SENSITIVITY OF TURKISH INCOME DISTRIBUTIONS TO CHOICE OF EQUIVALENCE SCALE

SINEM SEFIL

ISTANBUL COMMERCE UNIVERSITY

Key words: Income distributions, Equivalence scales, Inequality, Turkey
JEL codes: D31, D63, D30

Abstract

Income surveys are typically designed to collect income data on the household level. In order to obtain reliable outcomes from income distribution and inequality analysis, it is of crucial importance to consider households' composition and varying needs. Relying on data from Turkey's 2009-2011 Income and Living Conditions Survey (SILC), this paper examines the GE class inequality indices and Gini coefficient in terms of their sensitivity to choice of equivalence scales. It uses both one-parameter and two-parameter parametric equivalence scales to capture the effects of household size and decomposition. Following Coulter et al. (1992a), this study tests the sensitivity of the inequality indices by calculating a wide range of scale relativities and decomposing the distribution into sub-groups of household sizes.

INTRODUCTION

Examining income disparity requires comparisons of individual income levels. Since income surveys are typically designed for collecting income data on the household level, total household income must be converted into individual income by adjusting for households' different sizes and compositions. Researchers often use equivalence scales to obtain these individual income levels from household level data, transferring the nominal incomes of heterogeneous households to equivalent incomes that can be compared across individuals.

Although there is a wide range of applicable equivalence scales, no consensus exists regarding which equivalence scale is most appropriate (Cowell and Mercader-Prats, 1997). This incongruence has raised awareness about testing the robustness of inequality measures in the choice of scale relativities. Despite the importance of the issue, all equivalent income series launched by the Turkish Statistical Institute have been defined only with a modified OECD scale, and the literature has made little effort to address the impact of using alternative scales on Turkish inequality measures. The question considered in this paper is as follows: In Turkey's case, are the measures of inequality sensitive to the choice of equivalence scale relativities?

Within this context, this study examines whether or not income inequality measures are robust to the scale's relativity on households' size and composition. In this regard, as suggested by Coulter et al. (1992a), measures are calculated using a wide range of parametric equivalence scale relativities and decomposition by each household type, allowing comparisons within group inequality terms.

Section I briefly reviews the equivalence scales used in the study, while section II summarizes the relationship between inequality measures and scale relativity. Section III provides an empirical illustration for Turkey, and section IV presents brief conclusions.

I. A BRIEF REVIEW OF EQUIVALENCE SCALES

As indicated above, inference of individual income levels from household data requires adjusting households' income requirements based on different sizes and age compositions using equivalence scales**.** Buhmann et al. (1988) identify two classes of scales developed using experts' judgment. First are scales constructed only for statistical objectives, such as for counting individuals above or below a given standard of living. Such scales concentrate on identifying benefits for social programs. The second class of scales was developed empirically from analysis of survey data; these scales measure utility indirectly through consumer-revealed preference by using consumption surveys and subjective scales that aim to directly measure the utility associated with particular income levels or households characteristics. Even though each type of scale is reasonable with its own distinct theoretical foundation, each can be defined in a parametric form (Hunter et al, 2001). A parametric equivalence scale typically functions with explicit parameters that vary depending on household characteristics, such as size and age structure. Thus, they enable us to compare the welfare levels of households with different compositions. For instance, by converting all members of the households into equivalent adults, equivalence scales allow us to learn how much income a household requires with two adults and three children in order to reach the same welfare level as a household with two adults and one child. This information can be shown as follows:

$$Y_E = \frac{Y_U}{E_i} \qquad (1)$$

where Y_E is equivalent income, Y_U is the sum of individual income in the household (i.e. unadjusted household income) and E_i is equivalence scale.
Buhmann et al. (1988) introduced a widely-used functional form with one parameter:

$$E_i = N^{\theta}, \qquad 0 \leq \theta \leq 1 \qquad (2)$$

where N is the number of individuals in the household and θ is the parameter of equivalence elasticity representing the economies of scale in the household. If Θ=1, Y_E

equals per capita income. The underlying assumption here is that doubling the number of household members requires doubling the household income in order to maintain the same level of well-being (no economies of scale). However, the existence of public goods that can be shared by household members, such as housing, makes it possible for large households to attain the same standard of living as smaller households with a relatively higher level of per capita expenditures. θ=0 corresponds to perfect economics of scale where all commodities are public, and no adjustment of size is needed for the household income.

