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Demographic changes – are they the reason for increasing inequality?

Intersections. EEJSP
11(2): 183–204.
https://doi.org/10.17356/ieejsp.v11i2.1172
https://intersections.tk.hu

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Abstract

A high degree of equality has for a long time been a central feature of the Nordic welfare states – Denmark, Finland, Norway, and Sweden. This article shows that the overall increasing levels of inequality only to a limited degree can be explained by changes in demographic factors such as more elderly people, more living alone, an increasing share participating in longer-term education, and rising levels of assortative mating. There thus seems to be a small impact of demographic changes. Therefore, one also needs to be aware of the impact of political decisions when explaining development in inequality though a large part of inequality development is still unexplained. There are differences in the impact on inequality between the Nordic countries, although the countries belong to the same welfare regime cluster, which implies that even if demographic changes have an impact one needs to look into other factors as well in order to explain observed changes in all countries included in the analysis.

Keywords: inequality, demography, Nordic welfare states, re-centered influence functions, decomposition

1 Introduction

Since Esping-Andersen's path-breaking work (Esping-Andersen, 1990), the Nordic countries have been seen as a particular cluster of countries within welfare regimes labelled the Nordic welfare states (Arts & Gelissen, 2002; Powell & Barrientos, 2004; Kangas & Kvist, 2019; Powell & Barrientos, 2011). One of the core aspects of this model has been argued to ensure a high degree of economic equality, but also high gender equality, an ambition of achieving full employment through active labour market policy, generous social security benefits, and finally, an increasingly stronger focus on social services. Here we focus on economic inequality in four Nordic countries (Denmark, Finland, Norway, and Sweden) and whether there are demographic reasons for the change herein, i.e. we don't focus on the reasons behind the demographic changes. Existing analysis of the impact of demographic changes on economic inequality has been one reason for choosing the four selected demographic elements studied here. But there is also an inspiration from the

Second Demographic Transition (SDT) (Zaidi & Morgan, 2017) since it also focuses on the impact of ageing, "less stability in partnerships, more complex households and high levels of poverty or exclusion among certain household types (e.g. single person of all ages and lone mothers" (Lesthaeghe, 2014, p. 18112).

This focus is also warranted since inequality has increased in recent years in nearly all world regions, which include an increase in the share of income of the top-income earners (Alvarado, 2018), partly due to top incomes growing comparatively faster in low and middle-income countries (Hammar & Waldenström, 2017). The analysis of change in economic inequality is usually explained only by changes in taxes and duties, changes in levels of income transfers, and that capital income is often more unevenly distributed than other types of incomes (Aaberge et al., 2018). However, changes in inequality might also have other explanations such as those related to changes in different demographic aspects (Hasell et al., 2019; Grotti, 2020). Already in 2009 OECD (OECD, 2011; Burtless, 2009) pointed towards change in household structure, including more single households, higher labour market participation rates for women, and assortative mating as possible elements that could explain rising inequality. Looking into demographic factors, including women's participation on the labour market, has thus for some time been part of the analysis explaining why many countries have witnessed change in the degree of economic inequality (OECD, 2011, p. 199).

The rising employment rate of women reduces household inequalities, whereas assortative mating increases it (Chen et al., 2013). This is confirmed for household inequality in other studies (Caminada et al., 2019). Still, there is not a uniform agreement about the drivers of economic inequality in different welfare regimes (Nolan et al., 2019).

Overall, based upon the literature mentioned above, one part of the reason (besides policy decisions) for the increase in inequality has to do with change in age structure, labour market participation, types of cohabitation (rich with rich, poor with poor), and change in the number of singles (Aaberge et al., 2018; Søgaard, 2018; Pareliussen & Robling, 2018). Globalisation is also argued to be a cause of increasing inequality (Tridico, 2018), however in a Nordic context this might be mitigated by generous social security benefits (Nam, 2019) – these have been weakened in recent years implying that the change in inequality can still be due to change in the level of benefits (Barth et al., 2021). Thus, across the EU-countries, reducing inequality through change in benefits during the financial crisis was generally not successful, however it was important in the Nordic countries (Amate-Fortes et al., 2017), which hints towards the need for analysing other factors, such as change in demography, to try to explain changes in the degree of economic inequality. Other research has pointed out that "Demographic and societal change – more single and single-parent households, more people with a partner in the same earnings group – also played a role for increasing inequality, but much less than sometimes assumed" (Cohen & Ladaique, 2018, p. 39). Change towards a higher degree of assortative mating might also increase inequality given that there has been a squeezing of the middle class (OECD, 2019; Förster & Tóth, 2015). Ageing is expected to increase inequality, whereas upskilling due to more in education has an ambiguous effect (Dolls et al., 2019). Ageing's impact on inequality is caused by elderly people leaving the labour market implying lower income as they are often dependent on income transfers from the state. There is a connection between development on the labour market and these varied elements, including that the level of

education also influences, through labour market participation and wages, the level of inequality. Therefore, at the outset one could theoretically expect that a growing level of educational attainment would increase inequality.

Based upon these theoretically different causes for possible change in economic inequality, this article adds to the literature by disentangling more precisely whether factors related to a number of demographic elements (change in age structure, single households, and in assortative mating behaviour) and change in educational attainment level have impacted inequality development in the Nordic countries, and also whether the development has been the same in the countries within the Nordic welfare regime. Further, the article fills a gap in the knowledge of the recent development given that the applied data are more up-to date compared to other studies estimating distributional development in the Nordic countries – current literature having used data for Denmark, Finland, and Norway until 2013 and Sweden only up until 2005 (Pareliussen & Robling, 2018), not to mention that OECD (2011) using LIS-data covering the period from mid-1980s to mid-2000s (2004) – the Luxembourg Income Study (LIS) is an income, etc., database of harmonised microdata collected from fifty-three countries in Europe, North America, Latin America, Africa, Asia, and Australasia spanning five decades (LIS, 2024). The article further informs about whether there have been the same or different reasons for the witnessed change in inequality in the countries – Sweden, Norway, and Finland have had a strong increase in inequality until the mid-2000s whereas the Danish case experienced a growth in inequality at a later stage. Recent years have again seen an inequality increase in Sweden and Denmark, see Section 2. Given the higher growth in inequality in at least Denmark and Sweden than in countries in other welfare state regimes it is timely to look into whether part of this can be explained by factors that are not influenced by the policy makers. Thus, this article fills a gap related to the impact of demographic changes, and connected thereto, the impact of an increase in educational attainment on economic inequality in the Nordic welfare states, as well as comparing the development across four countries often seen as homogenous, e.g. belonging to the same welfare regime.

