



# Inequality in the use of childcare

**Research note no 8/2014**

Márton Medgyesi (TÁRKI)  
Niki Kalaverzou (AUEB)  
*September – 2014*



Athens University  
of Economics and Business

**EUROPEAN COMMISSION**

Directorate-General for Employment, Social Affairs and Inclusion  
Directorate A — Analysis, Evaluation, External Relations  
Unit A.2 — Social analysis

Contact: Bartek LESSAER

E-mail: <mailto:Bartek.LESSAER@ec.europa.eu>

*European Commission  
B-1049 Brussels*

**SOCIAL SITUATION MONITOR**

APPLICA (BE), ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS (EL),  
EUROPEAN CENTRE FOR SOCIAL WELFARE POLICY AND RESEARCH (AT),  
ISER – UNIVERSITY OF ESSEX (UK) AND TÁRKI (HU)

# **Inequality in the use of childcare**

## **Research note no 8/2014**

Márton Medgyesi (TÁRKI) and Niki Kalaverzou (AUEB)

***Europe Direct is a service to help you find answers  
to your questions about the European Union.***

**Freephone number (\*):**

**00 800 6 7 8 9 10 11**

(\*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

#### **LEGAL NOTICE**

This document has been prepared for the European Commission however it reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

More information on the European Union is available on the Internet (<http://www.europa.eu>).

© European Union, 2014  
Reproduction is authorised provided the source is acknowledged.

**Abstract**

Improving the availability and affordability of Early Childhood Education and Care (ECEC) services is high up on the EU policy agenda as affordable childcare supports parents' access to the labour market, addresses child poverty and contributes to breaking the intergenerational transmission of poverty. In this research note, the objective is to propose a synthetic and functional way of measuring the social gradient of childcare use, which allows regular monitoring. Two issues in the measurement of the social gradient are investigated: the choice of an indicator of socioeconomic status and the choice of summary measure of the social gradient. In this analysis socioeconomic status is measured by equivalised disposable income, parental education and also by using a composite indicator of socioeconomic status. Problems of using simple frequency ratios as a measure of the social gradient are reviewed and other measures that have been proposed in the literature on health inequality are presented, such as measures of association and measures based on rankings of the socioeconomic variable (concentration index, relative index of inequality). In the second part of the research note the social gradient in formal childcare use is calculated with different methods and results are presented and compared.

## TABLE OF CONTENTS

INTRODUCTION .....	7
DATA AND DEFINITIONS.....	8
Data used.....	8
Definition of child care use.....	8
Definition of socioeconomic status .....	9
THE LITERATURE .....	12
MEASURING THE SOCIAL GRADIENT .....	13
Frequency ratios: a simple but problematic measure.....	14
Measures of association between two categorical variables .....	15
Indices based on the ranking of the socioeconomic variable .....	15
Slope Index of Inequality (SII) and Relative index of inequality (RII).....	15
The concentration index .....	16
Choosing an appropriate measure based on the types of variables.....	17
APPLICATION TO THE USE OF FORMAL CHILDCARE BETWEEN 0-2 YEARS .....	18
The social gradient in formal childcare use in the 0-2 age group.....	18
Sensitivity of results to alternative definitions of income status or parental education .....	21
Correlation of the different measures of the gradient .....	21
Change in the use of formal childcare between 2008 and 2011.....	22
Average use of childcare and social gradient .....	24
CONCLUDING REMARKS .....	26
REFERENCES .....	27
ANNEX.....	29

## Introduction

Ensuring adequate access to high-quality Early Childhood Education and Care (ECEC) services should score high in the priority list for every European country as it entails high potential gains in multiple policy areas. With this in mind, the European Council has included the availability of affordable, high quality childcare institutions in its 2002 Barcelona objectives<sup>1</sup>. The European Commission has also shown growing interest in monitoring childcare policies and developments in individual member states (e.g. through the Recommendation “Investing in children: breaking the cycle of disadvantage” within the Social Investment Package or the European Platform for Investing in Children- EPIC among other initiatives).

There are various reasons behind this growing attention to childcare policies in Europe. To begin with, it has been demonstrated that the physical and cognitive development of children depends heavily upon the existence of a stimulating and sociability-enhancing environment early in life. The crucial effect of early life experiences on cognitive function, educational performance and life chances has been demonstrated by a number of studies during the last decades and across different scientific fields (Augustine et al, 2009; Gamoran et al, 1999; Heckman, 2008; Sylva,2008; Vandell,2010).

From a macroeconomic perspective, it is often publicly acknowledged that affordable access to childcare facilities can have a direct positive effect on employment rates. Indeed, without reconciliation policies for work and family life, it will remain hard for women to achieve equal participation in the labour market and for European member states to achieve the objective of an employment rate of 75% (as listed in the 2020 EU Strategy). Furthermore, providing access to childcare services for every family is a means of ensuring adequate household income for families with children across the socioeconomic spectrum and their inclusion through employment. This is best known as the “social investment” argument which is in line with the EC Recommendation “Investing in children: breaking the cycle of disadvantage”.

From a purely socioeconomic equity perspective, attendance of high-quality childcare institutions may play a central role in mitigating the effects of existing differences in household socioeconomic position during childhood. In particular, high-quality childcare is believed to have a neutralizing or equalizing effect on socioeconomic background disparities for children (Felfe et al, 2012). The effects of these disparities may follow the individual during the life course (Case et al, 2004; Lynch et al, 1997; Poulton et al, 2002; Starfield, 2008). As a consequence, the provision of high-quality childcare services may prove an important tool in reducing the magnitude of educational, socioeconomic and health inequalities not only during childhood, but also later in life.

In practice however, access to childcare services is compromised by a number of state-level and household-level factors. On the state level, there may be scarcity of public institutions and private provision may be accompanied by costs that are not covered or reimbursed by the government. In some cases, disadvantaged families are left with no childcare until children reach compulsory school age. On the household level, lower income families may systematically prefer or chose to entrust their children’s care to relatives instead of formal institutions. Or, they may willingly decide for the abstinence of one parent (usually the mother) from the labour market, especially if the expected financial gains from seeking and finding employment are relatively low. As a consequence, a vicious cycle of low parental (maternal) employment, lower household income and reduced access to the multiple benefits of quality care services for children is set in motion.

---

<sup>1</sup> The target was to provide childcare to at least 33% of children under 3 years old and to at least 90% of children between the age of 3 and mandatory school age by 2010.

Summarizing the above, there is good reason to believe that the overview and monitoring of childcare institutions and experiences across European countries should be a necessity in view of the broader goals of raising employment rates, reconciling work and family life, achieving gender equality and mitigating the adverse effects of socioeconomic inequalities in education and health for both children and adults.

This discussion on inequality in childcare inevitably brings to mind the discussion on health inequality (or the social gradient in health). This is not solely attributable to the fact that there are probable links between the pathways and mechanisms leading to the two social phenomena as explained above. More than that, the health inequality literature has been rich in producing various ways of measuring the social gradient that could be easily extended in the field of childcare (we will come to this issue again later).

In this Research Note, the objective is to propose a synthetic and functional way of measuring the social gradient which allows regular monitoring. After a brief literature review ways approaches to the measurement of social gradients in the literature on health inequality are presented. In the second part of the Research Note the social gradient in formal childcare use is calculated with different methods and results are presented and compared.

## **Data and definitions**

### **Data used**

This analysis uses data from the EU-SILC study, which is an output-harmonized data collection that is built on a common framework of concepts, procedures and classifications, but that also allows national statistics offices a degree of discretion in implementing the guidelines. As a result, there are considerable differences between participating countries in terms of sample design, data collection and post-collection processing (Wolff et al. 2010). The population surveyed is confined to those living in private households. We used EU SILC UDB 2011 version 3 for carrying out the calculations. The analysis was carried out using the cross-sectional weight of children (RL070) and the personal cross-sectional weight if the former was missing.

### **Definition of child care use**

EU-SILC includes a number of childcare variables that allow for the distinction between paid and unpaid childcare or across different types of childcare institutions. Formal childcare refers to the following four EU-SILC variables: number of hours during a usual week spent in education at pre-school or equivalent (RL010); number of hours in education at compulsory education (RL020); number of hours in childcare at centre-based services outside school hours (RL030); number of hours in childcare at day-care centre organised/controlled by a by public or private structure (RL040). Information on formal childcare in EU-SILC can be used as a binary indicator (measuring whether the child has received any type of care or not) or can be used to measure the duration or intensity of care provided- in hours per week<sup>2</sup>.

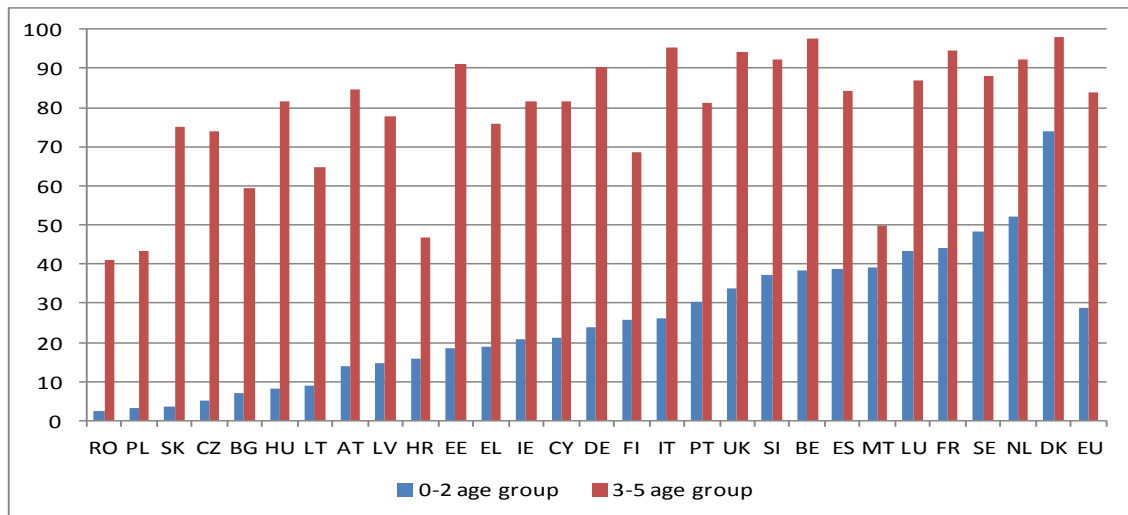
---

<sup>2</sup> Some of the scientific literature, such as Van Lancker (2013a, 2013b) follows the OECD practice and defines full-time equivalent (FTE) care use that represents the proportion of children who would be receiving childcare if all existing care use were full-time (30 hours per week or more). The calculation is as follows: FTE = proportion of children in formal childcare \* average number of hours per week (as % of 30 hours per week).



The Barcelona objectives regarding accessibility and affordability of high quality childcare services have been set in terms of the binary indicator (European Commission 2013c), so this analysis will focus on measures of the social gradient for the binary childcare variable. Unfortunately, the distinction between public and private institutions is not recorded in EU-SILC data, so this aspect is not taken into account here. See the percentage of children in formal childcare in the different age groups on Figure 1 (and also in Table A1 of the Annex).

**Figure 1 Use of formal childcare by MS for those aged 0-2 and 3-5**



Source: Own calculations based on EU-SILC 2011, UDB August 2013

### Definition of socioeconomic status

In this analysis we used equivalised disposable income and parental education as measures of socioeconomic status<sup>3</sup>. Total disposable household income is calculated as gross market income plus social transfers and minus direct taxes and social contributions. The income reference year is the calendar year prior to the year of study –i.e. in the case of the 2011 survey, income relates to the 2010 calendar year (except for Ireland and the UK, where it is the 12 months prior to the date of interview). For more details on the EU-SILC survey, see Decancq et al. (2013).

The income of all household members is aggregated, and total household disposable income is equivalised for differences in household size and composition, using the so-called modified OECD scale (which assigns a value of 1 to the first adult in the household, 0.5 to additional members aged 14 and over, and 0.3 to children under 14). Equivalised income so calculated is then assigned to each household member.

<sup>3</sup> The Indicators Subgroup of the Social Protection Committee considered several other socioeconomic variables for the measurement of inequalities in childcare use, such as urban/rural divide, household type or work intensity (EC 2013a, 2013b). Several of the proposed socioeconomic variables have been criticised however. Parent's employment and household work intensity is arguably endogenous: inactivity of the mother is often a consequence of the unavailability of childcare rather than being a cause of the non-use of such services. Urban/rural breakdown would be interesting since presumably there is important advantage in the availability of childcare places in more urbanised settings. Unfortunately data does not allow taking this into account. Differences in childcare use by household type are interesting and can be constructed from the available data, but as this is not an ordinal or interval scale variable it does not allow for the calculation of summary indices of inequality (gradient).

Several options have been explored to make use of the income variable as a continuous or a categorical variable. As categorical versions of the household income variable two measures were used. The first measure takes the quintiles of household income and divides the whole population in five equal sized groups according to income. There are arguments for defining income quintiles over households with children as done elsewhere in the literature on inequality in childcare use (see eg. Van Lancker 2013). However, to maintain consistency with the definition of other indicators (eg. at-risk-of-poverty among children) income quintiles will be defined over the whole population. This of course means that the composition of our sample of children under age 3 according to income quintiles will be different in every country (see Table A2 in the Annex). The second variable (this is called "income position") defines income categories in relation to the overall median income. Five groups are distinguished: those whose income is less than half the median; those whose income is between 50% and 80% of the median; those where it is between 80% and 120%; those where it is between 120% and 200%; and those where it is over twice the median income in the country.

The other measure of socioeconomic status used in the analysis is parental education. The main indicator of parental education is based on education level of the mother, or if the mother does not live in the household, education of the father. Two alternative versions of the parental education indicator are also explored. One measure takes the higher level of education of the two parents if both are living in the household, and the education level of the mother or the father in single parent households. The other measure takes the lower level of education of the two parents if both are living in the household, and the education level of the mother or the father in single parent households. In each case ISCED code is recoded into a three-category variable, with categories below upper secondary education (ISCED 0,1,2), upper secondary education (ISCED 3,4) and tertiary education (ISCED 5, 6). The composition of our sample of children under age 3 according to categories of maternal education are shown in Table A3 of the Annex.