Even though equation (2) is an appropriate instrument for describing a range of equivalence scales with varied economies of scales, it depends only on the household size and does not offer any information about household composition. An extended version of equation (2) that distinguishes between adults and children is the following:

$$E_i = (A + \alpha C)^{\theta}\ , \quad 0 \leq \theta \ \leq \ 1,\ \ 0 < \alpha \leq 1 \qquad (3)$$

where A is the number of adults in the household, C is number of children in the household, α is a weighting parameter for number of children relative to adults, and Θ is the parameter of economies of scale. (A+αC) is simply the weighted household size, which Jenkins and Cowell (1994) called the "effective household size." This modified version of equation (2) has been extended by Cutler and Katz (1992) and used in several studies.

II. INEQUALITY MEASURES AND SCALE RELATIVITY

This study employs the generalized entropy family of inequality indices and Gini coefficient in order to examine the measured inequality in the equivalence scale choice.

Following Coulter et al. (1992a),the generalized entropy family of inequality indices is shown as follows:

$$I_\alpha(Y_1, Y_2, \dots . Y_n) = \begin{cases} \dfrac{1}{n\alpha(\alpha-1)}\sum_{i=1}^{n}[(Y_i/\bar{Y})^\alpha - 1], & \alpha \neq 0{,}1 \\ (1/n)\sum_{i=1}^{n}(Y_i/\bar{Y}) * log(Y_i/\bar{Y}), & \alpha = 1 \\ (1/n)\sum_{i=1}^{n} log(\bar{Y}/Y_i), & \alpha = 0. \end{cases} \quad (4)$$

where α is the parameter representing "income share-distance." It can be positive or negative. A more positive (negative) α indicates a GE measure more sensitive to income differences at the top (bottom) of the distribution. Researchers commonly use several GE measure indices: $I_{0,}$ which is "the mean logarithmic deviation"; $I_{1,}$ the "Theil Index"; and $I_{2,}$ "half the squared coefficient of variation." Shorrocks (1984) expressed the GE family of inequality in a decomposable form with the assumption of J subgroups:

$$I_a = \sum_{j=1}^{J}(v_j)^\alpha (w_j)^{1-\alpha} I_{\alpha j} + I_{\alpha B} \quad (5)$$

where v_j is the total equivalent income share of subgroup j, andw_j is the population share of j.

Total inequality is equal to the sum of the between-group inequality ($I_{\alpha B}$) and a weighted sum of within-group inequality ($I_{\alpha j}$). Within group inequality component does not depend on the equivalence scale in use because the equivalence scale is independent of income, and all of the GE family of inequality indices are scale-independent.

As Coulter et al. (1992b) introduced, the impact of changes in equivalence scale relativity on measured inequality can be decomposed into two opposing effects.

Assuming that there is a positive correlation between household size and unadjusted household income, increasing the scale relativity (θ) will cause a larger fall in the equivalent incomes of households with above-average size relative to equivalent incomes of the households with below-average size. This effect, leading to a decrease in inequality is known as a "concentration effect." A change in scale relativity may also change rankings in equivalent income distribution, which may increase the measured inequality. This opposing effect is known as a "re-ranking effect."

Coulter et al. (1992b, p.1073) showed that the overall change in inequality, driven by the interaction of concentration and re-ranking effects, results from the change in the covariance between log household size and equivalent income. Increasing the scale relativity has an equalizing effect as it reduces the equalized income of larger families and brings it closer to the income of smaller families in the distribution. However, at some point, the increase in the scale relativity parameter makes larger households' incomes decrease to the point that larger households are no wealthier than the smaller ones. In other words, the covariance between equivalent income and household size, which was positive at θ=0, drops to zero. After this particular point, an increase in θ results in an increase in inequality. This inference implies a U-shaped relationship between measured inequality and scale relativity.

Coulter et al. (1992b) explained this phenomenon for I_E (generalized entropy measures) and equation (2) as follows:

$$\frac{\partial I_\alpha}{\partial \theta} = -\frac{cov(Y, \log(N))}{\mu(Y)} \tag{5}$$

$$\frac{cov(Y, \log(N))}{\mu(Y)} \approx \frac{cov(X, \log(N))}{\mu(X)} - \theta var(\log(N)) \tag{6}$$

where X is unequalized household income. Because we expect the unequalized household income to be positively correlated with the household size, normalized covariance between equivalent income and household size will be positive for θ values near zero and negative for θ values near one. Coulter et al. (1992b) also identified that the skewness degree of the U-curve changes depending on the I_E indices. Meanwhile, top-income sensitive indices have a J-shaped relationship with θ, and low-income sensitive indices reflect an inverted J-curve relationship with θ.

