female Employment within OECD Countries Really Change Its Sign?. Journal of Population Economics, 17, 45–65.

Kunze A. (2016). Parental leave and maternal labor supply. IZA World of Labor, Institute of Labor Economics (IZA), 279.

Landesmann M., Leitner S. M. (2023). Employment Effects of Offshoring, Technological Change and Migration in a Group of Western European Economies: Impact on Different Occupations. wiiw Working Papers, 226, The Vienna Institute for International Economic Studies, wiiw.

Liang J., Wang H., Lazear E. P. (2018). Demographics and Entrepreneurship. Journal of Political Economy, 126(S1), 140–196.

Matysiak A., Vignoli D. (2006). Fertility and women's employment: a meta-analysis. MPIDR Working Papers, WP-2006-048, Max Planck Institute for Demographic Research, Rostock.

Melhuish E., Ereky-Stevens K., Petrogiannis K., Ariescu A., Penderi E., Rentzou K., Tawell A., Slot P., Broekhuizen M., Leseman P. (2015). A review of research on the effects of Early Childhood Education and Care (ECEC) upon child development. CARE project; Curriculum Quality Analysis and Impact Review of European Early Childhood Education and Care (ECEC).

Molnárová Z. (2023). Productivity growth in Austria between 1995 and 2019. Report 03/23, Office of the Austrian Productivity Board, Wien.

Müller K-U., Wrohlich K. (2020). Does subsidized care for toddlers increase maternal labor supply? Evidence from a large-scale expansion of early childcare. Labour Economics, 62.

OECD (2019). Education at a Glance 2019: OECD Indicators. OECD Publishing, Paris.

OECD (2020). Promoting an Age-Inclusive Workforce: Living, Learning and Earning Longer. OECD Publishing, Paris.

OECD (2022). "Austria", in Education at a Glance 2022: OECD Indicators. OECD Publishing, Paris.

OECD (2023). Education at a Glance 2023: OECD Indicators. OECD Publishing, Paris.

OECD (2024). OECD Economic Surveys: Austria 2024. OECD Publishing, Paris.

Oreopoulos P., Petronijevic U. (2013). Making College Worth It: A Review of the Returns to Higher Education. The Future of Children, 23(1), 41–65.

Peneder M., Bittschi B., Köppl A., Mayerhofer P., Url T., Bärenthaler-Sieber S., Böheim M. (2023). Wettbewerbsfähigkeit und nachhaltige Entwicklung der österreichischen Wirtschaft. WIFO, Wien.

Pfeiffer P., Varga J., in 't Veld J. (2024). "Unleashing potential: Model-based reform benchmarking for EU Member States". European Journal of Political Economy, 83(C).

Produktivitätsrat (2023). Produktivitätsbericht 2023. Nachhaltige Wettbewerbsfähigkeit Österreichs. Wien.

Rechnungshof (2024). Rot–Weiß–Rot–Karte und Blaue Karte EU, Bericht des Rechnunghofes. Reihe BUND 2024-11, Rechnungshof Österreich.

Rindfuss R. R., Guzzo K. B., Morgan S. P. (2003). The Changing Institutional Context of Low Fertility. Population Research and Policy Review, 22, 411-438.

Schleicher A. (2018). Educating Learners for Their Future, Not Our Past. ECNU Review of Education, 1(1), 58-75.

Schuster P. (2021). The FISK OLG model – a numerical overlapping generations model for Austria – model description v2.2. Working Paper 7, Büro des Fiskalrates, Wien.

Sharpe A., Mobasher Fard S. (2022). The current state of research on the two-way linkages between productivity and well-being. ILO Working Paper 56 (Geneva, ILO).

Spence M. (2002). 'Signalling in Retrospect and the Informational Structure of Markets'. American Economic Review, 92, 434–459.

Statistics Austria (1985). Österreichs Volkseinkommen 1983 – mit Langzeitreihen 1954 – 1983. Beiträge zur Österreichischen Statistik, 751, Wien.

Statistics Austria (2022). Kindertagesheimstatistik 2021/22. Wien.

Statistics Austria (2023a). Demografisches Jahresbuch 2022. Wien.

