Labor productivity and the standard of living in Austria

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Abstract This study analyzes the relationship between labor productivity growth and the standard of living in Austria from 2006 to 2019 using the statistical decomposition proposed by Oulton (2022). The standard of living is represented by the Equivalized Household Disposable Income (EHDI). The growth rate of EHDI is decomposed into contributions from productivity growth, labor market and demographic indicators, and price competitiveness. The analysis shows that the contribution of labor productivity growth to EHDI growth is the most important component in EHDI growth. However, with the slowdown in labor productivity growth between 2006 and 2019, its contribution has declined, and was therefore an important factor in the sluggish development of household income. Positive contributors to household income growth include the decline in household size and the increase in labor force participation. Negative contributors to EHDI growth include the decline in the household share of total income, the decline in hours worked per employee and the aging of the labor force. In particular, the aging of the labor force is an ongoing concern and its negative contribution to the development of living standards in Austria has increased over time. The results also suggest that the decline in the competitiveness of the Austrian economy vis-à-vis its main trading partners has had a negative impact on living standards.

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Contents

List of Figures

List of Tables

1. Introduction

Standard of living refers to the level of income, material goods, services, and necessities available to people in a country. Gross household disposable income (GHDI) per capita is generally considered an appropriate measure for the standard of living or economic welfare. It includes real after-tax household income from all sources. While GHDI is not the sole determinant of quality of life, it does provide access to many of the intangible and non-monetary factors that affect people's subjective well-being and their ability to live healthy and fulfilling lives. The ability of the economy to raise the standard of living by increasing incomes naturally depends on the volume of goods and services produced by the workers. However, the exact nature of the relationship between labor productivity and household income is not clear and may vary over time.

Data for Austria suggest that the development of aggregate labor productivity and the GHDI have been subdued over the past decade. The OECD Compendium of Productivity Indicators (OECD, 2021) shows that the contribution of labor productivity to annual real GDP growth in Austria has declined compared to the period before the economic and financial crisis of 2008–2010.[1] The European Semester country report for Austria for 2022 (European Commission, 2022a) also notes that productivity growth in Austria has been below the EU average in recent years. At the same time, real GHDI per capita has declined compared to 2007.[2] GHDI per capita is high by international standards, but its development since the financial crisis has been sluggish. For this reason, the Joint Employment Report 2022 (European Commission, 2022b) recommends that its development be closely monitored. In the Proposal for a Joint Employment Report (European Commission, 2022c) Austria is one of five countries where the growth of gross household disposable income is considered "critical", the others being Greece, Italy, Spain and Cyprus.

In this paper we examine the relationship between the development of labor productivity and equivalized household disposable income (EHDI) for Austria using a statistical decomposition proposed by Oulton (2022). The equivalized household disposable income (EHDI) adjusts the GHDI for household size and composition. In this exercise, the growth rate of EHDI is decomposed into contributions from changes in labor productivity, household share of value added, measures of labor input, measures of inequality and equivalization, and terms of trade. While this statistical decomposition does not identify the underlying causal economic relationships between these indicators, it helps to develop an understanding of the potential transmission channels from productivity to income. Furthermore, we compare the development in Austria with the development in several groups of reference countries (EU member states, Euro Area countries, a group of countries consisting of Belgium, the Netherlands and the Scandinavian countries in the EU, and seven Central and Eastern European countries) for the period 2006 to 2019.

The results suggest that labor productivity is the most important factor contributing to EHDI growth, and its slowdown has played an important role in the observed decline in gross household income growth. The reduction in household size and the increase in labor force participation have been the main factors positively contributing to EHDI growth. The decline in the household share of total income and in labor intensity have, in turn, contributed to lower it. The aging of the labor force is likely to be a source of concern for income development in the long run. Moreover, the negative contribution of changes in the terms of trade to EHDI growth suggests that the competitiveness of the Austrian economy vis-à-vis its main trading partners is important for the development of household income. The development of each of the contributing factors is discussed in detail and compared with the peer country groups.

[1] Molnárová (2023) provides a detailed analysis of productivity development in Austria based on the latest EU-KLEMS data.

[2] Taking into account transfers in kind, the disposable income of households shifts upwards in such a way that it already returns to the level of 2008 in 2018. Even in this case, the overall dynamics of the GHDI remain sluggish. See Figure 15.

The paper is organized as follows. In Section 2 we outline the decomposition proposed by Oulton (2022) and discuss its underlying rationale and limitations. In Section 3 we describe the data used in this exercise. In Section 4 we present the decomposition and discuss the results for each measure. In Section 5 we draw conclusions and outline some avenues for further research.

2. Linking productivity growth and household disposable income

The relationship between the development of labor productivity and the standard of living is not clear ex-ante and may vary over time. Therefore, national productivity boards or international organizations often rely on *indirect* evidence when arguing for the importance of productivity growth for the standard of living or society more generally. For instance, the recent report of the Productivity Commission of Australia (Productivity Commission, 2022, chapter 1) argues that productivity growth is the only sustainable driver of long-term increases in living standards because

- the technological developments and inventions that have driven productivity growth over the past few centuries have also contributed to improvements in the quality and length of life, and because
- the tangible benefits of productivity growth come in the form of new or improved goods and services at a lower price and a reduction in the amount of labor needed to produce them.

In a recent paper Oulton (2022) attempts to establish a more formal, albeit descriptive, *direct* link between labor productivity growth and the standard of living. The author decomposes the growth rate of household income into the contributions from labor productivity and other influencing factors. The UK Productivity Commission's recent report for 2022 (National Institute of Economic and Social Research, 2022, p. 10) reported the results of this study. This paper applies the approach to data for Austria and several other peer country groups.

The preferred measure of economic welfare in Oulton (2022) is "real median equivalized household disposable income" (EHDI). While the well-being of individuals is influenced by several factors, such as leisure time, personal freedom and autonomy, good health, life expectancy, and a fulfilling emotional life, gross household disposable income (GHDI), defined as household income after taxes and transfers, is a key determinant of welfare.[3] By equivalizing GHDI, statistical offices increase the comparability of disposable income across individuals living in households of different sizes. In calculating per capita household income, additional adult household members are given lower weights. This allows accounting for the sharing of resources needed to achieve a certain standard of living (e .g. shared living space); children and adolescents are also given lower weights.[4] The EHDI therefore provides a more accurate picture of the standard of living. Using the median is a standard way of representing the income of an average person in a population, as income distributions are typically skewed. Deflating the EHDI by consumer prices ensures that changes in the EHDI over time reflect changes in purchasing power.

The decomposition of the growth rates of real EHDI, $\frac{\mathrm{EHDI}_{\mathrm{median}}}{\mathrm{P}_{\mathrm{CPI}}}$, into the contributions from the different factors is based on the expansion of the numerators and denominators to arrive at the following multiplicative form:

[3] See Sen (1987); Blanchflower and Oswald (2004); Kahneman and Deaton (2010); D'Ambrosio et al. (2020).

[4] Eurostat uses a weight of 1 for the first adult household member, 0.5 for each additional member aged 14 or over, and 0.3 for each household member aged under 14 ('OECD modified scale', see Eurostat). Although the resulting measure, "EHDI", contains the word "household", it actually measures a weighted value per-person, not for the household as a whole and not a measure aggregated over a household.

$$\frac{\mathrm{EHDI_{median}}}{\mathrm{P_{CPI}}} = \left(\frac{\mathrm{EHDI_{median}}}{\mathrm{EHDI_{mean}}}\right) \times \left(\frac{\mathrm{EHDI_{mean}}}{\mathrm{GHDI/N}}\right) \times \left(\frac{\mathrm{GHDI}}{\mathrm{GDP}}\right) \times \left(\frac{\mathrm{H}}{(1-\mathrm{u})\cdot \mathrm{L}}\right) \times (1-\mathrm{u}) \times \left(\frac{\mathrm{L}}{\mathrm{N_{wa}}}\right) \times \left(\frac{\mathrm{N_{wa}}}{\mathrm{N}}\right) \times \left(\frac{\mathrm{P_{GDP}}}{\mathrm{P_{CPI}}}\right) \times \left(\frac{\mathrm{GDP}}{\mathrm{P_{GDP}}\cdot \mathrm{H}}\right)$$

The variables used in the decomposition are:

- $\mathrm{EHDI_{median}}$: median value of *EHDI*
- P_{CPI}: harmonized index of consumer prices
- $\mathrm{EHDI_{mean}}$: mean value of *EHDI*
- GHDI: aggregate gross disposable income of households
- N: total population
- GDP: (nominal) GDP
- H: total hours worked
- u: unemployment rate
- L: labor force
- $\mathrm{N_{wa}}$: working age population (age 15–64)
- $\mathrm{P_{GDP}}$: GDP deflator

In order of their appearance in the identity above, the contributing components and their interpretation are:

1. **Inequality**, $\frac{\mathrm{EHDI_{median}}}{\mathrm{EHDI_{mean}}}$. Inequality is here defined as the ratio of median to mean EHDI. When income is distributed unequally, a higher share of the national income is allocated to fewer households. A median-to-mean ratio that is closer to one indicates a more equal income distribution. This is a measure of the inequality of the secondary income distribution, as the EHDI includes monetary social transfers. Nevertheless, it is an imperfect measure of changes in the secondary distribution of income, as it does not include transfers in kind.
2. **Equivalization**, $\frac{\mathrm{EHDI_{mean}}}{\mathrm{GHDI/N}}$. Equivalization adjusts household income to reflect the different resource needs of single adults, any additional adults, and children of different ages in the household. Household size changes over time due to a variety of demographic developments. The change in the equivalization factor over time captures these dynamics that affect household disposable income. The equivalization factor can be recovered (imperfectly as the discussion of the data will show) from the ratio of mean EHDI to mean GHDI.
3. **Households' income share of GDP**, $\frac{\mathrm{GHDI}}{\mathrm{GDP}}$. It is calculated as the share of GHDI in GDP. Not all of income generated in an economy is allocated to households. According to Oulton (2022), the bulk of retained income is allocated to social transfers in kind, e. g. free access to education, health care or other social transfers in kind. While these transfers contribute to individual welfare, households

cannot spend this part of their income freely, and access is conditional. We show how transfers in kind can affect the interpretation of the decomposition results in Section 4.