An attempt has been made to measure socioeconomic status also by the use of a composite indicator. A composite indicator has been constructed from household income and maternal education using principal component analysis (PCA). As PCA uses interval-scale variables we used the equivalised household income and mother education converted to years of education<sup>4</sup>. These variables were standardized (converted to z-score) and the first principal component resulting from the analysis was taken as the composite variable of socioeconomic status. The approach adopted here is similar to the method used to derive the PISA index of economic, social and cultural status (ESCS) (OECD 2013). This index was also derived using PCA from the following three indices: highest occupational status of parents, highest educational level of parents in years of education according to ISCED, and home possessions.

Table 1 summarises different measures of socioeconomic status used in the analysis.

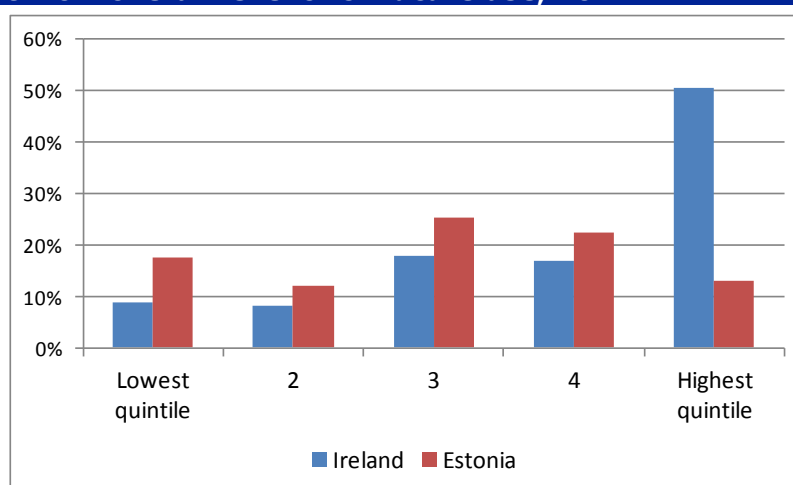
---

<sup>4</sup> Conversion of highest level of education obtained as measured by ISCED to years of education has been based on information contained in Annex E of OECD (2012).

**Table 1: Possible breakdown variables to identify socioeconomic status**

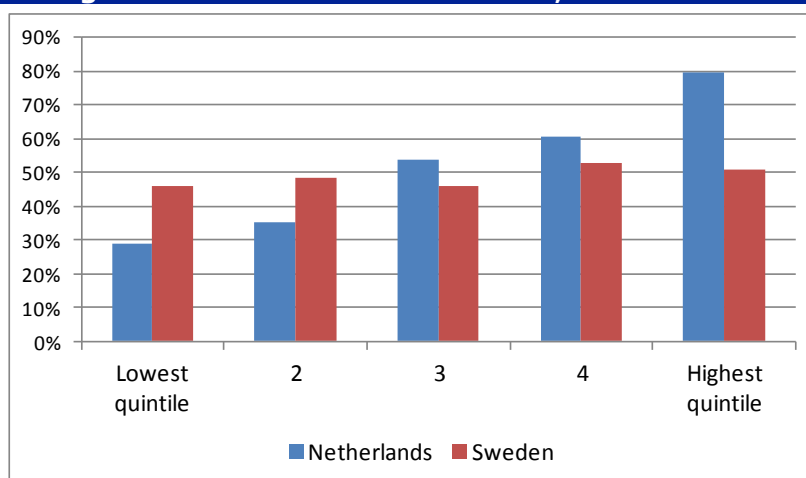
	Categorical variables	Continuous variables
Income-based indicators	<ul style="list-style-type: none"> <li>income quintiles</li> <li>income position relative to median income</li> </ul>	<ul style="list-style-type: none"> <li>equivalised disposable income</li> </ul>
Education-based indicators	<ul style="list-style-type: none"> <li>maternal education (ISCED)</li> <li>higher level of education of parents (ISCED)</li> <li>lower level of education of parents (ISCED)</li> </ul>	<ul style="list-style-type: none"> <li>years of maternal education</li> </ul>
Combined indicator of socio-economic status	<ul style="list-style-type: none"> <li>quintiles of parental socioeconomic score</li> </ul>	<ul style="list-style-type: none"> <li>parental socioeconomic score</li> </ul>

As an illustration of the socioeconomic differences of childcare use the following figures show percentage of children participating in formal childcare by income quintiles in a few selected member states. Figure 2a shows childcare use by family income in two countries with relatively low level of overall childcare use. In Estonia and Ireland around one fifth of children below 3 participated in formal childcare according the 2011 data. The pattern of childcare use along the income distribution is quite different in the two countries. In Ireland a steep gradient can be observed with the richest quintile having by far the largest proportion of children in formal childcare. In contrast in Estonia formal childcare use is lower in the richest quintile than the first quintile, while highest childcare use is observed in the middle and upper middle quintiles. Figure 2b shows the case of Sweden and the Netherlands, which are two countries with relatively high percentage of children in formal childcare (with around half of the children participating in formal childcare in 2011). In this case Netherlands shows important differences by income: 80% of children were in formal childcare in the richest quintile, while childcare use was below 30% in the poorest quintile. In Sweden childcare use is relatively equally distributed among the income groups.

**Figure 2a Differences in formal childcare use according to income quintiles in countries with low overall level of childcare use, 2011**


Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Figure 2b Differences in formal childcare use according to income quintiles in countries with high overall level of childcare use, 2011**



Source: Own calculations based on EU-SILC 2011, UDB August 2013

## The literature

Unfortunately, the literature on cross-country differences in childcare-related inequalities has been so far limited<sup>5</sup>. This is possibly attributable to the fact that this growing focus on childcare policies is relatively new and this is directly reflected on survey data availability.

A recent (and well-known) analysis of childcare in Europe according to income is provided by Van Lancker. In his paper, very big differences can be found between EU-27 countries in terms of formal childcare coverage ranging from over 70% in Denmark to below 5% in the Czech Republic and the Slovak Republic (Van Lancker, 2013). Furthermore, significantly higher levels of childcare use for higher income families, compared to their lower-income counterparts, are reported for all 27 countries examined. These inequalities are shown to persist for informal care as well, with lower-income families being less likely to use both formal and informal childcare arrangements (ibid). In this study authors take into account also the intensity of childcare use and use the full-time equivalent of childcare use. The social gradient in childcare use is measured along the income dimension by using the inequality ratio as the index of inequality. Average care use among children living in the highest income family (fifth quintile) is divided by the average care use among children living in a low-income family (first quintile).

In another paper, Van Lancker and Ghysels, find a negative association between formal childcare coverage and inequality in the use of childcare (Van Lancker and Ghysels, 2013). In this study the authors again use the full-time equivalent of childcare use, measure inequalities in childcare use by parental education and use as an index of inequality the Relative Index of Inequality borrowed from the literature on health inequalities (see later). The main finding of the paper is that inequality in childcare is not associated with reduced childcare costs or government spending in this policy sector. On the contrary, the authors find an association with the direct supply and availability of slots (more slots reduce the observed inequality). These findings can have serious policy implications. Furthermore, they find that the employment

<sup>5</sup> In the United States a study has shown that the cost-burden of child care is higher for low income families, even though "care" is defined in a much broader sense and lies outside the scope of the present discussion (Rosenbaum & Ruhm, 2004). In developing countries, the focus of the WHO is mainly on inequalities to child health care and maternity care (for an international comparison in 45 countries, see Houweling et al, 2007).

rates of low-skilled mothers are negatively correlated to childcare inequality (higher rates reduce the observed inequality). On the other hand well-paid parental leave schemes that exceed a certain time period increase inequality, whereas they find no association of inequality with cultural beliefs and values around motherhood and childcare.

Studies such as Vaalavuo (2011) or Förster and Verbist (2012) study the redistributive impact of ECEC services. These studies calculate the share of ECEC services received by different income groups and calculate the inequality- and poverty-reducing effect of these in-kind transfers. The value of in-kind services is based on the assumption that the transfer to beneficiaries is equal to the average cost of producing the given service. Vaalavuo (2011) finds the most important inequality reducing effect in Hungary and Sweden but in general the impact of ECEC services on overall income inequality is found to be modest. Despite a modest effect on overall inequality ECEC services were shown to have important effect on child poverty. Förster and Verbist (2012) found that these services reduce child poverty rates in OECD countries on average by one quarter.

Studies of social gradient are also frequent in other areas of education. For example the PISA study of the OECD (OECD 2013) describes equity in education by analysing the link between the socio-economic status of families and education performance of children. The study uses measures of the gradient along with mean level of educational performance in the given country to identify successful educational systems and to formulate policy recommendations.

Despite the fact that access to adequate childcare can be a crucial factor in both promoting growth and mitigating socioeconomic inequalities, so far very few studies have been carried out in this area, leaving room for the possible use of alternative methodological approaches, especially with respect to measurement of such inequalities.

## Measuring the social gradient

To guide the selection of a summary measure of the social gradient, indices proposed in the literature on health inequality are reviewed in this section (see Mackenbah and Kunst 1997, Regidor 2004a, 2004b). As the purpose of this paper is to measure the social gradient in childcare (childcare represents the health variable), we will only focus on measures of inequality<sup>6</sup>, that aim at quantifying the relation between one or more socioeconomic variables and service use.

The first dimension on which one can compare various inequality indices is whether they measure **absolute or relative inequality**. Absolute indices of inequality are invariant to increases or decreases of equal magnitude in the given variable for every individual, but might change if it is multiplied by the same amount. On the other hand, relative indices of inequality are invariant to multiplications by a constant of the variable whose distribution is being studied.

Another dimension on which different indices can be compared is whether they are able to reflect the **experiences of the total population or only the experiences of selected socioeconomic groups or categories**. This dimension is important as, in the latter case, categories between the extremes are usually excluded from the analysis and inequality measurement is based on the performances of the extremes of the socioeconomic distribution. This may lead both to information loss and sensitivity to data skewness.

Last but not least, when choosing an inequality measure, it is important to look at **whether it measures an "effect" or a "total impact"** of a given socioeconomic

---

<sup>6</sup> For a review of univariate inequality measures such as the Gini Index or the Index of Dissimilarity see Regidor(2004).

variable. In the first case the index is insensitive to the distribution of the socioeconomic variable chosen, while in the latter case, the magnitude of the measure will not only depend upon the differences according to socioeconomic position, but also upon the inequality in the distribution of the socioeconomic variable itself (Mackenbach & Kunst, 1997). As an example consider measuring the social gradient by the level of maternal education in two hypothetical societies A and B. Let society A and B be characterized by identical proportions of children in formal childcare in every category of maternal education (eg. 25% in case of children of mothers with low education, 40% in case of middle-level education and 50% in case of high level of education). Let however A and B differ in their composition according to maternal education. Suppose, that society A is relatively more equal, almost all children have mothers with middle level education, and only 5-5% of the children have mothers with low or high level of education. In society B in contrast, inequality in terms of maternal education is higher: 40% of children have low maternal education, 20% have middle level and 40% have high level of maternal education. Now, if the social gradient in childcare use is measured using the ratio of childcare use in the extreme groups, both societies show the same value of the index (equal to 2), the difference in social structure between the two countries does not affect the value of the index. The ratio is thus an example of a measure of "effect". Other indices, like the correlation index of concentration index would be different for the two societies, because they also take into account the structural differences. These are called indices of "total impact".

If we assume that the use of childcare is similar to the use of any healthcare service then the methods used in the measurement of health inequalities can be extended to the case of childcare. In fact, this assumption is quite plausible since childcare can be inaccessible to lower socioeconomic groups (due to limited affordability or systematic patterns in preferences according to household socioeconomic status). What is more absence of childcare is associated with worse outcomes for the well-being of children in the same way absence of health care is usually associated with detrimental health outcomes for any individual who chooses not to make use of such services. From a statistical point of view access to childcare can be treated as a binary variable (receives childcare or not) or a continuous variable (capturing the intensity of use) similar to variables measuring healthcare use (which traditionally take zero/one or count, positive values).

In the following section we briefly introduce the main inequality measures that can be used in the case of the gradient in childcare use. We concentrate on measures of inequality that can be applied both in the case of a binary childcare variable (receives childcare or not) and of a continuous childcare use variable (concentrating on the intensity of use) and discuss their advantages and disadvantages.

### **Frequency ratios: a simple but problematic measure**

The most simple measure of socio-economic differences in childcare use are differences or ratios of childcare use in the extreme categories of the socio-economic variable in question. Eg. if the socio-economic variable is income, than the ratio of the proportions of children in formal childcare in the fifth and the first income quintile (Q5/Q1) is a possible measure of the social gradient. This measure of inequality was used eg. in the study by Van Lancker (2013). The ratio is a measure of relative inequality, being insensitive to changes in average level of childcare use. The ratio is also insensitive to changes in the distribution of the population according to socioeconomic status (thus is a measure of "effect").

This measure has been used extensively in the literature on health inequalities. It has the benefit of easily illustrating the disparities in the use of any service or outcome between the top and the bottom of the SES distribution. These ratios can be used as a measure of the social gradient in case of both a binary and a continuous indicator of childcare use (like the FTE childcare use measure).

The great disadvantage of such indices is that they entail a large degree of information loss as in-between categories are not taken into account during the calculation. This measure will miss important part of inequality if the relationship between the socioeconomic variable and childcare use is non-monotone (like in the case of Estonia on Figure 2a). As a consequence, a policy which affects childcare use only in the middle groups but not the extreme groups (eg. increasing childcare use in lower-middle groups with below average service use) will not affect this indicator. Using only information from the extreme groups is also problematic from a statistical point of view: the index is estimated on a reduced sample which results in less precise estimates.

### Measures of association between two categorical variables

Several indices of association are suitable to measure the strength of the relationship between socioeconomic status and childcare use. If socioeconomic status and childcare use are measured by a **categorical ordinal variable**, measures of rank correlation can be used, which relate to the similarity of the orderings of the data when ranked by each of the quantities. Such measures include **Kendall's tau-b**<sup>7</sup>, which is a measure of the correspondence between two rankings. Actually Kendall's tau shows the difference between the probability that the observed data are in the same order versus the probability that the observed data are not in the same order. Values close to 1 indicate strong agreement, values close to -1 indicate strong disagreement between the rankings<sup>8</sup>. The value of the index is equal to zero, if the two variables are independent.