Statistics Austria (2023b). Arbeitsmarktstatistiken 2022 Ergebnisse der Mikrozensus-Arbeitskräfteerhebung und der Offene-Stellen-Erhebung. Wien.

Statistics Austria (2024a). Statistiken zur elementaren Bildung 2023/24, Monitoring-Bericht. Wien.

Statistics Austria (2024b). Statistisches Jahrbuch Migration & Integration 2024. Wien.

Tholen G., Brown P., Power S., Allouch A. (2013). The role of networks and connections in educational elites' labour market entrance. Research in Social Stratification and Mobility, 34, 142–154.

6. Annex

Table 3: **Overview of assumptions for alternative scenarios presented in sections 3 and 4**

Scenario	Description	Included costs and revenues for public budget
Baseline scenario		
Baseline scenario	• See section 3.1	
Alternative assumptions		
High technology progress	• Higher TFP growth assumption: 0.85% per year from 2029 onwards • Implied growth GDP p.c. of 1.2% per year between 2030 and 2070 (average value 1993-2023)	Indirect costs and revenues (taxes and transfers)
Zero technology progress	• Zero growth of the unexplained part of TFP from 2029	Indirect costs and revenues (taxes and transfers)
Fixed age structure	• Population age structure is held constant from 2024	Indirect costs and revenues (taxes and transfers)
Reform scenarios based on international benchmarks (EU median or EU TOP 3)		
Education: EU median	• Gradual increase in the share of population with high educational attainment (ISCED 6-8) by additional 12 percentage points compared to the baseline scenario from the 2006 birth cohort (number of students increases from around 2025 to 2029) • High elasticity of substitution between labor input of different skill groups.	Additional public education expenditures; indirect costs and revenues (taxes and transfers)
Education: EU TOP 3	• Gradual increase in the share of population with high educational attainment (ISCED 6-8) by additional 20 percentage points compared to the baseline scenario from the 2006 birth cohort (number of students increases from around 2025 to 2029) • Faster decline in the share of population with low educational attainment (ISCED 0-2) to 5% from the 2010 birth cohort • High elasticity of substitution between labor input of different skill groups.	
Women: EU median	• Gradual increase of the average hours worked per person such that the gap to the benchmarks (2023 level) in female employment in FTE in each education and 10-year age group closes by 2029	Indirect costs and revenues (taxes and transfers)
Women: EU TOP 3		
Older workers: EU median	• Gradual increase of the labor force participation of persons 55+ such that the gap to the benchmarks (2023 level) in employment in FTE in each education and 10-year age group closes by 2029	Indirect costs and revenues (taxes and transfers)
Older workers: EU TOP 3		
Combination education, women, older: EU median	• Combination of reform scenarios Education, Women, Older workers	Combination of reform scenarios Education, Women and Older workers
Combination education, women, older: EU TOP 3		
Reform scenarios without international benchmarks		
High migration	• Additional net immigration of 10,000 persons per year from 2025 • Educational structure equal to the Austrian population of the same age	Indirect costs and revenues (taxes and transfers)
Education: fixed low-skill share	• Constant share of people with low qualifications (ISCED 0-2) in the 25-34 age group from 2024 • High elasticity of substitution between labor input of different skill groups.	Additional public education expenditures; indirect costs and revenues (taxes and transfers)
Older workers: reduced pension insurance contr.	• Abolition of the employee share of pension insurance contributions (10.25% of gross labor income) for persons who have reached the statutory retirement age (65 years) from 2025 • Age-dependent elasticity of labor supply	Lower pension insurance revenues; indirect costs and revenues (taxes and transfers)
Older workers: higher retirement age	• Gradual increase in the effective retirement age in proportion to life expectancy from 2033	Indirect costs and revenues (taxes and transfers)

Source: PROD, simulations with FISK-OLG model.