4. **Labor intensity**, $\frac{H}{(1-u)\cdot L}$. Labor intensity is defined as hours worked per person employed. It reflects the extent to which changes in labor supply in terms of hours worked, for example through part-time work or labor hoarding by firms, affect EHDI growth.
5. **Employment rate**, $(1-u)$. The employment rate is defined here as the number of employees and self-employed as a percentage of the labor force. It is a measure for the utilization of the labor supply in a country. Underutilization affects EHDI growth through its impact on earnings. When more people are working, earnings are higher. As a second-order effect, tighter labor markets are also associated with higher earnings, while the opposite is true for loose labor markets.
6. **Participation**, $\frac{L}{N_{wa}}$. Labor market participation is defined as the share of active labor market participants in the working age population, i. e. persons aged 15–64. This factor reflects changes in the size of the labor force. Higher participation implies a higher national income as more people join the labor force. Higher participation rates are therefore associated with a higher GDP. A second-order effect of participation is that it affects the tightness of labor markets.
7. **Working-age population's share of total population**, $\frac{N_{wa}}{N}$. Population aging is widely expected to have detrimental effects on economic growth and lead to income inequality (e. g. Eggertsson et al., 2019). Increases in the working-age population share have been shown to have a significant positive effect on per capita income (e. g. Maestas et al., 2016; Vogel et al., 2017; Kotschy et al., 2020).
8. **Terms-of-trade**, $\frac{P_{GDP}}{P_{CPI}}$. The ratio of the GDP deflator to the consumer price index reflects the terms-of-trade of the Austrian economy.[5] The analysis is based on real values for EHDI and real GDP per hour worked. The appropriate price deflator for the former is the consumer price index, which is a measure of the price level of domestically *consumed* goods. In turn, the GDP should be deflated with the GDP deflator, which measures changes in the prices of domestically *produced* goods. The difference between these two deflators is thus largely determined by changes in the price of imported goods relative to the price of produced (and exported) goods. It thus reflects the barter terms-of-trade which is a measure of the changes in the price competitiveness of domestic producers. This factor also captures relative inflation rates across different countries, as well as variations in the exchange rate.
9. **Labor productivity**, $\frac{GDP}{P_{GDP}\cdot H}$. Labor productivity is defined as real GDP per hour worked.[6] Changes in labor productivity reflect the joint influence of changes in capital intensity, as well as technical, organizational and efficiency changes in production activities within and between firms, the influence of economies of scale, varying degrees of capacity utilization, labor composition effects of human capital accumulation, and learning.

In summary, this decomposition highlights the economic and demographic factors that contribute to the growth of real EHDI. It relates the growth rate of EHDI to the growth rate of labor productivity at the country level. The identification of the contributing factors is based on economic theory and available evidence. However, a growth rate decomposition of the kind used here does not explain a causal relationship between labor productivity and living standards. It is a diagnostic tool that provides insights

[5] This is an incomplete measure for the terms of trade as terms of trade are typically a measure of relative prices of a country's exports and imports. While export prices reflect domestic producer prices and are therefore coincide with the GDP deflator, the CPI is a mixed price index of domestic and foreign commodities and services consumed in a country. Despite these limitations the coefficient is a reasonable approximation to terms of trade.

[6] There are different concepts of productivity that are relevant for the assessment of the performance of an economy, as discussed in the appendix. As labor productivity measured as value added per hour is the measure most closely related to workers' incomes it is the appropriate indicator to assess its impact on the standard of living.

into the relative dynamics of labor productivity, household disposable income and the factors outlined in this section. An additional caveat is that this exercise does not analyze other potential factors affecting the development of household incomes. For example, the impact of the composition of the labor force in terms of the age profile and the educational attainment level is only implicitly considered in the development of labor productivity. This is an important driver of wage growth in the labor market t (e. g. Kouvavas et al., 2019). Another important omission is the impact of migration, which changes the composition of the working age population. These limitations must be borne in mind when interpreting the results presented in the following sections.

3. Data

The data used in the analysis are available from Eurostat and cover the period 2006 to 2019. The main data sources were the Statistics on Income and Living Conditions (SILC) survey, the Annual National Accounts database, the Labor Force Survey (LFS), the Harmonized Indices of Consumer Prices (HICP) database and the Population and Demography database. Data on household size and the equivalization factor for Austria were obtained from Statistics Austria. More information on the construction of each of the indicators listed in Section 2 and on the specific data series used is provided in the appendix.

To compare the results for Austria with relevant benchmarks, four groups of countries were constructed. These groups consist of all current EU Member States (EU27), the Euro-Area (EA) countries, the BENESCAND countries consisting of Belgium, the Netherlands, Denmark, Finland and Sweden, and finally a group of Central and Eastern European EU countries (EU-CEE-7) for which data were available (the Czech Republic, Slovakia, Slovenia, Hungary, Estonia, Lithuania, Latvia); the EU countries Bulgaria, Croatia, Malta, Poland and Romania are not included due to missing data. The EU27 and the EA allow a comparison with EU-wide developments. The BENESCAND group consists of the countries with the highest productivity levels in the EU and are classified as "innovation leaders" by the European Innovation Scoreboard for 2022.[7] Finally, the EU-CEE-7 consists of the EU member states in Austria's neighborhood and the Baltic states, which have experienced faster productivity growth due to the process of economic convergence after joining the EU and should therefore be analyzed separately to understand how the economic catching-up processes may change the results. The country group results presented in the next section are group averages derived from the country-level decomposition. No population weighting was applied.

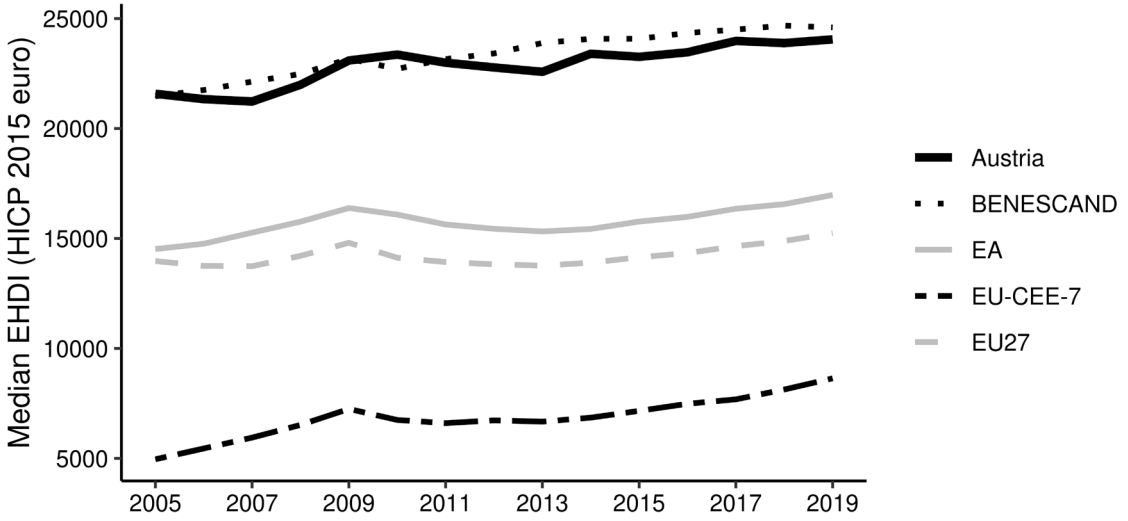
4. Results

4.1 Decomposition

We start by looking at the two indicators of interest in this paper, the growth rate of EHDI and the growth rate of labor productivity. Figure 1 shows the median of real EHDI between 2005 and 2019, for Austria and for four other peer groups of countries. The median EHDI has increased over the observation period with the series showing a decline after the economic and financial crisis 2008. For Austria and most country groups the recovery started in 2014, when the EHDI started to grow again. The median real EHDI in Austria is close to that of the BENESCAND countries. However, the recovery after the economic and financial crisis was faster than in Austria.

[7] See https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en.

Figure 1: **Median EHDI, Austria and country groups, 2005–2019**



Notes: Median and mean equivalized net income: EU-SILC and ECHP, ILC_DI03, MED_E and MEI_E, nominal values, euro; HICP harmonized index of consumer prices: annual data, 2015=100, PRC_HICP_AIND, Eurostat. Authors' calculations.

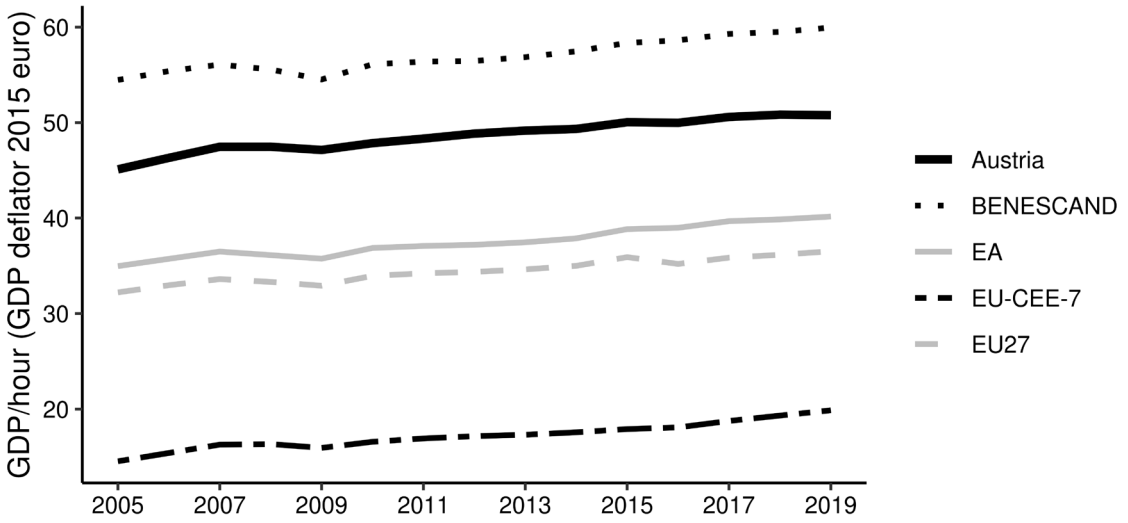
Figure 2 shows labor productivity as measured by real GDP per hour worked in levels per hour over time.[8] However, the figure indicates that in the aftermath of the great financial and economic crisis 2008 productivity development has slowed down as the series flatten out. The comparison with the country groups shows that in terms of labor productivity levels Austria is positioned well above most country groups except for the BENESCAND countries. Comparing EHDI with hourly labor productivity, the series shows a strong increase in the aftermath of the financial crisis in 2008. This is to some extent related to differences in the development of the GDP deflator which is used to deflate labor productivity and the harmonized consumer price index used to deflate EHDI (see Figure 13, for the factor P_{GDP}/P_{CPI}).

Table 1 presents the results of the decomposition linking labor productivity and household income growth for the period 2006 to 2019 in Austria. We also report the results for two subperiods of equal length to allow a separate analysis of developments around the great economic and financial crisis in 2008 and in its aftermath. For each factor, the table shows the mean contribution of each of the factors discussed in Section 2 to the growth rate of median EHDI over a given period. Their numbering corresponds to the one in Section 2. The columns present relative and the absolute contributions to the EHDI growth rate.[9] Figure 3 shows the growth rates of real median EHDI and labor productivity for Austria over time.

[8] Real GDP per hour worked follows a steadier development than real GDP per capita, see Figure 17 in the Appendix. Labor productivity is less volatile, which is a consequence of adjustment of hours worked while keeping people in employment during a downturn.