When childcare use and the socioeconomic variable are continuous (measured on an interval-scale) another way to describe the association between the two variables is to calculate regression coefficients from an OLS regression with childcare use as dependent and socioeconomic status as independent variables<sup>9</sup>. This approach is taken in the OECD PISA publications, where the social gradient in educational achievement is measured using a regression of the PISA test scores on a composite index of socioeconomic status (OECD 2013). In case of a binary variable of childcare use a corresponding method is to measure the effect of the socioeconomic variable by calculating the **odds ratio via logistic regression**.

The greatest advantage of these methods is the simplicity in the interpretation of the results. Furthermore, regression analysis provides the possibility of including other relevant variables in the regression model allowing for necessary controls. Nevertheless, the regression method does not lead to a single inequality measure in case of a categorical or ordinal socioeconomic variable. In order to achieve this one has to use an index of rank correlation, like those described above.

### Indices based on the ranking of the socioeconomic variable

#### Slope Index of Inequality (SII) and Relative index of inequality (RII)

---

<sup>7</sup> But also Spearman's rho, Kruskal Gamma, Somers-d, or Agrestis's alpha measures (Manor et al. 1997)

<sup>8</sup> If individuals are characterized by two ordinal variables  $x$ ,  $y$ , a pair of individuals  $i, j$  are called concordant pair, if  $i$  (or  $j$ ) has higher values on both variables, while a pair is called discordant if one individual has higher value on one variable and lower on the other. The Kendall-tau is defined as  $\tau = (C - D) / N$ , where  $C$  is the number of concordant pairs among all possible pairs,  $D$  is the number of discordant pairs, and  $N$  is the number of all possible pairs.

<sup>9</sup> In this case researchers estimate regression models of the form:  $y_i = \alpha + \beta x_i + \varepsilon_i$ , where  $y_i$  is childcare use,  $x_i$  is socioeconomic status,  $\alpha$ ,  $\beta$  are regression coefficients to be estimated, and  $\varepsilon$  is a residual. The OLS estimate of  $\beta$  ( $b$ ), is equal to  $b = \text{cov}_{xy} / \sigma_x^2 = \rho_{xy} (\sigma_y / \sigma_x)$ , which is closely related to the correlation coefficient.

If both childcare use and socioeconomic status are measured on interval scale, the calculation of the relative index of inequality is based on the estimation of an OLS regression model of the form  $y_i = \alpha + \beta r_i + \varepsilon_i$  where  $y_i$  is childcare use,  $r_i$  is the fractional rank,  $\alpha, \beta$  are regression coefficients to be estimated, and  $\varepsilon$  is a residual.

OLS estimation of the  $\beta$  coefficient gives the so called **Slope Index of Inequality**, which has to be divided by the mean of the dependent variable to arrive at the **Relative Index of Inequality**. This step is considered necessary as it accounts for the sensitivity to possible changes in the mean level of population health/childcare (if the mean use of health/childcare increases, so will the value of the Slope Index of Inequality). When childcare use is measured by a binary variable, the relationship between fractional rank and childcare use can be estimated by a logistic regression. In this case the exponent of the regression coefficient represents the RII (Regidor, 2004b).

Categorical socio-economic variables have to be transformed for this type of analysis. One possibility is to transform the original categorical variable into the so called "ridit" score, which is closely related to the cumulative frequency. This is calculated as follows: if the proportion of the population with the lowest level of education is 10%, the range of individuals in this category would be from 0 to 0.10, giving a mean of 0.05 which would be the value assigned to this category. If 20% of the population has the next highest level of education, their range would be from 0.1 to 0.3, giving a mean of 0.20, which would be the ridit score assigned to his category, and so on (Mackenbah and Kunst 1997, Regidor 2004b).

On the positive side, this measure incorporates the experience of all individuals across socioeconomic categories, so it entails no loss of information. Additionally, it is sensitive to the changes in the distribution of the populations across groups. On the negative side, even though the ordered nature of social position can be incorporated in the analysis, the needed assignment of mean (ridit) scores to each individual according to socioeconomic category may be problematic (for example in the case of adjacent categories with low relative frequencies which would lead to similar scores across different socioeconomic categories) or may complicate the interpretation of the results (Manor, 1997; Regidor, 2004).

### The concentration index

The concentration index (CI) is computed as:

$$CI = 2 \text{ cov}(y_i, R_i) / \mu$$

where  $y_i$  is the individual  $i$ 's indicator variable (e.g. health status),  $\mu$  its mean,  $R_i$  his fractional rank in the socioeconomic distribution and cov stands for covariance.

The concentration index can be defined using the concentration curve, similarly to the definition of the Gini index. The concentration curve ranks individuals according to a continuous or ordinal background socioeconomic variable starting from the most disadvantaged individual or category. It then plots cumulative proportions of the childcare use variable against the cumulative proportions of the population according to the ranking variable. The concentration index is based on the surface between the concentration curve of the given distribution and the diagonal, which is the curve of the equal distribution.

The concentration index can take values between -1 and 1. A negative CI stands for progressively distributed childcare (when child care use is concentrated among the most disadvantaged), while a positive CI means that higher status groups are using more childcare.

This particular index resembles the Relative Index of Inequality in the sense that it also incorporates the experiences of every socioeconomic category and does not only focus on the extremes of the socioeconomic distribution. When the dependent variable is unbounded the CI has also the advantage of allowing for consistent cross-time and



cross-country comparisons, as it is insensitive to the mean level of the dependent variable. It also allows for an easy interpretation of its results.

As for the kind of data needed, it can be computed with both binary (access to) and count (intensity of use) childcare variables, but if the outcome variable is binary, such as access to childcare, a **normalization of the CI** is needed. The interpretation of the concentration index for binary outcome variable is still subject of debate (Kjellsson and Gerdtham 2013) and several solutions have been proposed. A solution would be to employ the Wagstaff normalization (dividing by 1 minus the mean) or using the Erreygers' corrected CI (O'Donnell et al, 2008). Here we use the former modification of the CI, that is a modified concentration index is calculated by dividing the CI by 1 minus the mean.

It can also allow for the incorporation of various socioeconomic background variables in the gradient estimation through the CI decomposition approach. A CI can be computed using a strict continuous variable such as income or years of parental education as a ranking variable but at the same time including other explanatory variables in the regression. Then the CI can be decomposed with respect to each regressor and their contribution to total inequality examined (O' Donnell et al, 2008).

### Choosing an appropriate measure based on the types of variables

The choice of the appropriate measure of inequality is first determined by the nature of the childcare use variable and the socioeconomic variable. As a summary, the following table (Table 2) shows the indices proposed, grouped according to the types of socio-economic and childcare use variables.

**Table 2 Different indices of the social gradient with differing measurement levels of the variables**

Measurement of child care use		
Measurement of socio-economic variable	Binary	Continuous
<b>Nominal</b> (eg. ethnicity)	<ul style="list-style-type: none"> <li>ratio,</li> <li>odds ratio</li> </ul>	<ul style="list-style-type: none"> <li>ratio,</li> <li>regression coefficient</li> </ul>
<b>Ordinal</b> (eg. level of education)	<ul style="list-style-type: none"> <li>ratio,</li> <li>rank correlation,</li> <li>modified CI</li> </ul>	<ul style="list-style-type: none"> <li>regression coefficient,</li> <li>CI,</li> <li>RII (with transformed SES var.)</li> </ul>
<b>Continuous</b> (eg. income)	<ul style="list-style-type: none"> <li>modified CI,</li> <li>RII (odds ratio from logistic regression)</li> </ul>	<ul style="list-style-type: none"> <li>correlation or regression,</li> <li>CI,</li> <li>RII</li> </ul>

In Table 3 main advantages and disadvantages of the indices are listed. The simple frequency ratios are problematic, because they are based only on the extreme categories of the distribution of the socioeconomic variable. All the other indices are based on the entire distribution. The Relative Index of Inequality and the Concentration Index are probably the most widely used measures of the social gradient in the health inequality literature. They are indices of "total impact" meaning that they not only depend on the differences between childcare use in each socio-economic category, but also on the distribution of the population between socio-economic categories. **The Concentration Index probably stands out in the sense, that it's axiomatic properties are the best understood (see eg. Erreygers 2009).**

**Table 3 A comparison of different indices of the social gradient**

<b>Gradient Measure</b>	<b>Advantages</b>	<b>Disadvantages</b>
<b>Frequency Ratios</b>	Illustrational/ ease interpretational	-Information loss -Limited data applicability -One-dimensional
<b>Odds Ratios</b>	-Illustrational/ ease -Possibility of including control variables	-Information loss in the case of categorical SES variable -Data restrictions -One-dimensional
<b>Correlation index</b>	-Experience of total population -versions for continuous and categorical data	-One-dimensional
<b>Slope Index of Inequality</b>	-Experience of total population -Based on rankings - Possibility of including control variables	-Sensitive to mean population health -Possible interpretational difficulty
<b>Relative Index of Inequality</b>	-Experience of total population -Based on rankings - Possibility of including control variables	-Possible interpretational difficulty
<b>Concentration Index</b>	-Experience of total population -Based on rankings -Properties well understood -Multi-dimensional/ Possible to decompose	-Zero value does not imply equality in childcare use -Modification is necessary with binary dependent variable

### **Application to the use of formal childcare between 0-2 years**

The following section applies the methods above mentioned to the use of formal childcare. Results are shown in case of age group 0-2 (results for the 3-5 age group are presented in Annex). First, values of the different inequality indicators will be presented, then correlation between the different indices will be analysed, finally the evolution of indicators between 2008 and 2011 will be described.

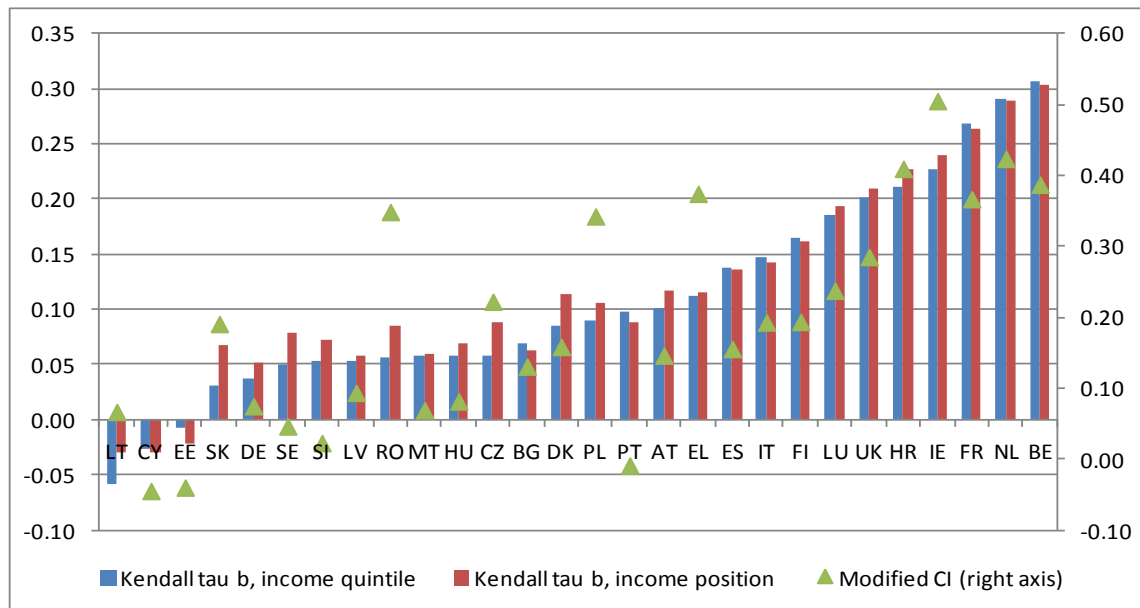
A **rank correlation index (Kendall's tau-b)** and the **modified concentration index** are used in the analysis as summary measures of the social gradient. These indices were calculated using household income and maternal education as main socioeconomic variables. In addition, gradients were calculated with the composite index of socioeconomic status and the sensitivity of the results to alternative definitions of household income and parental education was also analysed.

### **The social gradient in formal childcare use in the 0-2 age group**

Main results on indicators of the social gradient are shown in Figure 3 and Figure 4, while standard errors of the estimates are given in Table A6a and A6b of the Annex.

Results obtained with the rank correlation coefficient between **quintiles of household incomes** and childcare use show Belgium, the Netherlands and France with the highest inequality. In these countries the rank correlation index is between 0.27 and 0.30. Croatia, Ireland, the UK and Luxembourg follow in the ranking of countries. Lowest gradient is detected in the case of Lithuania, Cyprus and Estonia. In these countries the point estimate of the rank correlation coefficient is negative, meaning that childcare use is higher among those with lower income.

**Figure 3 Measures of the social gradient of formal childcare use by household income, 0-2 years age group 2011**



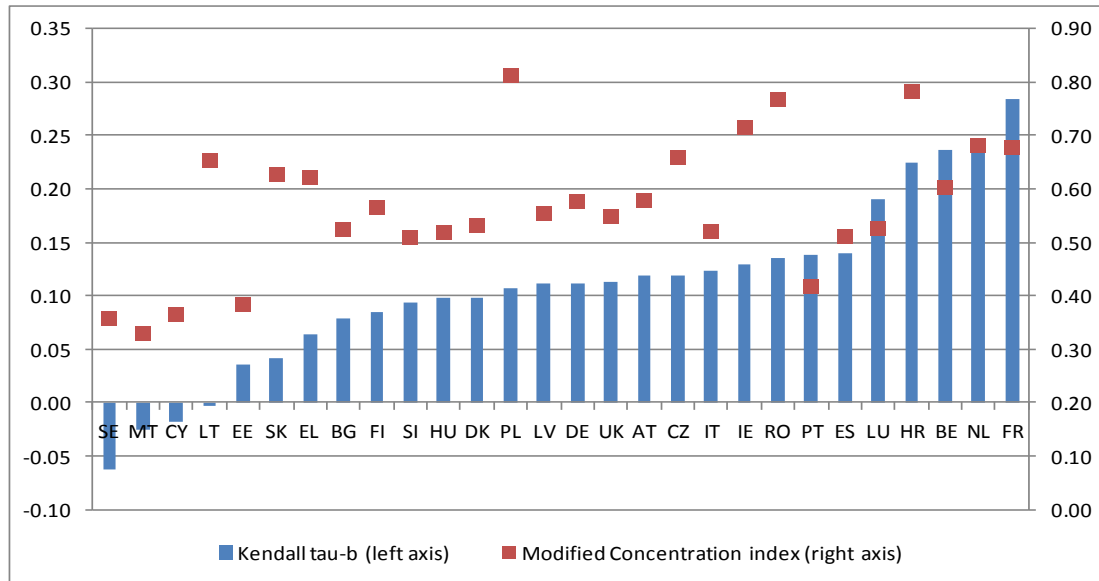
Source: Own calculations based on EU-SILC 2011, UDB August 2013

The concentration index by household income was calculated by using the original, continuous income variable, since using some categorized version would result in loss of information. **Countries with the highest rank correlation index are also at the top of the ranking when the modified concentration index is used as an inequality measure.** In this case Ireland is the most unequal country with a modified CI equal to 0.51, otherwise the five countries with the strongest gradient are the same. Important difference can be seen however in the position of Romania, Poland and Greece, which are now also among the countries showing a steep social gradient in the use of formal childcare. Countries which show low level of inequality are Estonia, Cyprus and Portugal. The point estimate of the concentration index is negative in case of these countries, meaning that childcare is concentrated in groups with lower incomes. The situation of Portugal is strikingly different in the two rankings: it is among the least unequal countries according to the CI, while stand in the middle of the ranking based on the rank correlation measure.