As Coulter et al. (1992b) stated in their study using data from the UK, it is not possible to show the Gini coefficient's reaction to scale relativity as done for I_E above: the aggregate income is computed by using the weights calculated on the rank ordering of each income instead of the income alone. Nevertheless, they indicated the existence of a U-shaped relationship between the Gini coefficient and θ, whereas changes in the rankings derived from the scale relativity are relatively small.

Banks and Johnson (1994) discussed Coulter et al.'s (1992b) results within the context of comparing one- and two-parameter forms of equivalence scales. For their part, Jenkins and Cowell (1994) showed that using the two-parameter scale does not change the U-, J- and reverse J-shaped relationships; however, decreasing the weight attached to the children makes them less pronounced. Figini (1998) updated the results of Coulter et al. (1992b) for Italy, the UK, Ireland and the US, showing that the U-shape remains for all the countries and indices, namely the Gini coefficient, coefficient of variations, Theil index (GE(1)), and Atkinson index (0.5). He also used a class of two parameter scales involving relative weights for adults and children, showing that inequality tends to increase with children's weight and decrease with adults' weight.

Cowell and Mercader-Prats (1997) compared the UK and Spanish estimates of GE inequality indices for one- and two-parameter scales. For both forms, they showed that, whereas inequality and scale parameters have a U-shaped relationship for Spain, the measured inequality of the UK rises almost monotonically with increases in the scale parameter. Creedy and Sleeman (2004) used two parameter scales for New Zealand data and found that the relationship between the measure of inequality (Atkinson) and scale relativity parameter for a given weight attached to children has a U shape**.** Okamoto (2012) used a one-parameter scale form with data from the Luxemburg Income Study for 34 countries. He calculated the Gini index, mean logarithmic deviation, and Theil indices, showing a U-shaped relationship between size elasticity and index value in high-income countries, and a non-U-shaped, nearly J-shaped curve with minimum points close to zero in low-income countries.

III. EMPIRICAL ANALYSIS FOR TURKEY

In this chapter, an analysis is conducted of Turkish SILC (Survey of Income and Living Conditions) data from 2009 to 2011, applying the general parametric form of the equivalence scales (2) and (3) with the generalized entropy (GE) family indices and Gini coefficient indices.

The sample unit is the household, and the sample size is 11870, 12106 and 15025 for 2009, 2010 and 2011, respectively. The unadjusted income distribution is disposable income. Since 2006, the Turkish Statistical Institute (TurkStat) has collected these data using a survey constructed with the panel survey method to provide comparable data on income distribution, living conditions, social exclusion and poverty as part of research regarding adaptation to the European Union (EU). The SILC aims to produce cross-sectional and panel data for Turkey at the national, rural, and urban levels.

Theta values are calculated over the range of [0-1] at intervals of 0.01 with the following weights attached to children: α=0.25, 0.50, 0.75, and 1. Notice that for α=1, equation (2) is equivalent to equation (3).

Table 1 shows the estimates of the GE inequality indices and Gini coefficient for different values of θ in equation (2). GE(1) in 2010 and GE(2) in the 2010 and 2011 indices seem to increase almost monotonically with the increase in θ. All the other GE indices and Gini coefficients show a small decrease initially with the increase in θ; then, they increase gradually from a θ value close to zero.

Table 1. GE Index and Gini Coefficient. Buhmann et al Equivalence Scale

θ	**0**	**0,1**	**0,2**	**0,4**	**0,6**	**0,8**	**1,0**
				2009			
GE(-1)	0.35282	0.3478	0.34752	0.3611	0.39425	0.44901	0.52434
GE(0)	0.26718	0.26473	0.26456	0.27121	0.28754	0.31398	0.34886
GE(1)	0.29409	0.2927	0.29316	0.29995	0.31522	0.33979	0.3725
GE(2)	0.50152	0.49944	0.49997	0.50987	0.53388	0.57578	0.6367
Gini	0.39431	0.39292	0.39295	0.39752	0.40823	0.42484	0.44548
				2010			
GE(-1)	0.30396	0.29824	0.29695	0.30752	0.33618	0.38469	0.45206
GE(0)	0.24542	0.24341	0.24366	0.25114	0.26823	0.29539	0.33092
GE(1)	0.26973	0.26989	0.27194	0.28206	0.30086	0.32921	0.36581
GE(2)	0.44228	0.45016	0.46152	0.4966	0.55265	0.63695	0.75185
Gini	0.37997	0.37878	0.37906	0.38432	0.3959	0.41351	0.43521
				2011			
GE(-1)	0.31825	0.31161	0.30956	0.31903	0.3471	0.39552	0.4633
GE(0)	0.25061	0.24822	0.24808	0.25481	0.27121	0.29773	0.33271
GE(1)	0.27347	0.27264	0.27369	0.28174	0.29836	0.3244	0.35867
GE(2)	0.4365	0.43786	0.44211	0.46024	0.49384	0.5474	0.62227
Gini	0.38356	0.38213	0.38217	0.38693	0.39804	0.41526	0.43667