Table 4: **Overview of simulation results for alternative scenarios presented in sections 3 and 4**

Scenario	Growth rates (in % p.a.)				Difference to baseline (in %)		
	1993 to 2023	2023 to 2030	2023 to 2070	2030 to 2070	2030	2040	2070
GDP per capita (real)							
Baseline scenario	1.20	0.78	0.85	0.87	0.00	0.00	0.00
High technology progress	1.19	0.83	1.14	1.20	0.34	2.99	14.43
Zero technology progress	1.21	0.68	0.33	0.26	-0.59	-5.27	-21.86
Fixed age structure	1.20	0.98	1.05	1.06	1.39	3.64	9.63
Education EU median	1.20	0.76	0.91	0.93	-0.14	-0.67	2.49
Education EU TOP 3	1.20	0.74	0.95	0.99	-0.29	-1.01	4.66
Education: fixed low-skill share	1.20	0.78	0.83	0.84	0.01	-0.09	-1.20
Women EU median	1.20	1.01	0.92	0.91	1.64	2.27	3.17
Women EU TOP 3	1.20	1.22	0.97	0.93	3.13	4.20	5.53
Older workers EU median	1.20	0.85	0.86	0.86	0.47	0.30	0.23
Older workers EU TOP 3	1.20	0.94	0.88	0.87	1.11	0.99	1.03
Older workers: reduced pension insurance contr.	1.20	0.78	0.86	0.87	0.03	0.03	0.04
Older workers: higher retirement age	1.20	0.78	0.91	0.94	-0.02	0.45	2.72
High migration	1.20	0.76	0.87	0.90	-0.16	-0.21	0.94
Combination education, women, older: EU median	1.20	1.10	1.01	0.99	2.28	2.30	7.34
Combination education, women, older: EU TOP 3	1.20	1.44	1.14	1.08	4.68	5.15	13.96
Consumption per capita (real)							
Baseline scenario	1.37	1.02	0.72	0.67	0.00	0.00	0.00
High technology progress	1.36	1.08	0.96	0.94	0.51	2.16	11.95
Zero technology progress	1.37	0.91	0.28	0.17	-0.96	-3.90	-18.64
Fixed age structure	1.37	1.57	1.06	0.98	3.86	6.99	17.44
Education EU median	1.37	0.99	0.77	0.73	-0.20	-0.74	2.41
Education EU TOP 3	1.37	0.96	0.81	0.79	-0.39	-1.14	4.62
Education: fixed low-skill share	1.36	1.02	0.69	0.63	-0.02	-0.12	-1.39
Women EU median	1.37	1.29	0.81	0.72	1.93	2.74	4.27
Women EU TOP 3	1.37	1.54	0.87	0.76	3.67	5.07	7.50
Older workers EU median	1.37	1.08	0.73	0.66	0.47	0.40	0.37
Older workers EU TOP 3	1.37	1.19	0.75	0.68	1.20	1.31	1.61
Older workers: reduced pension insurance contr.	1.37	1.02	0.72	0.67	0.03	0.04	0.07
Older workers: higher retirement age	1.37	0.99	0.61	0.55	-0.16	-0.95	-4.81
High migration	1.37	0.97	0.76	0.72	-0.32	-0.27	1.85
Combination education, women, older: EU median	1.37	1.39	0.90	0.81	2.61	2.95	8.86
Combination education, women, older: EU TOP 3	1.37	1.78	1.06	0.93	5.39	6.53	17.17
Total hours worked							
Baseline scenario	0.40	0.53	0.19	0.13	0.00	0.00	0.00
High technology progress	0.40	0.53	0.19	0.13	-0.05	-0.02	-0.08
Zero technology progress	0.41	0.54	0.19	0.13	0.13	0.04	0.19
Fixed age structure	0.40	0.89	0.38	0.30	2.51	5.51	9.65
Education EU median	0.40	0.47	0.16	0.11	-0.46	-1.35	-1.27
Education EU TOP 3	0.40	0.41	0.16	0.12	-0.90	-2.00	-1.24
Education: fixed low-skill share	0.40	0.53	0.17	0.10	0.00	-0.17	-0.97
Women EU median	0.40	0.83	0.24	0.13	2.08	2.19	2.41
Women EU TOP 3	0.40	1.15	0.28	0.13	4.37	4.42	4.52
Older workers EU median	0.40	0.63	0.19	0.12	0.65	0.30	0.22
Older workers EU TOP 3	0.40	0.75	0.21	0.11	1.52	1.00	0.92
Older workers: reduced pension insurance contr.	0.40	0.54	0.19	0.13	0.05	0.03	0.06
Older workers: higher retirement age	0.40	0.53	0.26	0.21	0.00	0.60	3.32
High migration	0.40	0.60	0.31	0.26	0.48	1.96	6.17
Combination education, women, older: EU median	0.40	0.92	0.24	0.13	2.72	1.62	2.73
Combination education, women, older: EU TOP 3	0.40	1.39	0.32	0.14	6.11	4.61	6.49

