

Moving together or drifting apart?

TERRITORIAL DIFFERENCES IN HOUSEHOLD
WEALTH ACROSS THE NORDIC REGION

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1. Introduction

Income inequality is associated with greater levels of poverty and social exclusion (Duque and Mcknight, 2019; Hills et al., 2019), slower economic growth in high-income countries (Soava et al., 2019; Topuz, 2022), lower levels of perceived well-being and happiness (Tavor et al., 2018) and lower levels of human development (O'Donnell et al., 2013; Shimonovich et al., 2022). Moreover, higher levels of income inequality may contribute to rising social discontent (Lenzi and Perucca, 2023), increase political instability and polarisation (Voorheis et al., 2015), foster an environment of anger and resentment that may lead to violence (Kwon and Cabrera, 2019) and negatively affect solidarity, trust and community cohesion, thereby undermining the sustainability and vitality of society as a whole (Jetten et al., 2021).

The Nordic Region is one of the most equal regions in the world (André et al., 2021). However, it is generally accepted that socio-economic gaps between social groups, as well as between richer and poorer parts of the Nordic Region – particularly between urban and rural areas – have increased over time. Previous research shows that differences in household income have grown in all of the Nordic countries, particularly since the 1990s and 2000s (Fritzell et al., 2012; Pareliussen et al., 2018).

The 2007-2008 financial crisis apparently disrupted the trend of rising income inequalities in the Nordic Region, but most sources conclude that this event constitutes a minor discontinuity in the time series. For instance, the State of the Nordic Region Reports 2020 and 2024 suggest that income inequalities between the highest and lowest-ranked regions grew moderately in most countries and self-governing territories of the Nordic Region in the 2010s (Grunfelder, 2020; Refsgaard et al., 2024). That is in line with findings presented in other Nordic studies (Aaberge and Bengtsson, 2023; Robling and Pareliussen, 2017).



2. Goal and scope

While there have been studies on the long-run evolution of income inequality in the Nordics (Aaberge and Bengtsson, 2023; Iacono and Palagi, 2020), there is still a need for more comprehensive analyses that cover the most recent years and consider the impact of recent economic and social policies. Moreover, there is a need for better understanding of the influence of the demographic makeup, including migration (Pareliussen and Robling, 2018) and gender intersections (Boschini and Gunnarsson, 2018), as well as income composition and the evolving role of taxation and welfare policies (Søgaard and Egholt, 2018). Additionally, there is a need for more detailed studies on regional disparities and comparative analyses with other regions (Iacono and Palagi, 2020).

This paper presents empirical evidence on the development of income inequalities in the Nordic countries and self-governing territories during the first decades of the 21st century (2005-2022). The analysis focuses on the social and territorial expressions of socio-economic inequalities, considering income differentials within and between territorial units. The exploration builds on data collected at the municipal level in Åland, Denmark, Finland, Greenland, Norway and Sweden, at the regional level in the Faroe Islands and for *Statistical Output Areas* in Iceland.

Our analysis pays particular attention to the development of household income in rural and urban areas since the pre-2007 financial crisis. We also aim to shed light on the relationship between average income levels and living standards in the various municipalities, as well as their respective levels of income inequality. We are interested in understanding whether those two dimensions reinforce each other, meaning that greater levels of affluence lead to greater levels of inequality. Last but not least, we also explore the contribution of income inequalities within and between municipalities to inequality at societal level.

This research is part of the Ensuring Inclusive Economic Growth in the Transition to a Green Economy (EnlGG) project. The EnlGG project analyses how the Nordic countries can accelerate the green transition towards a climate-neutral economy. This includes exploring contextual factors that might hinder public support for the green transition, such as increasing social and spatial gaps in income distribution. A subsequent research step in the EnlGG project will combine the results of this analysis with other indicators to explore the relevant contextual factors that may increase public discontent and political polarisation, potentially leading to the emergence of "geographies of discontent" in a Nordic context (Chilvers et al., 2024).



3. Data and methods

The empirical analyses presented in this work focus on the distribution of household income. That refers to the income earned by all members of a household, including wages, salaries, earnings from self-employment, social security benefits, pensions and retirement income, investment income, welfare payments and other sources of income. Income statistics can be expressed in various ways, depending on how such income streams and the household composition are considered in the calculation.

The main statistics on household income are as follows:

1. **Total Income** reflects the sum of all income received by all household members before any taxes or deductions are applied. This statistic is often shown as *gross income* and includes wages, salaries, benefits, pensions and other sources.
2. **Net Income** is the total income after deductions such as taxes, social security contributions and other mandatory payments. This shows the actual amount of money households have available to spend or save and is often referred to as *disposable income*.
3. **Equivalised Income** is adjusted household income that accounts for the size and composition of the household, providing a more accurate measure of economic well-being. *Equivalised household income* is typically calculated based on net (disposable) income using an equivalence scale (like the OECD scale), which assigns a weight to each household member (Eurostat, 2024). That allows for comparisons between households of different sizes and compositions.

All the above metrics can be shown as averages, medians or distributions across different income brackets. For example, equivalised income is often presented as median equivalised income or in income distribution analyses to reflect living standards more accurately. Regardless of whether household income values are expressed as total, net or equivalised values, official income statistics are normally expressed in national currency. That makes international comparisons difficult, not only because the units are different, but also because the purchasing power in different countries may follow different trends.

All the analyses included in this paper rely on two data strands from the National Statistical Institutes (NSIs) of the Nordic countries and self-governing territories. Those include both statistics on average equivalised (net) household income by income decile and information on socio-economic inequalities. The latter group includes information on Gini coefficients, percentile ratios and other measures of income inequality, which are generally available at an aggregated territorial level (regional or national).

To overcome the lack of inequality indicators at the local level and ensure harmonised processing of household income, the inequality metrics used in our analysis were calculated manually. The indicators were estimated based on household income by income decile at the municipal level, expressed in national currency. Missing income values for specific years were imputed using the chained equations method (van Buuren and Groothuis-Oudshoorn, 2011). For cross-regional comparisons of income data, income values were further standardised to euros in Purchasing Power Parity (PPP) standards. Annex 1 presents a detailed overview of the datasets used in this study, as well as the data preparation process.

The exploration of inequality patterns in this work relies on the estimation of density functions, Lorenz curves and various metrics of social inequality, including Gini, Atkinson, Theil, Hoover, Herfindahl, Coulter and Dalton indices on household income data. Those indicators were calculated for all units in the 2005-2022 period. The longitudinal analyses of the aforementioned inequality metrics were complemented by analyses of beta and sigma convergence (Sala-i-Martin, 1996), as well as by a club convergence analysis using the approach proposed by Phillips and Sul (2009).

Furthermore, we have combined the social and territorial dimensions by studying the contribution of inter-personal and inter-territorial inequalities to the overall inequality indices within each Nordic country and self-governing territory. That was done by applying inequality decomposition methods available in the literature (Attili, 2021; see e.g. Fields, 2003; Firpo et al., 2009; Mookherjee and Shorrocks, 1982; Panzera and Postiglione, 2020; Patil et al., 2014; Rey and Smith, 2013). Annex 2 provides additional information on the analytical methods applied in this research.



4. Results and discussion

4.1. Substantial differences in living standards

As shown in the map presented in Figure 1, the distribution of equivalised household income at municipal level in the Nordic Region was relatively unbalanced in 2022.

Two spatial patterns stand out:

1. Norway's households are more affluent than other households in the Nordic Region (average: 33,099 EUR-PPP). At the other end of the income distribution lies Greenland, which has the lowest levels of mean equivalised household income in the Nordic Region (average: 19,695 EUR-PPP);
2. In general, urban households across the Nordic Region have higher income levels than rural households, particularly in the largest cities of Sweden, Finland and, to a lesser extent, Denmark.

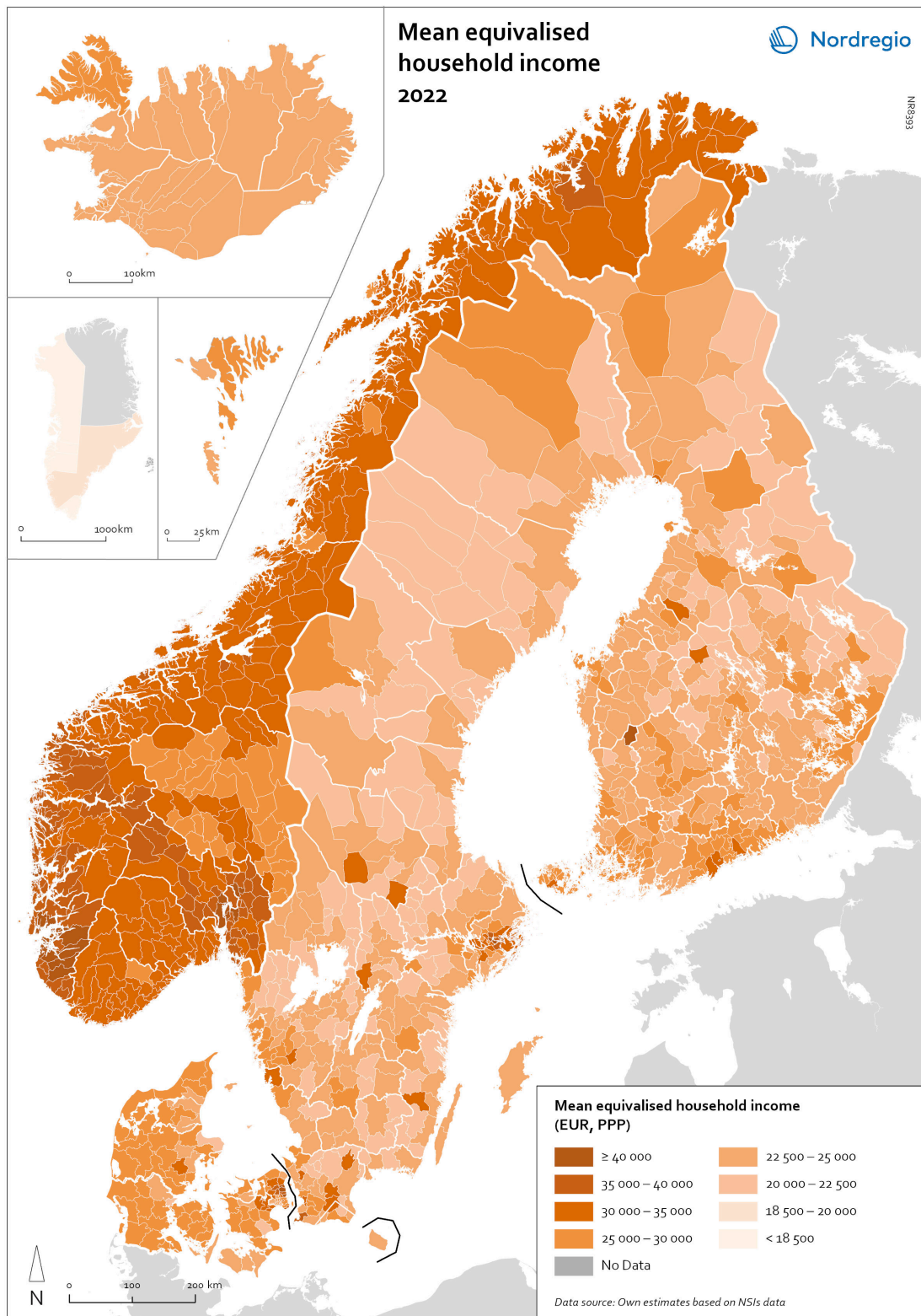


Figure 1: Mean equivalised household income in Nordic municipalities, 2022 (EUR, PPP)

Source: Own estimates based on NSI data.

The patterns observed in Figure 1 reflect important differences in local living standards. However, average equivalised household income values may conceal significant socio-economic disparities within municipalities. The map shown in Figure 2 captures those differences through the Gini coefficient of income inequality in 2022. That index reflects the average difference between all possible pairs of incomes in the distribution, expressed as a proportion of total income.

The spatial distribution of the Gini coefficients suggests that income inequalities tend to be higher in urban areas. Leaving aside some outliers observed in 2022 in rural Finland and Sweden, most of the municipalities with higher Gini coefficients are located in the largest urban agglomerations. The highest Gini coefficients can be found in municipalities such as Frederiksberg, Gentofte, Lyngby-Taarbæk, Hørsholm, Rudersdal, Sottunga, Danderyd, Lidingö and Smedjebacken.

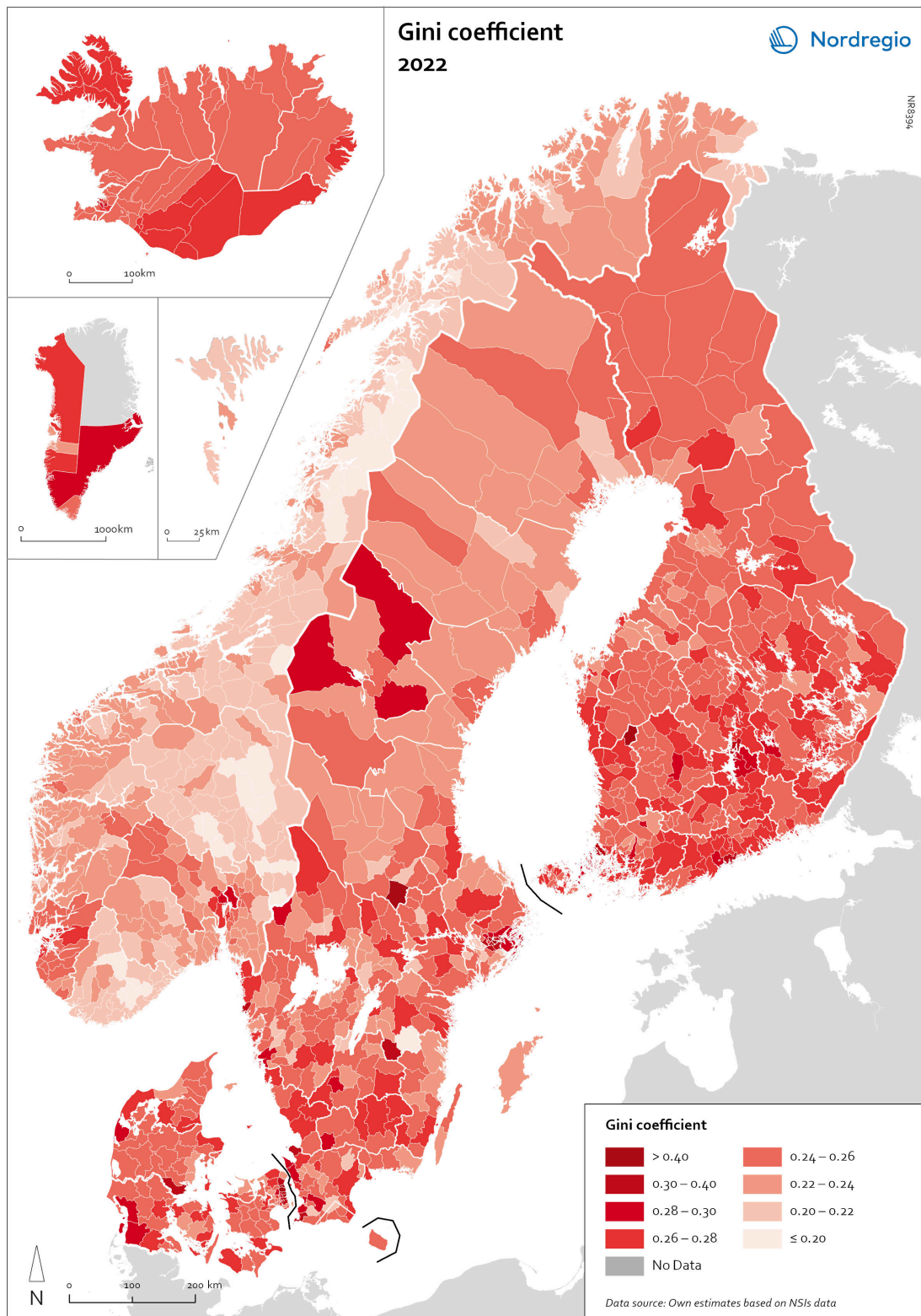


Figure 2: Gini coefficients calculated based on equivalised household income deciles in Nordic municipalities, 2022 (EUR, PPP)

Source: Own estimates based on NSI data.