On the basis of this information, it is understood that the re-ranking effect prevails over almost the entire range of θ values. This pattern can also been seen in the normalized covariance between equivalent income and log household size, as shown in Table 2.

Table 2. Covariance between log household size and equivalent income

cov (y, log(n))/μ(y)											
θ / Year	**0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**
2009	0.030	0.007	-0.017	-0.041	-0.066	-0.092	-0.117	-0.144	-0.170	-0.197	-0.225
2010	0.031	0.007	-0.015	-0.044	-0.064	-0.089	-0.114	-0.140	-0.166	-0.192	-0.219
2011	0.034	0.100	-0.013	-0.037	-0.062	-0.087	-0.112	-0.138	-0.165	-0.192	-0.219

As explained in the previous chapter, the covariance between log household size and equivalent income determines the relationship between measured inequality and parameter scale. It is positive initially, but negative from a low value of θ, confirming the dominance of the re-ranking effect, which is reflected as a J-shaped curve in the graph of the relationship between measured inequality and scale relativity (Figure 1a and Figure 1b). The curves of GE (2) in 2010 and 2011 and GE (1) in 2010 are more flattened curves with no minimum points apart from the first value. In particular, the GE(2) in 2010 flattens rapidly at the higher levels of θ. The other curves have almost a J-shape with minimum points close to zero. Thus, the shapes of the curves remain almost unchanged every year. For all the cases, increasing relativity has a disequalizing impact stemming from the re-ranking effect.

In examining change in inequality over time, it becomes clear that there is a decrease in inequality from 2009 to 2010. The decrease is more than 14% at the top- and bottom-sensitive GE indices: GE(-1) and GE(2). GE(0), GE(1), and the Gini coefficient drop relatively low. Then, from 2010 to 2011, there is a small increase in inequality.

When the scale relativity parameter varies from 0 to 1, the range of change in the bottom-sensitive GE measure (GE(-1)) is more than 45 percent each year. The top-sensitive range is also very high in 2010 at 70 percent and in 2011 at 43 percent. The range of the Gini coefficient is relatively low each year. In addition, the magnitude of the change in inequality relative to scale relativity over years appears to react opposite to changes in inequality over time.