Scenario	Growth rates (in % p.a.)				Difference to baseline (in %)		
	1993 to 2023	2023 to 2030	2023 to 2070	2030 to 2070	2030	2040	2070
Labor productivity							
Baseline scenario	1.27	0.66	0.88	0.92	0.00	0.00	0.00
High technology progress	1.27	0.72	1.17	1.25	0.39	3.01	14.52
Zero technology progress	1.27	0.56	0.35	0.31	-0.72	-5.31	-22.00
Fixed age structure	1.27	0.52	0.89	0.95	-1.06	-1.70	0.09
Education EU median	1.27	0.71	0.96	1.01	0.32	0.69	3.84
Education EU TOP 3	1.27	0.75	1.01	1.05	0.61	1.01	6.04
Education: fixed low-skill share	1.27	0.67	0.88	0.91	0.01	0.09	-0.24
Women EU median	1.27	0.60	0.90	0.95	-0.42	0.08	0.75
Women EU TOP 3	1.27	0.49	0.90	0.98	-1.18	-0.21	0.97
Older workers EU median	1.27	0.64	0.88	0.93	-0.18	0.00	0.01
Older workers EU TOP 3	1.27	0.60	0.89	0.93	-0.41	-0.01	0.11
Older workers: reduced pension insurance contr.	1.27	0.66	0.88	0.92	-0.02	0.00	-0.02
Older workers: higher retirement age	1.27	0.66	0.87	0.91	-0.02	-0.15	-0.58
High migration	1.27	0.63	0.86	0.91	-0.22	-0.71	-0.86
Combination education, women, older: EU median	1.27	0.60	0.98	1.04	-0.43	0.66	4.51
Combination education, women, older: EU TOP 3	1.27	0.47	1.03	1.13	-1.34	0.52	7.07
TFP (standard)							
Baseline scenario	0.74	0.51	0.60	0.61	-	-	-
High technology progress	0.74	0.58	0.81	0.85	-	-	-
Zero technology progress	0.74	0.39	0.19	0.16	-	-	-
Fixed age structure	0.74	0.52	0.60	0.62	-	-	-
Education EU median	0.74	0.53	0.66	0.68	-	-	-
Education EU TOP 3	0.74	0.55	0.70	0.72	-	-	-
Education: fixed low-skill share	0.74	0.51	0.59	0.60	-	-	-
Women EU median	0.74	0.56	0.60	0.61	-	-	-
Women EU TOP 3	0.74	0.56	0.60	0.61	-	-	-
Older workers EU median	0.74	0.52	0.60	0.61	-	-	-
Older workers EU TOP 3	0.74	0.53	0.60	0.61	-	-	-
Older workers: reduced pension insurance contr.	0.74	0.51	0.60	0.61	-	-	-
Older workers: higher retirement age	0.74	0.51	0.60	0.61	-	-	-
High migration	0.74	0.50	0.59	0.61	-	-	-
Combination education, women, older: EU median	0.74	0.58	0.67	0.68	-	-	-
Combination education, women, older: EU TOP 3	0.74	0.61	0.70	0.72	-	-	-
TFP (unexplained part)							
Baseline scenario	0.49	0.31	0.46	0.49	-	-	-
High technology progress	0.49	0.39	0.69	0.75	-	-	-
Zero technology progress	0.49	0.17	0.03	0.00	-	-	-
Fixed age structure	0.49	0.31	0.46	0.48	-	-	-
Education EU median	0.49	0.31	0.46	0.49	-	-	-
Education EU TOP 3	0.49	0.31	0.46	0.49	-	-	-
Education: fixed low-skill share	0.49	0.31	0.46	0.49	-	-	-
Women EU median	0.49	0.31	0.46	0.49	-	-	-
Women EU TOP 3	0.49	0.32	0.46	0.49	-	-	-
Older workers EU median	0.49	0.31	0.46	0.49	-	-	-
Older workers EU TOP 3	0.49	0.31	0.46	0.49	-	-	-
Older workers: reduced pension insurance contr.	0.49	0.31	0.46	0.49	-	-	-
Older workers: higher retirement age	0.49	0.31	0.46	0.49	-	-	-
High migration	0.49	0.31	0.46	0.49	-	-	-
Combination education, women, older: EU median	0.49	0.32	0.46	0.49	-	-	-
Combination education, women, older: EU TOP 3	0.49	0.32	0.46	0.48	-	-	-