4.2. Widening socio-economic inequalities

Figure 3 shows the development of total inequalities according to a set of indices calculated on the basis of equivalised municipal household income by decile for the entire Nordic Region. Those indices exhibit various properties, which are detailed in Annex 2 of this report. Regardless of their specific features, the harmonic evolution of all the inequality indices presented in Figure 3 confirms that the gap between income groups steadily increased in the Nordic Region as a whole during the 2005-2022 period.

Growing inequality in household income is generally linked to several coinciding factors. The literature indicates that the variability in the composition of individual incomes and the increasing weight of capital shares of income towards the top of the income distribution are broadly associated with higher personal income inequality. The Nordic Dual Income Taxation reforms in the early 1990s, which introduced lower progressivity of capital income taxation, are generally considered the triggering factor for that process (Iacono and Palagi, 2020).

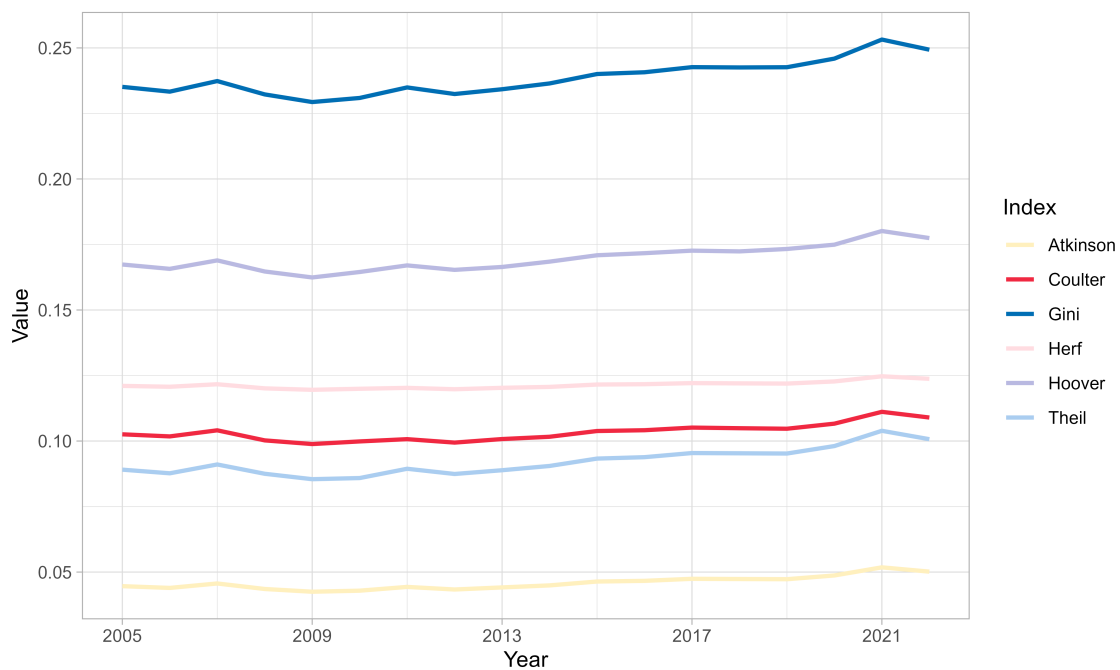


Figure 3: Inequality indices calculated based on equivalised household income deciles (Nordic average)

Source: Own calculations based on household income data provided by NSIs.

Figure 4 shows development of the Gini coefficients over recent years in the Nordic countries and self-governing territories and compares those trends with the EU-27 (2020) average. The figure confirms that income inequalities increased in most areas over the 2005 to 2022 period. The largest increase in the Gini coefficient can be observed in Denmark with a 4-point rise. The most positive development is found in Iceland with a 1-point decrease in the Gini coefficient during that period.

While the Gini coefficients in all the Nordic countries and regions are still below the average value observed for the EU-27 (2020) as a whole, the Nordic values are converging towards the EU level. Moreover, Nordic and EU inequalities seem to have been moving in opposite directions in recent years. While inequalities at the EU level declined over the 2005-2022 period, the Gini coefficients based on household income increased steadily in most of the Nordic countries and self-governing territories during those same years.

Another interesting pattern shown by development of the Gini indices plotted in Figure 4 is that, despite greater fluctuations in the less populated regions (Åland, Faroe Islands, Greenland), income inequalities seem to be growing faster in the largest Nordic economies, particularly in Denmark and Sweden – and to some extent also in Finland and Norway – than in the smaller ones (Greenland, Faroe Islands, Iceland).

Trends observed during that period seem to reflect partially overlapping processes. In the case of Sweden, Denmark and Norway, the development of the Gini coefficients presented in Figure 4 suggests a continuation of the long-term trajectory towards increasing income inequalities that began in the 1990s (Pareliussen et al., 2018). In the case of Finland and Iceland, that can mainly be attributed to the economic downturn of the early 2010s (Olafsson, 2011).

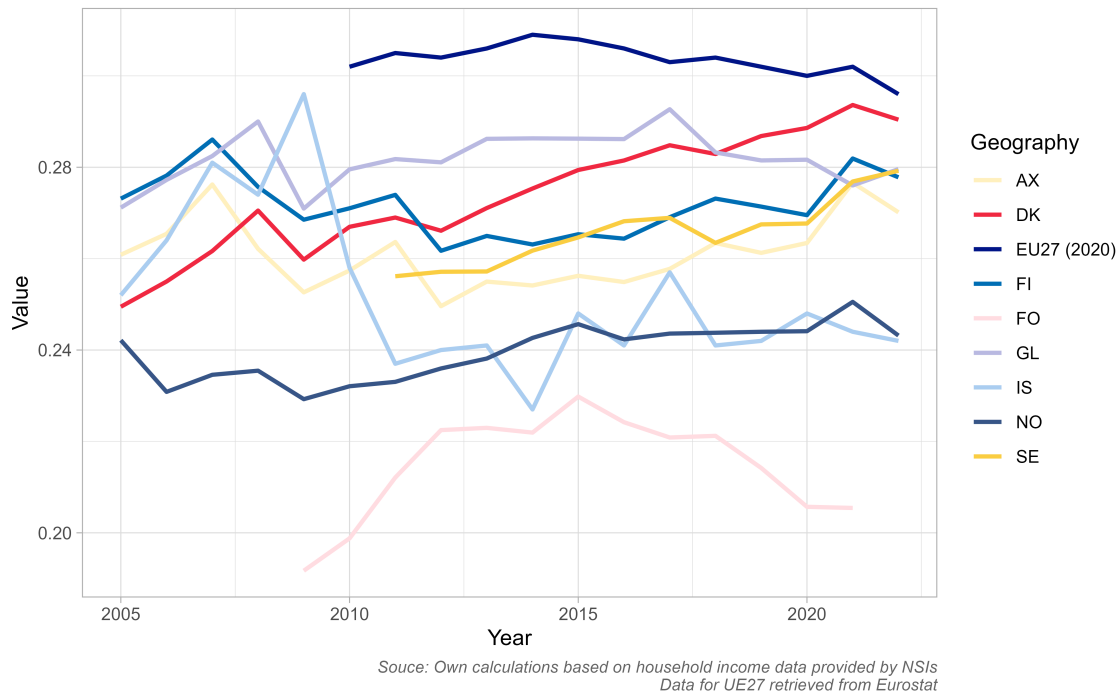


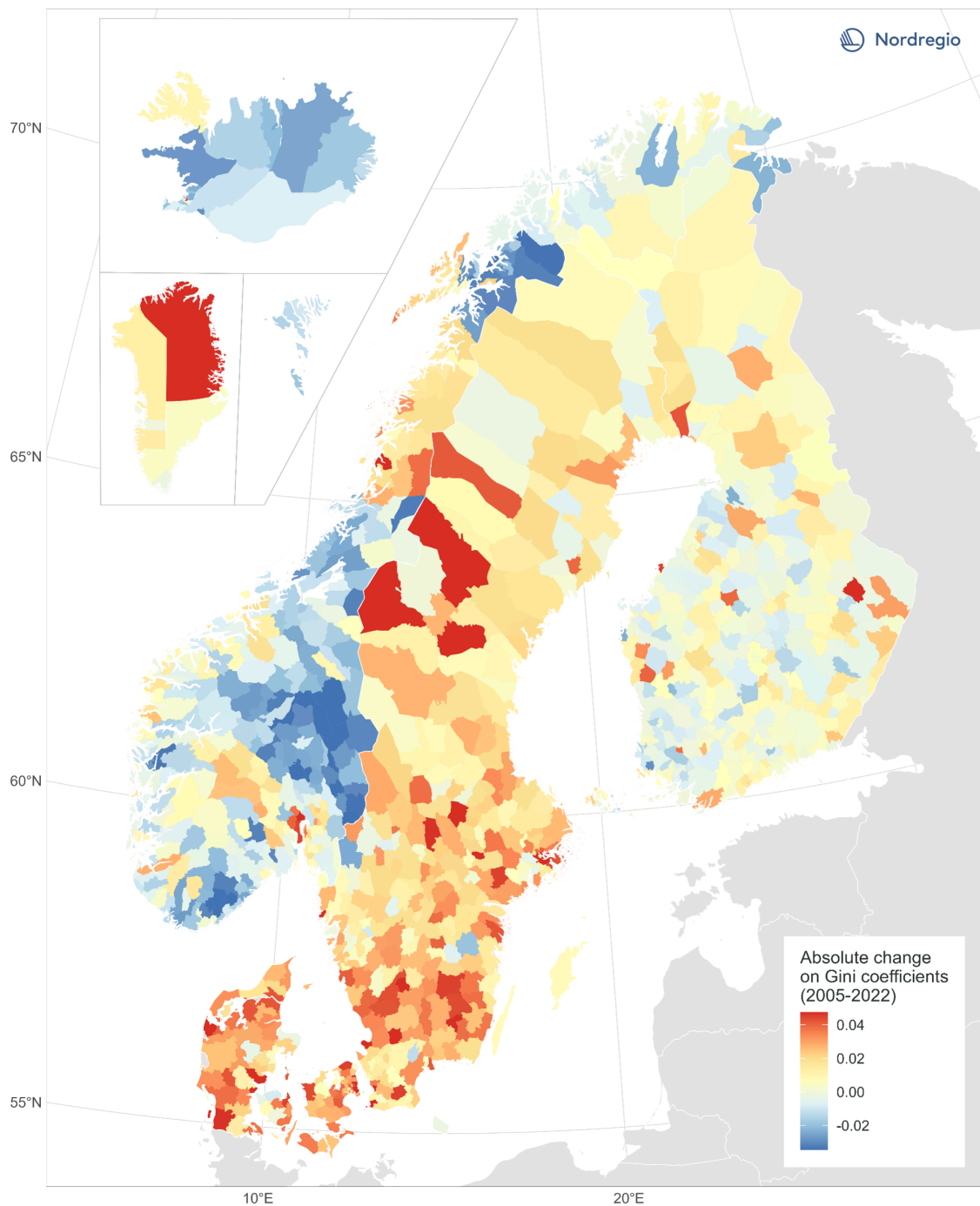
Figure 4: Gini coefficients calculated based on equivalised household income deciles (Nordic average)

Source: Own calculations based on household income data provided by NSIs. Data for EU27 retrieved from Eurostat.

4.3. Widening spatial inequalities

An aspect that previous research has not sufficiently addressed is the role of the spatial dimension of income inequality in explaining the widening socio-economic gap observed in the Nordic Region. Figure 5 sheds light on that aspect by showing the absolute change in Gini coefficients based on household income within each municipality^[1] in the Nordic Region between years 2012 and 2022. For better visualisation of results, statistical outliers have been replaced by the maximum or minimum values within 1.5 times the interquartile range.

1. With the exceptions of the Faroe Islands and Iceland, where the territorial divisions correspond to regions and Statistical Output Areas, respectively.



Source: Own, based on data from NSIs.
Data for Iceland refers to Statistical Output Areas.

Figure 5: Variation in Gini coefficients calculated based on equivalised household income deciles in Nordic municipalities (2005-2022)

Source: Own calculations based on household income data provided by NSIs. Data for Iceland refers to Statistical Output Areas.

In general, income inequality increased in most municipalities in Denmark and Sweden between 2005 and 2022. In Sweden, the largest increase took place in Jämtland County in the North, and Kalmar, Växjö, Jönköping, Älvsborg, and Halland counties in the South. In Denmark, the greatest increases in municipal Gini coefficients were seen in the northernmost and southernmost municipalities of Jutland, as well as in the more urban municipalities in Zealand and Fyn. In Norway, most local areas experienced a decrease in Gini coefficients for equivalised household income. However, income inequality grew in several municipalities in the Nordland region. In Finland, the situation is more varied, with some municipalities experiencing widening inequality gaps, while others have seen a decline. Nonetheless, in most cases, the variations in Gini coefficients in Finnish municipalities were small compared to other Nordic countries. Income inequality decreased in the Faroe Islands and most Statistical Output Areas in Iceland, except in central Reykjavik. Inequality also increased in most major urban agglomerations in the Nordic Region, but not in the largest Finnish cities.

Figure 6 provides a comparison of the distribution of household income at the municipal level for selected geographies and years. The charts display different density plots for the distribution of Gini coefficients, calculated based on equivalised household income deciles in Nordic municipalities. The plots also include the mean (vertical dotted lines) and marginal rug (tick marks placed along the bottom margins).