When using **maternal education** as the measure of socioeconomic background, countries found at the top and the bottom of the ranking are similar to the case of the income-based gradient. The five countries with the strongest gradients based on **the rank correlation index** are France, the Netherlands, Belgium, Croatia and Luxembourg (see Figure 4). Countries with low rank correlation between maternal education and childcare use are Sweden, Malta, Cyprus and Lithuania.

According to the **modified concentration index** countries with the strongest gradient in childcare use are Poland, Croatia, Romania, Ireland and France. Thus only two out of five countries among the most unequal are the same as in the case of the rank correlation index. Countries with lowest inequality are Malta, Sweden, Cyprus and Estonia.

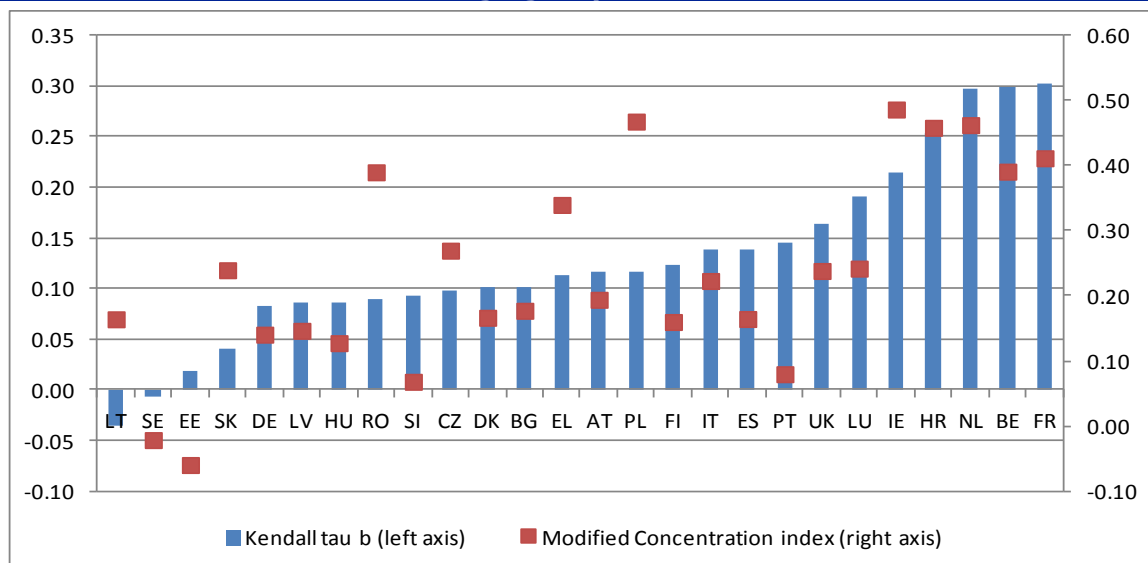
**Figure 4 Measures of the social gradient of formal childcare use by maternal education, 0-2 years age group 2011**



Source: Own calculations based on EU-SILC 2011, UDB August 2013

A third possibility to measure socioeconomic status was also explored. As described before a composite indicator of socioeconomic status was constructed from data on household incomes and maternal education using principal component analysis. Calculating social gradient measures using this composite socioeconomic variable shows a similar picture as was seen earlier (see Figure 5). France, Belgium, Netherlands, Croatia and Ireland are again the countries that show the highest level of inequality when measured by Kendall's rank correlation index. When inequality is measured by the modified concentration index also Romania, Poland and Greece are among the most unequal countries.

**Figure 5 Measures of the social gradient by quintiles of the composite socioeconomic status indicator, 0-2 age group 2011**



Source: Own calculations based on EU-SILC 2011, UDB August 2013

## Sensitivity of results to alternative definitions of income status or parental education

In the case of the socioeconomic gradient by household income, the rank correlation index has been calculated both with income quintiles and with income categories defined relative to the median (see in the section on measurement). **Rank correlation values and country ranking is similar in case of the two categorizations of income that were explored** (see Table A7 in the Annex). Small differences can be seen for Denmark, the Czech Republic, Sweden and Slovakia, where correlation seems to be somewhat stronger when income categories are defined relative to median income.

When using parental education as the measure of socioeconomic background, inequality indicators were calculated with two alternative versions of the variable (higher degree of education among parents, lower degree of education among parents). When the gradient is measured using the rank correlation index France, the Netherlands, Belgium, Croatia and Luxembourg stand out as being the most unequal in terms of childcare use irrespective of the parental education indicator used in the analysis (see Table A8 in the Annex). Sweden and Malta are among the least unequal countries also when alternative measures of parental education are used. On the other hand Cyprus enjoys a more favourable position in the country ranking in these cases.

In the case of the concentration index country rankings obtained with maternal education and highest level of parental education are fairly similar. More difference is seen when parental education is measured by the lower level of parent's education. Malta, Portugal and the Czech Republic show higher concentration indices when this measure of parental education is used, while Sweden, Luxembourg and Lithuania show lower inequality.

## Correlation of the different measures of the gradient

One issue is whether country rankings obtained with rank correlation index and the concentration index are correlated with the ranking according to the simple ratio indicator. As Table 4 shows in the case of the gradient according to income status correlation between country ranking obtained with the concentration index and the ratio indicator is high, above 0.91. When parental education is used as a measure of socioeconomic status, correlation between the rankings obtained with the concentration index and the ratio indicator are also relatively high, between 0.66 and 0.75. Correlation between the Kendall's tau-b and the ratio indicator is also high when the income quintile is the socioeconomic indicator (0.74), but less strong when status is measured by income position relative to the median and when parental education is used a measure of socioeconomic status (between 0.44 and 0.48).

**Table 4 Correlation of social gradients measured with the ratio indicator and alternative measures**

	Correlation of values		Correlation of ranks	
	Correlation: ratio-Kendall's tau-b	Correlation: ratio-MCI	Correlation: ratio-Kendall's tau-b	Correlation: ratio-MCI
Income quintile	0.615	0.878	0.740	0.905
Income position	0.361		0.480	
Maternal education	0.290	0.658	0.442	0.726
Parental education (higher)	0.125	0.393	0.460	0.660
Parental education (lower)	0.526	0.751	0.451	0.750

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: Concentration index with household income was calculated using the original household income variable.

Table 5 shows the correlations of income-based and education-based social gradient indicators. Country rankings of income-based and education-based gradients are generally strongly correlated, while correlation of the indices themselves are sometimes lower. With ratio-type measures (see upper block of Table 5), inequality indices are strongly correlated when parental education is measured by mother's education, while correlations are lower when parental education is measured by the lower level of parents' education. Correlations of the income-based and education-based Kendall-tau b indicators is generally low, but strong correlation were observed between the country rankings. We see again strong correlation of income-based and education-based inequality when inequality is measured by the concentration index. Exception is the case when parental education is measured by lower of the parent's education level.

**Table 5 Country-level correlations of inequality indicators and ranks in the country ranking, 0-2 age group 2011**

	Correlation of values		Correlation of ranks	
	Income quintile	Income position	Income quintile	Income position
<i>Ratio index of formal childcare use by</i>				
Maternal education	0.809	0.560	0.733	0.589
Parental education (higher)	0.632	0.246	0.704	0.594
Parental education (lower)	0.489	0.443	0.594	0.480
<i>Rank correlation (Kendall's tau-b) of formal childcare use with</i>				
Maternal education	0.819	0.801	0.789	0.761
Parental education (higher)	0.806	0.778	0.758	0.714
Parental education (lower)	0.761	0.734	0.746	0.686
<i>Modified Concentration index of formal childcare use by</i>				
	Household income		Household income	
Maternal education		0.779		0.772
Parental education (higher)		0.782		0.777
Parental education (lower)		0.590		0.525

Source: Own calculations based on EU-SILC 2011, UDB August 2013

### Change in the use of formal childcare between 2008 and 2011

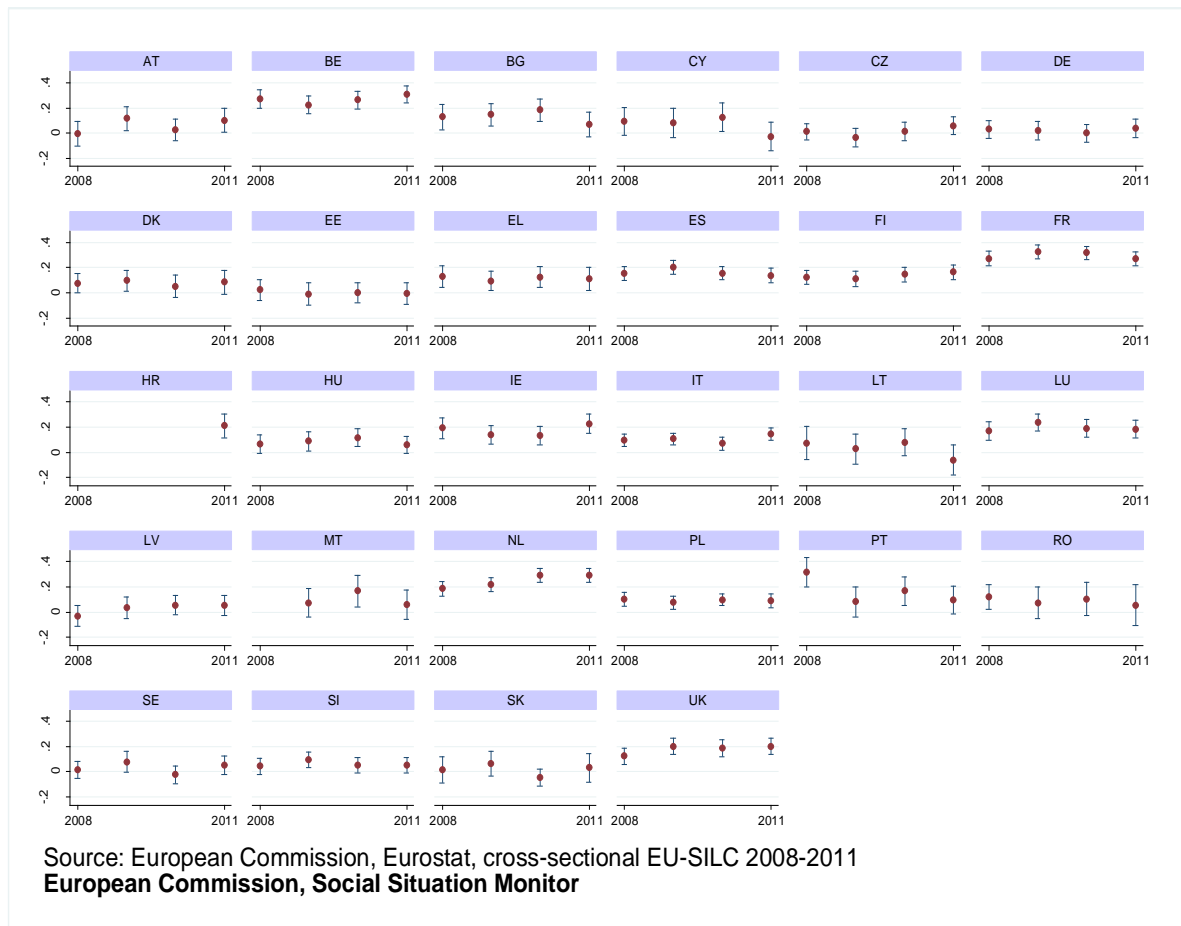
To be useful as a monitoring tool, the measure of inequality in childcare use should be fairly stable in time. To have a perspective on this we calculated the indices considered for four consecutive years between 2008 and 2011.

The social gradient measured by the Kendall's tau-b shows increasing trend in Finland, the Netherlands, UK and Latvia, while in Portugal and Lithuania the gradient declined (see Figure 6) over the period considered. In seven countries the index first increased and then decreased, while in three countries we see a reverse U-shaped picture with the index first declining and then increasing. In five countries the value of the index changes without clear trend, while no change can be seen in six countries.

Figure 7 shows the evolution of the gradient as measured by the modified concentration index. The value of the index increased in six countries over the 2008-2011 period. In Austria, the Czech Republic, Ireland, Luxembourg, Latvia and Romania. The most important increase in this index was seen in Ireland, where the MCI increased from 0.18 to 0.505. In contrast in countries such as Bulgaria, Hungary, Lithuania, Portugal, the MCI declined during the years between 2008 and 2011. In some countries we see changes in the MCI but without clear trend of the changes

(Cyprus, Denmark, Greece, Malta, Sweden, Slovenia, Slovakia). The inequality in childcare use as measured by this index remained unchanged in nine countries.