Based hereupon the hypotheses to be looked into here are that the following elements have implied a change in the level of inequality:

1) Change in the age structure, i.e. more elderly,
2) Increase in the length of education and the educational attainment level,
3) The increase in single person families, and
4) Change in mating towards more partners with similar earnings living together.

In relation to measuring economic inequality there is a central discussion about whether to look at the individual or household level (Hasell et al., 2019). In order to reduce the possible impact of this issue, income will here be corrected by looking at equivalised disposable income, e.g., the household is the economic unit. The article also takes into account that the demographic development in itself has resulted in a higher number of people living alone because women live longer than men. Since we are looking at inequality based on households, we assume equal sharing within households although this is often not the case (Daly, 2018). We are aware that the choice of how to equivalise income is important and we have here followed the tradition of OECD, which is the standard used in the analysis of economical distributional issues in developed nations.

Length of education is included since increasing educational attainment levels typically give better access to jobs and often results in higher wage levels, and, therefore have an impact on inequality not only during study-time (Piketty & Cantante, 2018), but also during the years on the labour market. Mating like-with-like in households would therefore also imply higher levels of inequality. Higher educational attainment typically implies a higher income, and therefore when more persons with (nearly) the same level of education live together, measured income inequality increases. Education and inequality are clearly related to each other, see for example (Corak, 2013; Blanden & Macmillan, 2016). There is thus a risk that educational attainment level overlaps with (i.e. also represents) other factors, however, given the change towards more people pursuing longer education in recent years it seems reasonable to include it as a specific variable.

There are, as always, a few limitations, also in our study. We have not looked into the gender divide. However, we have single-households included and as there is a larger number of women in single-households (among other things due to the longer life-expectancy) this will, albeit indirectly, imply an indication of the gender divide. There are a number of variations in understandings of inequality, including horizontal/vertical, health/death, and existential/material inequality (Therborn, 2012), which are not included and the same is true regarding Sen's discussion on inequality related to capabilities (Nussbaum, 2005; Robayna, 2006). Lack of inclusion of these elements is primarily due to unavailability of data.

The article is structured such that the next Section gives a descriptive account of the development in inequality in the Nordic countries since the beginning of the century, while methodological considerations are presented in Section 3. Section 4 then consists of the empirical analysis and discussion, and finally, in Section 5 we make concluding remarks.

2 Development in inequality

In this section, aggregate distributional data is analysed in relation to the four demographic elements that are in focus: Change in the age structure; Increase in the length of education and the educational attainment level; Increase in single person families; Change in mating towards more partners with similar earnings living together. A snapshot of the long-term development in inequality using the Gini coefficient as the inequality measure is presented. In Table 1 we show the Gini coefficient (applied as this shows the distribution of income in a solid way) of equivalised disposable income since 2001 for selected years. Given the often rather slow changes in the coefficient this selection of years seems reasonable for presentational purposes of how the development has been, but in the calculations more detailed information is naturally presented.

The table indicates that the development has been different from a standstill in the EU on average (albeit data was only available from 2010), to an increase in Sweden and Denmark, and a decline for Finland if starting in 2001, but a standstill since 2005, thus showing contrasting developments. Norway, especially compared to Denmark and Sweden, has had a different development with a Gini decline of close to three points since 2005. For an analysis of variations (albeit applying data mainly only until 2013), see (Barth et al., 2021). Looking into whether there has been an impact from the four demographic

elements (as depicted in Section 1) can inform about at least part of the reasons for the change in the Gini level. Given that the focus here is on other possible types of specific explanation for the change in the level of inequality using post-government income seems to be a reasonable choice, also because counting for changes on the labour market is outside the scope of the analysis.

Table 1 Gini coefficient of equivalised disposable income for the Nordic countries and the EU

	2001	**2005**	**2010**	**2012**	**2014**	**2016**	**2018**	**2019**
EU28			30.5	30.5	31.0	30.8	30.8	30.7
Denmark	22.0	23.9	26.9	26.5	27.7	27.7	27.8	27.5
Finland	27.0	26.0	25.4	25.9	25.6	25.4	25.9	26.2
Norway		28.2	23.6	22.5	23.5	25.0	24.8	25.4
Sweden	24.0	23.4	25.5	26.0	26.9	27.6	27.0	27.6

Note: The EU28 figures are population weighted averages of national figures (which will be different from the actual Gini coefficient for EU28).

Source: EUROSTAT, ilc_di12.

Change in the tax-system and benefits have had an impact on inequality in the Nordic countries, see (Kangas & Kvist, 2019; Nolan et al., 2019). Thus, for example, an analysis from a Think Tank shows that 15 years of tax reforms (since 2001) in Denmark has been most beneficial for the 1 % and 10 % richest of the population, with close to 8 percent increase in disposable income for the 10 % richest and around 1 % increase for those with the lowest income[1]. Besides these direct impacts, there is in Denmark (as in other countries) a negative impact on distribution from fiscal welfare (Barrios et al., 2020; Avram, 2018; Sinfield, 2019).