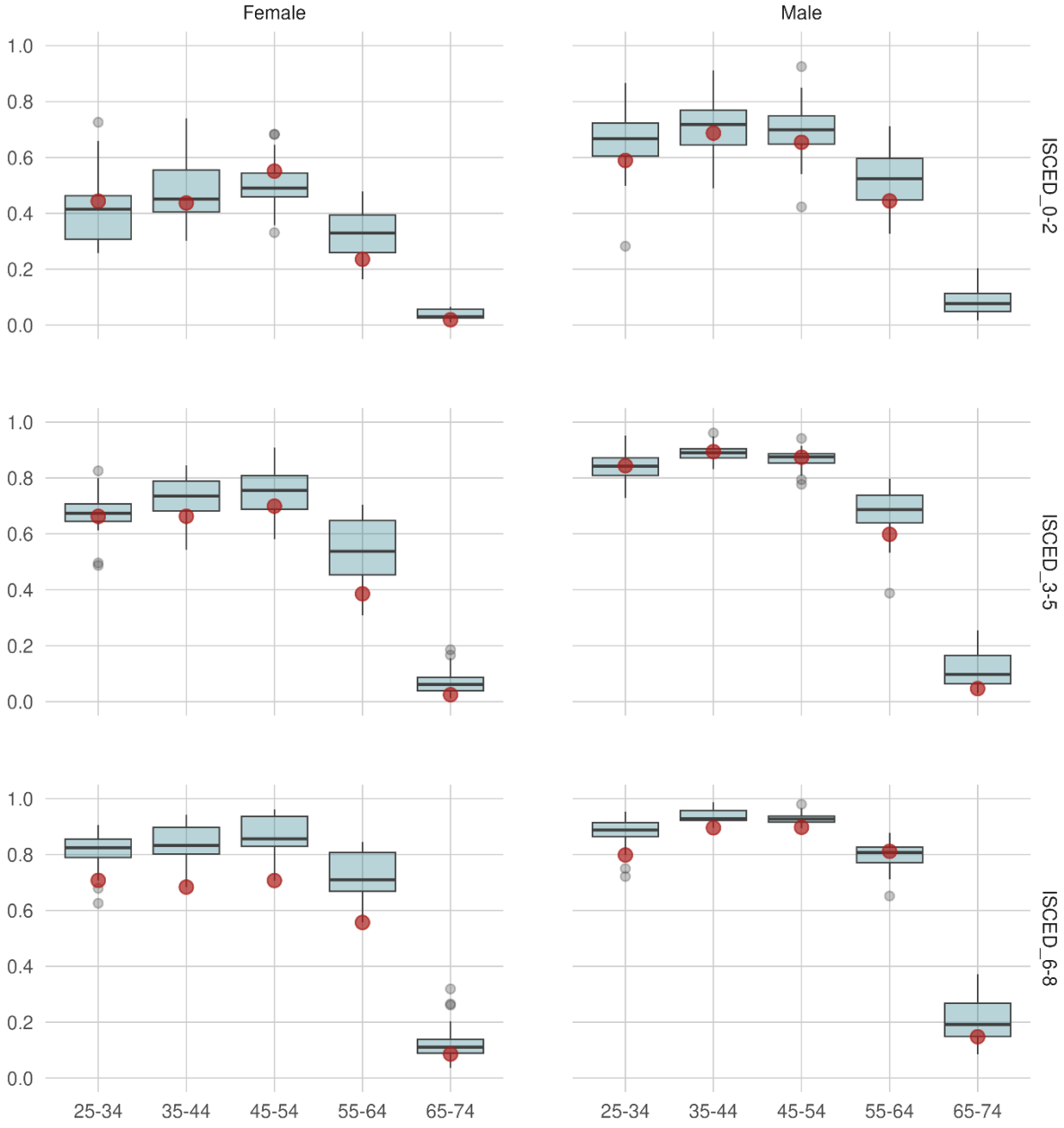
Scenario	Growth rates (in % p.a.)				Difference to baseline (in %)		
	1993 to 2023	2023 to 2030	2023 to 2070	2030 to 2070	2030	2040	2070
Real GDP							
Baseline scenario	1.68	1.20	1.07	1.05	0.00	0.00	0.00
High technology progress	1.67	1.25	1.36	1.38	0.34	2.99	14.43
Zero technology progress	1.69	1.10	0.54	0.44	-0.59	-5.27	-21.86
Fixed age structure	1.67	1.41	1.27	1.25	1.43	3.72	9.74
Education EU median	1.68	1.18	1.13	1.12	-0.14	-0.67	2.52
Education EU TOP 3	1.68	1.16	1.17	1.17	-0.29	-1.01	4.72
Education: fixed low-skill share	1.68	1.20	1.05	1.02	0.02	-0.08	-1.21
Women EU median	1.68	1.44	1.14	1.09	1.64	2.27	3.17
Women EU TOP 3	1.68	1.65	1.19	1.11	3.13	4.20	5.53
Older workers EU median	1.68	1.27	1.08	1.04	0.47	0.30	0.23
Older workers EU TOP 3	1.68	1.36	1.09	1.05	1.11	0.99	1.03
Older workers: reduced pension insurance contr.	1.68	1.20	1.07	1.05	0.03	0.03	0.04
Older workers: higher retirement age	1.68	1.20	1.13	1.12	-0.02	0.45	2.72
High migration	1.68	1.24	1.18	1.17	0.26	1.23	5.27
Combination education, women, older: EU median	1.68	1.53	1.22	1.17	2.28	2.30	7.37
Combination education, women, older: EU TOP 3	1.68	1.86	1.35	1.27	4.68	5.15	14.02
Investment (real)							
Baseline scenario	1.38	0.31	1.04	1.17	0.00	0.00	0.00
High technology progress	1.37	0.30	1.37	1.55	-0.30	3.48	16.19
Zero technology progress	1.41	0.33	0.43	0.45	0.73	-5.98	-24.18
Fixed age structure	1.38	-0.01	1.24	1.46	-2.23	1.86	9.68
Education EU median	1.38	0.27	1.12	1.27	-0.26	-1.65	3.81
Education EU TOP 3	1.38	0.21	1.19	1.36	-0.65	-2.59	7.44
Education: fixed low-skill share	1.38	0.33	1.00	1.12	0.18	0.02	-1.68
Women EU median	1.38	0.60	1.11	1.20	2.11	2.91	3.56