**Figure 6 Rank correlation (Kendall's tau-b) of formal childcare use with parental education with 95% confidence intervals, 2008-2011 (0-2 years age group)**

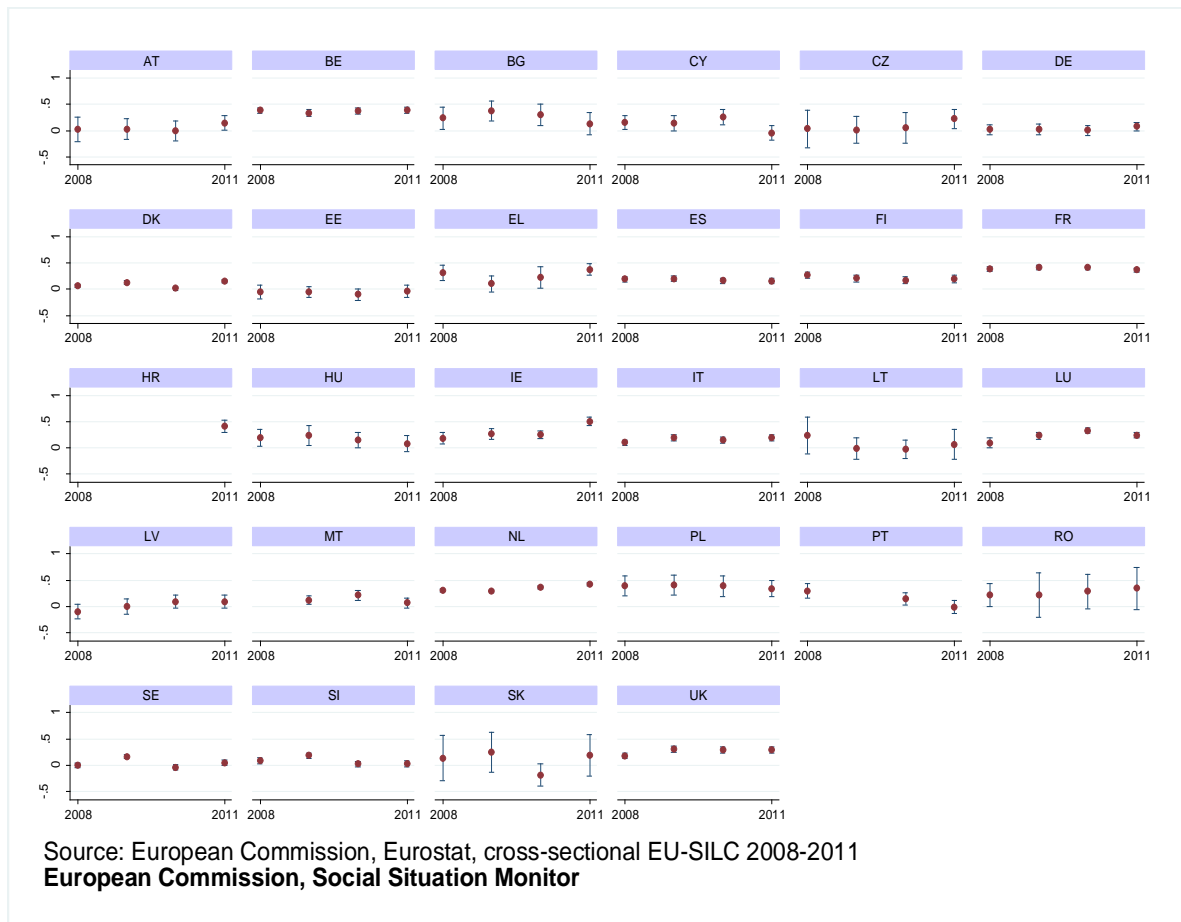


Although both indices (Kendall's tau-b and the concentration index) show change in time neither of these indices exhibit the type of extreme variability that is characteristic of the ratio indicator. The ratio of childcare use in extreme groups sometimes exhibits huge changes due to the low percentage of childcare use in the extreme groups in some of the countries (see Table A9 in the Annex). For example in case of Portugal the ratio for income equals 7.74 in 2008 and in the following year it drops to 0.97. In the case of Poland the ratio index just above three in the first two years jumps to 9.43 in 2010. Extremely high values are also seen in the case of Bulgaria, Greece and Lithuania.

The variability of the indices is partly related to sampling error. The indices of inequality have been estimated on small samples in some countries (see Table A1 in the Annex). In the case of Lithuania, the number of 0-2 age olds in the sample is below 200 in the survey years considered. This is also the case for Portugal in 2008 and Romania in 2010 and 2011. Sample sizes are only slightly higher in Malta and Cyprus. In contrast largest sample sizes for this age group are found in Italy and Poland, where approx. 1100 children of this age are in the sample. In countries with

low sample size the indicators are estimated with large standard error<sup>10</sup> and 95% confidence intervals are quite large as shown on Figures 9 and 10.

**Figure 7 Modified concentration index of formal childcare use with parental education with 95% confidence intervals, 2008-2011 (0-2 years age group)**



### Average use of childcare and social gradient

Figure 8 shows average use of formal childcare and the social gradient in childcare use measured by the concentration index by household income. Sweden, Malta and Slovenia are countries with relatively high average use and low inequality. Average use is even higher in Denmark, although inequality is somewhat higher than in the countries previously mentioned. Countries with relatively high average use but high inequality are France, the Netherlands, Belgium, UK and Luxembourg. Countries where low average use is combined with high inequality are Romania, Poland, Croatia,

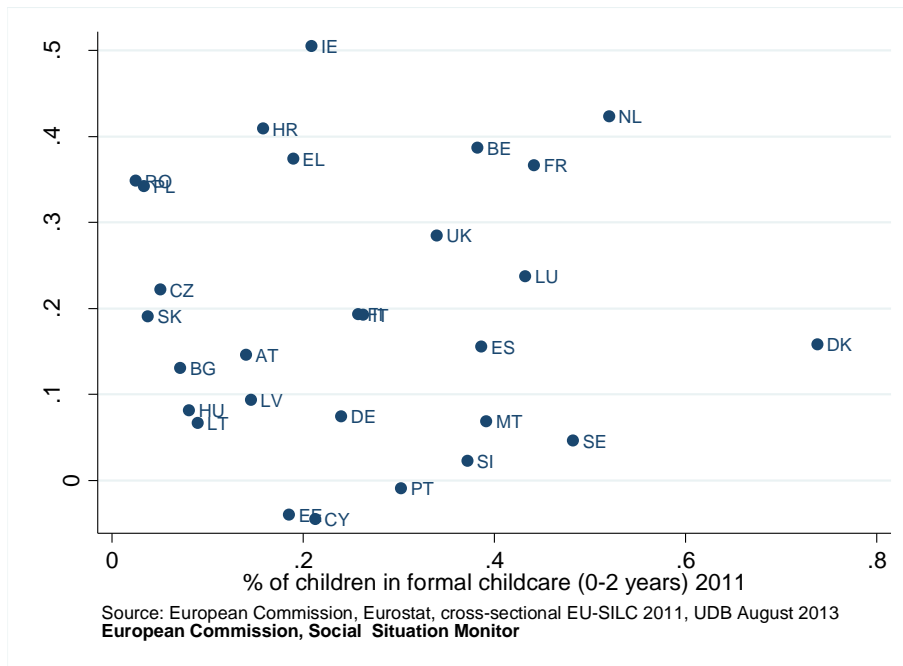
<sup>10</sup> Standard errors were calculated by assuming simple random sampling for all countries. In case of countries where more complex sample design was used this is likely to underestimate standard errors of the estimates.

Standard errors for the ratio indices were calculated by using the following formula for the log of the risk ratio. The standard error of the natural log of the risk ratio (Agresti 1995). With the aid of this formula confidence limits of the log risk ratio were obtained and then these confidence limits were exponentiated to derive confidence limits for the risk ratio. Standard error for the Kendall-tau is calculated by using the formula for asymptotic variance in StataCorp (2013). Standard errors of the concentration index are obtained by a "covariance" or "formula" method given in O'Donnell et al. (2008).

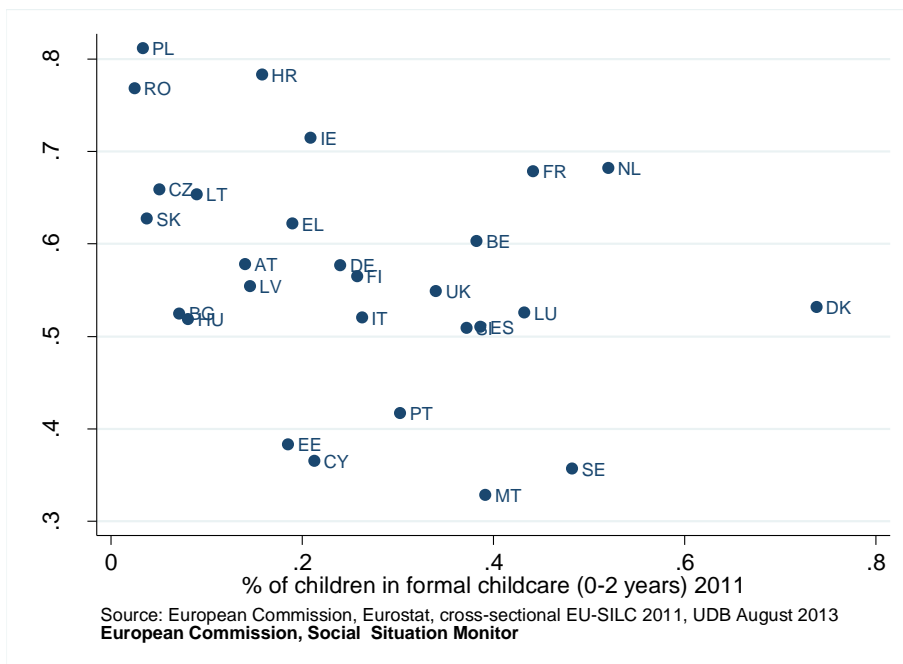


Ireland and Greece. A fourth group of countries is characterised by low average use of childcare and low inequality. These are Estonia, Cyprus, Latvia, Lithuania and Hungary. Figure 9 shows a similar picture when socioeconomic status is measured by parental education.

**Figure 8 Use and access to early formal childcare by household income, 0-2 age group, 2011**



**Figure 9 Use and access to early formal childcare by parental education, 0-2 years age group 2011**



## Concluding remarks

The aim of the research note was to review methodological issues in the measurement of the social gradient in childcare use and to propose a summary measure of the gradient.

One crucial issue is which socioeconomic variables should be used to describe the socioeconomic status of the households. In this analysis we used equivalised disposable income and parental education as measures of socioeconomic status and also experimented with a composite indicator of socioeconomic status. We reviewed different possible summary measures of the social gradient in childcare use based on the literature of health inequality. The simple frequency ratios are problematic, because they are based only on the extreme categories of the distribution of the socioeconomic variable. Other indices proposed in the literature are measures of association, and measures based on rankings of the socioeconomic variable. From the first group of indices a rank correlation index (Kendall's tau-b) has been selected, while among indices based on rankings the Concentration Index has been chosen for analysis.

Results of the analysis show similar country pattern of inequality in childcare use among the 0-2 year olds when income-based or education-based gradients are considered. In both cases Sweden, Malta, Slovenia and Denmark are countries with high average use and low inequality. Countries with relatively high average use but high inequality are France, the Netherlands, Belgium, UK and Luxembourg. Countries where low average use is combined with high inequality are Romania, Poland, Croatia, Ireland and Greece. A fourth group of countries is characterised by low average use of childcare and low inequality. These are Estonia, Cyprus, Latvia, Lithuania and Hungary.

The analysis showed that correlation between country rankings obtained with the concentration index and the ratio indicator is generally high, both in case of the income-based and the education-based gradients. Ranking by Kendall's tau-b index shows high correlation with the ranking according to the ratio indicator only in case of the gradient by income. The analysis also shows that country rankings of income-based and education-based gradients are generally strongly correlated, irrespective of the index of inequality used.

As a conclusion, it can be asked which of the indices studied could serve as an indicator to monitor changes in the social gradient of childcare use. An indicator of inequality in childcare use needs to be easy to understand, to be comparable in time and to be based on common method for different socio-economic variables. We have seen that both rank correlation indices and the concentration index are preferable to using simple ratios. Although these are more sophisticated indices, their degree of sophistication does not exceed that of other indicators used (eg. Gini index of inequality). Both the rank correlation index and the concentration index changes over time partly due to the relatively small sample sizes, but neither of them exhibits the type of extreme variability that is seen in the case of the ratio in some cases. As there is some controversy in the literature on the interpretation of the concentration index in case of a binary variables (Kjellson and Gerdtham 2013), the rank correlation has a slight advantage in terms of ease interpretation and understanding. It is also clear that for these indices to be useful as monitoring tools sample sizes should be raised and precision of estimates increased.