Given that inequality is not only the outcome of the changes in earnings inequality on the labour market we have used the income level after taxes and income transfers. Thus, the obtained income level is the consequence of both market and welfare state impacts. Nevertheless, it is still so that "welfare systems play a major role in levelling inequalities" (Eurofound, 2019, p. 16). Studies also indicates that this is the case (such as from 2006–2017) for Finland, which out of the four Nordic countries analysed here had the most redistributive approach reducing both inequality and the risk of poverty (Palviainen, 2019), although Finland in general has a weaker redistribution (Aaberge et al., 2018). We will also in the empirical analysis, cf. Section 4, present information on the changes in disposable income distributions as a way of indicating how distribution from 2004–2018 has changed, and, how this thus can be used for the analysis of inequality changes.

[1] See https://www.ae.dk/analyser/15-aars-skattereformer-har-tilgodeset-de-rigeste

The Lorenz curve is used for illustration of inequalities as it is in general argued to be a robust graphical representation of inequality (see Wagle, 2023). Actually, the Gini coefficient can be derived from that curve since it is double the area between the diagonal (line of hypothetical equality) and the Lorenze curve.

3 Methodological considerations

This section informs on the choice of methodology split into why we apply a case study, which inequality measurement to use, the decomposition of inequality, and the choice and operationalization of data.

3.1. Case study

This study is a case based study (Seawright & Gerring, 2008) using a group of countries which in the welfare state literature is considered to belong to the same regime (the Nordic) (Kangas & Kvist, 2019; van Gerven, 2022), and therefore the aim is not only to look into the four hypothesis as presented in the introduction, but also to look into whether there are differences across countries within the same welfare regime since there is an uneven historical development in inequality and because the financial crisis impacted the countries differently with Denmark and Finland less affected than Sweden (Ólafsson et al., 2019). Also, as discussed in Section 2, there is a cross-country time variation in when the most significant changes have taken place.

3.2. Inequality measures

We have chosen to use the Gini coefficient as the measure of inequality, which is the most frequently used measure in studies of inequality (Ou-Yang, 2019). This is not a perfect measure of inequality given its non-additive properties, but it is one with more available published data for a number of years and it is extensively applied across countries. Other measures such as the decile ratio P90/P10 and the percentile range P80-P20 are applied in the analyses for triangulation. For Pα and income Y, we have that $P(Y \leq P\alpha) = \alpha/100 = \alpha$ % (like, for instance $P(Y \leq P90) = 0.9 = 90$ %, e.g. 90 % of incomes are less than or equal to the 90th percentile P90).

3.3. Inequality decomposition

Decomposition of an inequality index in one dimension at a time has been in the literature for long and covers different inequality indices, incl. the widely applied Gini coefficient. The theory behind the inequality decomposition by population subgroups was developed by (Shorrocks, 1983), and numerous empirical analyses of dimensions like gender, age, education, and ethnicity has been done for some time since then, see (Ceriani & Verme, 2015; Schneider, 2013; Deding et al., 2010; Zürcher, 2004; Zandvakili, 1994). The decomposition of different income sources' effect on income inequality was carried out early (Shorrocks, 1982), but this is not the focus here. These descriptive methods either quantify

the contribution of individual income elements to the observed inequality or measure inequality within and between population subgroups to find out what sources of incomes or subgroups account for inequality but falls short of measuring the contributions of individual determinants to income inequality.

Decomposing the contributions from several variables simultaneously has been approached via regression-based methodologies (Fields, 2003; Morduch & Sicular, 2002). As the name suggests, inequality drivers are identified through income regressions that are then used to estimate the inequality effect of the right-hand side (explanatory) variables that can be of various types including discrete and continuous variables. Empirical analyses of this type are found for instance for Ireland, Japan, and USA (O'Donoghue et al., 2018; Aizawa et al., 2017).

A more direct way of quantifying the influence of various factors on the income distribution is by estimating (re-centred) influence functions (RIF) for a given inequality measure. The methodology was developed by (Firpo et al., 2018; Firpo et al., 2009) and enables quantification of the marginal effect of any variable on the unconditional quantile of the welfare metric (income), which can be transformed into the marginal effect on the inequality measure of interest. For illustration, if the aggregate measure of interest is the mean (of income), the influence of an observation is the level of income itself (the income level of the individual), and the average over all (individual) influences is the (total) average. In the case of the Gini coefficient the influence of a given observation is more complex, but still such that the average of (individual) Gini coefficient influences ends up being the (aggregate) Gini coefficient. In this application we apply the RIF procedure developed by (Rios-Avila, 2019). The estimated RIF in year t, I^t, is (X_j^t are household characteristics and are estimated parameters, e.g., marginal effects of the characteristics, k is the number of characteristics included in the analysis, and j=1,…,k):

$$\boldsymbol{I^t = b_0^t + b_1^t X_1^t + \cdots + b_k^t X_k^t} \,. \tag{1}$$

Utilizing the estimated RIF for each household in equation (1), we next decompose the change in inequality from year s to year t (I^t-I^s=ΔI) to see the contributions from demographic variables using the Oaxaca-Blinder decomposition (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973):

$$\boldsymbol{\Delta I = (b_1^t \Delta \bar{X}_1 + \cdots + b_k^t \Delta \bar{X}_k) + (\Delta b_0 + X_1^s \Delta b_1 + \cdots + X_k^s \Delta b_k)} \tag{2}$$

where $\Delta \bar{X}_j$ represents the change in the average of characteristic j. The contribution of characteristic j to the total change in inequality is $b_j^t \Delta \bar{X}_j$, and thus $100 \times b_j^t \Delta \bar{X}_j / \Delta$I is characteristic j's percentage contribution to the inequality change from year s to year t. The first parenthesis in equation (2) represents the explained part of the inequality change while the second parenthesis represents the unexplained part of the change, and together the sum of the two parentheses accounts for the total observed inequality change.

We consider three inequality measures in order to detect the robustness of the results. This includes the Gini coefficient, the decile ratio, and the percentile range, where the first two indices are based on equivalised disposable income, while the last one is based on the natural logarithm of equivalised disposable income.