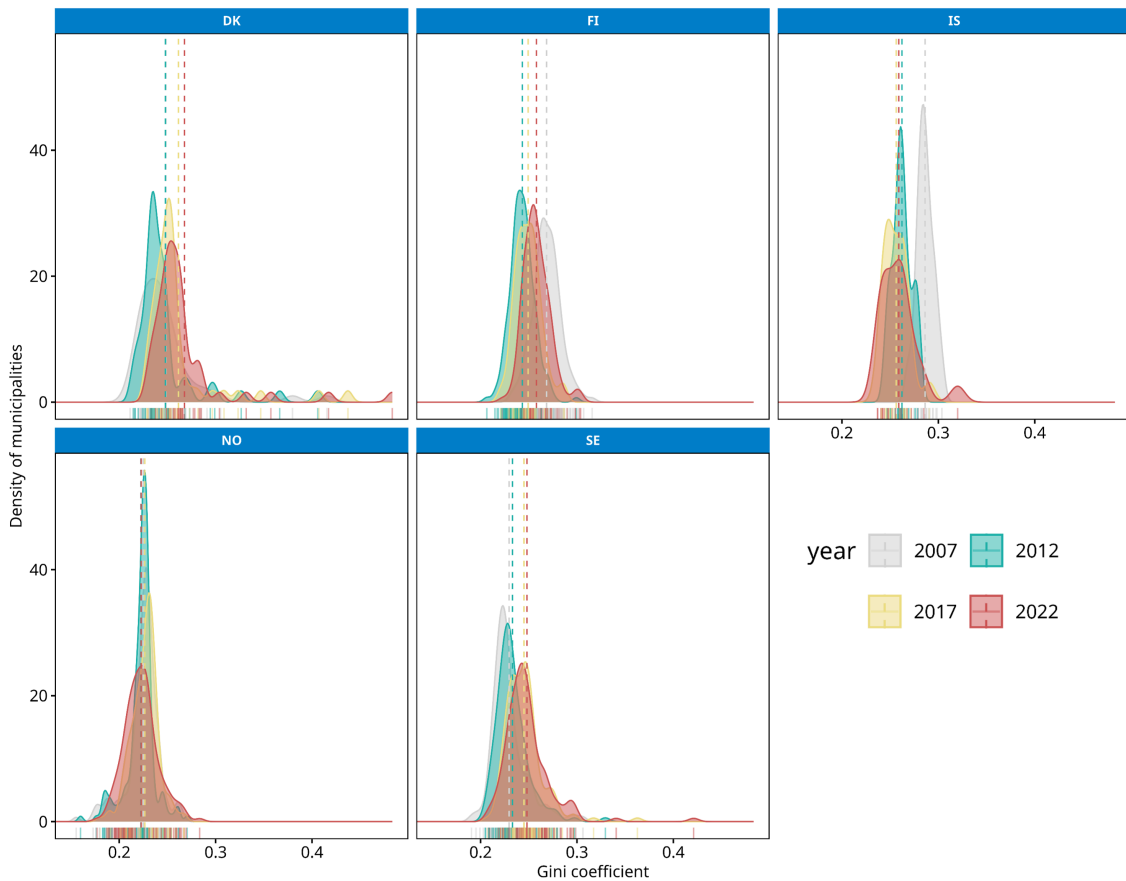


Figure 6: Density plots of Gini coefficients calculated based on equivalised household income deciles in Nordic municipalities

The vertical dotted lines in Figure 6 indicate the average Gini coefficient on equivalised household income for all the sampled municipalities. These values are similar to those shown in Figure 4 above. However, the match is not perfect, as coefficients in Figure 4 were calculated on the distribution of household income by decile at the national/regional level, while the vertical lines in Figure 6 show the mean value for Gini coefficients calculated at municipal level. In general, the mean values suggest that the distribution of household income has become more dispersed over time, particularly after 2012.

The shape and spread of the shaded areas in Figure 6 reveal several important characteristics of the data distribution. The peaks indicate the most common values in the data. A higher peak signifies a higher density of the Gini coefficients around similar values. Wider plots imply more spread-out values of municipal Gini coefficients on household income, while long tails suggest more skewed distributions of the coefficients between municipalities. Multiple peaks on the density plots indicate multiple modes in the distribution of municipal Gini coefficients.

Comparing the data for various years within each region, the plots suggest more spread distributions of the municipal Gini coefficients on income over time, particularly in Norway, Iceland, Finland, and Sweden, as compared to Finland. Note that a growing dispersion of income inequality levels across municipalities does not necessarily imply greater overall levels of income inequality, as an increase in the number of municipalities where income inequality has grown can be balanced by a similar number of municipalities where income inequalities have declined.

Figure 7 provides a different perspective on development of the spatial dimension of socio-economic inequalities. The lines in this chart reflect the development of spatial inequalities measured through mean equivalised household income values at the municipal level, instead of the more nuanced income distribution by decile group used thus far.

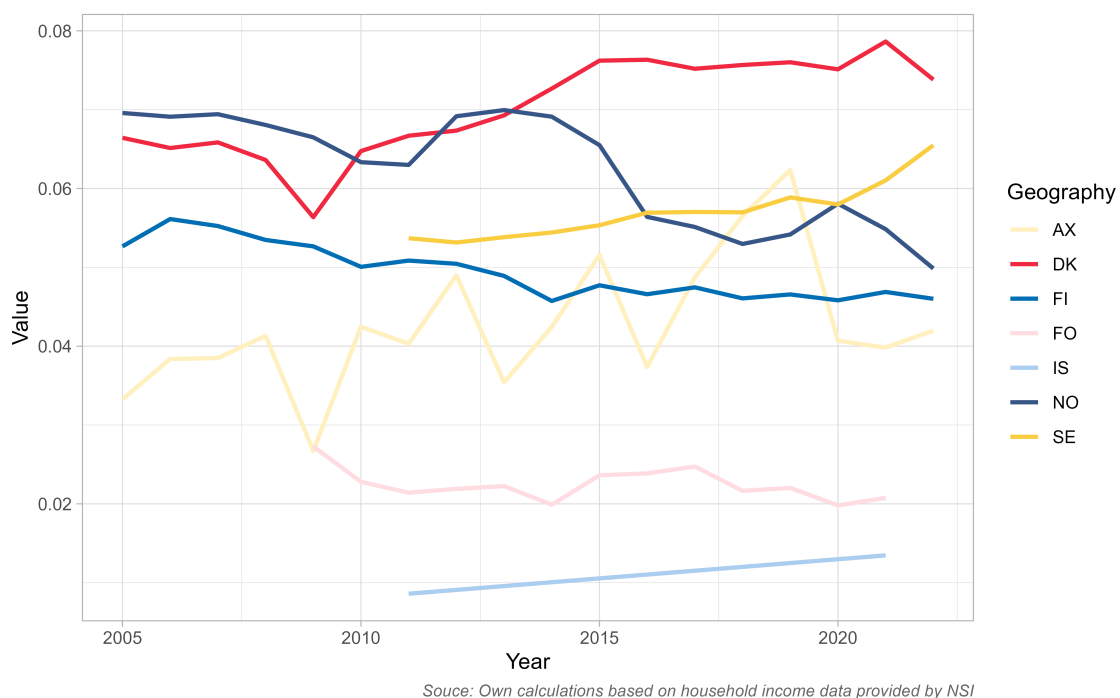


Figure 7: Gini coefficients calculated based on mean equivalised household income at municipal level

Source: Own calculations based on household income data provided by NSIs.

The use of mean equivalised household income values at the municipal level instead of average income values by decile explains the smaller absolute Gini coefficients in Figure 7, compared to those in Figures 3 to 6. Nonetheless, the trajectories of income inequalities shown in the three plots are consistent with one another overall. As income gaps between social groups widen, income differentials between

municipalities become larger and vice versa.

The comparison of the trends in Figures 4 and 7 allows us to understand how social and territorial inequalities are co-evolving. The Gini coefficients calculated on the basis of average equivalised municipal income (Figure 7) are increasing in Denmark, Sweden, Iceland and Åland (as are social inequalities; see Figures 3 and 4). However, the social and spatial gaps seem to be developing in the opposite direction in Norway, the Faroe Islands and Finland. In those areas, the Gini coefficients calculated on the basis of average household income at the municipal level (Figure 7) appear to be more stable – like in the Faroe Islands – or even declining over time – like in Finland and Norway – while social inequalities are still growing (Figures 3 and 4).

Figure 8 provides yet another perspective on the co-evolution of income inequalities between municipalities. The charts presented in this figure show the development of Gini coefficients calculated on the basis of income distributions within the same income levels across municipalities in Denmark, Norway and Sweden. Each line on the plot reflects the development of Gini coefficients calculated on the basis of mean equivalised income of households within each income decile. The variability reflected by the lines thus indicates the diversity of income levels among households in the same income deciles but located in different municipalities within each country. That enables a better understanding of the development of spatial inequalities within the same income groups.

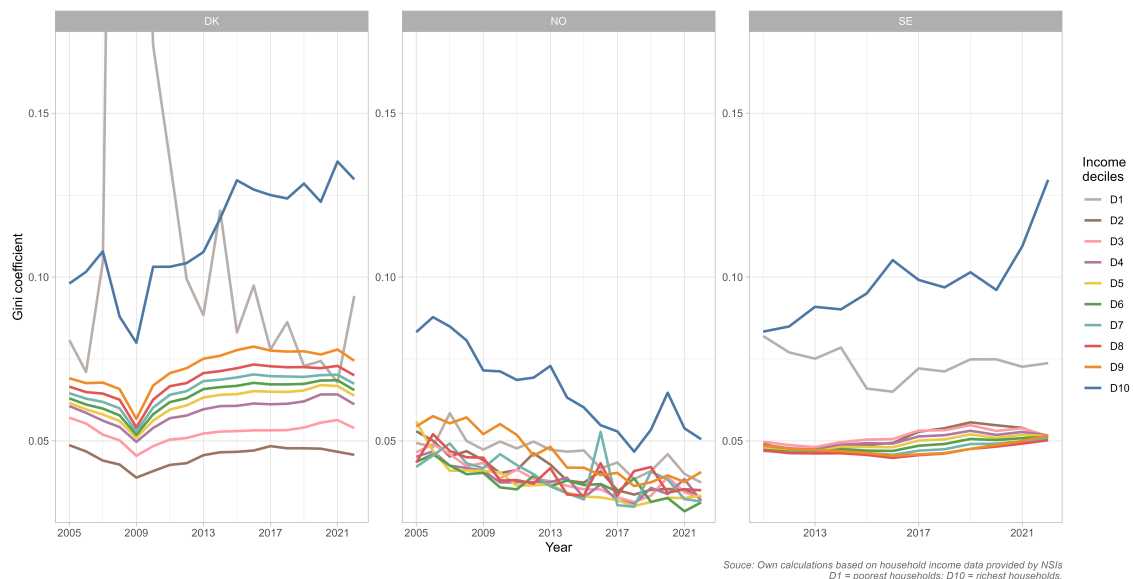


Figure 8: Gini coefficients calculated based on the equivalised income of households within the same income deciles across municipalities in the Nordic Region

Source: Own calculations based on household income data provided by NSIs.

D1 = poorest households, D10 = richest households

The data required to produce the plots in Figure 8 are only available for Denmark, Norway and Sweden. Moreover, since the data generation process differs from country to country, the absolute Gini coefficients are not directly comparable. However, the charts in Figure 8 provide interesting insights into the development of socio-economic inequalities between households in different income deciles.

In general, income differentials between households living in different areas tend to be greater for the deciles at both ends of the income distribution, namely the lowest-income households (D1) and, particularly, the highest-income households (D10). That indicates that the variability of average household income at the municipal level tends to be substantially greater for households in extreme income groups than for other categories.

A growing Gini coefficient for the upper income decile in Denmark and Sweden suggests that the spatial gap – i.e. the difference in average income levels for households in this specific income decile – is widening between municipalities in both countries. That pattern contrasts with the development of the Gini coefficients calculated on the basis of the average equivalised household income by municipality for other income groups within both countries, as well as with the development of income differentials between municipalities in Norway. Here, the spatial gap in household income seems to be declining for all income categories.

Looking at the relative trajectories of the inequality lines between different income groups in each country, it can be observed that in some areas and periods – e.g. in Sweden between 2011 and 2022 – the spatial divide increased for the highest income decile (D10), while it converged or stabilised for the remaining groups, particularly after 2018. The same logic holds for Denmark, where the gap within the top-earners category seems to be steadily increasing between municipalities. As mentioned, the situation in Norway differs, as the average levels of municipal household income seem to be converging over time, regardless of the income category.

4.3.1. Convergence analysis

To delve into the dynamics of changes in household income, it is necessary to examine convergence and catching-up processes. *Economic convergence* reflects a process where per-capita incomes of poorer economies grow at faster rates than those of richer economies. That logic led to the so-called *convergence hypothesis*, which has been the subject of heated debates among different schools of thought in economic and regional science since the classical contributions on economic growth and development (Myrdal, 1957; Solow, 1956).

Galor (1996) describes three main convergence scenarios: (1) an *absolute convergence* hypothesis, according to which national or regional economies tend to converge in the long run, independently of their initial conditions; (2) a *conditional*

convergence hypothesis, according to which only economies that are similar in their structural characteristics – e.g. in terms of specialisations, technologies, rates of population growth, governance etc. – converge in the long run, independently of their initial conditions; and (3) a *club convergence* hypothesis – polarisation, persistent poverty and clustering – according to which only economies that are similar in their structural characteristics converge in the long run, provided that their initial conditions are also similar.

Each convergence hypothesis is supported by a specific metric to validate it. The first two notions rely on the classic metrics of *beta* (1) and *sigma* (2) convergences, respectively. The *club convergence* (3) hypothesis has its own method to evaluate convergence processes, focusing on clustered trajectories of economic agents.^[2] In the remainder of this section, we will apply those metrics to investigate the development of average municipal household income across the Nordic Region.

Beta convergence

The *beta-convergence* hypothesis was originally formulated by neoclassical growth theory (Solow, 1956). The hypothesis is verified when poor economies tend to grow faster than rich ones, implying that laggards catch up to leaders. When calculated on the basis of average municipal household income, the beta-convergence metric can be used to assess if households in municipalities with a lower level of income are catching up with the leading municipalities in this indicator. Table 1 shows the results of the unconditional beta-convergence statistic calculated on the basis of the equivalised mean household income by Nordic municipality for the 2005 to 2022 period.

Indicator	Estimate	Std. Error	t-value	Pr (> t)
Alpha	0.341	0.028	12.060	0
Beta	-0.032	0.00	-11.549	0
Lambda	0.00	NA	NA	NA
Half-life	352.7	NA	NA	NA

Table 1: Results of the global beta-convergence analysis

2. Other metrics used in regional economics to assess convergence patterns at the territorial level include *gamma convergence*, which examines changes in country rankings with respect to a particular outcome or policy objective, and *delta convergence*, which analyses countries' distance from an exemplary model or group of countries. (see Heichel et al., 2005 for a review of economic convergence metrics).

Given that there is global beta convergence ($\beta < 0$), it is possible to calculate the speed of convergence (λ) and the so-called half-life indicator (H). The latter represents the time required to reduce disparities by half (Allington and McCombie, 2007). According to that metric, since the beta coefficient is quite small (-0.03), it would take approximately 353 years to halve the observed territorial disparities in average household income at the municipal level in the Nordic Region.

The beta statistic thus indicates that average income levels in Nordic municipalities tend to converge over time. However, that convergence occurs at such a slow pace that its cumulative effects are imperceptible even in the long run. The beta statistic can be represented by the slope of the regression line plotted in Figure 9. Despite the negative beta coefficient, the points appear to be concentrated in the central region of the chart, suggesting that the regression could be significantly influenced by municipalities with extreme values and statistical outliers.