## References

- Agresti, A. (1996): An Introduction to Categorical Data Analysis. Wiley series in probability and statistics. John Wiley and Sons, Inc.
- Augustine J.M. et al (2009): Maternal Education, Early Child Care and the Reproduction of Advantage. *Social Forces* 2009 September; 88(1): 1-29.
- Case A. et al (2005): The lasting impact of childhood health and circumstance. *Journal of Health Economics* 24 (2005) 365-389.
- Erreygers, G. (2009), "Correcting the concentration index", *Journal of Health Economics*, vol. 28(2), pp.504-515.
- European Commission (2013a): Indicators to monitor the social gradient in the use of childcare EC, DG Employment, Social Affairs and Inclusion.
- European Commission (2013b): Childcare: measuring access to quality and affordable childcare. Social gradient measurement and data needs SPC/ISG/2013.04/4.2. EC, DG Employment, Social Affairs and Inclusion.
- European Commission (2013c): Barcelona objectives. The development of childcare facilities for young children in Europe with a view to sustainable and inclusive growth, Luxembourg: Publications Office of the European Union, 2013.
- Felfe C. et al (2012): Can't Buy Mommy's Love? Universal Childcare and Children's Long-Term Cognitive Development, IZA Discussion Paper No. 7053
- Förster, M. F. and G. Verbist (2012), "Money or Kindergarten? Distributive Effects of Cash Versus In-Kind Family Transfers for Young Children", OECD Social, Employment and Migration Working Papers, No. 135, OECD Publishing.
- Gamoran A. (1999): Effects of Nonmaternal Child Care on Inequality in Cognitive Skills, Institute for Research on Poverty Discussion Paper no. 1186-99
- Heckman, J.J. (2008) : Schools, Skills and Synapses. *Economic Enquiry*, Vol. 46, No. 3, July 2008, 289-324
- Kjellsson, G. and Gerdtham, U. (2013) : On correcting the concentration index for binary variables. *Journal of health economics*. 32(3). p.659-670
- Lynch J.W. et al (1997): Why do poor people behave badly? Variation in adult health and psychosocial characteristics by stages of the socioeconomic lifecourse. *Social Science and Medicine* Vol.44, No.6, pp.809-819
- Mackenbach JP, Kunst AE. (1997): Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Soc Sci Med*. 1997 Mar;44(6):757-71.
- Manor O, Matthews S, Power C (1997): Comparing measures of health inequality. *Soc Sci Med*. 1997 Sep;45(5):761-71.
- O' Donnell O. et al (2008): Analyzing Health Equity Using Household Survey Data, 2008 World Bank Institute
- OECD (2012): PISA 2009 Technical Report, PISA OECD Publishing.
- OECD (2013): PISA 2012 Results: Excellence through Equity. Giving Every Student the Chance to Succeed, Volume II, OECD Paris.
- Poulton R. et al (2002): Association between children's experience of socioeconomic disadvantage and adult health: a life-course study, *Lancet* 2002 Nov 23;360(9346):1640-5.
- Regidor, E. (2004a): Measures of health inequalities: part 1. *J Epidemiol Community Health* 2004;58:858-861
- Regidor, E. (2004b): Measures of health inequalities: part 2. *J Epidemiol Community Health* 2004;58:900-903
- Starfield B.(2008): Social gradients and child health. In Heggenhuogen HK, Quah SR (eds.). *International Encyclopedia of Public Health*, Vol 6, pp.87-101

- StataCorp. (2013): Stata Base Reference Manual, Release 14. A Stata Press Publication, StatCorp LP, College Station, Texas.
- Vaalavuo, M. (2011), Towards an Improved Measure of Income Inequality. The Impact of Public Services in Income Distribution. An International Comparison, PhD Thesis. European University Institute, Florence, Italy.
- Vandell D.L. et al (2010): Do Effects of Early Child Care Extend to Age 15 Years? Results From the NICHD Study of Early Child Care and Youth Development, *Child Development* 81(3): 737–756
- Van Lancker, W.(2013) Putting the child-centred investment strategy to the test : evidence for the EU27 *European Journal of Social Security* vol.15:1(2013), p. 4-27
- Van Lancker, W. and Ghysels, J. (2013): Great expectations, but how to achieve them? Explaining patterns of inequality in childcare use across 31 developed countries Working Paper No. 13 / 05 December 2013

**Annex****Table A1 Percentage of children participating in formal childcare, 2008-2011, 0-2 age group**

	2008		2009		2010		2011	
	%	N	%	N	%	N	%	N
AT	7	403	10	379	9	401	14	372
BE	43	463	33	546	35	564	38	543
BG	11	279	8	284	7	241	7	255
CY	24	257	20	212	21	218	21	250
CZ	2	736	3	641	3	612	5	594
DE	19	594	19	605	20	607	24	573
DK	73	480	73	441	77	364	74	342
EE	16	405	25	400	21	414	19	408
EL	12	416	11	487	8	458	19	322
ES	36	947	35	941	37	995	39	830
FI	26	855	27	879	28	910	26	797
FR	39	840	41	856	42	872	44	882
HU	7	554	7	588	9	596	8	641
IE	24	429	20	526	29	601	21	530
IT	27	1,306	25	1,286	22	1,138	26	1,106
LT	9	186	10	204	13	216	9	191
LU	26	595	34	596	35	628	43	613
LV	12	340	13	414	14	423	15	414
MT			42	243	42	185	39	236
NL	47	925	49	893	50	844	52	839
PL	3	1,086	3	1,129	2	1,128	3	1,085
PT	30	172	32	211	31	209	30	257
RO	9	288	5	221	8	147	2	154
SE	48	677	59	472	49	626	48	600
SI	31	678	31	778	36	850	37	809
SK	2	353	2	338	3	324	4	237
UK	35	697	35	678	34	644	34	657

Source: Own calculations based on EU-SILC 2008-2011

**Table A2 Composition of the population aged 0-2 by income quintile, 2011**

	Q1	Q2	Q3	Q4	Q5	Total
AT	26	26	22	14	13	100
BE	28	15	19	23	16	100
BG	31	15	16	20	17	100
CY	19	16	14	26	24	100
CZ	21	18	22	21	19	100
DE	19	24	22	20	15	100
DK	17	18	24	27	15	100
EE	14	13	19	27	27	100
EL	19	18	18	22	23	100
ES	20	18	15	21	25	100
FI	22	24	23	18	14	100
FR	26	20	22	19	14	100
HR	23	15	19	22	22	100
HU	30	20	18	16	16	100
IE	19	21	20	18	21	100
IT	23	18	18	26	15	100
LT	13	12	14	27	34	100
LU	27	23	18	16	15	100
LV	24	14	13	21	27	100
MT	17	19	23	20	20	100
NL	20	19	18	23	20	100
PL	19	21	19	20	21	100
PT	20	19	20	20	22	100
RO	22	27	20	13	18	100
SE	22	29	23	17	9	100
SI	22	18	21	22	18	100
SK	27	22	16	18	18	100
UK	24	23	20	19	14	100
Total	22	21	20	20	17	100

Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Table A3 Composition of the population by maternal education, 0-2 years 2011**

	Primary or lower secondary	Upper secondary	Tertiary	Total
AT	16	55	29	100
BE	19	31	50	100
BG	38	36	27	100
CY	10	36	53	100
CZ	5	65	30	100
DE	7	54	39	100
DK	7	41	52	100
EE	10	41	49	100
EL	11	46	43	100
ES	31	22	47	100
FI	6	40	54	100
FR	15	41	44	100
HR	16	62	22	100
HU	22	50	28	100
IE	13	29	58	100
IT	29	48	23	100
LT	10	39	51	100
LU	32	35	34	100
LV	19	42	39	100
MT	44	30	26	100
NL	11	40	49	100
PL	7	54	40	100
PT	44	31	25	100
RO	30	50	21	100
SE	7	39	55	100
SI	8	48	44	100
SK	9	52	39	100
UK	13	46	41	100
Total	17	44	39	100

Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Table A4 Percentage of those in formal childcare by income quintile, age 0-2 years (2011)**

	Q1	Q2	Q3	Q4	Q5	Ratio Q5/Q1
AT	12	10	14	15	23	1.84
BE	17	32	38	49	66	3.85
BG	4	7	5	16	5	1.14
CY	18	33	18	20	19	1.07
CZ	2	6	5	4	8	5.07
DE	21	21	24	32	21	0.98
DK	65	71	75	76	80	1.23
EE	18	12	25	23	13	0.75
EL	7	8	17	25	33	4.64
ES	28	37	41	42	44	1.57
FI	16	23	28	33	34	2.13
FR	22	35	49	67	59	2.62
HR	5	12	7	20	33	6.21
HU	5	9	14	6	8	1.43
IE	9	8	18	17	51	5.75
IT	19	21	25	29	40	2.11
LT	4	7	18	9	8	1.91
LU	31	39	48	56	53	1.72
LV	10	21	13	14	17	1.73
MT	39	37	32	42	47	1.20
NL	29	35	54	60	80	2.75
PL	1	3	1	4	7	7.99
PT	33	24	33	36	26	0.80
RO	0	3	4	0	6	
SE	46	48	46	53	51	1.11
SI	34	40	42	33	39	1.14
SK	2	7	3	0	8	4.60
UK	17	31	35	55	39	2.31
EU	18	25	30	38	35	1.96

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: Income quintiles were defined among the whole population.



**Table A4a Percentage of those in formal childcare (with RL050) by income quintile, age 0-2 years (2011)**

	Q1	Q2	Q3	Q4	Q5	Ratio Q5/Q1
AT	13	16	17	20	27	2.06
BE	17	34	43	55	68	4.00
BG	4	7	5	16	5	1.14
CY	18	34	22	23	29	1.63
CZ	2	6	5	4	14	8.85
DE	25	25	28	36	29	1.19
DK	65	71	75	76	80	1.23
EE	21	14	25	26	18	0.88
EL	7	8	17	27	42	5.81
ES	29	39	41	42	46	1.59
FI	17	23	28	33	42	2.51
FR	22	38	61	77	71	3.20
HR	5	17	7	20	35	6.56
HU	5	9	14	6	8	1.43
IE	9	10	23	27	67	7.36
IT	19	21	26	33	42	2.15
LT	4	9	18	9	15	3.83
LU	33	51	59	64	60	1.81
LV	10	21	13	21	24	2.49
MT	39	37	32	42	47	1.20
NL	35	47	61	69	83	2.33
PL	1	5	3	8	22	19.54
PT	40	32	43	47	51	1.29
RO	5	3	4	0	9	1.77
SE	49	51	46	55	53	1.09
SI	34	42	44	41	46	1.37
SK	2	9	3	0	10	6.29
UK	19	33	39	65	47	2.52
EU	19	27	34	44	43	2.20

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: Definition of formal childcare use also includes childcare by professional child-minder at child's home or at child-minder's home (variable RL050). Income quintiles were defined among the whole population.

**Table A4b Percentage of those in formal childcare by income quintile (among those with children), age 0-2 years (2011)**

	Q1	Q2	Q3	Q4	Q5	Ratio Q5/Q1
AT	11	12	14	14	19	1.81
BE	20	22	35	49	62	3.11
BG	2	6	7	14	5	2.06
CY	18	30	16	23	19	1.04
CZ	2	6	6	4	7	3.86
DE	18	26	23	25	27	1.47
DK	65	76	70	80	77	1.19
EE	16	19	18	30	8	0.48
EL	7	11	13	32	31	4.67
ES	29	38	39	37	49	1.73
FI	15	18	29	30	34	2.19
FR	23	28	48	57	64	2.83
HR	5	11	8	20	33	7.01
HU	6	4	12	9	9	1.35
IE	8	9	16	17	50	5.85
IT	19	19	26	28	38	2.01
LT	6	15	5	7	13	2.23
LU	23	49	38	57	51	2.26
LV	8	22	13	17	14	1.78
MT	40	32	32	44	47	1.16
NL	30	35	50	60	81	2.66
PL	1	2	2	4	7	7.25
PT	34	24	34	34	26	0.76
RO	0	0	3	4	4	
SE	46	44	50	46	55	1.20
SI	34	39	43	31	38	1.12
SK	2	0	9	0	7	2.70
UK	16	29	33	47	44	2.71
EU	18	23	29	34	39	2.11

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: income quintiles were defined among those with children under the age of 6.

**Table A4c Percentage of those in formal childcare (with RL050) by income quintile (among those with children), age 0-2 years (2011)**

	Q1	Q2	Q3	Q4	Q5	Ratio Q5/Q1
AT	12	17	16	19	24	2.07
BE	20	23	39	57	64	3.21
BG	2	6	7	14	5	2.06
CY	18	34	19	26	28	1.56
CZ	2	6	6	4	12	6.73
DE	22	30	26	29	36	1.62
DK	65	76	70	80	77	1.19
EE	19	20	18	38	11	0.57
EL	7	11	13	34	41	6.17
ES	29	39	40	38	51	1.73
FI	16	19	29	31	39	2.40
FR	23	30	56	69	76	3.35
HR	5	15	8	20	35	7.41
HU	6	4	12	9	9	1.35
IE	9	11	20	26	67	7.32
IT	19	20	27	32	40	2.09
LT	7	15	5	12	20	2.99
LU	25	59	51	61	60	2.37
LV	8	22	14	25	23	2.83
MT	40	32	32	44	47	1.16
NL	34	47	59	69	84	2.43
PL	1	4	4	7	21	18.49
PT	40	34	39	50	51	1.27
RO	7	0	3	4	7	0.97
SE	49	48	50	47	57	1.17
SI	34	40	46	38	46	1.35
SK	2	0	11	0	9	3.69
UK	18	30	39	55	53	2.90
EU	20	25	32	40	46	2.33

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: Definition of formal childcare use also includes childcare by professional child-minder at child's home or at child-minder's home (variable RL050). Income quintiles were defined among those with children under the age of 6.

**Table A5 Percentage of those in formal childcare by maternal education, age 0-2 years (2011)**

	Lower than upper secondary	Upper secondary	Tertiary	Ratio High/low
AT	7	14	19	2.75
BE	22	35	51	2.31
BG	4	8	10	2.40
CY	22	24	20	0.90
CZ	5	3	9	1.85
DE	17	21	31	1.78
DK	67	71	79	1.19
EE	18	20	17	0.97
EL	5	17	24	5.31
ES	31	36	45	1.47
FI	21	22	30	1.39
FR	23	35	61	2.69
HR	0	15	29	
HU	5	8	10	2.16
IE	6	15	28	4.64
IT	20	25	37	1.87
LT	7	5	13	1.73
LU	35	38	57	1.65
LV	5	16	17	3.67
MT	39	43	35	0.90
NL	35	38	68	1.94
PL	0	2	7	
PT	26	37	31	1.20
RO	0	3	5	
SE	59	52	45	0.76
SI	35	34	42	1.19
SK	0	4	5	
UK	15	35	40	2.69
EU	19	24	39	2.04

Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Table A6a Indices of social gradient by income quintiles with 95% confidence intervals around the estimates, 0-2 age group 2011**

	Ratio	Lower	Higher	Kendall tau- b	Lower	Higher	Modif. Conc. Index	Lower	Higher
AT	1.84	0.88	3.87	0.101	0.007	0.196	0.146	0.002	0.290
BE	3.85	2.63	5.63	0.307	0.239	0.375	0.387	0.329	0.446
BG	1.14	0.20	6.62	0.070	-0.028	0.168	0.131	-0.086	0.347
CY	1.07	0.48	2.40	-0.027	-0.139	0.085	-0.045	-0.180	0.091
CZ	5.07	1.11	23.17	0.059	-0.010	0.127	0.222	0.041	0.404
DE	0.98	0.56	1.70	0.038	-0.034	0.110	0.075	-0.008	0.158
DK	1.23	0.92	1.65	0.085	-0.010	0.179	0.158	0.128	0.189
EE	0.75	0.36	1.54	-0.007	-0.091	0.077	-0.040	-0.151	0.071
EL	4.64	1.81	11.94	0.113	0.021	0.205	0.374	0.263	0.485
ES	1.57	1.17	2.10	0.138	0.079	0.198	0.156	0.105	0.206
FI	2.13	1.39	3.24	0.164	0.105	0.223	0.194	0.125	0.263
FR	2.62	1.96	3.51	0.268	0.213	0.323	0.367	0.328	0.406
HR	6.21	2.21	17.44	0.212	0.117	0.306	0.375	0.254	0.496
HU	1.43	0.59	3.51	0.059	-0.009	0.126	0.089	-0.067	0.246
IE	5.75	3.03	10.92	0.227	0.150	0.304	0.505	0.423	0.587
IT	2.11	1.53	2.91	0.147	0.095	0.198	0.193	0.135	0.251
LT	1.91	0.25	14.27	-0.059	-0.176	0.059	0.067	-0.219	0.352
LU	1.72	1.27	2.33	0.185	0.117	0.254	0.238	0.185	0.290
LV	1.73	0.83	3.58	0.053	-0.030	0.136	0.094	-0.030	0.217
MT	1.20	0.74	1.96	0.058	-0.057	0.173	0.069	-0.026	0.165
NL	2.75	1.99	3.81	0.291	0.235	0.346	0.424	0.396	0.451
PL	7.99	2.03	31.47	0.090	0.037	0.143	0.343	0.186	0.499
PT	0.80	0.44	1.46	0.098	-0.011	0.207	-0.009	-0.128	0.111
RO				0.056	-0.106	0.218	0.349	-0.052	0.750
SE	1.11	0.81	1.53	0.051	-0.021	0.122	0.046	-0.003	0.096
SI	1.14	0.85	1.54	0.052	-0.009	0.114	0.023	-0.032	0.077
SK	4.60	0.46	46.06	0.031	-0.083	0.144	0.191	-0.205	0.587
UK	2.31	1.50	3.54	0.201	0.136	0.266	0.285	0.227	0.344

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note : standard errors were calculated by assuming simple random sampling for all countries. For more detail on calculation of standard errors, see Footnote 10 on page 25.