3.4. Data

It is important to equivalise income as this implies comparing like with like, and thus avoiding the problem with the different sizes and compositions of households. OECD's modified equivalence scale (ES) is used since many studies applying the same data also use this scale, and also because the scale has been widely applied, tested, and validated. ES is defined as:

$$\text{ES} = 1 + 0.5 \times (\text{Number of Adults} - 1) + 0.3 \times (\text{Number of Children}). \quad (3)$$

EU-SILC data from Eurostat/Euromod is used as they can in a comparative way show change over time and with systematized information on development in key data and structure of the welfare states. The analysis covers the years 2004 (=*s*) and 2018 (=*t*). Specifically, we are using the user database (UDB) files version 04, for instance including the csv-file UDB_cDK04D. With these data, we are exactly able to replicate Eurostat's published Gini coefficients, except for Finland and Sweden for 2004 that are marginally underestimated with a mere 0.2 Gini coefficient points discrepancy, which could be due to different UDB versions being used. In the following analysis we exclude 102 households who have either negative or zero incomes, which slightly affects the Gini coefficients, but still nearly preserves the change in the Gini coefficients from 2004 to 2018. For the Nordic countries one could have used detailed administrative registers that presumably better cover top-incomes. On the other hand, survey data (ideally) cover any informal incomes. Also, administrative data are not harmonized across countries.

3.5. Operationalization of variables

In addition to the dependent variable (equivalised disposable income) that is used to calculate inequality measures, we also have explanatory variables related to the four hypotheses stated above. All of these variables are measured at the household level since the economic unit is the household. The right-hand side variables are: the age of the household head (*X*1); whether the household consists of a single (parent) or a couple (outcome denoted 1 respectively 0) (*X*2) – being single thus means either never married, separated, widowed, or divorced, while couple means married (though a sizable fraction of couples are unmarried in the analysed countries); highest educational level among household members measured in years (*X*3). Both *X*1 and *X*3 (age groups and educational level groups) are included as dummies for each year in the regressions that are the basis for the decompositions, i.e. no linearity is enforced.

Assortative mating is operationalized by calculating the absolute percentage difference between income of the two persons in a couple (*X*4). The percentage is relative to the average income of the couple's two members. This variable is transformed into five categories going from 0 to 100% (denoted 1-5), e.g. the relative difference is 0%, 0.01–25%, 25.01–50%, 50.01–99.99%, or 100%). Earnings within a couple can be different, inter alia, because: One spouse is earning and the other is not; Intra-couple productivities differ, i.e. human capital differs due to age, experience, education, gender, industry, sector, etc.; The two couple

members are in different phases of their life-cycles, like, gender-biased caring for the family and children is still present – even in gender egalitarian Nordic countries; Preferences regarding quantity of labour supplied. Although, labour market participation might thus be correlated with our measure of assortative mating, several other reasons might be behind the couple members' earnings difference – in fact in this case, the correlation between assortative mating and a measure of labour market participation chances is rather weak. The variable is thus an indicator of assortative mating. The assortative mating measure is undefined for singles, which is why it is set to a value of 1 for this variable (0 %) for singles in order to have a correct regression specification.

Summary statistics for variables are displayed in Table 2.

Table 2 Summary statistics. (Unweighted).

	2004				2018			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Denmark:								
Disp. Equi. Income	15296	8684	0.5	260071	21774	14470	151	448577
Disp. Equi. Inc., ln	9.54	0.45	-0.69	12.47	9.88	0.45	5.02	13.01
Age	48.70	15.49	16	80	56.37	16.38	16	81
Single	0.38	0.48	0	1	0.51	0.50	0	1
Education	13.94	3.58	8	18	14.69	3.50	8	18
Assortative mating	2.03	1.38	1	5	1.76	1.31	1	5
Finland:								
Disp. Equi. Income	1669	1519	0.42	90886	2489	1499	0.56	26982
Disp. Equi. Inc., ln	7.28	0.54	-0.88	11.42	7.69	0.52	-0.59	10.20
Age	47.82	15.75	16	80	51.37	16.53	16	81
Single	0.44	0.50	0	1	0.45	0.50	0	1
Education	14.12	3.66	8	18	15.15	3.33	8	18
Assortative mating	2.18	1.56	1	5	2.12	1.54	1	5
Norway:								
Disp. Equi. Income	20053	24047	5.8	1494957	34565	18673	0.5	471496
Disp. Equi. Inc., ln	9.77	0.51	1.76	14.22	10.32	0.63	-0.69	13.06
Age	46.31	15.74	0	80	50.12	16.55	16	81
Single	0.47	0.50	0	1	0.51	0.50	0	1
Education	14.48	3.06	8	18	15.14	3.38	8	18
Assortative mating	2.08	1.41	1	5	1.90	1.35	1	5
Sweden:								
Disp. Equi. Income	14142	6195	8.3	97981	23811	13116	1	317499
Disp. Equi. Inc., ln	9.46	0.51	2.11	11.49	9.96	0.53	0.00	12.67
Age	49.10	16.98	15	80	52.59	17.17	16	81
Single	0.53	0.50	0	1	0.51	0.50	0	1
Education	13.99	3.42	8	18	14.79	3.48	8	18
Assortative mating	1.89	1.36	1	5	1.85	1.32	1	5

Note: See data section for variable definitions. N=57,006 (between 5,595 and 11,188 observations for each country in each year).

Source: Own calculations based on EU-SILC.

4 Empirical analysis

4.1. Income distributions

In Figure 1 we show the change in inequality in the Nordic countries since 2004 by presenting the distributions of income.