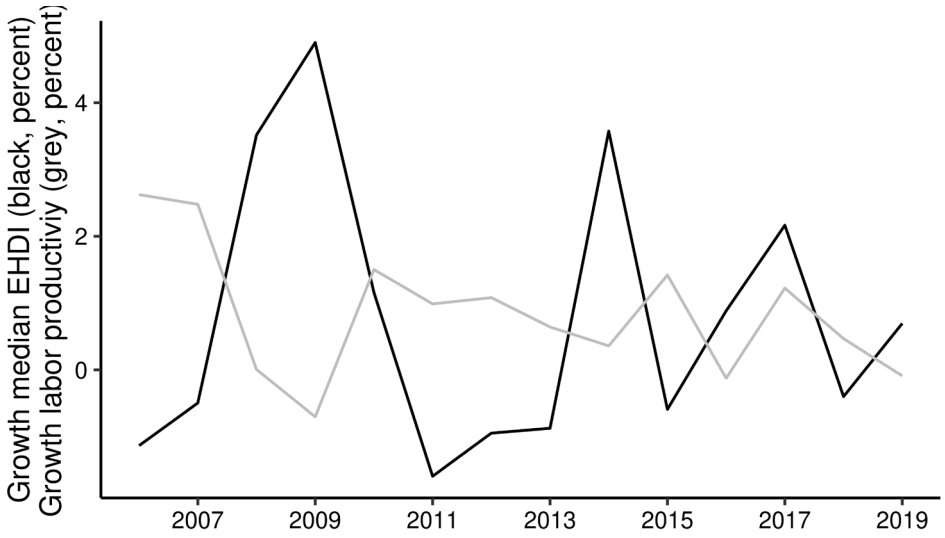
[9] The annual change of each factor can be expressed as a multiplicative value relative to the previous year. The natural logarithm of this multiplicative value is approximately equal to the growth rate. Therefore, formulating the decomposition equation's evolution from one year to the next with multiplicative values (of the form 1 plus the growth rate), dividing by the previous year's values, and taking logs yields approximately an additive decomposition of the growth rate of real median EHDI into the sum of the growth rates of the factors. The appendix lists the steps of the calculation.

Figure 2: **Labor productivity Austria and country groups (2005–2019)**



Notes: GDP at market prices, million euro, and chained linked volumes, index 2015=100, national accounts, NAMA_10_GDP; GDP-deflator, calculated as GDP (nominal) divided by GDP in chained volumes; employment, thousand hours worked NAMA_10R_2EMHRW. Source: Eurostat. Authors' calculations.

Figure 3: **Percent growth of real EHDI and labor productivity Austria (2006–2019)**



Notes: Median and mean equivalized net income: EU-SILC and ECHP, ILC_DI03, MED_E and MEI_E, nominal values, euro; HICP harmonized index of consumer prices: annual data, 2015=100, PRC_HICP_AIND. GDP at market prices, million euro, and chained linked volumes, index 2015=100, national accounts, NAMA_10_GDP; GDP-deflator, calculated as GDP (nominal) divided by GDP in chained volumes; employment, thousand hours worked NAMA_10R_2EMHRW. Eurostat. Authors' calculations.

The absolute contributions of a factor reflect the growth rate of that factor and can be interpreted as contributions to the growth rate of the median EHDI shown in the top row of data in percentage points. Negative values thus indicate that in a given period the development of a factor has reduced EHDI growth, whereas positive values indicate that a factor has increased EHDI growth. The relative

contributions indicate the importance of each factor for the periods shown in the table.[10] They sum up to 100 (percent of the growth rate of EHDI).

Table 1: **Austria, factor contributions to growth of median equivalent incomes**

	Factor	Measure	Sub-period 2006-2012		Sub-period 2013-2019		Overall 2006-2019	
		Growth median EHDI	0,77		0,78		0,78	
			Contributions					
			relative	absolute	relative	absolute	relative	absolute
1.	Inequality	Median EHDI/Mean EHDI	-8.51	-0.07	15.83	0.12	3.71	0.03
2.	Equivalization	Mean EHDI/Mean GHDI	67.70	0.52	47.11	0.37	57.36	0.45
3.	Households' income share	GHDI/GDP	-52.12	-0.40	-67.83	-0.53	-60.01	-0.47
4.-7.	Labor	[sum of 4.-7.]	-7.69	-0.06	12.63	0.10	2.51	0.02
4.	Labor intensity	Hours/person employed	-106.45	-0.82	-9.67	-0.08	-57.86	-0.45
5.	Employment rate	1–unemployment rate	14.26	0.11	7.5	0.06	10.87	0.08
6.	Participation	Labour force/working age pop.	92.03	0.71	39.76	0.31	65.78	0.51
7.	Working-age population share	Share of total population	-7.53	-0.06	-24.96	-0.19	-16.28	-0.13
8.	Terms-of-trade	GDP deflator/HICP	-46.96	-0.36	20.85	0.16	-12.91	-0.10
9.	Labor productivity	GDP per hour worked	147.58	1.14	71.41	0.56	109.33	0.85
1.-9.	Total	[sum of 1.-9.]	100	0.77	100	0.78	100	0.78

Notes: See the appendix for data sources and specifications of indicators. Authors' calculations based on Eurostat data.

The growth rates of the median EHDI are very similar in both subperiods, at just over 3/4 percent per year. Labor productivity growth averaged 0.85 percent, which corresponds to an average contribution to EHDI growth of 109.33 percent over the entire period. The subperiods show that labor productivity growth more than halved between the first and second subperiods. In the first subperiod it amounted to 1.14 percent corresponding to a relative contribution of 147.58 percent. In the second subperiod, labor productivity in Austria fell to 0.56 percent equaling 71.41 percent relative contribution. This implies that labor productivity transforms less than one to one into higher household incomes. Despite its decline, labor productivity stands out as the most important factor contributing to the growth in income also in Austria. This is in line with the results by Oulton (2022) for the UK.

Next to labor productivity the most important contributions to EHDI growth came from changes in household size (equivalization) and changes in labor participation. Household size has decreased whereas labor participation has steadily increased over the observation period (see Figure 14 and Figure 10, and the discussion of these data below). The absolute contribution of equivalization has decreased from 0.52 to 0.37 percentage points. Participation in turn has slowed down over time. The contribution of this factor was considerably smaller in the subperiod 2013-2019 than in the subperiod 2006-2012. Its absolute contribution decreased from 0.71 to 0.31 percentage points.

The most important negative contributions to EHDI growth came from the household share of total income and labor intensity measured in terms of hours worked per person employed. Both the household share of total income and hours worked have decreased over time (see Figure 7 and Figure 8). The negative contribution of labor intensity has weakened in the second period, whereas the negative contribution of household share of income has slightly increased. The joint contribution of all labor supply variables to EHDI growth was however positive. The negative impact of the share or working age population has in turn increased over time. The higher labor participation contributed to offset this effect.

[10] The factors' growth rates can be transformed to a sum, and each growth rate's contribution relative to the overall growth rate of labor productivity. For example, when EHDI would grow by 2 percent and this would be the sum of two factors, each of them growing by 1 percent, then each factor would contribute 50 percent to the total growth rate.

Table 2 compares the development in Austria with the groups of countries presented in Section 3. Median EHDI growth in Austria was above the EU27 average, but growth was slower than in all other country groups over the observation period. Labor productivity growth in turn was on average lower than in all peer country groups, except the BENDSCAND group. As in Austria, it was the most important factor contributing to EHDI growth across all country groups. The relative contribution of productivity growth and thus its importance as a factor contributing to the development of household incomes was higher in Austria in most cases.

While the factors that provide a positive contribution to EHDI growth are similar across country groups, the development in the BENESCAND group was different. Here the contribution of changes in the household's share of total income and in labor intensity to EHDI growth was positive whereas it was negative in Austria and all other country groups. As Figure 7 and Figure 8 show, both the average level of hours worked and the labor share of total income are considerably lower in these countries. On the other hand, the labor share of income has experienced a marked increase in the BENESCAND countries and has remained at this higher level ever since, whereas in the other countries the labor share peaked around the economic crisis of 2008 and then slowly declined again. The observed differences are most likely related to institutional differences in labor market and social policies. A further examination of the causes for this outcome is warranted but beyond the scope of this paper.

A specific pattern of development can also be observed for the EU-CEE-7 countries. The growth rates of median EHDI and labor productivity were particularly large in this country group. EHDI growth averaged 3.96 percent and labor productivity growth 2.23. The relative contribution of labor productivity to EHDI growth was however smaller than in the other countries. The absolute contribution of the reduction in household size was very large. Labor supply factors such as participation or employment contributed more than in other countries to EHDI growth. Aging, captured by the share of the working age population in the total population, however, offsets to some extent the contribution of labor supply factors. As in these countries a larger set of factors combine to contribute positively to EHDI growth the relative importance of labor productivity growth is smaller despite being very large in absolute terms.

Table 2: **Factor contributions to growth of median equivalized incomes, country groups (2006-2019)**

	Factor	Measure	2006–2019									
			Austria		EU27		EA		BENESCAND		EU-CEE-7	
		Growth median EHDI	0.78		0.62		1.12		0.97		3.96	
			Contributions									
			rel.	abs.	rel.	abs.	rel.	abs.	rel.	abs.	rel.	abs.
1.	Inequality	Median EHDI/Mean EHDI	3.71	0.03	9.69	0.06	9.16	0.10	-2.32	-0.02	5.97	0.24
2.	Equivalization	Mean EHDI/Mean GHDI	57.36	0.45	90.78	0.56	51.41	0.58	7.16	0.07	34.32	1.36
3.	Households' income share	GHDI/GDP	-60.01	-0.47	-38.70	-0.24	-23.15	-0.26	22.6	0.22	-2.43	-0.10
4.-7.	Labor	[sum of 4.-7.]	2.51	0.02	43.51	0.27	17.87	0.20	18.35	0.18	8.36	0.33
4.	Labor intensity	Hours/person employed	-57.86	-0.45	-25.48	-0.16	-13.69	-0.15	9.1	0.09	-7.44	-0.29
5.	Employment rate	1–unemployment rate	10.87	0.08	30.07	0.19	8.97	0.10	12.45	0.12	8.73	0.35
6.	Participation	Labor force/working age pop.	65.78	0.51	85.85	0.53	46.35	0.52	27.49	0.27	17.82	0.71
7.	Working-age pop. share	Share of total population	-16.28	-0.13	-46.93	-0.29	-23.76	-0.27	-30.69	-0.30	-10.75	-0.43
8.	Terms-of-trade	GDP deflator/HICP	-12.91	-0.10	8.07	0.05	7.92	0.09	-14.62	-0.14	3.13	0.12
9.	Labor productivity	GDP per hour worked	109.33	0.85	144.17	0.89	88.41	0.99	70.49	0.68	56.38	2.23
1.-9.	Total	[sum of 1.-9.]	100	0.78	100	0.62	100	1.12	100	0.97	100	3.96

Notes: See the appendix for data sources and specifications of indicators. Authors' calculations based on Eurostat data. Country groups: EU27 - current EU member atates; EA - Euro-Area countries; BENESCAND - Belgium, the Netherlands, Denmark, Finland, Sweden; EU-CEE-7 - Czech Republic, Slovakia, Slovenia, Hungary, Estonia, Lithuania, Latvia. Values for country groups represent unweighted group means of country values.