**Table A6b Indices of social gradient by maternal education with 95% confidence intervals around the estimates, 0-2 age group 2011**

	Ratio	Lower	Higher	Kendall tau- b	Lower	Higher	Modif. Conc. Index	Lower	Higher
AT	2.75	0.93	8.10	0.119	0.024	0.213	0.578	0.469	0.688
BE	2.31	1.54	3.47	0.236	0.156	0.315	0.603	0.548	0.659
BG	2.40	0.68	8.47	0.079	-0.036	0.194	0.525	0.313	0.737
CY	0.90	0.44	1.87	-0.018	-0.140	0.103	0.365	0.212	0.518
CZ	1.85	0.39	8.79	0.119	0.031	0.206	0.659	0.518	0.801
DE	1.78	0.87	3.64	0.112	0.032	0.192	0.577	0.506	0.648
DK	1.19	0.82	1.73	0.098	-0.009	0.205	0.532	0.502	0.562
EE	0.97	0.53	1.76	0.035	-0.053	0.124	0.383	0.257	0.510
EL	5.31	1.35	20.87	0.064	-0.033	0.161	0.622	0.518	0.726
ES	1.47	1.19	1.83	0.140	0.076	0.204	0.511	0.463	0.558
FI	1.39	0.77	2.50	0.084	0.017	0.151	0.565	0.501	0.629
FR	2.69	1.92	3.75	0.285	0.226	0.343	0.679	0.643	0.714
HR				0.225	0.137	0.312	0.717	0.636	0.798
HU	2.16	0.92	5.07	0.097	0.025	0.170	0.566	0.429	0.704
IE	4.64	1.76	12.22	0.129	0.055	0.204	0.715	0.638	0.792
IT	1.87	1.40	2.48	0.124	0.069	0.178	0.521	0.473	0.569
LT	1.73	0.39	7.76	-0.003	-0.132	0.126	0.654	0.347	0.961
LU	1.65	1.33	2.05	0.190	0.116	0.263	0.526	0.472	0.580
LV	3.67	1.33	10.14	0.112	0.030	0.193	0.555	0.441	0.668
MT	0.90	0.58	1.38	-0.026	-0.147	0.095	0.329	0.244	0.414
NL	1.94	1.37	2.76	0.239	0.175	0.303	0.682	0.656	0.708
PL				0.107	0.053	0.161	0.812	0.707	0.916
PT	1.20	0.74	1.95	0.138	0.021	0.255	0.417	0.309	0.525
RO				0.136	0.023	0.249	0.768	0.534	1.003
SE	0.76	0.56	1.02	-0.062	-0.140	0.016	0.357	0.306	0.408
SI	1.19	0.83	1.70	0.093	0.026	0.160	0.509	0.459	0.559
SK				0.041	-0.070	0.152	0.628	0.376	0.880
UK	2.69	1.49	4.86	0.113	0.040	0.186	0.549	0.496	0.603

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note : standard errors were calculated by assuming simple random sampling for all countries. For more detail on calculation of standard errors, see Footnote 10 on page 25.

**Table A7 Social gradient measures by household income, 0-2 age group 2011**

	Rank correlation (Kendall's tau-b)		Modified CI
	Income quintile	Income position	Household income
AT	0.101	0.117	0.146
BE	0.307	0.304	0.387
BG	0.070	0.063	0.131
CY	-0.027	-0.030	-0.045
CZ	0.059	0.088	0.222
DE	0.038	0.051	0.075
DK	0.085	0.115	0.158
EE	-0.007	-0.022	-0.040
EL	0.113	0.115	0.374
ES	0.138	0.136	0.156
FI	0.164	0.161	0.194
FR	0.268	0.263	0.367
HR	0.212	0.227	0.410
HU	0.059	0.069	0.082
IE	0.227	0.239	0.505
IT	0.147	0.142	0.193
LT	-0.059	-0.030	0.067
LU	0.185	0.193	0.238
LV	0.053	0.059	0.094
MT	0.058	0.059	0.069
NL	0.291	0.289	0.424
PL	0.090	0.105	0.343
PT	0.098	0.088	-0.009
RO	0.056	0.085	0.349
SE	0.051	0.078	0.046
SI	0.052	0.072	0.023
SK	0.031	0.068	0.191
UK	0.201	0.209	0.285

Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Table A8 Social gradient measures by parental education, 0-2 years 2011**

	Rank correlation (Kendall's tau-b)			Modified Concentration Index		
	Maternal education	Higher level of parental education	Lower level of parental education	Maternal education	Higher level of parental education	Lower level of parental education
AT	0.119	0.131	0.114	0.578	0.643	0.579
BE	0.236	0.221	0.222	0.603	0.622	0.551
BG	0.079	0.106	0.109	0.525	0.617	0.599
CY	-0.018	0.064	0.023	0.365	0.464	0.408
CZ	0.119	0.150	0.094	0.659	0.610	0.766
DE	0.112	0.088	0.078	0.577	0.600	0.578
DK	0.098	0.109	0.111	0.532	0.570	0.532
EE	0.035	-0.017	0.036	0.383	0.419	0.340
EL	0.064	0.039	0.052	0.622	0.613	0.524
ES	0.140	0.154	0.156	0.511	0.577	0.481
FI	0.084	0.070	0.063	0.565	0.574	0.509
FR	0.285	0.271	0.295	0.679	0.734	0.650
HR	0.225	0.209	0.188	0.783	0.752	0.833
HU	0.097	0.090	0.085	0.519	0.493	0.580
IE	0.129	0.142	0.080	0.715	0.703	0.657
IT	0.124	0.118	0.132	0.521	0.553	0.543
LT	-0.003	-0.011	-0.039	0.654	0.611	0.472
LU	0.190	0.164	0.182	0.526	0.568	0.442
LV	0.112	0.151	0.099	0.555	0.555	0.596
MT	-0.026	-0.018	-0.015	0.329	0.326	0.472
NL	0.239	0.240	0.242	0.682	0.714	0.656
PL	0.107	0.071	0.105	0.812	0.812	0.691
PT	0.138	0.155	0.138	0.417	0.411	0.582
RO	0.136	0.129	0.116	0.768	0.738	0.825
SE	-0.062	-0.113	-0.042	0.357	0.444	0.272
SI	0.093	0.057	0.085	0.509	0.525	0.484
SK	0.041	0.045	0.019	0.628	0.579	0.671
UK	0.113	0.144	0.133	0.549	0.584	0.580

Source: Own calculations based on EU-SILC 2011, UDB August 2013



**Table A9 Evolution of the social gradient as measured by the ratio of extreme groups, 0-2 age group**

	Income quintile				Maternal education			
	2008	2009	2010	2011	2008	2009	2010	2011
AT	1.06	1.24	0.88	1.84	2.66	3.40	3.59	2.75
BE	3.24	2.63	3.39	3.85	1.95	2.78	3.74	2.31
BG	3.03	14.04		1.14	2.94	7.36		2.40
CY	1.12	1.80	2.94	1.07	1.04	0.99	2.42	0.90
CZ	0.34	1.39	1.22	5.07		1.47		1.85
DE	1.01	1.04	1.07	0.98	0.77	1.92	1.16	1.78
DK	1.21	1.10	0.95	1.23	1.09	1.01	0.90	1.19
EE	0.67	0.74	0.86	0.75	0.74	1.73	1.83	0.97
EL	4.09	1.22	2.04	4.64	8.75	1.12	1.26	5.31
ES	2.14	1.80	1.51	1.57	1.99	1.66	1.72	1.47
FI	2.83	1.89	2.36	2.13	1.25	2.74	2.46	1.39
FR	3.44	4.37	4.01	2.62	2.58	3.81	2.83	2.69
HR				6.21				
HU	2.26	2.60	1.89	1.43	2.96	2.17	4.46	2.16
IE	2.69	2.69	2.54	5.75	1.59	2.18	2.80	4.64
IT	1.62	2.03	1.67	2.11	1.33	1.71	1.88	1.87
LT	2.18	1.45	5.10	1.91	33.50	9.60	2.34	1.73
LU	1.66	1.95	2.43	1.72	1.63	2.85	2.37	1.65
LV	0.46	1.71	1.11	1.73	1.72	2.36	3.71	3.67
MT		1.38	1.90	1.20		0.96	1.32	0.90
NL	2.17	2.20	2.68	2.75	2.47	2.13	1.62	1.94
PL	3.30	3.24	9.43	7.99	2.31	10.98		
PT	7.74	0.97	2.52	0.80	1.83		1.18	1.20
RO	3.65	1.73	2.47		1.32	1.19	3.18	
SE	1.05	1.56	0.69	1.11	0.92	1.70	1.41	0.76
SI	1.39	1.74	0.97	1.14	1.48	1.98	0.96	1.19
SK	3.52	1.72	0.00	4.60				
UK	1.86	2.82	2.59	2.31	4.02	1.80	1.73	2.69

Source: Own calculations based on EU-SILC 2008-2011

**Table A10 Evolution of the social gradient as measured by rank correlation index (Kendall's tau-b), 0-2 age group**

	Income quintile				Maternal education			
	2008	2009	2010	2011	2008	2009	2010	2011
AT	-0.006	0.116	0.028	0.101	0.019	0.121	0.099	0.119
BE	0.270	0.223	0.262	0.307	0.234	0.166	0.288	0.236
BG	0.129	0.148	0.182	0.070	0.166	0.224	0.210	0.079
CY	0.095	0.079	0.126	-0.027	0.045	0.005	0.007	-0.018
CZ	0.011	-0.037	0.012	0.059	0.009	0.001	0.045	0.119
DE	0.029	0.018	-0.001	0.038	0.000	0.129	0.047	0.112
DK	0.075	0.097	0.052	0.085	0.012	0.013	-0.033	0.098
EE	0.023	-0.009	-0.002	-0.007	-0.030	0.106	0.096	0.035
EL	0.128	0.094	0.123	0.113	0.130	0.059	0.079	0.064
ES	0.153	0.200	0.155	0.138	0.179	0.191	0.176	0.140
FI	0.122	0.110	0.146	0.164	0.120	0.106	0.107	0.084
FR	0.272	0.324	0.316	0.268	0.237	0.336	0.287	0.285
HR				0.212				0.225
HU	0.065	0.089	0.118	0.059	0.064	0.114	0.132	0.097
IE	0.192	0.142	0.133	0.227	0.208	0.142	0.101	0.129
IT	0.095	0.107	0.071	0.147	0.107	0.061	0.120	0.124
LT	0.074	0.029	0.081	-0.059	0.151	0.184	0.111	-0.003
LU	0.171	0.237	0.191	0.185	0.172	0.238	0.221	0.190
LV	-0.030	0.036	0.055	0.053	0.068	0.135	0.115	0.112
MT		0.073	0.168	0.058		-0.037	0.107	-0.026
NL	0.185	0.218	0.292	0.291	0.244	0.187	0.185	0.239
PL	0.101	0.076	0.099	0.090	0.103	0.074	0.083	0.107
PT	0.316	0.081	0.167	0.098	0.217		0.112	0.138
RO	0.119	0.074	0.105	0.056	0.048	0.044	0.126	0.136
SE	0.014	0.079	-0.022	0.051	-0.051	0.058	-0.013	-0.062
SI	0.043	0.097	0.051	0.052	0.021	0.100	0.031	0.093
SK	0.015	0.063	-0.047	0.031	-0.005	0.053	0.114	0.041
UK	0.124	0.202	0.187	0.201	0.142	0.174	0.111	0.113