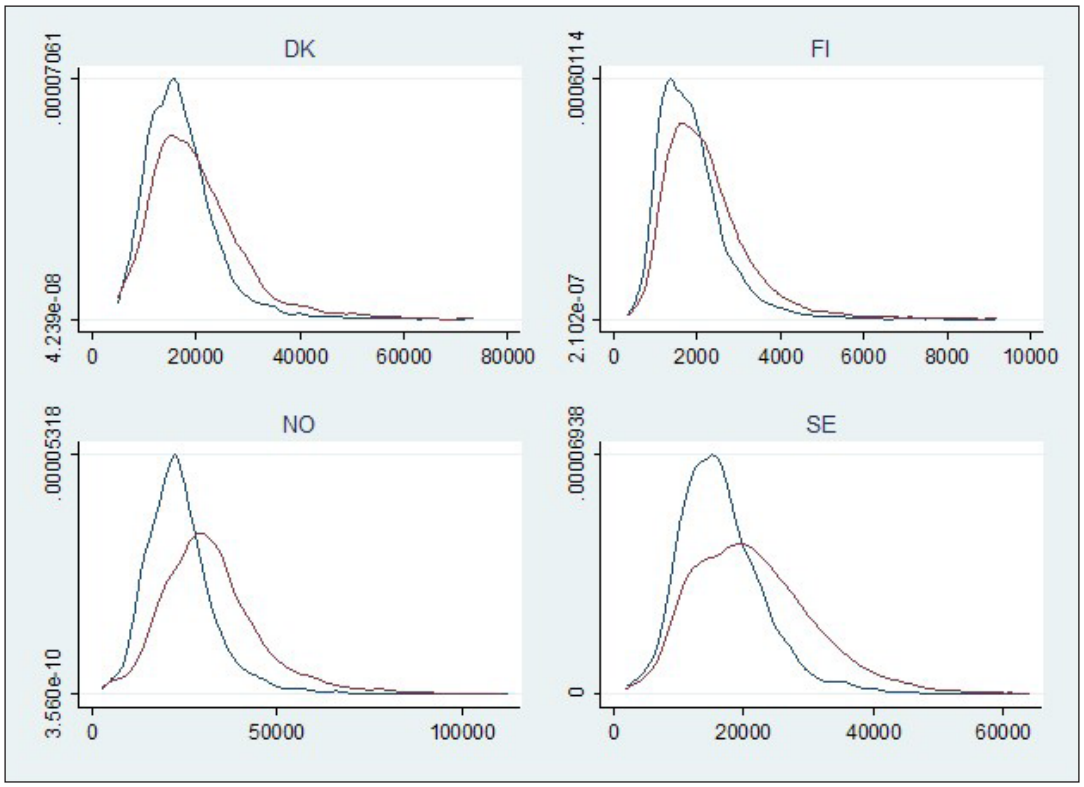

Figure 1 Equivalised income kernel distributions in Nordic countries. 2004 (blue) and 2018 (red). National currencies (horizontal axis).

Note: The income for 2004 has been inflated by the 2004-2018 price increase as reflected by the harmonized price index from Eurostat. A half percent of a country's observations at the bottom and at the top are excluded (in this figure only) in order to focus on the remaining main part of the distribution. The height of the curves indicates the relative frequency of a given income level.

Source: See Table 2.

Looking at the income distributions indicates that major changes have taken place (Figure 1). A similarity for the four Nordic countries is clearly that the top of the curve is becoming lower resulting in heavier tails. This is particularly the case for Sweden, where the middle incomes become less prevalent and instead a larger spread in incomes is seen. What more precisely happens at the different parts of the distribution is highlighted by looking at the

average change in real equivalised disposable income in Figure 2. Here, Denmark and Sweden stand out with generally much greater increase in incomes for the top of the distribution compared to the bottom of the distribution (if we disregard the very bottom of the distribution which often has an odd behaviour since it includes some self-employed as well as unrealistically low incomes). Particularly, the top 2-3 percent in Denmark and Sweden experienced a much higher income increase than lower incomes. In contrast, the top-incomes in Finland and Norway experienced lower increases than the bottom incomes. Hence, a possible reason why assortative mating should have a higher impact in Denmark and Sweden than in Norway and Finland.