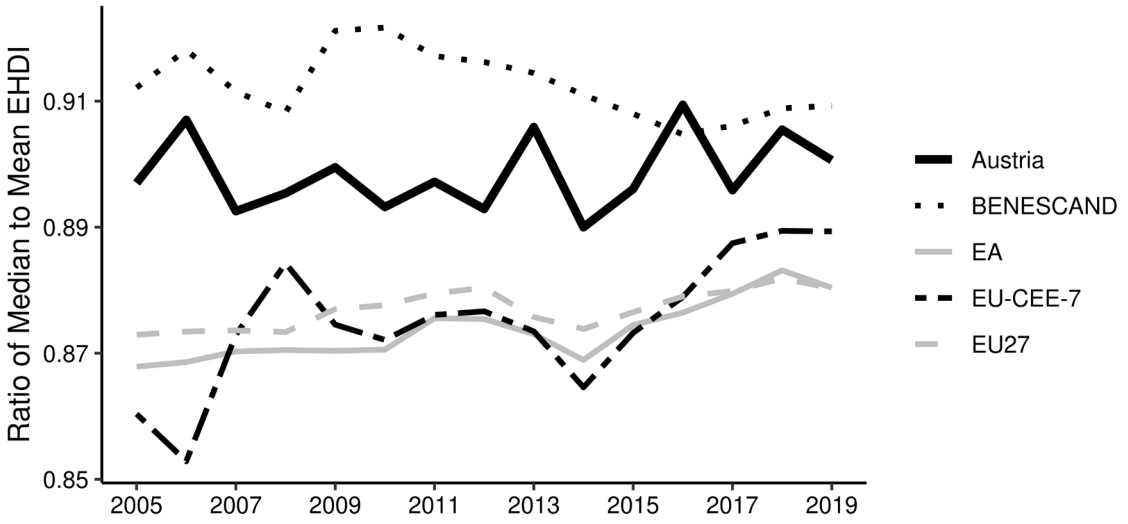
4.2 Contributing factors

We will now discuss the single time series of each contributing factor for Austria and the peer country groups to better understand the implications of these results.

Inequality

Figure 4 shows the development of the ratio of median-to-mean EHDI over time for Austria and for the other country groups. Values closer to unity reflect a more equal (secondary) distribution of household incomes. Inequality has therefore slightly increased in the aftermath of the financial and economic crisis 2008 but has recovered between 2015 and 2019. The level of inequality in Austria is close to but slightly below that of the BENESCAND countries. The income distribution by this measure is, however, more equal in Austria than in all other peer country groups.

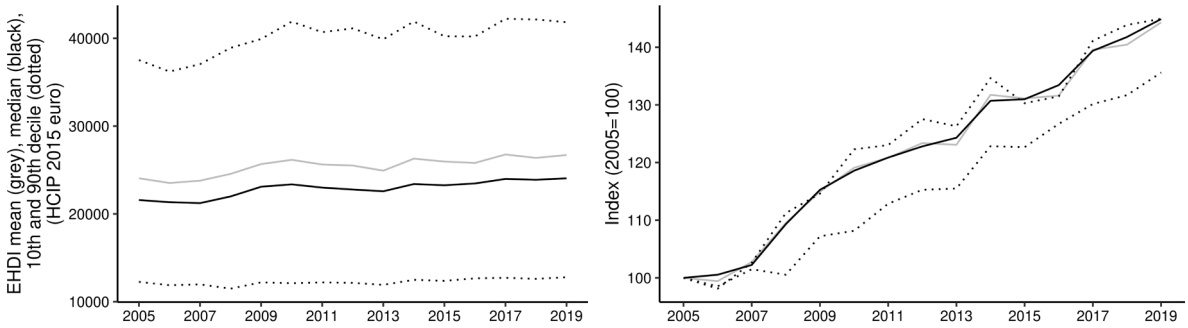
Figure 4: Inequality in Austria and country groups (2005–2019)



Notes: Inequality defined as ratio of median-to-mean EHDI. This is a measure of inequality in secondary income distribution. Transfers in kind are not included. Source: Median and mean equivalized net income: EU-SILC and ECHP, ILC_DI03, MED_E and MEI_E, nominal values, euro; Eurostat. Authors' calculations.

Figure 5 shows additional information on the distribution of EHDI in Austria. The left panel shows the development of the 1st and the 9th decile of EHDI, compared to mean and median EHDI. There is a large gap between the 1st and 9th decile, and, as expected, some distance between the mean and the median. The right panel shows the development of to the distribution over time. The gap widens for the lower incomes in the 1st decile, starting during the financial crisis. Until the end of the period, the lowest decile is unable to close the gap. Between 2009 and 2015 household incomes in the 9th decile increases faster than the median income such that inequality increases in this period. After 2015 the development of the top household income decile converges to that of the median. The mild decrease in inequality at the end of the observation period was therefore largely due to the top income decile moving closer to the median, and not by a faster growth of household incomes in the lowest income decile.

Figure 5: **Distribution of EHDI (left), and indexed to 2005=100 (right); Austria**



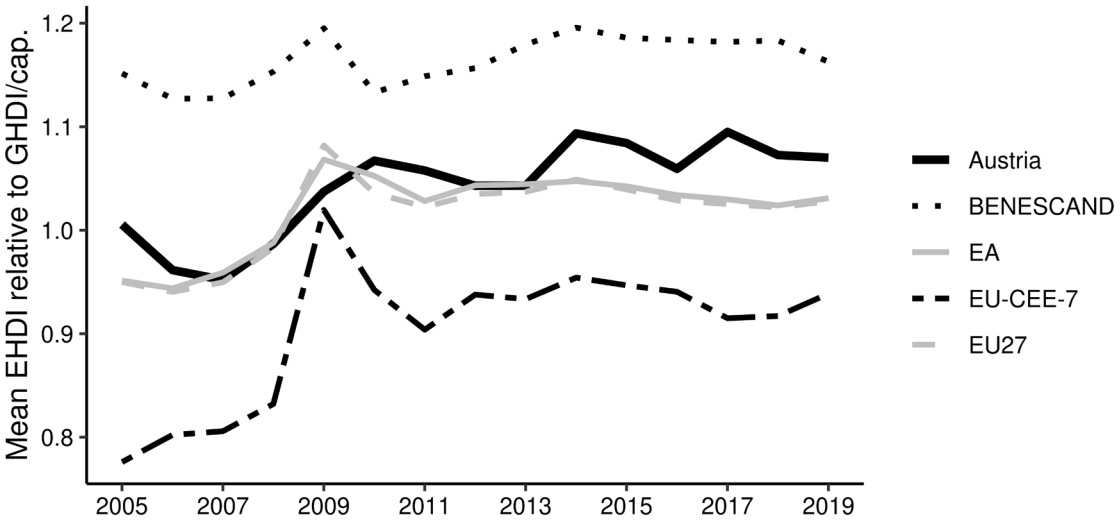
Notes: Median and mean equivalized net income for Austria; Eurostat. Authors' calculations.

Equivalization

Changes in the size and composition of households have had a significant impact on the results on EHDI in Austria and the peer country groups according to Table 1 and Table 2. Figure 6 shows the development of the underlying series. Despite some year-on-year variation, the equivalization factor increases over time. As the discussion in the appendix shows, this is largely determined by a reduction in household size. Higher values of this indicator therefore largely capture smaller households. In Austria household size has decreased over time. It is slightly above the EU27 and EA averages up to 2011, but has decreased faster after 2013. Relative to the EU27 figures, household sizes are on average larger in the EU-CEE-7 countries, and much smaller in the BENESCAND countries.

The contributions of equivalization to household incomes observed in the decomposition exercise reflect these developments. In the BENESCAND countries the contribution to EHDI growth was very small in absolute and relative terms. In Austria the absolute contribution was close to that in the EU27 countries but relatively less significant. In In the EU-CEE-7 the absolute contribution was significant also given the low level as compared to the EU27. Given that the contribution of productivity growth was so dominant in these countries, its relative significance was not as high as for the EU27 countries in total.

Figure 6: **Equivalization in Austria and country groups (2005–2019)**



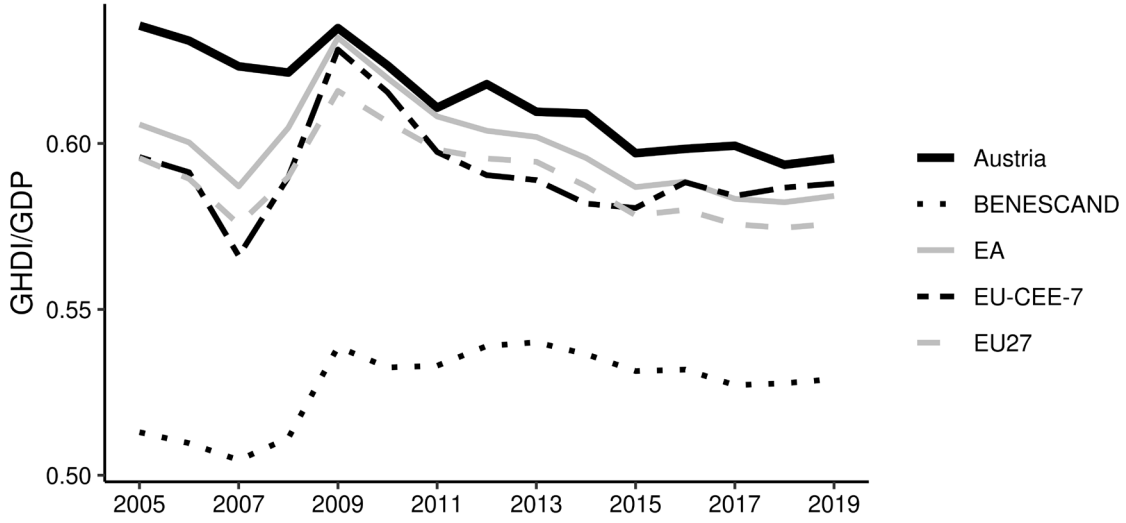
Notes: Equivalization reflects changes in household size and composition. Source: Median and mean equivalized net income: EU-SILC and ECHP, ILC_DI03, MED_E and MEI_E, nominal values, euro; disposable income (gross), households and NPISH, nominal prices, euro. National accounts, NASA_10_NF_TR, B6G, S14_S15; total population and working age population (15-64 years). DEMO_PJANBROAD; Eurostat. Authors' calculations.

The literature on economic development has long stressed that the reduction in household size goes along with lower poverty (e. g. Lanjouw and Ravallion, 1995), higher educational attainment of the adult parents living in a household (e. g. Lutz and KC, 2011), as well as the educational attainment of children and further fertility decisions (e. g. Ejrnæs and Pörtner, 2004). In advanced economies this association with affluency is however also associated with an erosion of economies of scale in consumption. This goes along with higher CO_2 emissions (e. g. Underwood and Zahran, 2015).

Households' income share of GDP

This share reflects income that is available to households for consumption from wages and salaries, income from self-employment and from unincorporated enterprises, income from financial investments, and monetary transfers such as pensions and other social benefits, less taxes, social insurance contributions, and interest payments. The decomposition in Table 1 shows that the contribution of this share to EHDI growth has declined over time. This is associated with a decline in the household disposable income share of GDP, as Figure 7 suggests.

Figure 7: **Households' income share of GDP in Austria and country groups (2005–2019)**



Notes: Households' income share defined as GHDI/GDP. Source: GDP at market prices, million euro; and chained linked volumes, index 2015=100, national accounts, NAMA_10_GDP; GDP-deflator, calculated as GDP (nominal) divided by GDP in chained volumes; disposable income (gross), households and NPISH, nominal prices, euro. National accounts, NASA_10_NF_TR, B6G, S14_S15; Eurostat. Authors' calculations.

As noted in the introduction, the European Commission has identified the slow development of GHDI as a critical factor for social development in Austria (European Commission, 2022b, p. 96). This decline drives the drop of households' disposable income share of GDP observed in Figure 7. This development was not specific to Austria. The drop of the households' disposable income share of GDP across country groups suggests that GHDI has declined in almost all peer country groups in the aftermath of the financial and economic crisis 2008 after a rising during the crisis. In Austria the drop was more accentuated starting from an overall higher initial value. The group of BENESCAND countries in turn shows a distinctive time pattern. Starting from a much lower level, the households' share of total income increased during the crisis, levelled off for some years afterwards and started a slow decline only in the most recent years of the observation period.