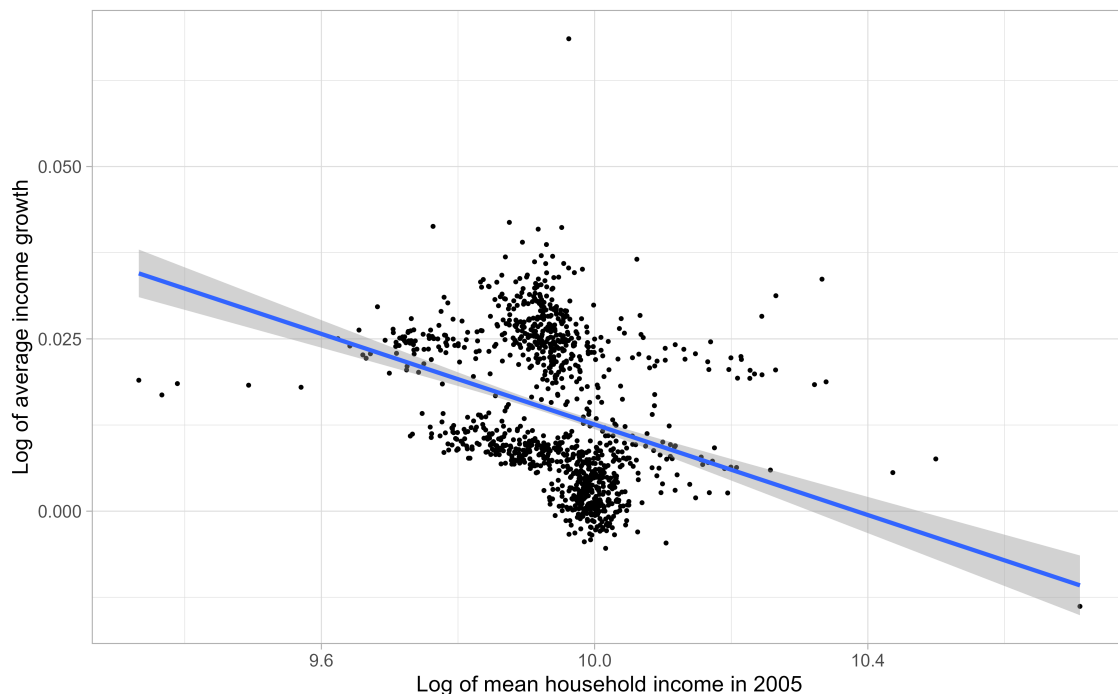


Figure 9: Beta convergence analysis for Nordic municipalities based on mean equivalised household income (2005-2022)

Sigma convergence

The *sigma-convergence* hypothesis is defined as a decrease in the variation of economic outcomes, such as household income. Sigma convergence occurs when the dispersion of the variable (σ), calculated as the standard deviation or

coefficient of variation of regional economic output or income, lessens over time. Here, we estimate σ based on the coefficient of variation of the mean equivalised household income at the municipal level for each year in the time series. Figure 10 shows the resulting trend and regression line for the measure of income.

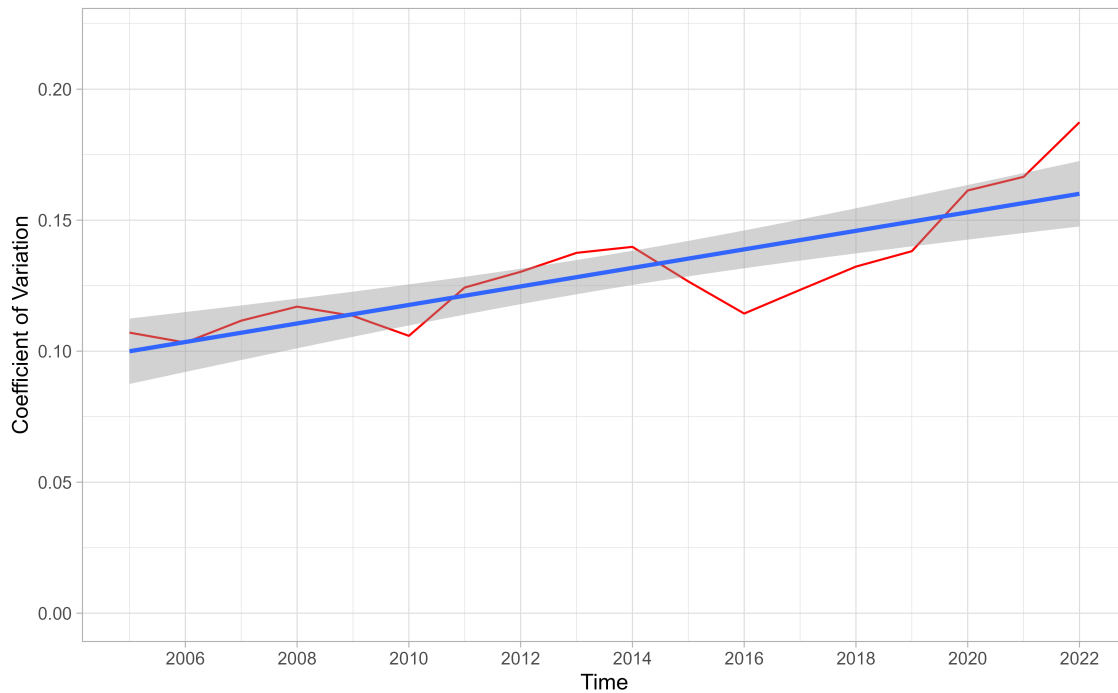


Figure 10: Sigma convergence analysis for Nordic municipalities based on mean equivalised household income (2005-2022)

The positive slope of the trend regression in Figure 10 suggests that there is sigma divergence in our data sample. That result seems to contradict the one obtained above for beta convergence. If the regression line in the beta-convergence analysis was free from specification issues, the outcome would imply that, even if poorer municipalities experienced stronger income growth than richer ones (beta convergence), the average household income at the municipal level could still be gradually dispersing (sigma divergence).

Consistent with the theoretical properties of both metrics, our data show that while beta convergence is a necessary condition for sigma convergence, it is not a sufficient condition (Young et al., 2008). That behaviour could be explained by divergent income growth trajectories among households in different income categories, as observed in Figure 6. That necessitates the use of more flexible metrics, such as the club convergence analysis introduced below.

Club convergence analysis

In addition to global measures of convergence, an increasing number of studies delve into the co-evolution of individual spatial trajectories through the club convergence analysis. That approach was originally introduced by Baumol (1986) to describe the relative evolution of a subset of national economies and was more recently streamlined by Phillips and Sul (2007). Essentially, the analysis is based on a time-varying factor model that allows for individual and transitional heterogeneity to identify clustered trajectories known as "convergence clubs" (Phillips and Sul, 2009).

The club convergence method has several advantages over traditional metrics. First and foremost, it allows for individual heterogeneity over time, implying that different transitional paths for different groups are possible. Additionally, unlike other approaches where economies are grouped a priori, the club convergence method enables the endogenous, data-driven determination of convergence clusters. Moreover, it does not impose any particular assumption concerning trend stationarity or stochastic non-stationarity of the time series, as it is robust with respect to both properties (Sichera and Pizzuto, 2019).

Here, we have applied the club convergence method to explore the income development trajectories of households in the Nordic Region. Figure 11 shows the results of applying that method to the mean household income dataset for all Nordic municipalities^[3] from 2012 to 2022. The plot describes the relative transition of each municipality against the benchmark of a full cross-sectional average. Each line in the chart represents the time profile of transition for one group of individual municipalities with a similar development, relative to the average behaviour.

3. With the exceptions of the Faroe Islands and Iceland, where the territorial divisions correspond to regions and Statistical Output Areas, respectively.

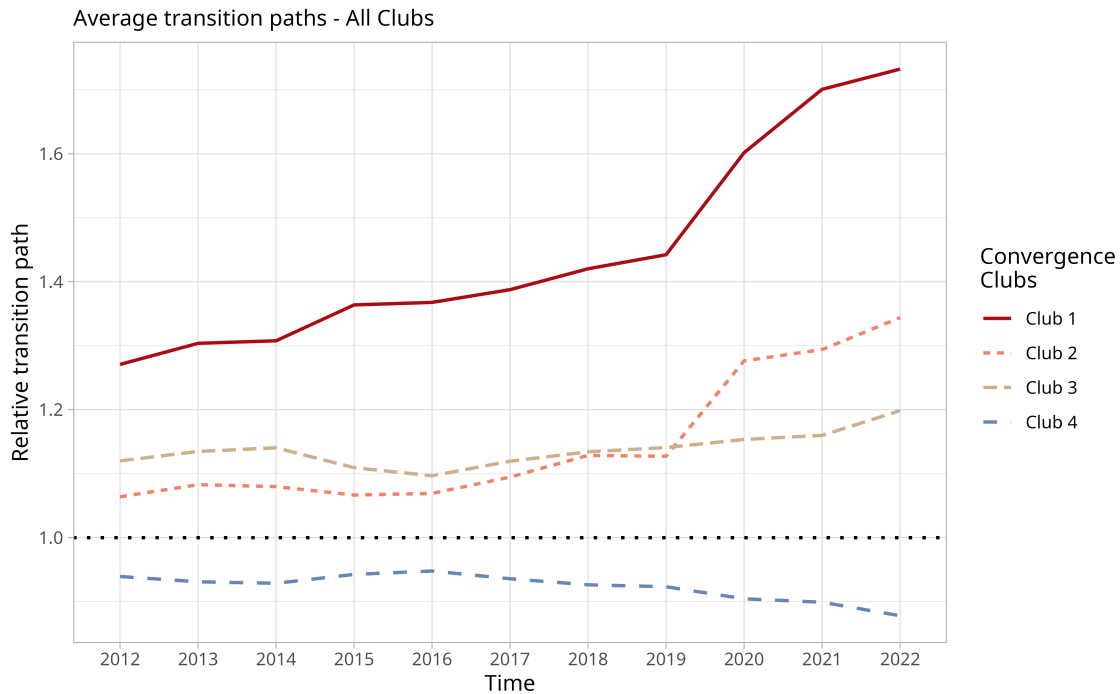


Figure 11: Convergence clubs in Nordic municipalities based on mean household income (2012-2022)

The club convergence algorithm identified four convergence clubs. *Club 1* groups municipalities that are *diverging from above* in terms of average household income. In other words, in those municipalities, average household income has increased much faster than the Nordic average. *Club 2* consists of municipalities where mean equivalised household income at the municipal level picked up relative to the Nordic average after 2019, but not before. *Club 3* is composed of municipalities that performed systematically better than the baseline behaviour for the whole period, but where average household income levels are increasing at a slower rate compared to municipalities in Clubs 1 and 2. Finally, *Club 4* clusters municipalities that performed worse than the other clubs during the entire 2012 to 2022 period, particularly since 2016. Table 2 shows how many municipalities are included in each group, alongside a number of descriptive statistics for each cluster.^[4]

4. The statistical significance of convergence clubs is determined by examining the t-values of individual units. Units with t-values greater than -1.65 are part of the core group, indicating within-group convergence.

	Number of municipalities	Beta	Std. Error	t-value
Club 1	9	0.515	0.457	1.127
Club 2	55	0.168	0.177	0.948
Club 3	317	-0.980	0.595	-1.649
Club 4	725	-1.421	0.032	-43.963

Table 2: Statistical overview of the club convergence clusters

The map in Figure 12 illustrates the convergence clubs cartographically. It highlights the fact that the greatest variation in club membership is found in Norway.

Generally, national economic drive and the degree of urbanisation appear to be the key factors influencing club performance in terms of equivalised mean household income at the municipal level.

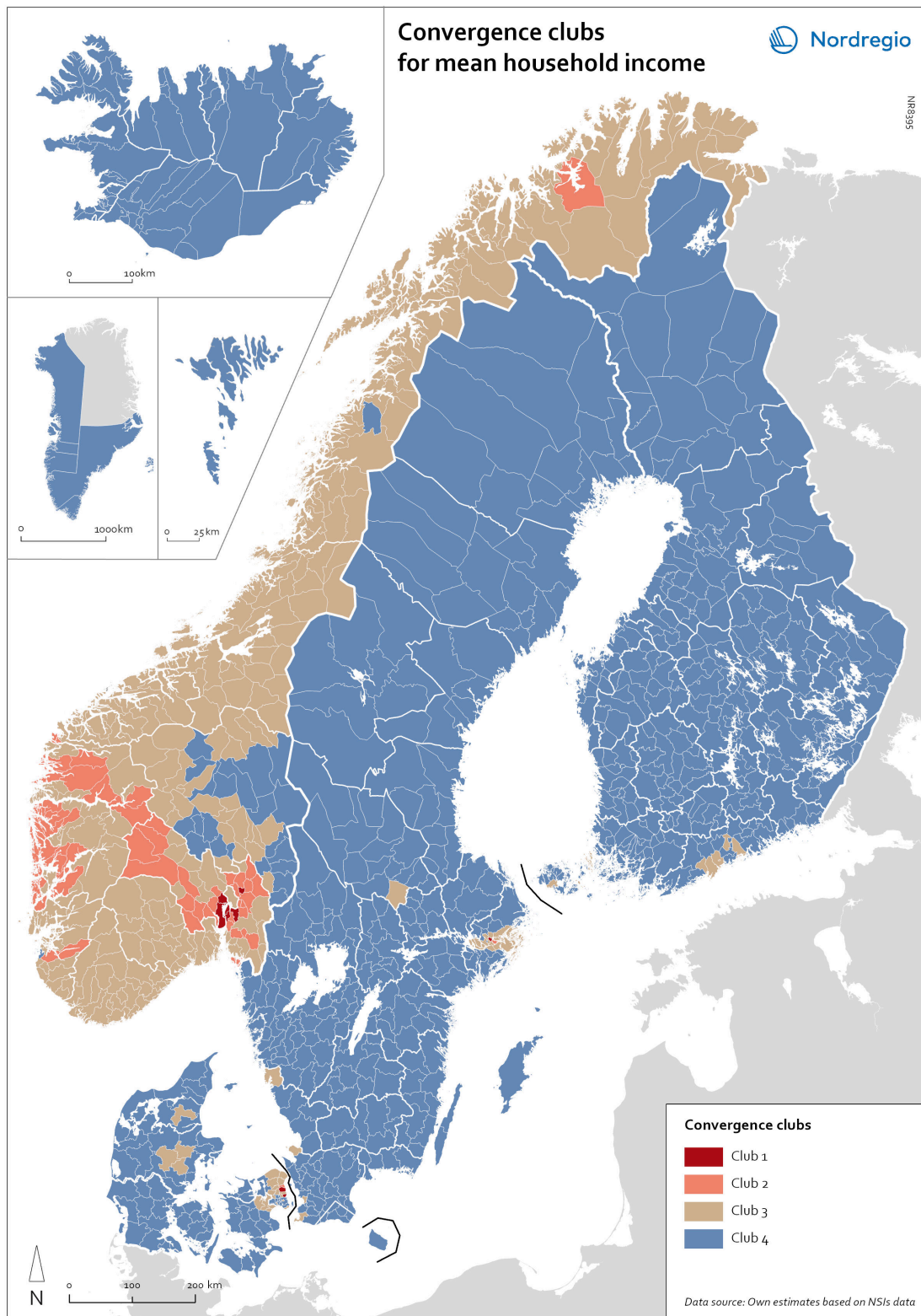


Figure 12: Convergence clubs for mean household income in Nordic municipalities (2012-2022)

Source: Own calculations based on NSI data.

Club 1 is composed of nine small municipalities located within or near the largest metropolitan areas in Denmark, Norway and Sweden. The club consists of the municipalities of Gentofte and Rudersdal in Denmark; Nordre Follo, Frogn, Nesodden, Bærum, Asker and Gjerdrum in Norway; and Danderyd in Sweden.