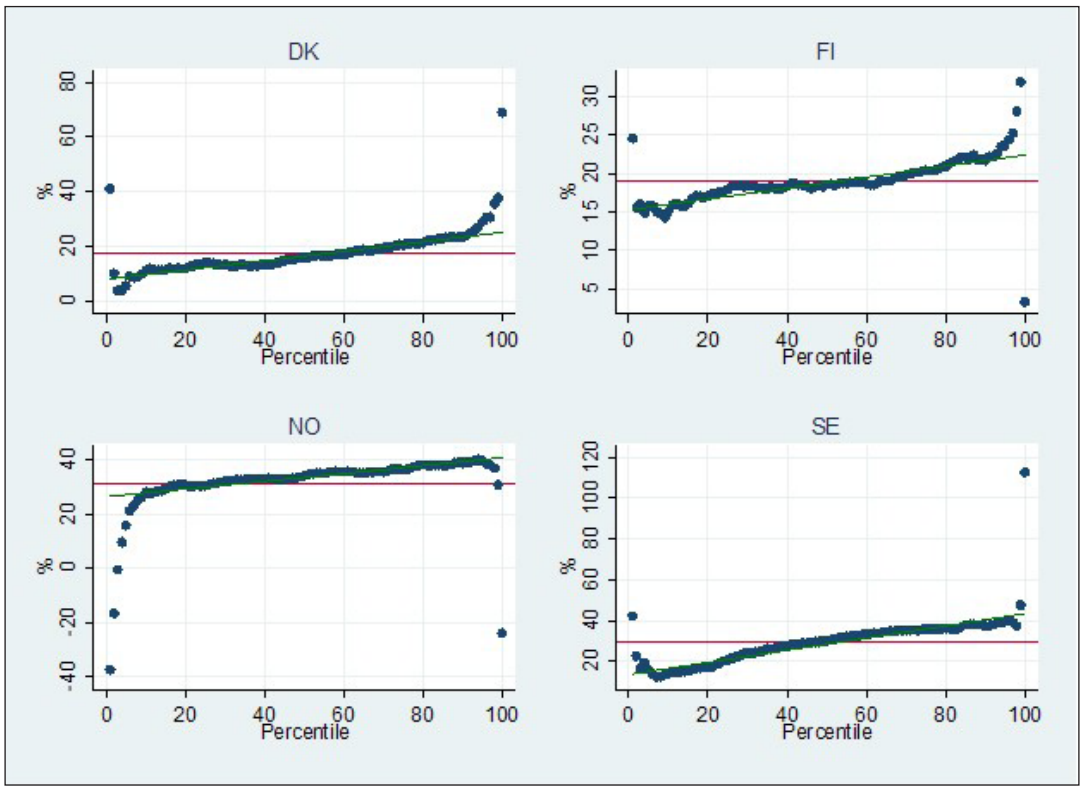

Figure 2 Percentage average annual change in equivalised disposable income by percentile from 2004 to 2018

Note: The horizontal line represents the arithmetic average change of all percentiles.

Source: See Table 2.

All in all, this reflects the fact that the top increased its income shares in Denmark and Sweden over time, which is seen in the change of the Lorenz curves (Figure 3).

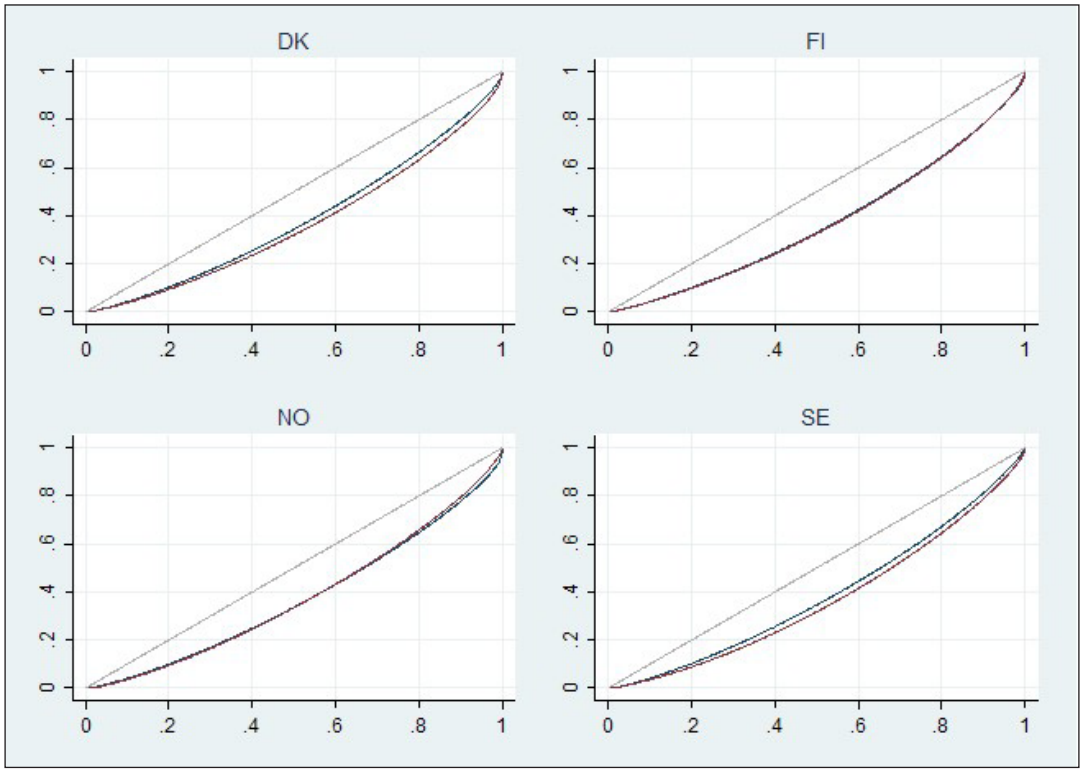

Figure 3 Lorenz curves for 2004 (blue) and 2018 (red). Nordic countries

Source: See Table 2.

The Lorenz curves for Denmark and Sweden are clearly moving away from the diagonal from 2004 to 2018 reflecting increased inequality. In Finland, the Lorenz curve hardly changes from 2004 to 2018. Norway is the only country which has crossing Lorenz curves, such that at the lower part of the distribution 2018 is below 2004, while at the upper part of the distribution 2004 is below 2018. Thus, while the inequality development conclusion is ambiguous for Norway, we see an increase in Denmark and Sweden and no change in Finland. However, this does not by itself show whether demographics and educational attainment have had any role in the inequality change.

4.2 Decomposition of Gini coefficient change

We do see that the Gini coefficient increased significantly in both Denmark and Sweden from 2004 to 2018. In Denmark the change was 0.040 (from 0.232 to 0.272) and in Sweden the increase was slightly higher at 0.043 (from 0.224 to 0.267).

In contrast, the Gini coefficients in Finland and Norway were almost constant from 2004 to 2018. In Finland it changed from 0.252 to 0.259 (increase of 0.007) and in Norway from 0.251 to 0.246 (drop of 0.005). Thus, there is little change to decompose for Finland and Norway, which means even a small impact can lead to relatively large numbers.

The two other inequality measures show very much the same development in inequality, except for Norway, where the interquartile ratio as well as the interquartile range are both increasing (albeit not much), while the Gini coefficient shows a decrease. Implying that using the Gini coefficient is a solid measure for the changes in the Nordic welfare states.