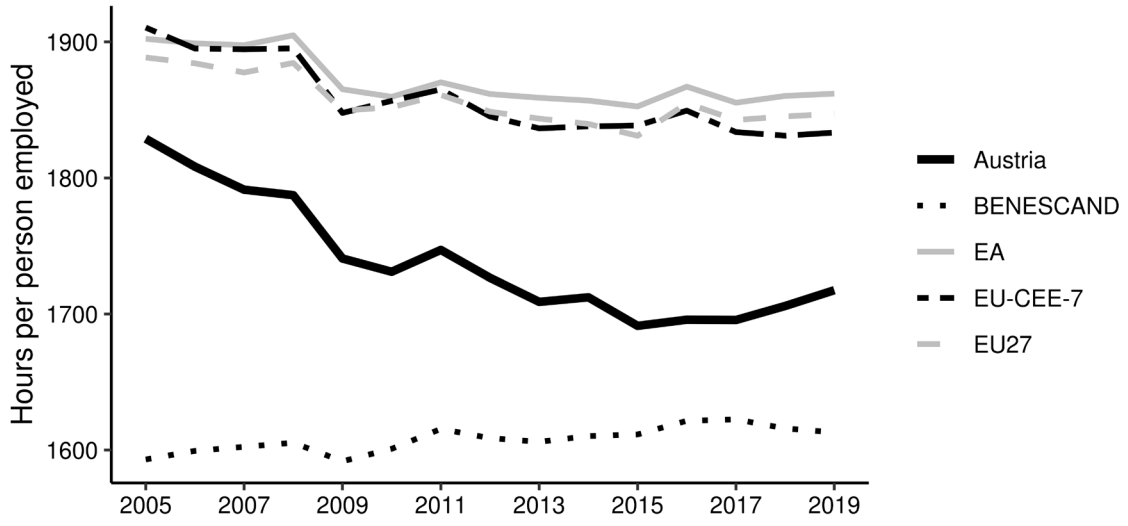
Further examinations reported in the appendix suggest that the decline in the share of household income would not have been affected if transfers in kind been had taken into account. They affect the level but not the growth of household income. It is also unlikely that the decline in the household income

share is related either to changes in the labor share of total income or to a decoupling of labor productivity from hourly wages.

Labor intensity

Hours worked decreased on average in Austria, by about 2.1 hours per week over the observation period (Figure 8). In Austria, the level of labor intensity is lower than in the EU27, the EA and the EU-CEE-7 countries, but higher than in the BENESCAND countries. In all groups of countries, except the BENESCAND countries, the labor intensity has declined steadily over the period. In Austria, however, it has risen slightly at the end of the period. The level in Austria developed from just over 1,800 hours per employee per year to just over 1,700 in 2019.

Figure 8: **Hours per person employed in Austria and country groups (2005–2019)**



Notes: Employed persons, thousand hours worked, national accounts, NAMA_10R_2EMHRW. Employment, LFS (Labor Force Survey), LFSA_EGAN; Eurostat. Authors' calculations.

For a given level of employment, changes in labor intensity reflect changes in the labor supply of labor market participants, for example through part-time work. From a welfare point of view, a decline in labor intensity may not reduce living standards and (subjective) well-being. Such reductions can be either voluntary, involuntary or mandated and have a direct impact on per capita income. Causes of involuntary changes in working time can be related to forced part-time work during cyclical downturns in economic activity or overtime work imposed by management during peaks in demand.

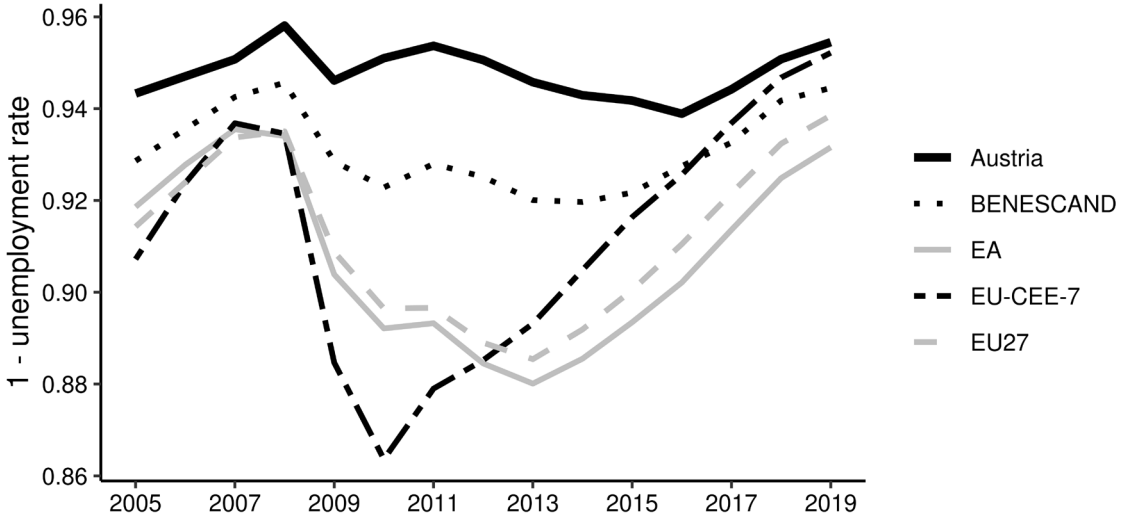
In the case of a voluntary reduction in work intensity, i. e. when there are no external constraints forcing this decision, an individual forgoes income in order to spend more leisure time. This can have a positive effect on subjective well-being. In this case, total welfare may increase despite a loss of income. In the case of an involuntary reduction in hours worked, on the other hand, an individual forgoes income and is forced to do so by external circumstances. This causes both income loss and possibly psychological or physical stress. The overall impact on well-being may therefore be even more negative than the loss of

income alone would suggest. This may be the case if the labor market is not in equilibrium and people working part time would like to work more hours.[11]

Employment rate

The employment rate affects household income growth through its impact on earnings. Figure 9 shows that the employment rate in Austria was higher than in all other comparison groups. Starting from this higher level the decline of the employment share after the great financial and economic crisis 2008 was more protracted in Austria. The trough during the recession in the aftermath of the crisis was less pronounced than in the other groups. At the end of the observation period the employment rate has increased reaching pre-crisis levels. In the case of the EU-CEE-7 countries these were also exceeded. Overall, Table 2 shows a small contribution of changes in the employment share to changes in EHDI growth. This may be the result of the factor's changes being relatively small on average, with ups and downs mostly cancelling out in the periods reported. Only in the EU-CEE-7 country group the increase in the employment rate was relatively more important and contributes also more in absolute terms to EHDI growth.

Figure 9: **Employment rate in Austria and country groups (2005–2019)**



Notes: Employment rate defined as employed persons (covers employees and self-employed) as a percentage of the labor force. Source: unemployment: LFS (Labor Force Survey), LFSA_UGAN, persons; employment: LFS (Labour Force Survey), LFSA_EGAN, persons; Eurostat. Authors' calculations

Participation

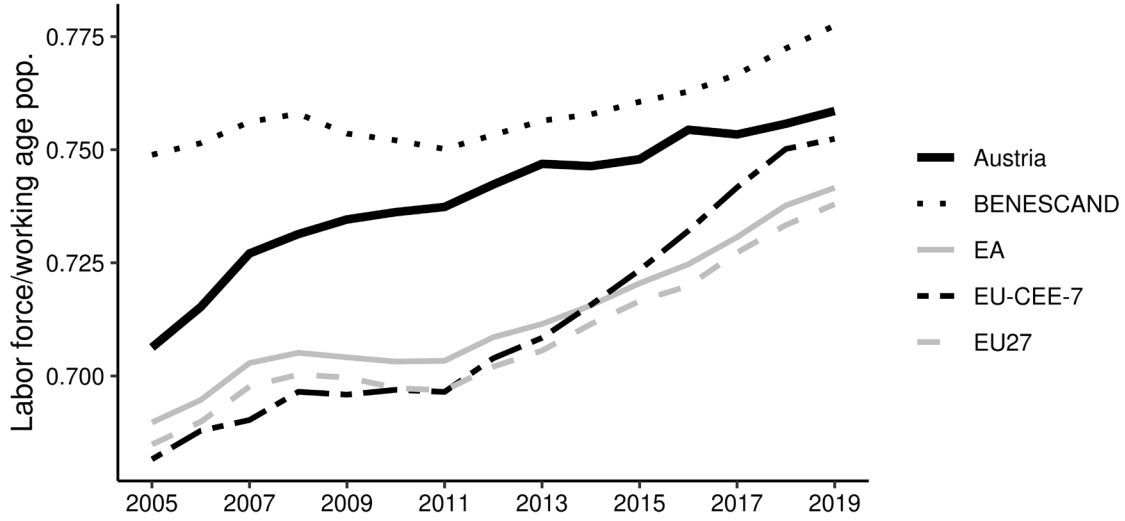
Labor market participation in Austria has increased almost monotonically over time. In 2019 it was above 75 percent (see Figure 10).[12] As will be shown in the next paragraph, this development was driven by an increase in female labor market participation. The decomposition shows that this factor

[11] Other aspects contributing to the ambiguity of changes in hours worked on individual well-being are, for example, the question of how absenteeism and presenteeism are related to hours worked. Both phenomena influence hours worked and productivity at work (see for example Arnold, 2016), to an extent that is economically significant (Mattke et al., 2007). Another aspect of the digital transformation of modern economies is related to the question of how digital technologies affect labor intensity. As people spend more and more time online performing various activities related to market and household production as well as leisure, labor intensity and its impact on both income and subjective well-being become more difficult to measure and assess.

[12] This development is similar in Germany and in line with the target rate of 75 percent set by the European Commission (see Jahresgutachten des Sachverständigenrates 2022/23, Grimm et al., 2022, p. 363).

contributed significantly to EHDI growth. In Austria, the mean annual growth rate of labor market participation was about 0.5 percent and almost identical to the EU27 and EA. In the EU-CEE-7 it was about 0.7 percent (see absolute contributions in Table 2). Participation in Austria converged to the level of the BENESCAND countries, but did not reach it at the end of the observation period.