Club 2 is composed of 55 municipalities where average household income levels increased moderately during the period under analysis, relative to other areas, but without completely detaching from the baseline. The club consists of one municipality in Denmark, Hørsholm; one municipality in Sweden, Lidingö; and 53 municipalities in Norway. Most of those municipalities are either located close to the capital cities, like those in Denmark and Sweden or, in the case of Norway, along the Oslo-Bergen corridor and in coastal locations in Rogaland (e.g. Sandnes municipality) and Finnmark (e.g. Alta municipality).

Club 3 gathers 317 municipalities where average household income levels have grown faster than those in *Club 4*, but not as rapidly as those in *Club 1* and *Club 2*. The group consists of 274 Norwegian municipalities, alongside 20 municipalities in Denmark, 9 municipalities in Finland and 14 municipalities in Sweden. Examples of municipalities in this club include Rebild, Roskilde and Skanderborg in Denmark, Sipoo, Sottunga and Tuusula in Finland, Kvinesdal, Tysnes and Surnadal in Norway and Båstad, Solna and Österåker in Sweden.

Finally, *Club 4* gathers 725 Nordic municipalities characterised by a relative decline in average household income during the 2005-2022 period compared to municipalities in the other clubs. Note that such a relative decline does not imply an absolute reduction in average income levels. Municipalities in this club include most municipalities in Iceland, Greenland and the Faroe Islands and most rural municipalities in Denmark, Finland and Sweden. Examples of municipalities in this club include Vejen, Glostrup and Nordfyns in Denmark; Kopavogur: Smarinn and Fífuhvammur, Reykjavik: Hlíðar and Reykjavik: Vesturbaer south in Iceland; Kommune Qeqertalik, Avannaata Kommunua and Kommuneqarfik Sermersooq in Greenland; Engerdal, Våler (Innlandet) and Søndre Land in Finland; Rendalen, Dovre and Kongsvinger in Norway; and Helsingborg, Hörby and Tidaholm in Sweden.

A general conclusion from the club convergence analysis is that Nordic municipalities exhibit a relatively divergent trajectory in terms of average equivalised household income, particularly after 2019. That divergence may be related to the varying impact of the COVID-19 pandemic on household income, depending on how it is made up of income from labour, capital or transfers. The analysis suggests (1) a distinctly different trajectory for Norwegian municipalities compared to those in other Nordic territories and (2) a clear divide in the development of household income levels between municipalities in greater urban agglomerations and those in other areas within each territory.

However, more sophisticated interpretations of the temporal and spatial traits revealed by the club convergence analysis are challenging due to the influence of external macroeconomic factors. Specifically, the relative evolution of free-floating currencies and Purchasing Power Parity transformations may affect the outcome. Such factors might explain why national patterns seem to prevail over other spatial considerations.

4.4. Relationship between average municipal income and income distribution

A relevant aspect in understanding the genesis and evolution of economic inequalities is the relationship between income and inequality levels. The map in Figure 13 simultaneously represents average equivalised household income and inequality levels for all municipalities^[5] in the Nordic Region. The legend uses a bivariate colour scale based on equivalised mean household income and Gini coefficients calculated on the basis of mean income deciles within each municipality.

5. With the exceptions of the Faroe Islands and Iceland, where the territorial divisions correspond to regions and Statistical Output Areas, respectively.

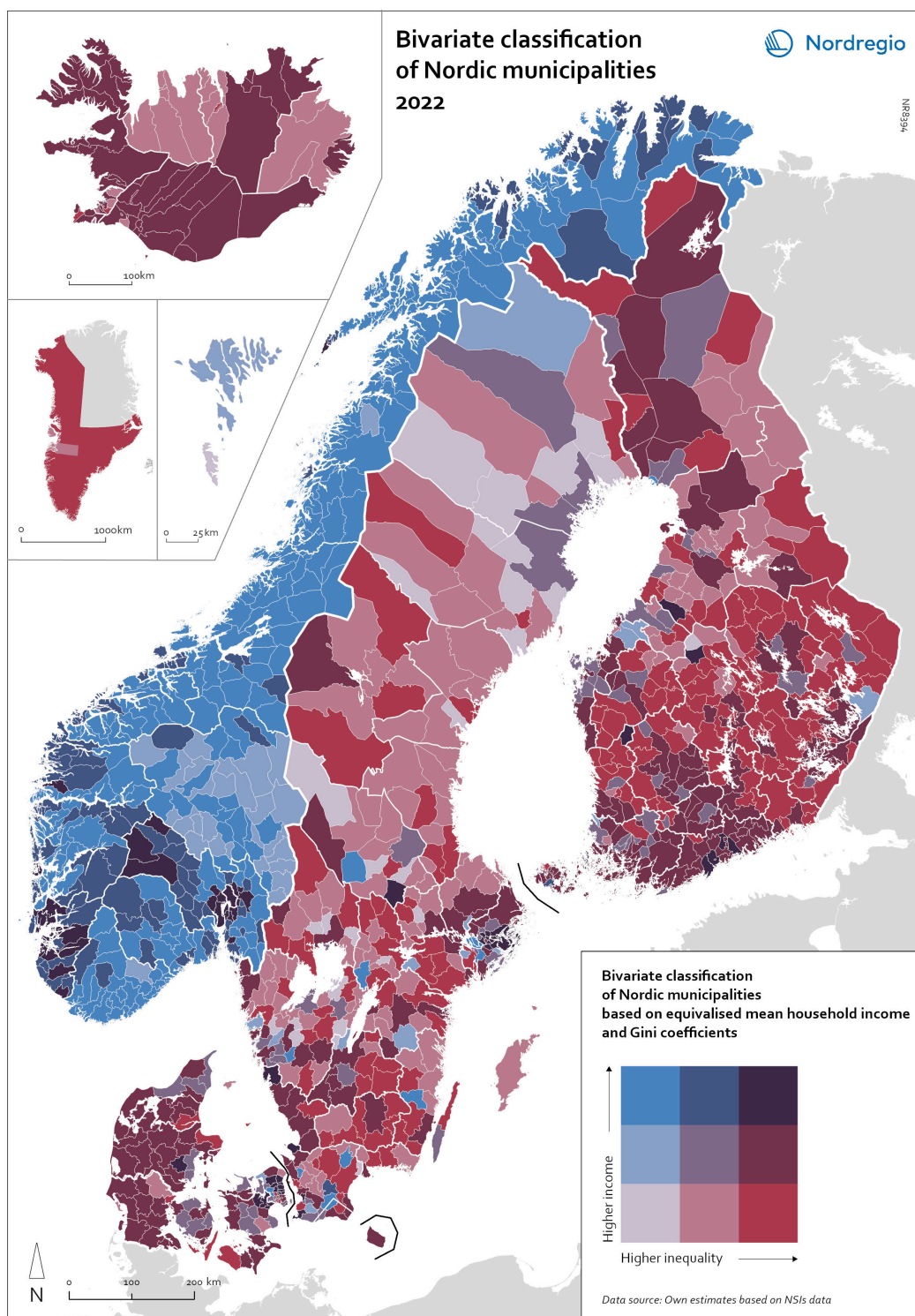


Figure 13: Bivariate classification of Nordic municipalities based on equivalised mean household income and Gini coefficients (2022)

Administrative boundaries: EuroGeographics. Source: Own based on data from NSIs.

Again, the spatial patterns shown in the map in Figure 13 allow Norway to be singled out as a special case regarding the distribution of household income within and between spatial units. In general, Norwegian municipalities show higher levels of average household income than other Nordic regions. Moreover, the distribution of household income at the municipal level also seems more equal in Norway than in other countries.

Additionally, the map in Figure 13 indicates marked territorial differences between areas. The largest Nordic urban agglomerations show higher income and higher inequality levels. That is true for the urban agglomerations of Copenhagen and Aarhus in Denmark, Helsinki and Tampere in Finland, Reykjavik in Iceland, Oslo and Bergen in Norway and Stockholm and Gothenburg in Sweden.

By contrast, some rural municipalities in predominantly land-locked regions of Norway and Sweden show lower levels of average household income and lower levels of income inequality. That pattern is visible in many cross-border and land-locked municipalities in Sweden, Finland and Norway, suggesting that smaller municipalities with traditional economies based on forestry and agriculture have evolved into low-income but socially cohesive communities.

Many intermediate municipalities and medium-sized towns in all countries and self-governing territories show lower levels of average household income, combined with higher-than-average levels of income inequality. Such municipalities tend to be located in cross-border regions of Finland and Sweden, as well as in Iceland and Greenland.

Figure 14 provides a more detailed view of the relationships between municipal income and inequality levels. The figure includes two scatterplots representing Gini coefficients of income inequality (on the horizontal axis) and mean equivalised household income (on the vertical axis). Each scatterplot refers to one territorial level (TL), where TLO means national or self-governing territory level and TL5 means municipal level. Each point represents one spatial unit in one year. The colour legend identifies the observations per country or self-governing territory. To ease interpretation, regression lines summarising the relationship between income and inequality levels have also been plotted for each country. That does not necessarily imply that the relationship between both variables is linear.

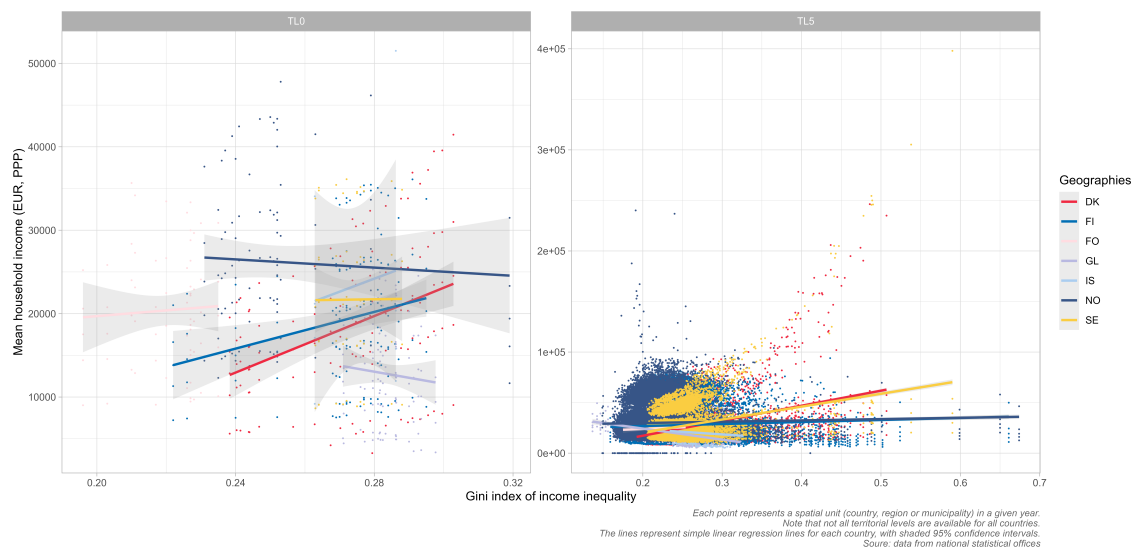


Figure 14: Relation between income levels and income distribution in the Nordic Region (2005-2022)

Each point represents a spatial unit (country, region or municipality) in a given year. Note that all territorial levels are available for all countries. The lines represent simple linear regression for each country, with shaded 95% confidence intervals. Source: Data from national statistical offices.

The scatterplots in Figure 14 show a positive correlation between household income and inequality levels across virtually all areas and scales. However, the distribution of the points suggests that the relationship is neither consistent across territorial levels nor between areas within the same territorial level. While a linear relationship between income and inequality levels appears to hold in some cases, in others such a relationship either does not exist or is not linear.

That indicates that the relationships between average municipal household income and inequality levels may be governed by a variety of *spatial regimes*. The plots in Figure 15 provide further insights into the relationship between those variables by country and degree of urbanisation. Each point on the charts in Figure 15 represents a municipality in Denmark, Finland, Norway and Sweden in 2022. The regression lines have been generated using two linear effects models. The model predictions shown in the chart on the left include random intercepts, while the one on the right includes both random intercepts and slopes. The grouping factors used in both models are the countries and degree of urbanisation, as defined by the Nordic urban-rural typology (Nordregio, 2023). Each level is identified with a different colour and shape for the points and different colours and types for the regression lines.

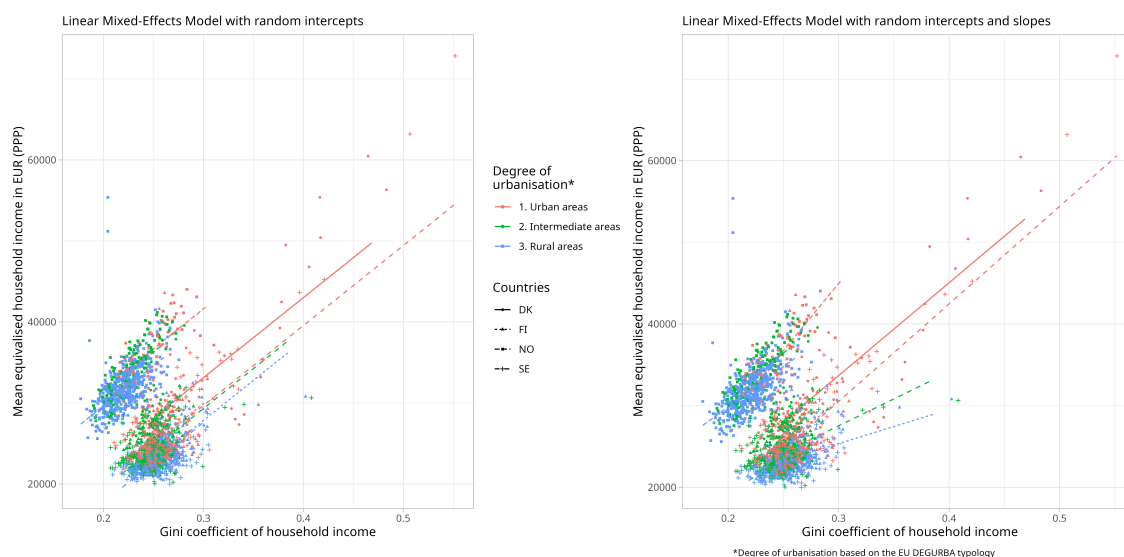


Figure 15: Relationship between income and income inequality, by degree of urbanisation and country (2022)

*Degree of urbanisation based on EU DEGURBA typology.

The charts in Figure 15 confirm that the structural relationships between income and inequality levels vary in strength depending on the country and the degree of urbanisation of each municipality. In general, in more urbanised municipalities, income inequalities tend to grow proportionally with income levels. In those municipalities, the relationship between both variables is stronger than it is for intermediate and, particularly, rural areas, where the link between both dimensions appears to be somewhat weaker. Additionally, the differences in the strength of the relationship between average municipal income and income inequality by degree of urbanisation appear to be greater in Sweden and Finland than in Norway and Denmark.

4.5. Spatial decomposition of inequality indices

Single-point inequality measures fail to capture the role of the geographical distribution of income. That is mostly due to the *anonymity property* of traditional inequality metrics, by which different spatial distributions of household income may yield identical inequality measurements (Panzera and Postiglione, 2020). In general, the lack of decomposable indicators of income inequality prevents the measurement and comparison of income inequality by spatially defined subgroups (Novotný, 2007).