Figure 1a. Sensitivity of GE Family Inequality Indices to the Changes in θ

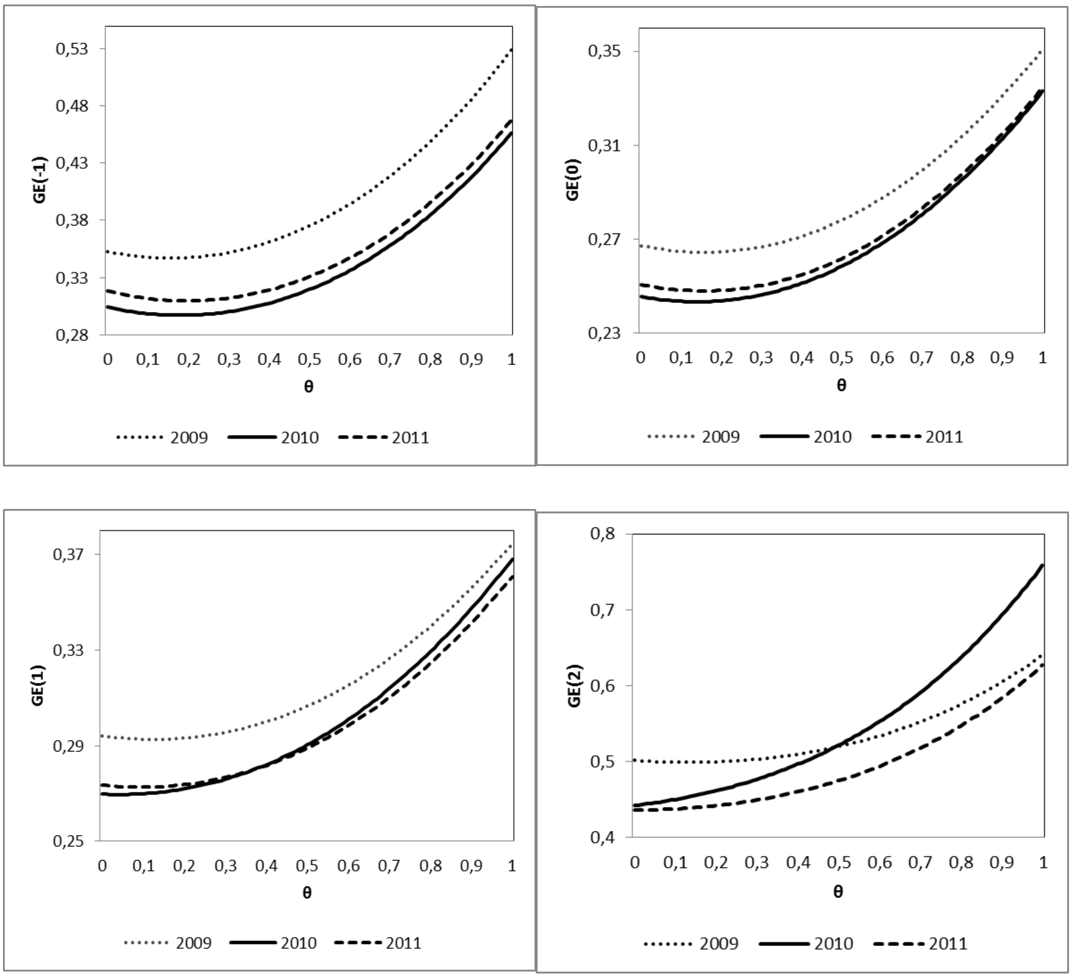
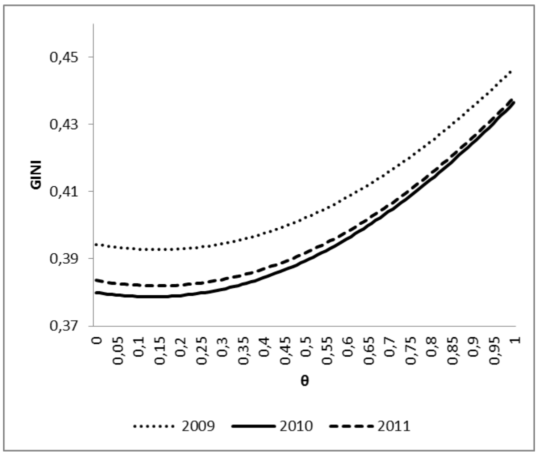


Figure 1a. Sensitivity of Gini Coefficient to the Changes in θ



Using two parameter equivalence scales (equation 3), Tables 3, 4, and 5 show that when α is reduced from 1 to pre-determined values (0.75, 0.50, 0.25), measured inequality decreases monotonically for each θ value. As explained by Banks and Johnson (1994), diminishing the weight given to children results in lower measured inequality, if the covariance between disposable income and number of children in a specific household size group is negative. Table 6 shows that this is the case for each household size group

Table 3.GE Index and Gini Coefficient. Buhmann et al Equivalence Scale

Year 2009

α	**ϴ**	**0**	**0,1**	**0,2**	**0,4**	**0,6**	**0,8**	**1**
0,25	GE(-1)	0.35282	0.34390	0.33837	0.33719	0.34917	0.37484	0.41546
	GE(0)	0.26718	0.26260	0.25976	0.25935	0.26610	0.28017	0.30176
	GE(1)	0.29409	0.29058	0.28857	0.28918	0.29620	0.30999	0.33100
	GE(2)	0.50152	0.49484	0.49047	0.48896	0.49801	0.51941	0.55579
	Gini	0.39431	0.39134	0.38951	0.38943	0.39427	0.40398	0.41821
0,5	GE(-1)	0.35282	0.34544	0.34177	0.34535	0.36361	0.39744	0.44864
	GE(0)	0.26718	0.26342	0.26152	0.26338	0.27302	0.29073	0.31684
	GE(1)	0.29409	0.29139	0.29025	0.29286	0.30239	0.31948	0.34480
	GE(2)	0.50152	0.49658	0.49393	0.49607	0.50968	0.53743	0.58303
	Gini	0.39431	0.39195	0.39079	0.39223	0.39890	0.41075	0.42741
0,75	GE(-1)	0.35282	0.34671	0.34478	0.35333	0.37880	0.42258	0.48725
	GE(0)	0.26718	0.26412	0.26310	0.26734	0.28025	0.30220	0.33360
	GE(1)	0.29409	0.29209	0.29177	0.29645	0.30881	0.32958	0.35958
	GE(2)	0.50152	0.49809	0.49707	0.50307	0.52178	0.55654	0.61184
	Gini	0.39431	0.39247	0.39192	0.39493	0.40360	0.41782	0.43711