Women EU TOP 3	1.38	0.88	1.16	1.21	4.07	5.36	6.08
Older workers EU median	1.38	0.41	1.04	1.15	0.70	0.29	0.14
Older workers EU TOP 3	1.38	0.54	1.05	1.14	1.63	0.99	0.67
Older workers: reduced pension insurance contr.	1.38	0.31	1.04	1.16	0.05	0.01	-0.01
Older workers: higher retirement age	1.38	0.31	1.13	1.27	0.00	1.52	4.32
High migration	1.38	0.38	1.14	1.28	0.55	1.40	4.99
Combination education, women, older: EU median	1.38	0.72	1.23	1.32	2.90	1.84	9.35
Combination education, women, older: EU TOP 3	1.38	1.13	1.39	1.43	5.89	4.70	17.70
Unemployment rate	**Anteil an Erwerbsbevölkerung (in %)**				**Interschied zum Basiszenario (in PF**		
Baseline scenario	6.44	5.26	4.14	3.94	0.00	0.00	0.00
High technology progress	6.44	5.27	4.15	3.95	0.01	0.01	0.01
Zero technology progress	6.43	5.25	4.13	3.93	-0.02	-0.01	-0.02
Fixed age structure	6.44	5.30	4.24	4.06	0.07	0.11	0.14
Education EU median	6.44	5.26	4.08	3.87	-0.01	-0.06	-0.13
Education EU TOP 3	6.44	5.24	3.99	3.78	-0.06	-0.16	-0.23
Education: fixed low-skill share	6.44	5.31	4.34	4.17	0.07	0.14	0.37
Women EU median	6.44	5.29	4.19	4.00	0.05	0.06	0.06
Women EU TOP 3	6.44	5.31	4.25	4.07	0.10	0.13	0.13
Older workers EU median	6.44	5.27	4.15	3.95	0.02	0.01	0.01
Older workers EU TOP 3	6.44	5.29	4.17	3.97	0.05	0.03	0.02
Older workers: reduced pension insurance contr.	6.44	5.27	4.14	3.95	0.00	0.00	0.00
Older workers: higher retirement age	6.44	5.26	4.17	3.98	0.00	0.02	0.07
High migration	6.44	5.26	4.14	3.95	0.00	0.00	0.00
Combination education, women, older: EU median	6.44	5.30	4.16	3.96	0.06	0.02	-0.03
Combination education, women, older: EU TOP 3	6.44	5.34	4.17	3.97	0.12	0.03	-0.03