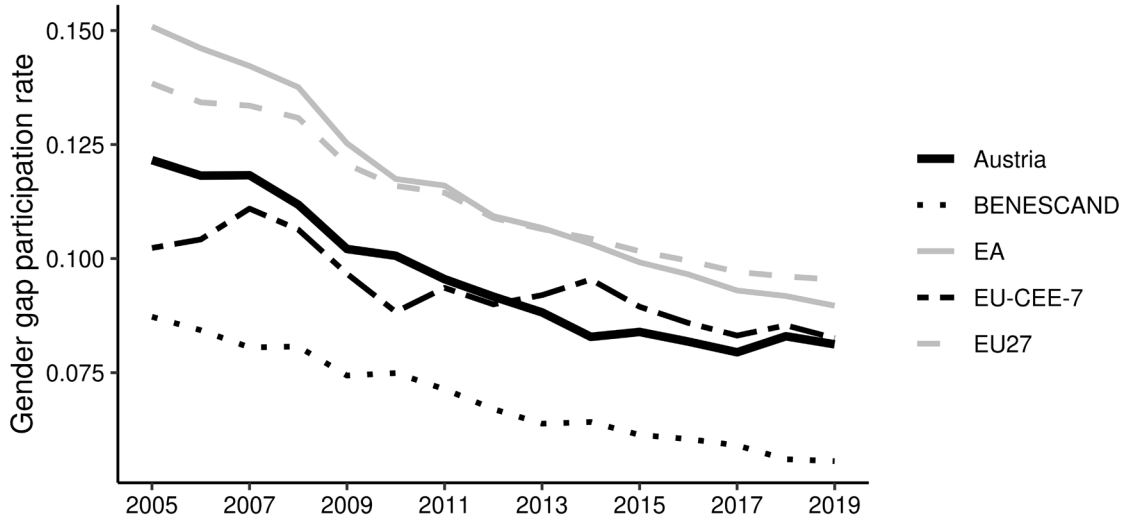
Figure 10: **Labor market participation in Austria and country groups (2005–2019)**



Notes: Labor market participation is the share of active labor market participants in the working age population. Source: Working age population (15-64 years), DEMO_PJANBROAD; employed persons, national accounts, LFSA_EGAPS; Eurostat. Authors' calculations.

One aspect of labor market participation is the participation of women. It has increased in Austria both overall and relative to men. Figure 11 shows the difference between men and women, the gender gap in labor force participation, for Austria. It has been decreasing for most of the time interval, but has stagnated in the last few years of our observation period.

Figure 11: **Gender gap in labor participation in Austria and country groups (2005–2019)**

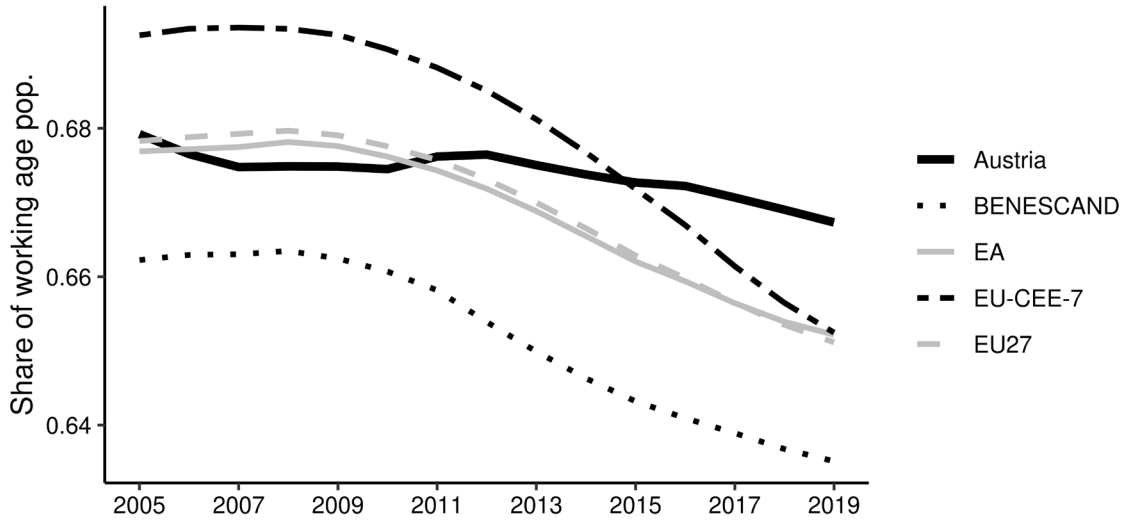


Notes: Working age population (15-64 years) by sex, DEMO_PJANBROAD; employed persons, by sex, national accounts, LFSA_EGAN; Eurostat. Authors' calculations.

Working-age population's share of total population

The shares of working age population have been decreasing in Austria. A similar development is observed across all peer country groups (see Figure 12). The decomposition results in Table 1 show that this development has contributed to lower EHDI growth and that this effect has become even more accentuated in the second subperiod of our data for Austria. This factor therefore merits particular attention.

Figure 12: **Share of working age population in Austria and country groups (2005–2019)**



Notes: Total population and working age population (15-64 years). DEMO_PJANBROAD. Eurostat. Authors' calculations.

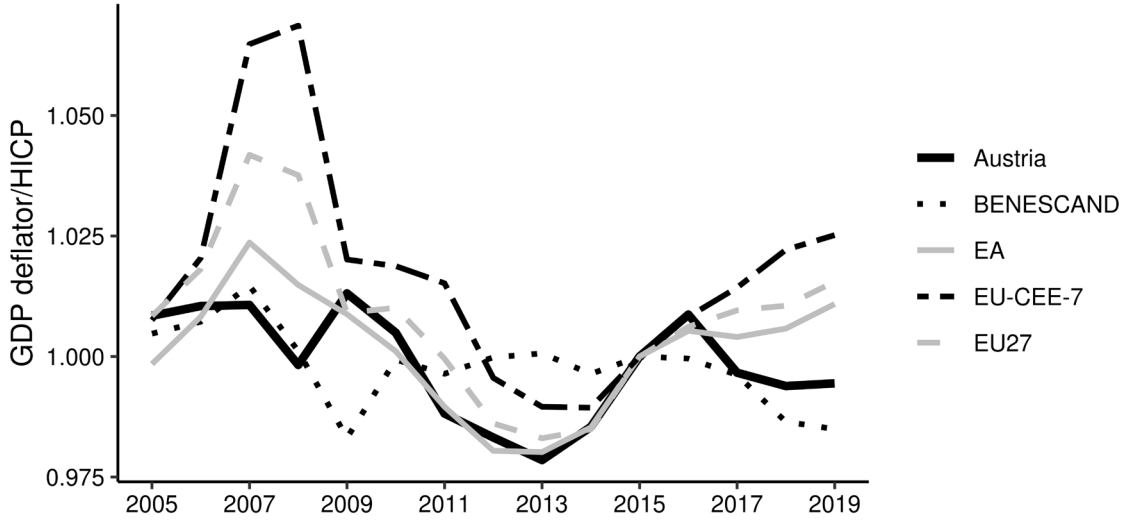
The effects of an aging workforce on household income arise through its impact on the size of the labor force and through age-related productivity effects. For example, Feyrer (2007) finds the highest positive effect on productivity for the 40-49 age group and lower productivity for older groups. In this case, average productivity will decline as relatively more employment falls into the older age groups. In the secular stagnation hypothesis, summarized by Eggertsson et al. (2019), a smaller share of the working age population decreases GDP per capita because GDP is produced by a smaller number of employed people. Two developments may mitigate or overcompensate for the decline in growth: (i) capital deepening, which can be expected due to the decline in real interest rates associated with aging due to higher time preferences of the elderly, and (ii) labor-saving innovation. Eggertson et al. (2019) confirm an overall positive effect of aging on GDP per capita found in previous studies, but a reversal leading to a negative effect of aging on GDP as countries approach the zero lower bound on interest rates. They also show that capital deepening follows the same pattern: it increases with an aging society, but stops when near the zero lower bound.

One aspect that affects both demographics and labor force participation that is not included in this decomposition, but that has a direct impact on the share of the working age population participating in the labor force as well as on other labor market indicators, is migration. Marois et al. (2020) emphasize that the demographic effect interacts crucially with migration policy, and that there is an additional interplay between migration and labor force participation because migrants often have lower participation rates (lowest in Denmark). An additional factor is the possibility of migration selective on productivity, which Marois et al. (2020) approximates by the level of education (lowest recently in Italy). Future extensions of this framework may include this factor.

Terms-of-trade

The ratio of the GDP deflator to the HICP measures the aggregate price of goods produced (and exported) versus goods consumed (and imported) in the economy. This ratio thus captures a terms-of-trade effect. It has developed unfavorably for Austria over the period 2006–2019 (Figure 13). As a consequence, the contribution of this effect to EHDI growth has been negative, as the decomposition results in Table 1 show. In the subperiod 2012-2019 the ratio developed more favorably, but this development was partly offset by the negative effect observed for the first period. Although this terms-of-trade factor is an incomplete and very rough measure of the international competitiveness of an economy, the results point to the importance of the performance of an economy relative to its main trading partners for household income growth.

Figure 13: **Terms-of-trade in Austria and country groups (2005–2019)**



Notes: Defined as GDP deflator/HICP. Source: GDP at market prices, million euro, and chained linked volumes, index 2015=100, national accounts, NAMA_10_GDP; GDP-deflator, calculated as GDP (nominal) divided by GDP in chained volumes; HICP harmonized index of consumer prices, annual data, 2015=100, PRC_HICP_AIND; Eurostat. Authors' calculations.

Inflation driven by prices of imported goods affects household disposable income through this channel as well. Increases in foreign commodity prices relative to domestic producer prices will reduce EHDI growth. The inflation of the consumer price index in the Euro area in the years 2021 and 2022 was strongly influenced by supply chain disruptions in the aftermath of the COVID-19 pandemic and by energy price shocks induced by the Russian invasion of Ukraine (e. g. Gonçalves and Koester, 2022). This has led to a stronger increase in consumer prices relative to the GDP deflator in 2022.[13] While the government in Austria has adopted measures aimed at cushioning rising consumer prices for households and companies it is at this stage not clear whether they have been sufficient to compensate the negative impact of the terms-of-trade effect on household disposable incomes.

5. Conclusions

The decomposition exercise in this paper has explored the link between labor productivity and the standard of living in Austria. Both measures have shown a subdued development since the great financial and economic crisis and have been identified by the European Commission as factors to monitor.

[13] In December 2022 Statistik Austria reported a HICP increase for 2022 relative to 2021 of 10.5%, whereas the increase of the GDP deflator was reported to have increased by 6% for the same time period.

The exercise provides some diagnostic insights into developments that are likely to have affected the development of household disposable incomes in Austria and what role labor productivity growth may have played in the recent past.

The main results of this paper are as follows:

- The growth of median equivalized disposable household incomes (EHDI) in Austria was above the EU27 average, but below the growth rate observed for all other country groups over the observation period.
- Between 2006 and 2019 labor productivity growth was slower in Austria than in the country groups included in the analysis for comparison, with the exception of the BENESCAND countries. It is the most important factor accounting for the development of EHDI. The poor productivity growth in Austria over the last decade is thus likely to have translated into a sluggish improvement of the (material) standard of living over the past decade.
- The demographic developments that have led to the reduction of the size of households and to an increase in labor participation are likely to have contributed to improve the standard of living of households in Austria. The gender gap in labor market participation in Austria is favorable in comparison to other countries in the EU and has decreased over time. It remains, however, well above the level observed for the BENESCAND countries.
- The decline of the household share in total income and of labor intensity in terms of hours worked per capita are likely to have contributed to lower the standard of living. Our examination of related indicators suggests that this development was not related to a decoupling of labor productivity from hourly wages, or a falling labor share in income. The decrease of labor intensity is most likely due in large part to the rise of part-time work over the observation period, especially for women.[14]
- The development of income inequality and the employment share during the observation period are likely to have had a mildly positive effect on the standard of living in Austria. Income inequality measured by the ratio of mean to median EHDI has mildly decreased overall. However, a gap of the lowest income decile to mean and median EHDI that has started to open after the great economic and financial crisis in 2008 has widened over time.
- The aging of the working population is a factor of concern. Its contribution to the standard of living was negative and has increased over time. With the expected increase of the average age of the working population this factor will gain further importance.
- Terms-of-trade effects have had a negative impact on the standard of living especially around and in the immediate aftermath of the financial and economic crisis in 2008. A deteriorating competitiveness of the Austrian economy relative to its main trading partners has a negative impact on the standard of living. In addition, increases in foreign commodity prices relative to domestic producer prices also act through this channel on EHDI. The worsening of the terms-of-trade in Austria in the year 2022 are thus likely to have had a negative impact on EHDI growth. Whether these have been offset by government measures aimed at cushioning rising consumer prices is a question for further research.