Table 3 Gini RIF and marginal effects. 2004

	DK	FI	NO	SE
Age	0.000999***	0.000681	0.000857	−0.0000131
Single	0.0421***	0.0545***	0.0474	0.0161*
Education	0.00213	0.00199	0.00484	−0.000258
Assortative mating	0.000726***	0.000553**	0.000878*	0.000104
Constant	0.125***	0.155***	0.0994	0.218***
n	6841	11188	6040	5729
R-sq	0.006	0.002	0.001	0.001

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes:
- For illustrative purposes age and education is measured in years.
- The assumptions behind the regression models are fulfilled to a reasonable extent although residuals (as is often the case) are not exactly normally distributed, which is not an issue here since we have a large sample size and thus some deviations from the normal distribution do not invalidate subsequent testing of parameters due to the Central Limit Theorem (Wooldridge 2019; Greene 2019). Detailed model testing results for regressions in this and subsequent tables are available from the authors upon request.
- The present magnitude of R2 is not uncommon when micro-data are applied (Kennedy 2008). It reflects the fact that many other determinants are also important for income inequality.

Source: See Table 2.

The marginal effects of household characteristics as detailed in the regression equation (1) are shown in Table 3. In the following we exemplify the interpretation using the regression estimates for Denmark. We see that increase in age ("household age") with one year increases the Gini coefficient with 0.001 points using the 2004 Gini RIF regression estimations. More singles will similarly increase the Gini (10 % percentage points increase is associated with a Gini increase of 0.042 points). If people stay a year longer in education then that will increase the Gini with 0.0021 (statistically insignificant). And, finally, if mating becomes more unequal then that increases the Gini by 0.0001.

Before we quantify the inequality change contribution of the different factors, we briefly give an overview over the development in the factors themselves (see Table 4 with changes in variable averages). We observe that all variables move in the same direction in the four Nordic countries. The ageing appears in all countries and amounts to a change of

between 1.32 (Sweden) and 2.54 years (Finland), the share of singles is also increasing amounting to a change of between 2 (Sweden) to 9 % points (Denmark), the educational level is increasing as well with a change between 0.35 (Sweden) and 1.58 years (Denmark), and lastly assortative mating increases since the difference between couples is reduced by between 0.08 (Sweden) and 0.20 points (Norway).

Table 4. Change in characteristics from 2004 to 2018.

	Denmark	Finland	Norway	Sweden
Age	2.26	2.54	2.28	1.32
Single	0.09	0.03	0.05	0.02
Education	1.58	0.59	0.40	0.35
Assortative mating	−0.15	−0.10	−0.20	−0.08

Note: See Table 2.

Source: See Table 2.

The observed inequality changes are next decomposed into contributions from the factors mentioned above, see Tables 5a-5c. In Denmark and Sweden, we see that the ageing population contributed to the increase in Gini inequality over the period (coefficient of 0.07 and 0.04), while more singles decreased it in both countries (−0.01 in both countries). More education contributed to a lower Gini in Denmark (−0.003) and an increase in Sweden (0.008). More assortative mating increased the Gini in Denmark (0.001) and decreased it in Sweden (−0.000).

Table 5a. Decompostion of Gini inequality change 2004-2018. Nordic countries

	Gini level and change				Contribution to Gini change, %			
	Denmark	Finland	Norway	Sweden	Denmark	Finland	Norway	Sweden
Gini level:								
2004	0.232	0.252	0.251	0.224				
2018	0.272	0.259	0.246	0.267				
Change	0.040	0.007	-0.005	0.043	100	100	100	100
Contribution to Gini change:								
Age	0.007	-0.001	0.004	0.001	19	-10	-70	2
Single	-0.010	0.000	0.001	-0.001	-24	4	-14	-3
Education	-0.003	0.000	0.008	0.003	-7	5	-147	6
Assortative mating	0.001	-0.001	-0.004	0.000	3	-17	70	-1
Unexplained	0.044	0.007	-0.013	0.040	110	118	261	95
Change	0.040	0.006	-0.005	0.042	100	100	100	100

Table 5b. Decompostion of inter-quartile ratio inequality change 2004-2018. Nordic countries

	Gini level and change				Contribution to Gini change, %			
	Denmark	Finland	Norway	Sweden	Denmark	Finland	Norway	Sweden
Gini level:								
2004	2.66	2.85	2.70	2.73				
2018	2.94	3.00	2.92	3.31				
Change	0.27	0.15	0.22	0.58	100	100	100	100
Contribution to Gini change:								
Age	0.07	-0.04	0.04	-0.02	25	-25	19	-4
Single	-0.01	0.00	-0.01	-0.02	-5	2	-4	-4
Education	0.01	0.00	0.13	0.04	3	-2	59	8
Assortative mating	0.00	0.00	-0.02	0.03	1	0	-9	5
Unexplained	0.21	0.18	0.08	0.55	76	125	36	95
Change	0.27	0.15	0.22	0.58	100	100	100	100

Table 5c. Decompostion of inter-quartile range inequality change 2004-2018. Nordic countries

	Gini level and change				Contribution to Gini change, %			
	Denmark	Finland	Norway	Sweden	Denmark	Finland	Norway	Sweden
Gini level:								
2004	0.626	0.680	0.613	0.643				
2018	0.708	0.713	0.671	0.797				
Change	0.082	0.033	0.058	0.154	100	100	100	100
Contribution to Gini change:								
Age	0.015	-0.004	0.004	-0.004	19	-13	7	-3
Single	-0.003	0.003	0.013	0.000	-4	8	22	0
Education	-0.010	-0.006	0.028	0.013	-12	-18	48	8
Assortative mating	-0.001	-0.001	-0.018	0.003	-2	-3	-32	2
Unexplained	0.081	0.042	0.032	0.142	99	126	55	92
Change	0.081	0.033	0.058	0.154	100	100	100	100

Note: Interquartile range is defined as the distance between 80th and 20th percentile of log income.

Source: See Table 2.

Although, the development in all countries is not the same, Finland's development affects the Gini development in exactly the opposite direction to Denmark. This needs further investigation, but points to the fact that there is no unidirectional change, despite what was argued in the hypothesis.

Norway has the most atypical effect of factors on Gini development, which cannot be explained by the very small Gini change (-0.005) since Finland experienced almost a similar small change (0.007) in magnitude. In Norway, all factors, except for assortative mating, contributed to an increase in Gini from 2004 to 2018, indicating that other factors have been more important in explaining the decline in inequality.