Source: PROD, simulations with FISK-OLG model.

6.1 Additional empirical evidence

Figure 18: **Employment rates in full time equivalents by gender and age group and education, 2023**

Distribution across EU member states (boxplot) and Austria (red dot).



Source: Labor Force Survey, Eurostat (2024), PROD calculations and figure. Interpretation: employment rate in full-time equivalents is defined as employment rate weighted by work intensity of employed persons. For example, an employed person working 40% of usual full-time hours is counted as 0.4 employed persons. A rate of 0.6 means the same labor quantity as 60% of persons in a given demographic group working full-time.

6.2 Sensitivity analysis

Table 5 shows the sensitivity analysis for six alternatives to the baseline model assumptions (robustness checks): high productivity growth, high population growth, lower substitutability between labor input of different skill groups, two alternative fiscal instruments and debt safeguard rule. For each robustness check, the table shows the impact of each reform scenario on GDP per capita in 2030, 2040 and 2070. *High productivity growth* follows the assumptions of the high productivity growth scenario introduced in section 3.1.3. *Low substitutability of labor input (skill groups)* shows the results for an alternative value of the substitution elasticity between labor inputs of various skill groups in the production function. In contrast to the linear case (elasticity goes to infinity), decreases for the low elasticity case (elasticity equals 20), the skill premium and relative labor productivity decrease as the supply of high-skilled labor increases. *Population growth: high migration scenario* follows the population projection of Statistics Austria (2023a). *Alternative fiscal instrument: government consumption* and *consumption tax* show the effects of sustaining a constant debt path with the use of alternative instruments. *Compliance with the EU debt safeguard* shows the effects for the case of following a more restrictive debt rule.

The sensitivity analysis shows that the simulation results are robust. In line with the economic theory, the effects are somewhat stronger in the case of using consumption taxes as the fiscal instrument, as this tax is more distortionary than the lump sum tax. With lower elasticity of substitution between labor input of various skill groups, the long term effects of the education reforms are smaller but remain positive and substantial. For the education reform scenarios, the effects are also stronger in the case of government consumption, as the direct costs of additional education are by construction offset by savings in other areas of government consumption.

Table 5: **Overview of effects of reform scenarios on GDP per capita under alternative assumptions**

	Effect on GDP p.c. in reform scenario difference to no-policy-change (in %)		
Reform scenario / Alternative assumption	**2030**	**2040**	**2070**
Education EU median			
Baseline assumptions	-0.14	-0.67	2.49
High productivity growth	-0.14	-0.66	2.46
Population growth: high migration scenario	-0.14	-0.66	2.50
Low substitutability of labor input (skill groups)	-0.12	-0.66	1.84
Alternative fiscal instrument: gov. consumption	-0.14	-0.51	3.30
Alternative fiscal instrument: consumption tax	-0.15	-0.56	3.46
Compliance with the EU debt safeguard rule	-0.14	-0.67	2.46
Education EU TOP 3			
Baseline assumptions	-0.29	-1.01	4.66
High productivity growth	-0.29	-1.01	4.62
Population growth: high migration scenario	-0.29	-0.99	4.68
Low substitutability of labor input (skill groups)	-0.26	-1.03	3.52
Alternative fiscal instrument: gov. consumption	-0.27	-0.69	5.80
Alternative fiscal instrument: consumption tax	-0.30	-0.77	6.09
Compliance with the EU debt safeguard rule	-0.30	-1.01	4.63
Women EU median			
Baseline assumptions	1.64	2.27	3.17
High productivity growth	1.64	2.26	3.16
Population growth: high migration scenario	1.65	2.28	3.17
Low substitutability of labor input (skill groups)	1.60	2.21	3.09
Alternative fiscal instrument: gov. consumption	1.75	2.34	3.07
Alternative fiscal instrument: consumption tax	2.16	2.74	3.44
Compliance with the EU debt safeguard rule	1.65	2.27	3.17