The analysis presented in this paper is a simple diagnostic of the factors affecting the standard of living, and the link established between household income and productivity growth is necessarily incomplete. The results neglect other important factors contributing to the standard of living such as migration, changes in the composition of qualifications of the labor force or costs households face to reduce the impact of environmental degradation and climate change on their health and well-being. More detailed analyses to better understand the causal channels and policy implications for Austria are warranted.

[14] The most recent data on part-time work can be accessed at https://www.statistik.at/statistiken/arbeitsmarkt/arbeitszeit/teilzeitarbeit-teilzeitquote.

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Appendix

Appendix 1: Productivity

There are many ways to measure productivity. Labor productivity is one important and (maybe the most) frequently used measure. The conceptual idea and its standard implementation are:

$$\frac{\text{quantity index of value added}}{\text{quantity index of labor input}} = \frac{\frac{\text{GDP}}{\text{GDP-deflator}}}{\text{total hours worked}}$$

What are its major advantages that explain why it is used so often? What are major limitations?[15] Major advantages of labor productivity per quantity unit of value added are:

1. Determinant of living standards as measured by per capita income.
2. Simplicity and availability, also for comparisons between countries.

Major limitations of labor productivity (some also applicable to other productivity measures):

1. Difficulty to account for heterogenous labor (skill differences).
2. It is not possible to conclude something about the source of productivity changes whether changes come from more productive labor, capital deepening (capital intensity, capital per unit of labor), or technical change (e. g., multi-factor productivity). For example, Pessoa and Van Reenen (2014) argue that the slow recovery of labor productivity in the UK after the Great Recession — compared to earlier recessions — is to a large extent driven by a fall in the capital-labor ratio.
3. Cyclical effects may lead to an exaggeration of short-run changes in productivity in the sense of measuring the general ability or potential of converting input to output. One reason for high hours may be labor hoarding (Biddle, 2014; see for example, Gugler et al., 2020, for Austria during the Great Recession). In particular in the presence of short-term work programs, though, hours worked can be less affected than number of employees (see Landais and Giupponi, 2018).

The decomposition of the change in median EHDI and its connection to labor productivity will provide evidence on the relationship between living standards and productivity. Presenting the relationship in somewhat longer time periods reduces the sensitivity to short-run cyclical variations.

[15] See Schreyer and Pilat (2001); Schreyer (2001).

Appendix 2: Data

Variable	Definition	Unit	Statistical series	Labels	Data source
$EHDI_{median}$, $EHDI_{mean}$	Median and mean equivalized net income.	Nominal values, euro	EU-SILC and ECHP	ILC_DI03, MED_E and MEI_E,	Eurostat
P_{CPI}	HICP harmonized index of consumer prices.	Annual data, 2015=100		PRC_HICP_AIND	Eurostat
$GHDI$	disposable income (gross), households and NPISH.[16]	Nominal prices, euro	National accounts	NASA_10_NF_TR, B6G, S14_S15.	Eurostat
Adjusted $GHDI$	adjusted disposable income (gross), households and NPISH.	Nominal prices, euro	National accounts	NASA_10_NF_TR, B7G, S14_S15	Eurostat
N, N_{wa}	total population and working age population (15-64 years). Available by sex.			DEMO_PJANBROAD	Eurostat
GDP	GDP at market prices.	Million euro; and chained linked volumes, index 2015=100	National accounts	NAMA_10_GDP	Eurostat
H	Employment, thousand hours worked. Employment covers all persons engaged in some productive activity (within the production boundary of the national accounts). Employed persons are either employees (working by agreement for another resident unit and receiving remuneration) or self-employed (owners of unincorporated enterprises). (ESA 2010.)		National accounts	NAMA_10R_2EMHRW	Eurostat
L	Labor force, sum of *unemployment* and *employment*. Available by sex.	Persons	LFS (Labor Force Survey)	LFSA_UGAN (Unemployment), LFSA_EGAN (Employment)	Eurostat
u	Unemployment rate, *unemployment* divided by *L* (labor force).				
P_{GDP}	GDP-deflator, calculated as GDP (nominal) divided by GDP in chained volumes.				
Employees, self-employed	15 years or over.	Persons	National accounts	LFSA_EGAPS (employees, wstatus=SAL; self-employed, wstatus=SELF)	Eurostat
H employees	Defined as hours actually worked by employees, including overtime, (paid time in) training; excluding paid leave (e.g. sick).	Thousand hours worked	National accounts	NAMA_10R_2EMHRW (wstatus=SAL)	Eurostat
Compensation of employees	the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the accounting period. Compensation of employees consists of wages and salaries, and of employers' social contributions. (ESA 2010.)	Million euro	National accounts	NAMA_10_GDP, TIPSLM13	Eurostat
Household size			EU-SILC		Statistics Austria
Equivalization factor			EU-SILC		Statistics Austria

[16] Non-profit institutions serving households (NPISH) are non-profit institutions that are not mainly controlled or financed by the government. They form a relatively small sector consisting of political parties, churches, religious societies, sports and other clubs, and trade unions. See ESA 2010 and Eurostat. Notes: Oulton (2022, FN9) suggests to use sector "households" (S14) only ("Note that the data used here, whether from the national accounts or from surveys, are strictly for households and do not include income accruing to Non-profit Institutions Serving Households (NPISH)."), but for some countries (Austria (2012-), Germany (2012-) and Ireland (2010)) not all years covered here are available. Growth rates, as used here, are highly correlated for the sector data S14 and S14_S15 across the EU27 (corr=.999, n=232).

Appendix 3: Decomposition logic

The transformation of the decomposition equality to the exposition in the results (Table 1 and Table 2) can be demonstrated as follows, using a simplified example and introducing time with index t.

$$\frac{y_t}{p_t} = \frac{y_t}{x_t} \cdot \frac{x_t}{p_t}$$

Defining the growth factor of each variable from $t-1$ to t as g (neglecting its time dimension to simplify the exposition), for example, $y_t = y_{t-1} \cdot g_y$, the previous equality can be rewritten and, together with the equality for $t-1$, there are two equations:

$$\begin{aligned} \frac{y_{t-1} \cdot g_y}{p_{t-1} \cdot g_p} &= \frac{y_{t-1} \cdot g_y}{x_{t-1} \cdot g_x} \cdot \frac{x_{t-1} \cdot g_x}{p_{t-1} \cdot g_p} && \text{for } t \\ \frac{y_{t-1}}{p_{t-1}} &= \frac{y_{t-1}}{x_{t-1}} \cdot \frac{x_{t-1}}{p_{t-1}} && \text{for } t-1 \end{aligned}$$

Dividing the top equation by the bottom equation gives the growth factor on each side, from t to $t-1$:

$$\frac{g_y}{g_p} = \frac{g_y}{g_x} \cdot \frac{g_x}{g_p}$$

Taking natural logs:

$$\ln\left(\frac{g_y}{g_p}\right) = \ln\left(\frac{g_y}{g_x}\right) + \ln\left(\frac{g_x}{g_p}\right)$$

These log-values are approximately equal to and therefore interpreted as percentage growth rates, with $\ln(g) = \ln(1+r) \approx r$. Growth rates vary over time. In Table 1 and Table 2, the entry for "Growth median EHDI" shows the average of the growth rate (left hand side of the previous equation) over the time periods 2006-2019. For the other entries, lines 1. to 9., the average growth rates are put in relation to the left-hand side and are evaluated for each term of the sum. Denote the average growth factor as $\bar{g}$, and putting them in relation to the left-hand side, gives the final values for the entries in lines 1. to 9.:

$$\frac{\overline{\ln\left(\frac{g_y}{g_p}\right)}}{\overline{\ln\left(\frac{g_y}{g_p}\right)}} = \frac{\overline{\ln\left(\frac{g_y}{g_x}\right)}}{\overline{\ln\left(\frac{g_y}{g_p}\right)}} + \frac{\overline{\ln\left(\frac{g_x}{g_p}\right)}}{\overline{\ln\left(\frac{g_y}{g_p}\right)}}$$

The left-hand side is 1, which demonstrates that the growth rates relative to the growth rate of the left-hand side, $EHDI_{median}/P_{CPI}$), must sum to 1 (that is, 100%).

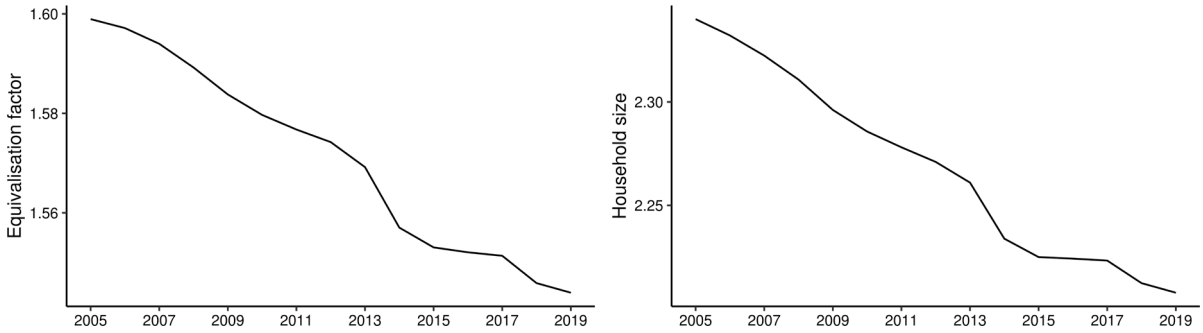
Appendix 4: Equivalization and household size

There are a number of statistical issues that have to be considered before it is possible to draw the conclusion that the contribution of the equivalization factor in the decomposition results in Table 1 and Table 2 are largely determined by a decrease in household size. Statistical issues arise as the indicators entering this ratio, EHDI and gross household disposable income (GHDI), stem from different data sources.[17] GHDI is the mean of actual non-equivalized household disposable income. If data were consistent, mean EHDI and mean GHDI should differ only due to the equivalization factor, i. e. the weights attached to the number of persons living in households. However, mean EHDI is based on survey data, whereas GHDI is based on data from National Accounts. These data sources measure income in different

[17] Oulton (2022) highlights this problem for UK data as well.

ways. The resulting inconsistencies in the data therefore play a role both in the pattern observed in Figure 6 and the decomposition exercise in Table 1.

Figure 14: **Equivalization factor (left) and household size (right), Austria**



Notes: EU-SILC. Data provided to the Office of the Austrian Productivity Board by Statistics Austria. Authors' calculations.

For this reason, we examine to what extent income equivalization determines the pattern observed in Figure 6. The left panel of Figure 14 shows the equivalization factor used in the EU-SILC data for Austria over time, whereas the right panel shows the development of average household size in Austria during the same period. The two series follow an identical pattern. This suggests that the underlying trend observed for the ratio of mean EHDI to mean GHDI for Austria in Figure 6 is likely to reflect the decrease of household size over time. The year-on-year variation in turn should be driven by differences in income measurement. While the difference between mean EHDI to mean GHDI warrants further study, the income equivalization factor shown in Table 1 and Table 2 is likely to capture the effects of changes in household size, even though it is biased by data inconsistencies in the measurement of income.