Several inequality decomposition methods are available in the literature to address that issue (Attili, 2021; see e.g. Fields, 2003; Firpo et al., 2009; Mookherjee and Shorrocks, 1982; Panzera and Postiglione, 2020; Patil et al., 2014; Rey and Smith, 2013). Here, we have applied the method proposed by Rey and Smith (2013) to compare the Gini coefficients within each territorial unit with those in the neighbouring and non-neighbouring municipalities within each country or self-governing territory and year. That method, which considers spatial dependence in shaping the geographical distribution of income, yields a global Gini coefficient (G^*) and the two components of the spatial Gini: (1) the inequality among nearest (geographically) neighbours (G_s^*) and (2) the inequality of non-neighbours (G_{ns}^*).

A shortcoming of that method is that it is highly sensitive to the number of nearest neighbours chosen. Since the spatial and administrative configurations of the sampled regions may differ, even at the same territorial level, the number of nearest neighbours selected can lead to biased results. In regions with fewer spatial units (like the Faroe Islands and Greenland) and in countries with very ad-hoc territorial configurations (like Iceland's *Statistical Output Areas*), results are particularly sensitive to the number of nearest neighbours chosen. As a consequence, the (G_s^*) and (G_{ns}^*) estimates should be interpreted with particular care in those regions.

For the sake of comparability, we sampled 1, 5, 10, 20 and 30 percent of nearest neighbours in each area. The results for a selection of 10 percent of nearest neighbours are shown in Figure 16. The chart indicates the extent to which the contribution of (G_s^*) is above or below the expected value, in this case, 10 percent of the global inequality (G^*). That level is indicated by the horizontal dashed line that crosses the vertical axis at value 1. Points located above that line are those where the spatial component of inequality is greater than expected. Conversely, points below the line are those where the spatial component is smaller than expected, according to the number of nearest neighbours sampled.

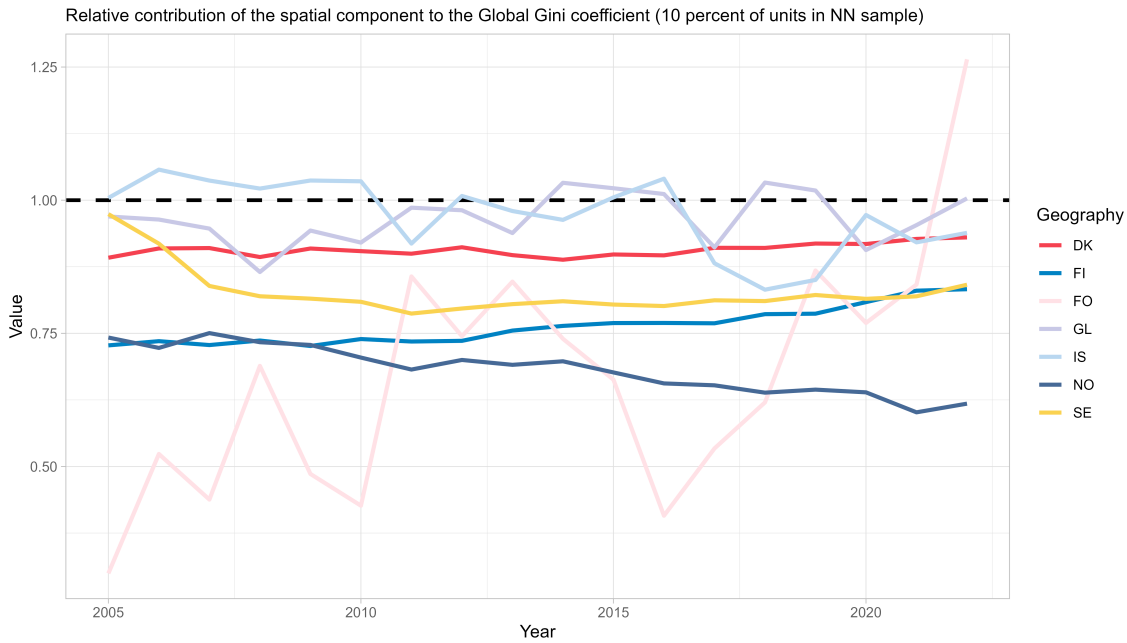


Figure 16: Inequality decomposition of income inequality in spatial and non-spatial components

Source: Own calculations based on household income data proved by NSIs. The horizontal line with 1 denotes equal contribution of within and between inequalities to (G^*)

Looking at the results presented in Figure 16, it may be argued that the contribution of $f(G_s^*)$ to (G^*) is fairly stable over time in the largest economies and less so in the smaller territories. The relative contribution of spatial inequalities to the global (G^*) index ranges from roughly 5 percent in the Faroe Islands to 21 percent in the Faroe Islands.

With the exception of the least populated regions of the Faroe Islands, Greenland and Iceland, the overall contribution of the spatial inequality component remains below the theoretical level in most areas. Nonetheless, the contribution of spatial inequalities to the overall inequality, relative to the social income gap within the municipalities, is on the rise in several regions, particularly in the Faroe Islands. The lines for the larger economies also seem to indicate a slightly upward trajectory of the spatial component, particularly in Finland and Denmark and to a lesser extent in Iceland and Sweden. That emphasises the role of spatial logics of segregation and concentration in shaping income inequalities across the Nordic Region.

Again, the exception to this general rule is Norway, where the contribution of the spatial component of income inequality (G_s^*) to the global inequality level (G^*) appears to be decreasing over time. That trend also holds when considering alternative numbers of nearest neighbours (not shown) and is consistent with the

charts provided in Figures 7 and 8 above. The decomposition analysis hence confirms that Norway has been particularly successful in reducing the income gap between municipalities, even more so than between income groups.

According to Angell et al. (2016), three key factors explain why the regional disparities in disposable income per capita remain relatively small in Norway and have declined over time. The first is the active redistributive role of its powerful welfare state (also confirmed by Aaberge et al., 2018). Public transfers make up 25 percent of disposable income in many municipalities, particularly in those with a large share of people in the pre-work or retiring age groups. A second reason explaining the decline in income levels between urban and rural households in Norway is the development of several high-income industries, such as energy production, salmon farming, marine resources and oil-related activities, in many rural municipalities. A third reason is a well-developed public sector, which has a solid wage base and often dominates the local labour markets in rural and remote regions. However, understanding the role of policies that make Norway stand out as a more cohesive space, relative to other Nordic countries and regions, would require further comparative research.

5. Conclusions and policy implications

Using official data on income statistics by quantile provided by the NSIs, we explored the distribution and development of income inequalities in the Nordic countries and self-governing territories between 2005 and 2022. Our results are limited by the availability of comparable income data at the municipal level, particularly due to the different presentations of income statistics by various NSIs. The data harmonisation strategy adopted has certainly improved the cross-country comparability of those data, but the results are not perfect, calling for a judicious interpretation of the findings presented in this report.

Our analyses confirm the trajectory towards a widening income gap between Nordic households in different income deciles. According to evidence from previous research, that process started about 30 years ago, in the early 1990s and has various manifestations and implications. Our analysis of the equivalised household income data shows that income dispersion has grown moderately in most regions in recent years. That pattern was not structurally altered by periods of economic expansion or downturn.

Showing some specific features, the development of household income gaps at the Nordic level is a consequence of the development of income inequalities between income groups within all of the municipalities in the Nordic countries and self-governing territories (*social inequality*) and between households in different municipalities (*spatial inequality*).

In general, our analysis for the 2005-2022 period shows that differentials between income groups (*social inequality*) have been increasing in all Nordic territories. Inequalities are growing faster in the largest economies, namely Denmark, Sweden, Finland, Norway and, to a lesser extent, Iceland, particularly in the aftermath of the 2007-2008 financial crisis.

Development of the income gap between households in different municipalities (*spatial inequality*) is more nuanced. Income inequalities calculated on the basis of the average equivalised household income at the municipal level have increased in Denmark, Sweden, Iceland and Åland, but declined in Norway and to a lesser extent in Finland and the Faroe Islands.

Such dissonant trends in income inequalities within and between municipalities was further studied using decomposition techniques. That analysis confirms that while between-group inequalities are still the predominant factor explaining socio-economic inequalities in the Nordic Region, the spatial expression of income inequalities is becoming increasingly relevant, particularly in Finland and the Faroe Islands.

Another perspective addressed in this paper is the link between average household income at the municipal level and how it correlates with inequality levels within the municipalities. Our analysis shows a generally positive association between household income and income inequality. However, the relationship between both variables differs in intensity between and within countries, according to the territorial level and spatial conditions. At all territorial levels, the relationship seems to be governed by a variety of spatial regimes. Specifically, at the municipal level, the association between average income and income inequality levels tends to be stronger in cities and intermediate areas and weakens as the degree of rurality increases.

The exception to that general state of affairs is Norway. Measured in Purchasing Power Parity terms, Norway shows the highest levels of disposable household income during the analysed period. At the same time, while income inequalities are also increasing in that country, the distribution of household income at the municipal level is generally more equal in Norway than elsewhere in the Nordic Region. Moreover, in stark contrast to other Nordic territories, the differences in average municipal household income levels have been declining over time. That has resulted in a more socially and spatially cohesive society in Norway in terms of household income, compared to other Nordic countries and regions.

The relatively successful example of regional and rural development and welfare policies implemented in Norway can be a source of inspiration for equivalent policies in the other countries and self-governing territories of the Nordic Region. Further research should be conducted to understand the particular features of those policies, their design elements, implementation processes and the contextual factors that have led them to perform better than elsewhere in the Nordic Region.

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7. Annex 1: Data preparation

7.1. Overview of data used

The analyses presented in this paper were produced using data from the National Statistical Institutes (NSIs) of all the Nordic countries and regions. The tables were accessed programmatically using the APIs provided by the NSIs. Table 3 presents an overview of the key datasets used.

Table 3: Income data used

Country	Dataset	Indicator	Unit	Time
DK	IFOR32	Avg. equivalised disposable income in decile groups, by decile average, municipality and time	Decile average (DKK)	1987-2022
FI & AX	11wh	Income shares (%), means, medians and maximum values of decile and percentile groups by income decile or fractile group, information and year	Disposable cash income per consumption unit, mean (EUR)	1995-2022
FI & AX	12hh	Dwelling population by income decile by year, income decile or fractile group, region and Information	Household-dwelling unit population in income decile, persons	1995-2022
FI & AX	12hh	Dwelling population by income decile by year, income decile or fractile group, region and information	Share of population belonging to the income decile, %	1995-2022
FO	IP01027	Equivalent income by percentile intervals, age, sex and region (2009-2021)	Decile average (DKK)	2009-2021
GL	INEH	Decile distribution of household income by time, municipality, place of residence, number of adults, number of children, decile and type of income	Average equivalised disposable household income (DKK)	2002-2018
IS	CEN1603	Census: total equivalised income of private households by income deciles and statistical output area 2011 and 2021	Mean equalised total income (ISK)	2011,2021
NO	09557	Persons equivalent income (percentile). Income after tax per consumption unit in NOK nominal, by region, percentile, contents and year	Income after tax per consumption unit (NOK)	2004:2022
NO	12558	Households, by region, income before / after tax, decile group, contents and year	Highest value in decile (NOK)	2005:2022
NO	12558	Households, by region, income before / after tax, decile group, contents and year	Percentage households	2005:2022
SE	TabVX2DisplnK	Income distribution (fractiles) by region, type of income, distribution measurements, observations and year	Mean equivalised disposable income excluding capital gains (SEK)	2011-2022

More often than not, the statistical definitions, units of measure and presentations of the databases providing information about household income and inequality differed. That made it necessary to pre-process the datasets to enable pan-Nordic comparisons. In general, the process can be summarised as follows:

1. Retrieve the relevant statistical tables from the NSIs of the Nordic countries and self-governing territories.
2. Pre-process the data (merge tables, filter and combine variables etc.) to extract or estimate the information on average equivalised net household income by income decile, territorial level and year.
3. Calculate inequality metrics, including Gini, Atkinson, Theil, Hoover, Herfindahl, Coulter and Dalton indices on original income data in national currency.
4. Transform income data into Purchasing Power Parity (PPP). That enables more meaningful comparisons of income levels between areas. The following EU databases were used to perform these transformations:
 - European Central Bank:
ECB reference exchange rates for various local currencies (annual values).
 - Eurostat: Purchasing Power Parities (PPPs), price level indices and real expenditures for ESA 2010 aggregates prc_ppp_ind

The following section outlines the processing steps performed to prepare the data for analysis in each country.

7.2. Country data

7.2.1. Denmark

In the case of Denmark, the following table was used:

- IFOR32: Avg. equivalised disposable income in decile groups, by decile average, municipality and time

As its name suggests, IFOR32 provides information on average equivalised disposable income by decile average, municipality and time. The information in IFOR32 was used to calculate several inequality metrics, including Gini, Atkinson, Theil, Hoover, Herfindahl, Coulter and Dalton indices. For the sake of comparability between different countries, the average household income values in IFOR32 were also converted into euros using Purchasing Power Parities (PPPs) standards. These values complement the inequality indicators available in table INFOR41. As described below, that information was also used for quality assessment.

7.2.2. Faroe Islands

For the Faroe Islands, we downloaded the following table:

- IP01027 Equivalent income by percentile intervals, age, sex and region (2009-2021)

IP01027 was used to retrieve information on average income per household. Since the information on equivalised household income is provided by percentiles rather than deciles, we grouped the percentiles into ten categories and then calculated the arithmetic mean for each decile. Subsequently, we computed the Gini, Atkinson, Theil, Hoover, Herfindahl, Coulter and Dalton indices on the basis of the decile averages. As a final step, income values were converted into euros using Purchasing Power Parities (PPPs) standards, thereby simplifying comparability across areas.

7.2.3. Finland

In the case of Finland, the following tables were used:

- 11wh: Income shares (%), means, medians and maximum values of decile and percentile groups by income decile or fractile group, information and year
- 12hh: Dwelling population by income decile by year, income decile or fractile group, region and information

Statistics Finland does not provide information on equivalised income by income group and municipality. However, the inequality measures can be approximated by combining information on income levels (i.e. average disposable cash income per "consumption unit") by decile groups at the national level (Table 11wh) with information on the number of persons in each area (region or municipality) in each income category (Table 12hh). That allows for the approximation of a series of inequality measures, including the Gini, Theil, Hoover and Coulter indices, by weighting income levels according to population shares in each income category.

We also estimated the mean equivalised household income (i.e. average disposable cash income per "consumption unit") in each decile by weighting by population shares in each income category and region and referencing those values to the national average. The calculation is based on the income and population volume ratios for each area and year. The formula is given by:

$$I_{id} = I_{cd} \cdot \left[\frac{\frac{V_{id}}{\sum_{i=1}^N V_{id}}}{\frac{V_{cd}}{\sum_{i=1}^N V_{cd}}} \right] \cdot \left[\frac{\frac{P_{id}}{\sum_{i=1}^N P_{id}}}{\frac{P_{cd}}{\sum_{i=1}^N P_{cd}}} \right]^{-1} \quad (1)$$

where I_{id} is the estimated mean equivalised household income for any given income decile d and territorial unit i , I_{cd} is the known average income for any given decile d , as defined at the national level, V_{id} is the total volume of equivalised household income in any given decile d and territorial unit i , V_{cd} is the total volume of equivalised household income in any given decile d , as defined in the national distribution, P_{id} is the population in any given income decile d and territorial unit i , and P_{cd} is the population in any given income decile d at the national level.

Those income estimates were used to calculate the inequality metrics that cannot be derived from weighted values, namely the Atkinson, Herfindahl and Dalton indices. As usual, we also transformed the average household income estimates into Purchasing Power Parities (PPPs) standards to facilitate comparability across areas.