	Effect on GDP p.c. in reform scenario difference to no-policy-change (in %)		
Reform scenario / Alternative assumption	**2030**	**2040**	**2070**
Women EU TOP 3			
Baseline assumptions	3.13	4.20	5.53
High productivity growth	3.12	4.19	5.51
Population growth: high migration scenario	3.14	4.21	5.54
Low substitutability of labor input (skill groups)	3.10	4.15	5.46
Alternative fiscal instrument: gov. consumption	3.31	4.29	5.34
Alternative fiscal instrument: consumption tax	3.81	4.78	5.75
Compliance with the EU debt safeguard rule	3.13	4.20	5.52
Older workers EU median			
Baseline assumptions	0.47	0.30	0.23
High productivity growth	0.45	0.29	0.22
Population growth: high migration scenario	0.47	0.30	0.26
Low substitutability of labor input (skill groups)	0.44	0.29	0.23
Alternative fiscal instrument: gov. consumption	0.48	0.29	0.24
Alternative fiscal instrument: consumption tax	0.82	0.60	0.53
Compliance with the EU debt safeguard rule	0.47	0.30	0.22
Older workers EU TOP 3			
Baseline assumptions	1.11	0.99	1.03
High productivity growth	1.10	0.98	1.02
Population growth: high migration scenario	1.10	0.99	1.08
Low substitutability of labor input (skill groups)	1.09	0.99	1.04
Alternative fiscal instrument: gov. consumption	1.19	1.02	1.09
Alternative fiscal instrument: consumption tax	1.23	1.02	1.05
Compliance with the EU debt safeguard rule	1.12	0.99	1.02
Combination education, women, older: EU Median			
Baseline assumptions	2.28	2.30	7.34
High productivity growth	2.27	2.28	7.30
Population growth: high migration scenario	2.28	2.32	7.38
Low substitutability of labor input (skill groups)	2.22	2.19	6.39
Alternative fiscal instrument: gov. consumption	2.27	2.33	7.36
Alternative fiscal instrument: consumption tax	2.71	2.70	7.93
Compliance with the EU debt safeguard rule	2.28	2.29	7.29
Combination education, women, older: EU TOP 3			
Baseline assumptions	4.68	5.15	13.96
High productivity growth	4.67	5.13	13.91
Population growth: high migration scenario	4.68	5.18	14.04
Low substitutability of labor input (skill groups)	4.64	5.01	12.40
Alternative fiscal instrument: gov. consumption	4.66	5.17	13.67
Alternative fiscal instrument: consumption tax	5.26	5.66	14.46
Compliance with the EU debt safeguard rule	4.68	5.13	13.87
High migration			
Baseline assumptions	-0.16	-0.21	0.94
High productivity growth	-0.16	-0.21	0.97
Population growth: high migration scenario	-0.14	-0.19	0.78
Low substitutability of labor input (skill groups)	-0.17	-0.22	0.93
Alternative fiscal instrument: gov. consumption	-0.01	0.09	0.99
Alternative fiscal instrument: consumption tax	0.33	0.44	1.35
Compliance with the EU debt safeguard rule	-0.16	-0.20	0.98

Source: PROD, simulations with FISK-OLG model. Notes: *Population growth: High migration scenario* according to the population projection of Statistics Austria (2023a). *Alternative fiscal instrument: consumption tax* shows the effects in terms of value added per capita, as GDP effects are distorted by the variations of the consumption tax.