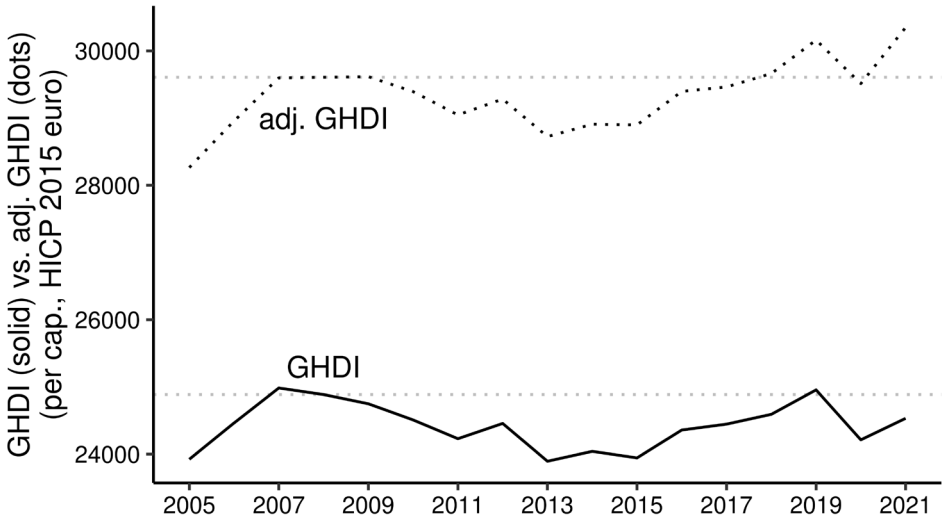
Appendix 5: GHDI and changes in the labor share of incomes

An important aspect that puts the critique by the European Commission on sluggish development of GHDI in Austria and its likely impact on the households' disposable income share of GDP into perspective is that income not allocated to households is largely retained by the government to finance, amongst other things, social transfers in kind (education, health care, etc.). Changes in GHDI do not account for this.[18] National accounts contain an alternative measure, the adjusted disposable income, which contains social transfers in kind (ESA, 2010). The adjustment consists in the addition of expenditures of government (or NPISH) for individual services of households, most importantly education and healthcare. Not added are collective services that benefit society as a whole, like law and order, or general public management (Lequiller and Blades, 2014).

Figure 15 shows that the levels of GHDI and its adjusted alternative show a very similar time pattern. Both grow at low rates: real GHDI per capita at 0.28 percent per year, and real adjusted GHDI per capita at 0.43 percent per year. The consequence is that adjusted GHDI — in contrast to GHDI — surpasses the level of 2008 in 2021. During the second year of the pandemic, 2021, adjusted GHDI reaches a higher level than before the pandemic, whereas GHDI decreases to even lower levels compared to 2019. This implies that the critique put forward in European Commission (2022b) remains largely valid, even though it neglects the importance of transfers in kind in Austrian social policy.

[18] This caveat also applies to EHDI from EU-SILC, but cannot be addressed within EU-SILC-data.

Figure 15: GHDI (solid) vs. adj. GHDI (dots), (per cap., HICP 2015 euro), Austria



Notes: Disposable income (gross), households and NPISH., nominal prices, euro. National accounts, NASA 10 NF TR, B6G, S14 S15; adjusted GHDI: adjusted disposable income (gross), households and NPISH. Nominal prices, euro. National accounts, NASA 10 NF TR, B7G, S14 S15; Source: Eurostat. Authors' calculations.

A further factor potentially contributing to the decline in disposable income share is the development of the labor share of incomes. Several international studies report a decline of the labor share in the last decades.[19]

One of the measurement issues with the labor share commonly discussed is how the labor component of income earned by the self-employed is to be treated, because it is not separately identifiable, but recorded as mixed income. Two adjustments which are made are (1) imputation of labor income for the self-employed (see, for example, Giandrea and Sprague, 2017), and (2) neglecting mixed income, but using a base year that fixes the relationship of employees to the total of employees and self-employed to avoid composition effects (see, for example, Adler et al., 2022).

Conceptually, the link between adjustment (1) and (2) is as follows. When w_t is the average wage per employee, the number of employees is A_t and the number of self-employed is S_t, then the imputation adjustment simply extends w_t over the self-employed:

$$\text{labor share}_t^{(1)} = \frac{w_t(A_t + S_t)}{\text{total incomes}_t}$$

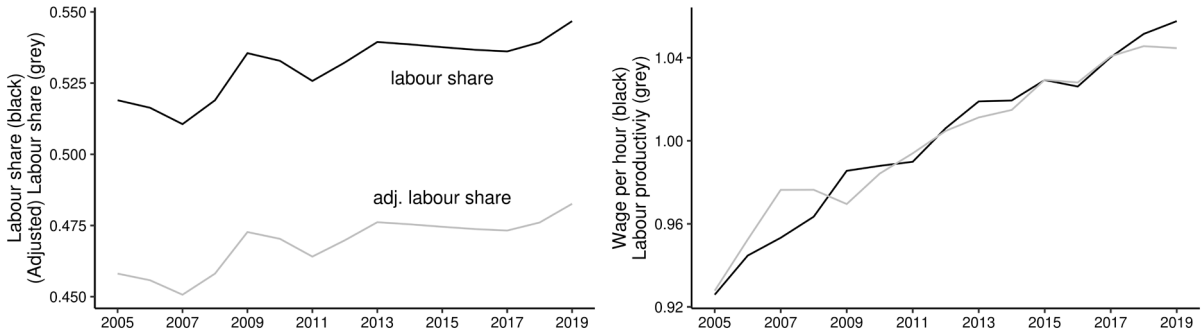
In the base year adjustment, self-employed incomes are neglected, but to prevent a bias from possible shifts in the relation of employees to self-employed, the relation is fixed in a base year 0:

$$\begin{aligned}\text{labor share}_t^{(2)} &= \frac{\frac{A_0}{A_0 + S_0}}{\frac{A_t}{A_t + S_t}} \cdot \frac{w_t A_t}{\text{total incomes}_t} \\ &= \frac{w_t(A_t + S_t)}{\text{total incomes}_t} \cdot \frac{A_0}{A_0 + S_0}\end{aligned}$$

[19] See for example Grossman and Oberfield (2022), for a review of some of the "more than 12,000 books, articles and papers written in the last decade alone" they found on "Google Scholar website for the joint appearance of the phrase 'labor share' and the word 'decline'."

The first line of (2) can be motivated by the idea to divide the labor share of the employed in t ($w_t A_t$/total incomes$_t$) by the employee-share of total employment in t ($A_t/(A_t + S_t)$) and then rescale it to the employee-share in the base year 0 ($A_0/(A_0 + S_0)$). The second line of (2) is simply a rearrangement to emphasize the relationship between (1) and (2); it shows that (2) conceptually is the labor share in (1) scaled down to the share of employees in base year 0.

Figure 16: (Adjusted) Labor share (left), and hourly wages and labor productivity (right), all for Austria



Notes: Wages (labor compensation) and labor productivity, both in the right panel, are normalized by their means, to make the development over time comparable in the graph. Compensation of employees, million euro, national accounts, NAMA 10 GDP, TIPSLM13; GDP at market prices, million euro, national accounts, NAMA 10 GDP; employees, thousand hours worked, national accounts, NAMA 10R 2EMHRW (wstatus=SAL). Eurostat. Authors' calculations.

Figure 16, left panel, shows both versions of the labor share, relative to GDP.[20] Another way to look at the possible decoupling of wages and output growth that may go along with the decline in the labor share is to look at the relation between hourly wages and hourly productivity.

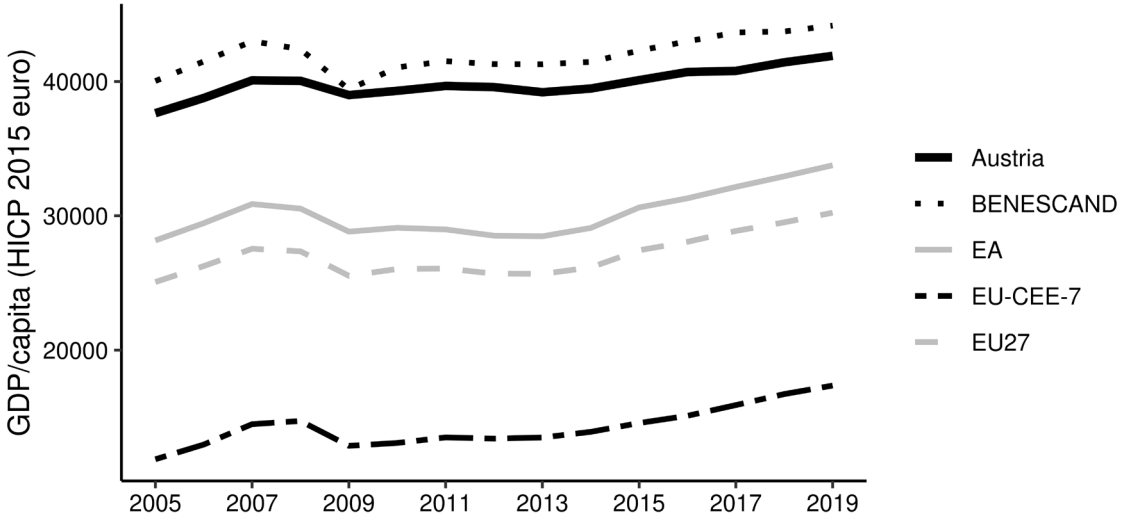
The right panel of Figure 16 shows the development of wages and labor productivity, both per hour and both divided by the GDP deflator. A decoupling of hourly wages from labor productivity could be observed only during the years in the run up to and during the great financial and economic crisis 2008-2010. Starting from 2011 the development was largely aligned. In the most recent years a decoupling could again be observed, but with hourly wages growing more quickly than hourly productivity.[21]

[20] The basis of the labor share also varies. Adler et al. (2022) describe the use of net national income minus taxes on products plus subsidies on products as the basis for the German Federal Statistical Office. Giandrea and Sprague (2017), for the US Bureau of Labor Statistics, suggest either net or gross value added, adding: "gross value-added output is more appropriate if one is interested in the extent to which compensation tracks productivity." OECD (2018) defines the labor income share relative to GDP.

[21] There are limitations and caveats to judging wage–productivity decoupling based on labor income shares and hourly wages, including: i) Imputation and adjustment for the labor income part of mixed incomes both rely on strong assumptions. ii) Longer time horizons show that the decline in the labor share primarily is recorded before 2007 and it is possible that the increase in the labor share is not made up by the more recent positive development depicted in the left panel of Figure 16 (see, for example Altzinger et al., 2017), and iii) labor compensation deflated by a CPI can develop differently than deflated by the GDP deflator (which is done for comparability reasons; see, e. g., OECD, 2021).

Appendix 6: Additional material

Figure 17: **GDP/capita (HICP deflated, 2015 euro), Austria and country groups**



Notes: GDP per capita, euro, index 2015=100, national accounts, NAMA_10_GDP; total population, DEMO_PJANBROAD; Eurostat. Authors' calculations.