For all countries, we see that a large fraction of the Gini change is not explained by any of the four variables (0.044, 0.007, –0.013, and 0.040 in respectively Denmark, Finland, Norway and Sweden). This is not surprising since these four variables in themselves cannot explain much of the income distribution since other factors also have an effect – this includes determinants such as earnings dispersion and change in tax-systems and income transfers, as also argued in the first two sections.

The findings above are robust to using the two other inequality measures (interquartile ratio in Table 5b and interquartile range in Table 5c) for Denmark and Sweden, while this is to a less extent the case for Finland. For Norway there is almost a reverse effect of the three investigated causes on the inter-percentile ratio/range compared to applying the Gini coefficient as the inequality measure. The Gini coefficient explicitly includes every observation in the dataset. The decile ratio on the other hand is focused on the first and last deciles, while the interquartile range is focused on the first and last quintiles. The lack of robustness to the inequality measure for Norway requires further analysis, which is left for future research.

An overview over the different factors' development effects on the change in inequality is presented in Box 1. A "+" (plus) sign indicates that the factor's impact implied a higher level of inequality, a "-" (minus) sign implied higher equality, while "0" (zero) indicated a limited or no impact.

Box 1 Overview over factors' effect on Gini change from 2004–2018

	Denmark	**Finland**	**Norway**	**Sweden**
Demography, age structure	+	–	+	+
Demography, single households	–	0	+	–
Education	–	0	+	+
Assortative mating	+	–	–	0

Note: "+" (plus) indicates that a factor's impact implied a higher level of inequality, a "–" (minus) implied higher equality, while "0" (zero) indicates a limited or no impact.

4.3 Decomposition of Gini inequality using gross income

It can be argued that disposable income distorts the effect of demographics since the tax and benefit system is also at play. Therefore, a separate analysis was made by utilizing the available "employee cash or near cash income" measure, which here represents gross (pre-government) income (Table 6).

Table 6. Decompostion of Gini change 2004-2018 with gross income. Nordic countries

	Gini level and change				Contribution to Gini change, %			
	Denmark	Finland	Norway	Sweden	Denmark	Finland	Norway	Sweden
Gini level:								
2004	0.448	0.478	0.427	0.463				
2018	0.479	0.517	0.450	0.460				
Change	0.031	0.039	0.023	-0.003	100	100	100	100
Contribution to Gini change:								
Age	0.033	0.025	0.022	0.012	109	65	94	-418
Single	-0.011	-0.005	-0.008	-0.003	-36	-12	-33	118
Education	-0.014	-0.008	0.007	0.003	-47	-20	29	-105
Assortative mating	0.004	0.006	0.012	0.000	13	16	52	-12
Unexplained	0.018	0.020	-0.010	-0.015	61	51	-41	516
Change	0.030	0.039	0.024	-0.003	100	100	100	100

Source: See Table 2.

Denmark (Gini change of 0.031), Finland (0.039) and Norway (0.023) experienced an increase in gross income Gini inequality from 2004 to 2018, while there was hardly any change in Sweden (-0.003). For all three countries, age is the main inequality driver, i.e. ageing contributed to increased inequality. Similarly, assortative mating also contributed to increased inequality. The higher single person household prevalence contributed to less inequality. The development in education was mixed – it decreased inequality in Denmark and Finland (-0.014 and -0.008), while it increased it in Norway (0.007).

Generally, the decomposition using disposable income differs compared to using gross income. This happens because the disposable income concept includes the effects of the equalizing tax-benefit systems, while the gross income concept is "unaffected" by these two systems, which means inequality is expected to be higher when gross income is used compared to when disposable income is used.

5 Concluding remarks

Decompositions of the change in the Gini coefficient from 2004–2018 shows that ageing contributed to an increase in Gini inequality over the period in Denmark as well as in Sweden, while more singles reduced the Gini in Denmark and Sweden, thereby confirming the first hypothesis, but not as expected for all Nordic countries. Higher educational attainment level contributed to a reduction in the Gini coefficient in Denmark and an increase in Sweden, which is also in contrast to the theoretical knowledge-based hypotheses. More assortative mating increased the Gini in Denmark and decreased it in Sweden. In contrast, the effect of the four factors in Finland was exactly in the opposite direction to Denmark. In Norway, all factors, except for assortative mating, contributed to an increase in the Gini coefficient.

The analyses, at the same time, show that the impact on inequality from changes in the demographic components here explains a smaller part of the change in inequality in the Nordic countries in contrast to what one perhaps could have expected, and thus there are also other factors at play. The main type of explanation for change in inequality might then be how, also particularly after the financial crisis, changes in the tax- and transfer system have played a role in the Nordic welfare states. The implication being that the increase in inequality to a large degree could be a consequence of policy decisions and to a less degree due to the demographic factors analysed in the article. This also implies that if countries want to reduce inequality this will require specific targeted policy decisions such as higher taxes on high income earners and/or more generous social benefits to people with low incomes.

The implications are also that apart from income redistribution per se, governments still have an important role to play in reducing economic inequality through targeted employment, social, and health policies. Employment policies, like enforcing minimum wages, promoting equal pay, and funding job training programmes, help reduce income disparities by creating fair opportunities for citizens. Social policies, including well-designed welfare programmes for vulnerable children, and a more holistic approach to help people dependent on social assistance to regain a foothold on the labour market, are also required. Universal healthcare policies can reduce inequality by ensuring equitable access to essential health services, which particularly mitigates the economic burden of illness on low-income groups. Investments in public education and healthcare can improve long-term economic mobility by enhancing skills and productivity, while conditional cash transfer programs incentivize healthy behaviours and education in poorer communities.

Finally, there is a need for further research in order to explain how even countries belonging to the same specific welfare regime have no unidirectional impact of these demographic factors on inequality in contrast to what could have been expected.

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