Source: Own calculations based on EU-SILC 2008-2011

**Table A11 Evolution of the social gradient as measured by modified concentration index, 0-2 age group**

	Income quintile				Maternal education			
	2008	2009	2010	2011	2008	2009	2010	2011
AT	0.022	0.027	-0.009	0.146	0.536	0.633	0.631	0.578
BE	0.381	0.334	0.373	0.387	0.619	0.590	0.682	0.603
BG	0.235	0.376	0.297	0.131	0.573	0.722	0.753	0.525
CY	0.154	0.142	0.261	-0.045	0.356	0.447	0.554	0.365
CZ	0.032	0.014	0.048	0.222	0.644	0.575	0.679	0.659
DE	0.017	0.022	0.002	0.075	0.431	0.606	0.486	0.577
DK	0.067	0.128	0.016	0.158	0.417	0.376	0.430	0.532
EE	-0.054	-0.056	-0.103	-0.040	0.318	0.531	0.500	0.383
EL	0.309	0.107	0.227	0.374	0.588	0.504	0.574	0.622
ES	0.192	0.203	0.161	0.156	0.563	0.508	0.542	0.511
FI	0.268	0.204	0.170	0.194	0.545	0.623	0.613	0.565
FR	0.383	0.417	0.408	0.367	0.634	0.713	0.685	0.679
HR				0.410				0.783
HU	0.190	0.235	0.145	0.082	0.570	0.564	0.582	0.519
IE	0.180	0.264	0.250	0.505	0.508	0.625	0.601	0.715
IT	0.101	0.192	0.150	0.193	0.436	0.492	0.511	0.521
LT	0.235	-0.010	-0.026	0.067	0.729	0.824	0.512	0.654
LU	0.094	0.230	0.327	0.238	0.467	0.674	0.641	0.526
LV	-0.094	-0.002	0.095	0.094	0.484	0.549	0.563	0.555
MT		0.119	0.214	0.069		0.378	0.492	0.329
NL	0.313	0.292	0.364	0.424	0.676	0.615	0.594	0.682
PL	0.398	0.405	0.389	0.343	0.688	0.741	0.721	0.812
PT	0.294		0.145	-0.009	0.610		0.417	0.417
RO	0.219	0.219	0.287	0.349	0.441	0.501	0.581	0.768
SE	-0.007	0.164	-0.040	0.046	0.366	0.517	0.429	0.357
SI	0.085	0.183	0.023	0.023	0.497	0.549	0.466	0.509
SK	0.134	0.246	-0.186	0.191	0.642	0.649	0.827	0.628
UK	0.179	0.306	0.285	0.285	0.593	0.567	0.541	0.549

Source: Own calculations based on EU-SILC 2008-2011

**Table A12 Percentage of those in formal childcare by income quintile, age 3-5 years (2011)**

	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>	<b>Q5</b>	<b>ratio Q5/Q1</b>
AT	79	69	85	77	78	0.99
BE	88	98	100	99	98	1.11
BG	14	61	40	69	70	4.95
CH	61	54	58	79	86	1.41
CY	61	56	88	70	86	1.39
CZ	56	57	62	70	85	1.5
DE	78	82	94	87	91	1.16
DK	95	100	97	98	98	1.02
EE	76	90	94	98	93	1.21
EL	40	52	73	79	83	2.03
ES	71	87	81	80	90	1.26
FI	45	57	57	77	81	1.81
FR	83	88	91	97	96	1.15
HR	10	28	39	42	69	6.87
HU	58	63	78	84	86	1.48
IE	48	53	62	52	81	1.68
IS	97	100	97	100	100	1.02
IT	83	86	97	99	99	1.18
LT	37	71	69	61	62	1.65
LU	59	89	76	91	99	1.67
LV	62	67	74	77	80	1.29
MT	45	62	40	42	39	0.86
NL	82	84	88	92	94	1.14
NO	77	80	85	90	96	1.24
PL	16	26	38	30	57	3.48
PT	44	85	75	81	85	1.91
RO	22	37	20	49	58	2.61
SE	76	86	90	90	91	1.19
SI	88	87	89	91	95	1.08
SK	38	56	81	80	66	1.71
UK	89	94	92	90	97	1.09

Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Table A12a Percentage of those in formal childcare (with RL050) by income quintile, age 3-5 years (2011)**

	Q1	Q2	Q3	Q4	Q5	Ratio Q5/Q1
AT	85	85	85	84	90	1.06
BE	94	98	100	99	99	1.06
BG	30	64	52	78	80	2.71
CY	70	78	99	86	91	1.30
CZ	70	61	69	83	91	1.31
DE	85	88	95	94	95	1.12
DK	95	99	98	98	100	1.05
EE	75	93	90	97	96	1.28
EL	48	77	77	83	94	1.99
ES	78	82	86	83	96	1.24
FI	56	63	66	80	91	1.63
FR	90	94	96	98	100	1.11
HR	16	32	44	66	71	4.53
HU	69	81	88	89	90	1.31
IE	68	79	86	85	96	1.40
IT	89	91	100	99	100	1.12
LT	54	62	63	80	78	1.46
LU	80	94	97	94	95	1.19
LV	65	78	79	82	85	1.30
MT	53	61	42	48	42	0.79
NL	90	94	94	97	99	1.10
PL	29	40	46	52	66	2.26
PT	64	92	85	95	98	1.54
RO	30	38	42	51	58	1.94
SE	78	91	95	95	96	1.23
SI	90	90	92	95	96	1.07
SK	57	85	85	87	69	1.20
UK	92	95	95	93	98	1.06
EU	76	83	87	89	92	1.21

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: Definition of formal childcare use also includes childcare by professional child-minder at child's home or at child-minder's home (variable RL050). Income quintiles were defined among the whole population.

**Table A12b Percentage of those in formal childcare by income quintile (among those with children), age 3-5 years (2011)**

	Q1	Q2	Q3	Q4	Q5	Ratio Q5/Q1
AT	73	69	89	70	80	1.10
BE	94	98	100	98	100	1.07
BG	13	53	33	74	66	5.13
CY	61	62	87	92	93	1.52
CZ	55	63	59	69	85	1.56
DE	91	94	93	91	100	1.10
DK	99	100	95	96	97	0.98
EE	52	77	89	100	93	1.81
EL	64	58	66	93	93	1.45
ES	81	88	97	77	97	1.20
FI	34	41	47	40	67	1.98
FR	91	95	95	98	100	1.10
HR	13	31	33	61	79	6.29
HU	70	63	84	87	85	1.21
IE	95	83	86	75	90	0.95
IT	87	88	98	100	100	1.14
LT	41	70	77	36	64	1.57
LU	88	92	69	99	86	0.98
LV	35	70	54	82	79	2.22
MT	29	37	84	45	33	1.15
NL	81	85	97	100	98	1.21
PL	24	37	53	46	64	2.66
PT	86	58	100	96	77	0.89
RO	12	48	37	11	67	5.79
SE	76	81	88	97	88	1.15
SI	94	81	91	93	97	1.04
SK	23	51	89	87	63	2.70
UK	88	98	96	98	95	1.08
EU	76	83	88	88	93	1.22

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: income quintiles were defined among those with children under the age of 6.

**Table A12c Percentage of those in formal childcare (with RL050) by income quintile (among those with children), age 3-5 years (2011)**

	Q1	Q2	Q3	Q4	Q5	Ratio Q5/Q1
AT	73	69	91	70	86	1.18
BE	94	98	100	98	100	1.07
BG	13	53	33	74	89	6.98
CY	61	62	100	100	100	1.64
CZ	55	63	59	69	85	1.56
DE	91	94	93	93	100	1.10
DK	99	100	95	96	97	0.98
EE	52	77	89	100	93	1.81
EL	64	58	66	93	97	1.52
ES	81	88	97	78	97	1.20
FI	34	41	47	40	71	2.10
FR	91	95	96	99	100	1.10
HR	13	31	33	61	79	6.29
HU	70	63	84	87	85	1.21
IE	96	83	86	78	91	0.96
IT	87	88	98	100	100	1.14
LT	41	70	77	36	64	1.57
LU	88	92	96	99	86	0.98
LV	35	70	54	82	79	2.22
MT	29	37	84	45	33	1.15
NL	81	93	98	100	100	1.23
PL	24	37	53	46	70	2.90
PT	86	58	100	96	100	1.17
RO	12	48	37	11	67	5.79
SE	76	87	95	100	92	1.21
SI	94	81	91	93	97	1.04
SK	23	51	89	87	63	2.70
UK	88	98	96	98	95	1.08
EU	76	83	88	88	94	1.24

Source: Own calculations based on EU-SILC 2011, UDB August 2013

Note: Definition of formal childcare use also includes childcare by professional child-minder at child's home or at child-minder's home (variable RL050). Income quintiles were defined among those with children under the age of 6.

**Table A13 Percentage of those in formal childcare by parental education, age 3-5 years (2011)**

	Lower than upper secondary	Upper secondary	Tertiary	High/low
AT	81	78	70	0.86
BE	90	99	98	1.09
BG	24	59	83	3.44
CH	50	67	87	1.73
CY	62	71	80	1.29
CZ	20	70	72	3.52
DE	88	85	91	1.03
DK	94	97	100	1.06
EE	81	92	95	1.17
EL	48	67	83	1.73
ES	76	83	94	1.23
FI	61	57	79	1.28
FR	84	91	97	1.14
HR	13	42	92	6.94
HU	66	77	83	1.26
IE	45	61	70	1.53
IS	97	100	100	1.02
IT	88	98	100	1.13
LT	45	57	71	1.57
LU	72	83	99	1.35
LV	60	72	87	1.44
MT	49	41	38	0.77
NL	87	86	95	1.09
NO	75	87	92	1.22
PL	12	28	62	4.93
PT	70	79	87	1.24
RO	27	41	52	1.88
SE	85	84	92	1.08
SI	82	92	92	1.12
SK	22	70	71	3.16
UK	90	91	97	1.08

Source: Own calculations based on EU-SILC 2011, UDB August 2013



**Table A14 Social gradient measures by household income, 3-5 age group 2011**

	Rank correlation (Kendall's tau-b)		Modified CI
	Income quintile	Income position	Household income
AT	0.043	0.066	0.057
BE	0.078	0.070	0.558
BG	0.289	0.296	0.371
CY	0.169	0.117	0.254
CZ	0.190	0.200	0.281
DE	0.115	0.129	0.223
DK	0.039	0.079	0.219
EE	0.223	0.212	0.422
EL	0.190	0.181	0.414
ES	0.111	0.118	0.204
FI	0.269	0.256	0.342
FR	0.184	0.175	0.387
HR	0.348	0.349	0.486
HU	0.247	0.244	0.329
IE	0.146	0.173	0.241
IT	0.184	0.182	0.589
LT	0.117	0.108	0.163
LU	0.214	0.198	0.478
LV	0.128	0.123	0.176
MT	-0.045	-0.048	-0.104
NL	0.133	0.138	0.286
PL	0.206	0.214	0.323
PT	0.230	0.247	0.340
RO	0.189	0.212	0.330
SE	0.114	0.145	0.267
SI	0.079	0.067	0.180
SK	0.177	0.207	0.280
UK	0.097	0.123	0.201

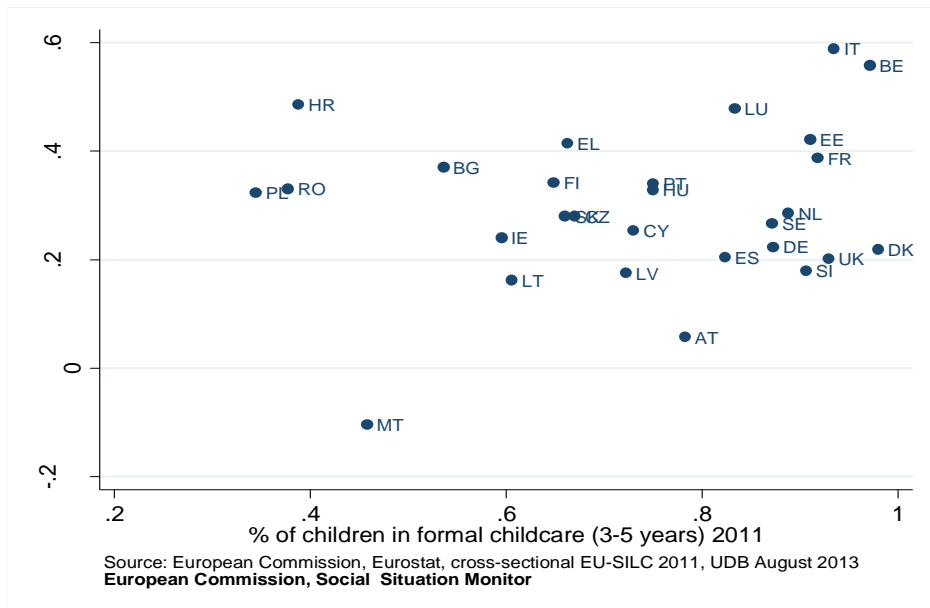
Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Table A15 Social gradient measures by parental education, 3-5 years 201**

	Rank correlation (Kendall's tau-b)			Modified Concentration Index		
	Maternal education	Higher level of parental education	Lower level of parental education	Maternal education	Higher level of parental education	Lower level of parental education
AT	-0.043	-0.054	-0.062	0.358	0.401	0.376
BE	0.075	0.044	0.056	0.799	0.767	0.752
BG	0.387	0.365	0.390	0.774	0.795	0.807
CY	0.117	0.111	0.187	0.604	0.693	0.528
CZ	0.147	0.154	0.147	0.717	0.694	0.791
DE	0.048	0.053	0.021	0.516	0.491	0.569
DK	0.037	0.096	0.064	0.596	0.670	0.850
EE	0.123	0.162	0.107	0.648	0.626	0.640
EL	0.064	0.146	0.086	0.536	0.577	0.660
ES	0.177	0.153	0.166	0.620	0.587	0.644
FI	0.147	0.157	0.109	0.590	0.577	0.588
FR	0.132	0.159	0.161	0.609	0.621	0.652
HR	0.317	0.311	0.324	0.899	0.881	0.896
HU	0.204	0.168	0.182	0.618	0.602	0.583
IE	0.143	0.150	0.066	0.560	0.555	0.528
IT	0.172	0.151	0.181	0.883	0.878	0.905
LT	0.163	0.100	0.143	0.601	0.537	0.588
LU	0.193	0.192	0.173	0.749	0.620	0.766
LV	0.165	0.192	0.174	0.557	0.554	0.607
MT	0.035	-0.042	0.046	0.396	0.360	0.404
NL	0.133	0.146	0.072	0.481	0.437	0.534
PL	0.297	0.270	0.296	0.756	0.761	0.779
PT	0.139	0.158	0.160	0.570	0.572	0.663
RO	0.179	0.163	0.193	0.598	0.691	0.571
SE	0.136	0.111	0.163	0.614	0.656	0.605
SI	0.107	0.106	0.104	0.588	0.624	0.575
SK	0.210	0.199	0.170	0.700	0.667	0.718
UK	0.106	0.090	0.098	0.646	0.638	0.682

Source: Own calculations based on EU-SILC 2011, UDB August 2013

**Figure A1 Use and access to early formal childcare by household income, 3-5 age group, 2011**



**Figure A2 Use and access to early formal childcare by parental education, 3-5 years age group 2011**