7.2.4. Greenland

In the case of Greenland, the following tables were used:

- INXFI401: Decile distribution of income for families by municipality and type of income
- INXFI101: Family income by municipality and type of income

Greenland provides information on income levels by decile groups, municipalities and time (INXFI401). However, since the information in this table is not equivalised, we had to calculate it using the information on family structures (number of adults and children) from the same table. We applied the modified OECD equivalence scale (Eurostat, 2024), which attributes a weight to all members of the household:

- 1.0 for the first adult;
- 0.5 for the second and each subsequent person aged 14 and over;
- 0.3 for each child aged under 14.

We then computed the inequality indicators, namely the Gini, Atkinson, Theil, Hoover, Herfindahl, Coulter and Dalton indices, using the equivalised household income by decile. Those values were validated by comparing them to the equivalised disposable household income by municipality in INXFI101. In general, the deviation between both values was small, with the greatest differences found in some areas of Kommune Kujalleq, where the maximum relative deviation reached -15 percent for one observation. In the remaining areas, the differences were smaller (averaging -3.18 percent).

7.2.5. Iceland

In the case of Iceland, the following tables were collected:

- TEK01002: Income by municipalities and sex 1990-2022 – division into municipalities as of 1 January 2023
- TEK01003: Income by municipalities and sex 1990-2022 – current municipalities
- CEN1603: Census: total equivalised income of private households by income deciles and statistical output area 2011 and 2021

Iceland provides aggregated income data at the municipal level (TEK01002 and TEK01003). However, the income data in those tables are not classified by income deciles, nor are the values equivalised by household size. Alternatively, the table CEN1603 provides data on equivalised income of private households by income deciles and region. However, those data come from population censuses and are only available for *Statistical Output Areas* in 2011 and 2021. Further, they are provided as total household income instead of net household income.

As a first processing step, the equivalised household income figures in CEN1603 were transformed from total to net values by applying decile-specific scaling factors loosely reflecting taxation data in Iceland. The ratios applied ranged from 0.63 for decile 1 to 0.53 for decile 10. The inequality metrics were calculated on the basis of those values. Additionally, the mean and median equivalised household income values were further re-scaled so that the estimated aggregated values at the national level matched those available in the Eurostat table *Median and median income by age and sex – EU-SILC and ECHP surveys* (ilc_di03). The re-scaling factors used were 0.682 for the mean and 0.732 for the median). Moreover, to enable currency transformation to euros, it was also necessary to interpolate the EUR/ISK exchange rates for the period 2009-2017. Finally, all income values were converted into Purchasing Power Parities (PPPs) standards.

7.2.6. Norway

The analysis for Norway draws on the following tables:

- 12558: Households, by region, income before / after tax, decile group, contents and year
- 09557: Persons equivalent income (percentile). Income after tax per consumption unit in NOK nominal, by region, percentile, contents and year
- 06081: Persons in private households, by region, type of household, contents and year

Table 12558 provides information on the number of households by municipality and region, income before and after tax, decile group, contents and year. However, the table does not include average income values within each percentile and the income information is categorised by the highest value in each decile. Moreover, the values are not equivalised according to the characteristics of the households. Table 09557 provides information about average income after tax per "consumption unit" in NOK. The information is available by county and, as in the previous case, the income values for the upper percentiles are not provided. Finally, Table 06081 provides information on household composition by area.

The data processing started by combining the three tables and estimating the equivalised household income values in Table 12558 by weighting the after-tax income values by the equivalised household sizes, according to Table 06081. To calculate the equivalent household sizes, we applied the modified OECD equivalence scale (Eurostat, 2024) as follows:

- 1.0 for the first adult;
- 0.5 for the second and each subsequent person aged 14 and over;
- 0.3 for each child aged under 14.

Given that neither Table 12558 nor Table 09557 provide income values for the upper income deciles, those were estimated using a cubic extrapolation spline (Hyman method).^[6]

Subsequently, we combined both tables and calculated the average household income for each area as a weighted mean of the equivalised income values reported in 09557, considering the population shares in 12558 (see Equation 1). We also estimated a series of inequality measures, including the Gini, Theil, Hoover and Coulter indices, using that same weighting approach.

Further, we defined median equivalised income in each statistical unit as the upper threshold in the fifth income decile and calculated unweighted Atkinson, Herfindahl and Dalton inequality indices. Finally, all income values were converted into euros and euros in Purchasing Power Parities (PPPs) standards.

6. In the case of 09557, however, the mean equivalised household income estimates for the upper decile were further increased by 30%. That was done to further align the Gini coefficients calculated based on these values with those provided by the NSI.

7.2.7. Sweden

For Sweden we used the following table:

- TabVX2DisplnkN: Income distribution (fractiles) by region, type of income, distribution measurements, observations and year

TabVX2DisplnkN provides information on various types of income. We focused on mean equivalised disposable income excluding capital gains, measured in SEK thousands. Those values are provided as upper bound values, alongside the mean values for each income decile. The mean income values were used to compute the Gini, Atkinson, Theil, Hoover, Herfindahl, Coulter and Dalton inequality metrics on the decile averages. The median equivalised income in each unit was obtained from the upper threshold in the fifth income decile, whereas the income values for the upper threshold in the 10th decile were estimated using a cubic extrapolation spline (Hyman method). As a final step, income values were converted into euros using Purchasing Power Parities (PPPs) standards.

7.3. Eurostat and ECB

In addition to the country-level statistics, the following complementary tables were downloaded from official data repositories in the EU:

- The European Central Bank's (ECB) reference exchange rates for Nordic currencies
- Purchasing Power Parities (PPPs), price level indices and real expenditures for ESA 2010 aggregates (*prc_ppp_ind*)
- Mean and median income by household type – EU-SILC and ECHP surveys (*ilc_di04*)
- Mean and median income by age and sex – EU-SILC and ECHP surveys (*ilc_di03*)
- Gini coefficient of equivalised disposable income by age (*ilc_di12*)

7.4. Data validation

The inequality metrics from NSIs (shown in in Table 4) were used to validate the calculations described in the previous section.

Table 4: Inequality indicators provided by the NSIs

Country	Dataset	Indicators	Unit	Time
DK	IFOR41	Inequality indicators on equivalised disposable income	Gini coefficient, Hoover index, P90/10 (Upper decile boundary divided by lower), S80/S20 (Income quintile share ratio)	1987-2022
FI	127I	Income differences and equalising impact of current transfers on income differences in the dwelling population by year, region and information	Gini coefficient	1995-2022
FO	IP01010	Gini and Hoover indexes and income quantile ratios by age, sex, type of household and region (2009-2021)	Gini index, Hoover index, income quantile ratio 90/10, income quantile ratio 99/1, income quintile ratio 80/20, population	2009-2021
GL	INXIU101	Inequality indicators on equivalised disposable income by indicator	At-risk-of-poverty rate. 40 per cent threshold, at-risk-of-poverty rate. 50 per cent threshold, at-risk-of-poverty rate. 60 per cent threshold, Gini coefficient, S80/20	2002-2022
IS	LIF01110	Gini coefficient and quintile share ratio 2004-2022	Gini coefficient	2004-2022
NO	O9114	Measures of income dispersion. household equivalent income (EU-scale) between persons, by region, contents and year	Gini coefficient, P90/P10	2004-2022
SE	TabVX1DisplnkN	Income inequality indicators by region, type of income, observations and year	At-risk-of-poverty rate, percent, Gini coefficient, high economic standard, percent, mean value, SEK thousands, median at-risk-of-poverty gap, percent, median value, SEK thousands, number of persons, P05/P50, P10/P50, P20/P50, P80/P20, P80/P50, P90/P10, P90/P50, P95/P05, P95/P50	2011-2022

The validation was done by looking at the deviations between the official Gini coefficients and those calculated on the basis of the mean equivalised household income by decile. Figure 17 provides an overview of the absolute deviations of our Gini coefficients in relation to the official indicators provided by the NSIs of the Nordic countries.

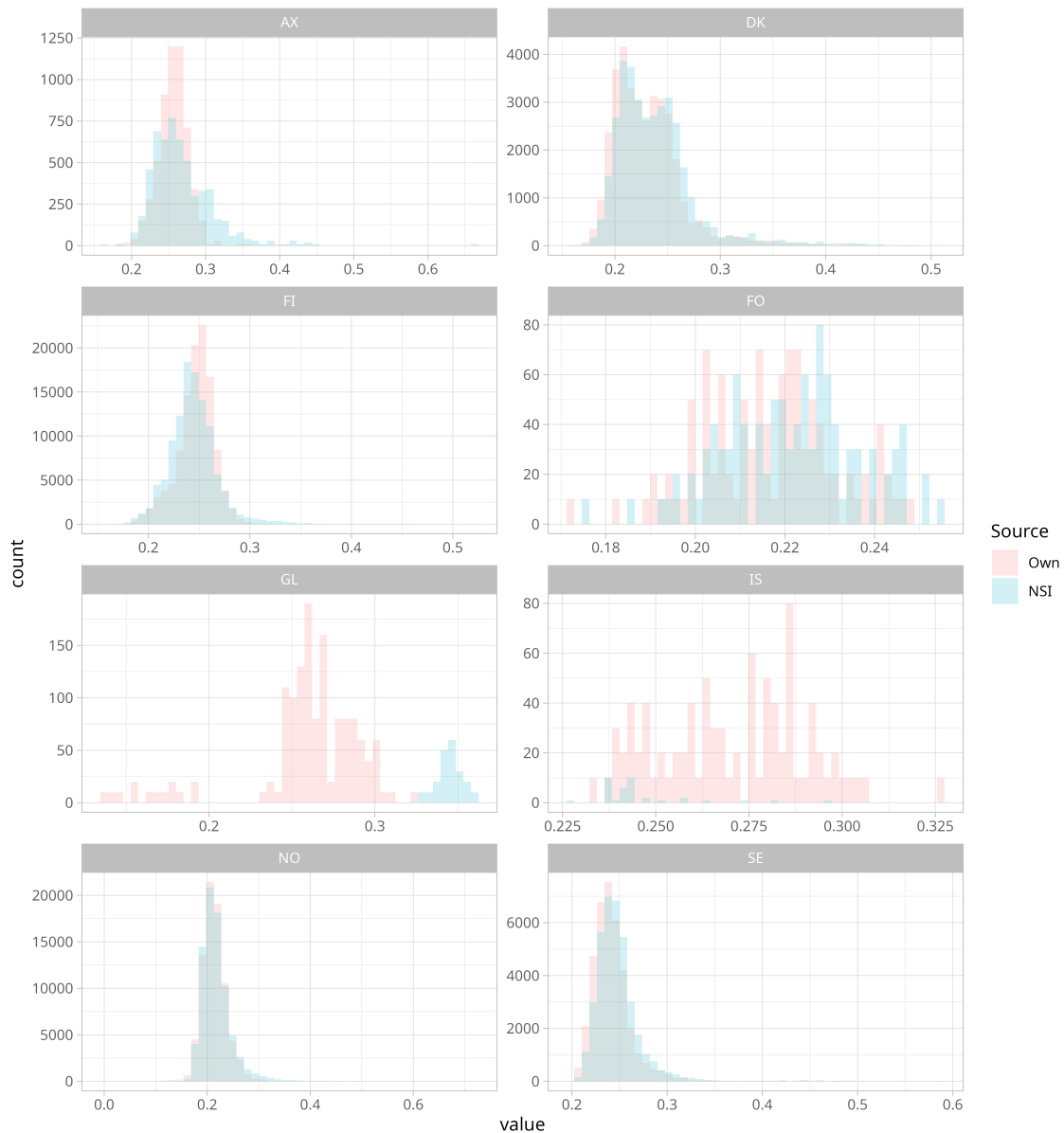


Figure 17: Comparison of inequality metrics by source

Note: The NSIs of Iceland and Greenland do not provide regionalised inequality metrics.

As seen in Figure 18, the larger deviations in Gini scores in Greenland do not seem to be affected by the data imputation step performed. Rather, the deviation seems to be due to the use of different statistical presentations of income measures in this region.



Figure 18: Comparison of inequality metrics by source

The analysis based on income values is only possible for the units where both official statistics and our own calculations are simultaneously available. However, it can be used as an indication of the overall precision of the estimates for areas where official information is not available. Moreover, since the inequality indices are calculated based on income data, the assessment also provides information about the consistency of the decile income estimates. Figure 19 shows a comparison of the aggregated mean equivalised household income values estimated in this work and those provided by the NSIs and Eurostat (ilc_di04).

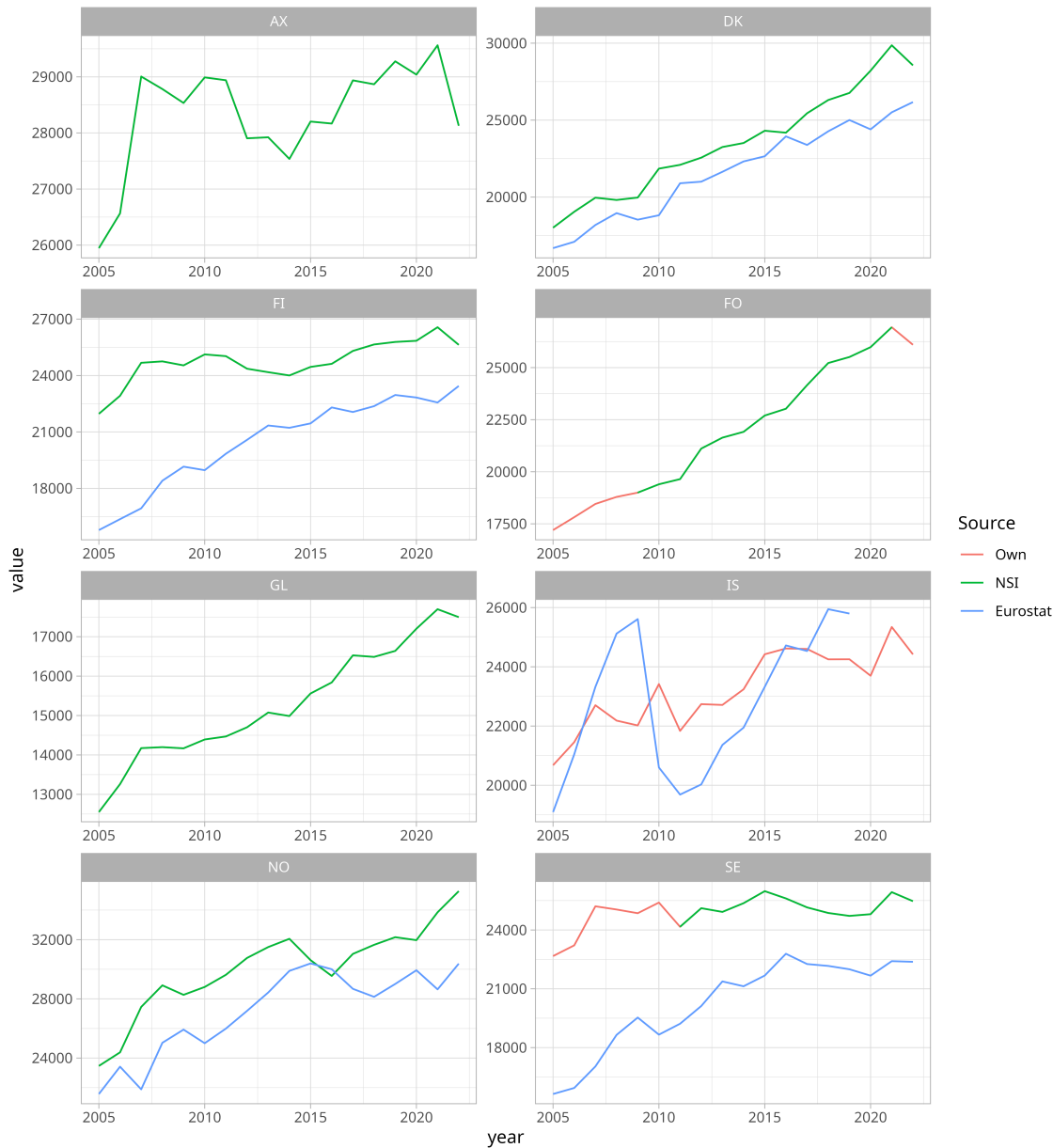


Figure 19: Comparison of household income data by source

7.5. Data limitations

The data preparation steps described in this annex highlight several caveats and limitations of the municipal income and inequality statistics available from the Nordic NSIs:

- **Non-harmonised statistical definitions:** Income data are not entirely comparable across countries and territorial levels. In some cases, the data aggregate various sources of income, including capital gains and similar streams, while other data only include cash income. Most frequently, income data are provided as net income (after tax), but in some cases they are given as total income (before tax). Some data are provided as equivalised monetary values (i.e. household income divided by the equivalised number of household members), whereas other NSIs provide non-equivalised household income. Additionally, some income datasets are segmented by deciles or similar groupings, while others provide aggregated income inequality data alongside mean or median values for the entire statistical unit.
- **Persistent data gaps:** Virtually all the income datasets available from the NSIs of the Nordic countries have data gaps. That may be due to the discontinuation of various indices and/or modifications of internal territorial definitions and geographical delimitations within each country. Since some of the statistical methods applied in this work require long data series, such gaps had to be filled using data interpolation and/or imputation methods.
- **Lack of robust measures of income inequality:** Virtually all the Nordic NSIs provide Gini coefficients at various territorial levels. However, only a few offices provide alternative indices such as Theil and Atkinson indices. Often, those complementary metrics are not the same or are not calculated on the basis of the same data across regions.

All those factors hinder an accurate analysis of the structural characteristics and development of income inequalities in the Nordic Region.

8. Annex 2: Inequality metrics

This annex presents the key metrics used to perform the analysis of income inequalities for the Nordic countries.

8.1. Global inequality indicators

8.1.1. Lorenz curves

The *Lorenz curve* of income typically shows the percentage of total income earned by the cumulative percentage of the population. In this case, the curve illustrates the percentage of average household income "earned" by a cumulative percentage of municipalities.

Under a perfectly equal distribution of household income across the territory, the "poorest" 25% of municipalities would receive 25% of the total average income, the "poorest" 50% would earn 50% of the total income and so on. In that scenario, the Lorenz curve would be a straight line following the 45° line of equality. As territorial inequality increases, the Lorenz curve deviates from the line of equality. For instance, the "poorest" 25% of municipalities might earn only 10% of the total household average income, while the "poorest" 50% might represent 20% of the mean household income and so forth.

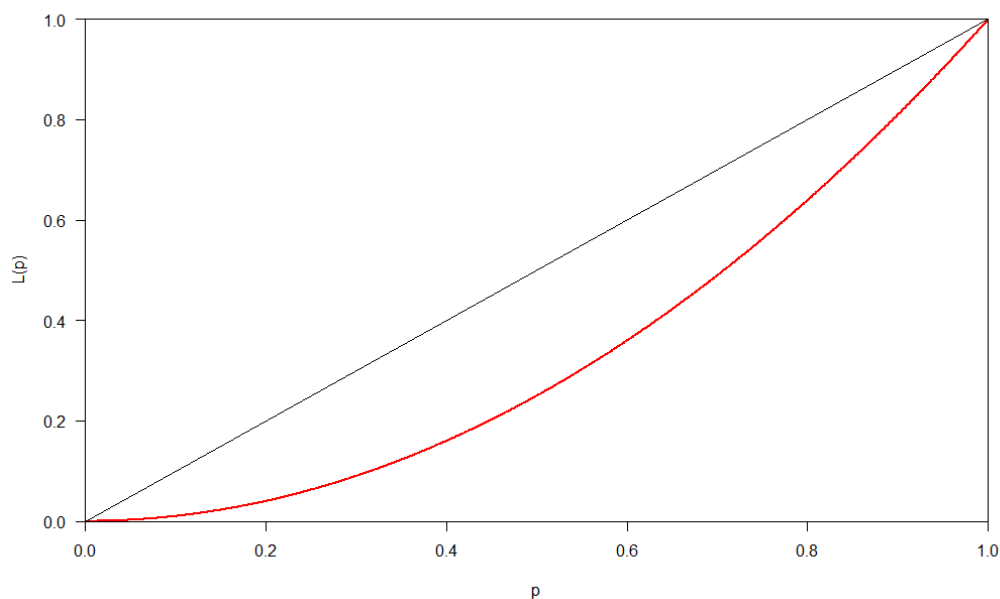


Figure 20: Lorenz curve of household income (2022)

Figure 20 illustrates a Lorenz curve for all Nordic municipalities in 2022, calculated based on mean equivalised household income. The Lorenz curve shows a fairly balanced distribution of the indicator, reflecting a relatively equitable territorial structure. On average, mean equivalised household income at the municipal level appears to be evenly distributed across the territory. However, it is important to highlight that this metric can conceal significant intra-municipal disparities between income groups. Nevertheless, the Lorenz curve remains a fundamental metric for calculating many of the inequality measures described below.

8.1.2. An overview of widely used inequality indices

There are literally hundreds of indicators of inequality. In this section we review a selection of those that are most commonly used in social research:

Gini coefficient is the average difference between all possible pairs of incomes in the distribution, expressed as a proportion of total income. The Gini coefficient can be represented using the Lorenz curve; the coefficient is equal to the area below the line of perfect equality, formally:

$$G = \frac{\sum_{i=1}^n \sum_{j=1}^n |x_i - x_j|}{2n^2 \bar{x}} \quad (2)$$

Ricci-Schutz coefficient (also called Pietra ratio, Hoover index or "Robin Hood index") is the relative mean deviation of the population. It can be interpreted as the proportion of income that has to be transferred from those above the mean to those below the mean in order to achieve an equal distribution. Graphically, the Ricci-Schutz coefficient is equivalent to the maximum vertical distance between the Lorenz curve and the line of equal incomes, formally:

$$RS = \frac{1}{2} \frac{\sum_i |x_i - \bar{x}|}{\sum_i x_i} \quad (3)$$

Squared coefficient of variation: The coefficient of variation is a standardised measure of dispersion of a probability or frequency distribution. It shows the extent of variability of data in a sample in relation to the mean of the population. When applied to income distribution, the CV is smaller when income is distributed more equally between individuals. The coefficient of variation is a highly consistent and mathematically traceable indicator. However, unlike the Gini coefficient, it does not have an upper bound, making interpretation and comparison somewhat more difficult. Moreover, the two components of the coefficient of variation (the mean and the standard deviation) may be greatly influenced by extreme low or high income values.

Formally, the squared coefficient of variation can be expressed as:

$$SCV = \sqrt{\frac{\sigma}{\mu}} \quad (4)$$

where σ is the standard deviation and μ is the mean.

Atkinson index: The Atkinson index aims to overcome the main weakness of Lorenz curves and related inequality indicators, namely their inability to differentiate between various kinds of inequality distributions. In fact, contrasting patterns of income distribution may ultimately result in very similar Lorenz curves. The Atkinson index allows for varying sensitivity to inequalities in different parts of the income distribution by incorporating a sensitivity parameter (ϵ). Intuitively, Atkinson values can be used to calculate the proportion of total income that would be required to achieve an equal level of social (or territorial) welfare as at present if incomes were perfectly distributed. For example, an Atkinson index value of 0.20 suggests that we could achieve the same level of social welfare with only 80% of income. The theoretical range of Atkinson values is 0 to 1, with 0 being a state of equal distribution. The Atkinson index can be defined as:

$$A_{\epsilon}(y_1, \dots, y_N) = \begin{cases} 1 - \frac{1}{\mu} \left(\frac{1}{N} \sum_{i=1}^N y_i^{1-\epsilon} \right)^{1/(1-\epsilon)} & \text{for } 0 \leq \epsilon \neq 1 \\ 1 - \frac{1}{\mu} \left(\prod_{i=1}^N y_i \right)^{1/N} & \text{for } \epsilon = 1 \end{cases} \quad (5)$$

where y_i is individual income ($i = 1, 2, \dots, N$), μ is the mean income and ϵ is the sensitivity parameter. This parameter can be seen as a way to include the concept of *social justice* in the measurement of income inequality. The higher the value, the more sensitive the Atkinson index becomes to inequalities at the bottom of the income distribution. Even if ϵ can be set to any positive value in theory, in practice ϵ values of 0.5, 1, 1.5 or 2 are typically used. In this study we have opted for the conservative value of 0.5 for ϵ .

Theil entropy index: The Theil index is an entropy-based measure of inequality. It is related to other generalised entropy indices (E_{θ}), developed by information theory. The Theil index represents the maximum possible entropy of the data minus the observed entropy in the sample. The theoretical range of (E_{θ}), values is 0 to infinity, with 0 being a state of equal distribution and greater values representing increasing levels of inequality. If everyone had the same income, then T would equal 0. If one person has all the income available, then T gives the result $\log N$, which is maximum inequality.

Like the Atkinson index, the Theil index incorporates a sensitivity parameter α that varies in the weight given to inequalities in differing parts of the income spectrum. The general formula is given by:

$$E_{\theta}(\alpha) = \frac{1}{\alpha(\alpha - 1)} \left[\frac{1}{N} \sum_{i=1}^N \left(\frac{x_i}{\bar{x}} \right)^{\alpha} - 1 \right] \quad (6)$$

where x_i is the income of the i th person or subgroup and $\bar{x}$ is the mean income in a population of N individuals or subgroups and the parameter α in the E_{θ} class represents the weight given to distances between incomes at different parts of the income distribution and can take any real value. The measure is sensitive to changes at the lower end of the distribution with an α parameter value close to zero and is equally sensitive to changes at the higher end of the distribution for higher values of α .

So, with $\alpha = 1$, the Theil T_T index is defined as:

$$T_T = T_{\alpha=1} = \frac{1}{N} \sum_{i=1}^N \left(\frac{x_i}{\bar{x}} \cdot \ln \frac{x_i}{\bar{x}} \right) \quad (7)$$

where x_i is the income of the i th person or subgroup and $\bar{x}$ is the mean income in a population of N individuals or subgroups.

Given that in our calculations we applied $\alpha = 1$, we assumed a relative concept of distance between income pairs. In other words, income levels x_1 and x_2 are the same distance apart as income levels x_3 and x_4 would be, if the ratios x_1/x_2 and x_3/x_4 are equal.

With α , we have:

$$T_L = T_{\alpha=0} = MLD = \frac{1}{N} \sum_{i=1}^N \left(\ln \frac{\bar{x}}{x_i} \right) \quad (8)$$

T_L is also known as the mean log deviation because it gives the standard deviation of $\ln(x)$. T_L is derivable from T_T by

$$T_L(x) = T_T \left(\frac{1}{x} \right) \quad (9)$$

T_L is generally preferred over T_T when changes in lower incomes are more important.

8.1.3. Statistical properties of inequality indices

The metrics described above offer a wide range of statistical approaches to measure inequality. To determine the most suitable approach, five basic properties, or axioms, of inequality measures should be considered (Cowell, 2011):

- *Anonymity or symmetry*: The index algorithm treats individual incomes anonymously, i.e. the inequality score does not depend on the particular assignment of labels to members of the population. This property distinguishes the concept of inequality from that of fairness, where who owns a particular level of income and how it has been acquired is of central importance. The anonymity criterion is met by all the indices considered here.
- *The Transfer principle* (also called Distance principle): An inequality measure satisfies this principle if a transfer of a positive amount of income from a richer to a poorer group leads to a reduction in inequality (strong form) or at least overall inequality does not increase (weak form), no matter what amount is transferred. This quality is satisfied by all entropy-based indices, including T_T and T_L . The Gini, Atkinson and squared coefficient of variation indices have a weak performance in terms of this principle (e.g. the inequality value decreases more if the redistribution from richer to poorer involves extremes), whereas the relative mean deviation approach (Ricci-Schutz index) only meets the weakest form of the axiom (i.e. a rich-to-poor transfer may not lead to a reduction in inequality score at all).
- *Scale independence*: Simply put, this means that the measured inequality of the slices of the cake should not depend on the size of the cake. This property is shared by all the inequality measures we have examined.
- *Population independence*: The value of the metric should not depend on population size either. This property is shared by all the inequality measures discussed here.
- *Decomposability*: This property implies that there should be a coherent relationship between inequality in the whole of society and inequality in its constituent parts. Decomposability is found to be an important quality of income indicators, particularly when internal (e.g. social or territorial) disparities within the population might occur (Novotný, 2007). It turns out that it is possible for some inequality measures,

including the Gini coefficient, "to register an increase in inequality in every subgroup of the population at the same time as a decrease in inequality overall" (Cowell, 2011). The criterion is met by all the indices, with the exception of the Ricci-Schutz and Gini coefficients, which are not decomposable.

It emerges that the Theil's entropy index T_T is the only metric in the previous list to meet all the aforementioned criteria.

8.2. Convergence measures

This section describes the metrics used to analyse the evolution of income inequalities over time, focusing on their territorial expression.

8.2.1. Beta convergence

The *beta-convergence* hypothesis is tested by estimating the following regression:

$$\ln(\Delta y_{i,t}) = \alpha + \beta \ln(y_{i,t-1}) + \epsilon_{i,t} \quad (10)$$

where $y_{i,t}$ is the level of indicator y in region i at time t , $\Delta y_{i,t}$ is the growth rate of indicator y in region i at time t , α , and β are the parameters to be estimated and $\epsilon_{i,t}$ is the error term.

The *beta-convergence* hypothesis is verified when the partial correlation between growth in the income variable over time and its initial level are negative.

8.2.2. Sigma convergence

The *sigma-convergence* hypothesis is verified using the following equation:

$$\sigma_{i,t} = \left(\frac{1}{n}\right) \sum_{i=1}^N \left[(\ln(y_{it}) - \mu_t)^2 \right] \quad (11)$$

where v_i is the sample mean of (log) income at time t in region i .

The hypothesis is confirmed when the dispersion of σ lessens over time (Furceri, 2005; Goecke and Hüther, 2016).

8.2.3. Club convergence

The club convergence method, introduced by Phillips and Sul, is formulated as a non-linear time-varying factor model that allows for different time paths and individual heterogeneity (Phillips and Sul, 2007). Unlike other methods where economies are grouped a priori, this method enables the endogenous determination of *convergence clubs*. The formal equation of their model is:

$$\log(y_{it}) = \alpha + \beta \cdot \log(y_{it-1}) + u_{it} \quad (12)$$

where y_{it} is the variable of interest for unit (i) at time (t), α and β are coefficients – time-varying parameters –, (y_{it}^*) is the common component and (e_{it}) is the error term.

About this publication

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