Table 4.GE Index and Gini Coefficient. Buhmann et al Equivalence Scale

Year 2010

Ѳα	**Ѳ**	**0**	**0,1**	**0,2**	**0,4**	**0,6**	**0,8**	**1**
0,25	GE(-1)	0.30396	0.29548	0.29016	0.28875	0.29960	0.32323	0.36081
	GE(0)	0.24542	0.24148	0.23925	0.23994	0.24762	0.26245	0.28463
	GE(1)	0.26973	0.26796	0.26770	0.27179	0.28229	0.29956	0.32410
	GE(2)	0.44228	0.44586	0.45218	0.47393	0.51008	0.56448	0.64239
	Gini	0.37997	0.37728	0.37574	0.37632	0.38192	0.39242	0.40747
0,5	GE(-1)	0.30396	0.29655	0.29262	0.29493	0.31091	0.34136	0.38792
	GE(0)	0.24542	0.24223	0.24086	0.24370	0.25419	0.27261	0.29930
	GE(1)	0.26973	0.26870	0.26925	0.27526	0.28827	0.30890	0.33789
	GE(2)	0.44228	0.44750	0.45560	0.48175	0.52432	0.58855	0.68149
	Gini	0.37997	0.37786	0.37696	0.37905	0.38648	0.39916	0.41671
0,75	GE(-1)	0.30396	0.29745	0.29486	0.30123	0.32330	0.36228	0.42048
	GE(0)	0.24542	0.24286	0.24232	0.24745	0.26115	0.28380	0.31582
	GE(1)	0.26973	0.26934	0.27065	0.27869	0.29453	0.31896	0.35283
	GE(2)	0.44228	0.44891	0.45868	0.48931	0.53859	0.61292	0.72074
	Gini	0.37997	0.37835	0.37806	0.38173	0.39121	0.40633	0.42660

Table 5.GE Index and Gini Coefficient. Buhmann et al Equivalence Scale

Year 2011

α	**Ѳ**	**0**	**0,1**	**0,2**	**0,4**	**0,6**	**0,8**	**1**
0,25	GE(-1)	0.31825	0.30880	0.30265	0.29992	0.30987	0.33298	0.37042
	GE(0)	0.25061	0.24640	0.24388	0.24404	0.25121	0.26559	0.28736
	GE(1)	0.27347	0.27098	0.26999	0.27258	0.28147	0.29701	0.31966
	GE(2)	0.43650	0.43523	0.43636	0.44604	0.46659	0.50006	0.54953
	Gini	0.38356	0.38075	0.37909	0.37938	0.38467	0.39490	0.40972
0,5	GE(-1)	0.31825	0.30989	0.30515	0.30622	0.32140	0.35146	0.39805
	GE(0)	0.25061	0.24710	0.24541	0.24763	0.25753	0.27542	0.30164
	GE(1)	0.27347	0.27162	0.27132	0.27559	0.28674	0.30540	0.33225
	GE(2)	0.43650	0.43621	0.43836	0.45051	0.47479	0.51426	0.57330
	Gini	0.38356	0.38128	0.38021	0.38193	0.38899	0.40135	0.41863
0,75	GE(-1)	0.31825	0.31081	0.30743	0.31263	0.33401	0.37274	0.43117
	GE(0)	0.25061	0.24769	0.24680	0.25124	0.26429	0.28635	0.31784
	GE(1)	0.27347	0.27216	0.27254	0.27866	0.29247	0.31473	0.34628
	GE(2)	0.43650	0.43708	0.44027	0.45530	0.48406	0.53043	0.59974
	Gini	0.38356	0.38174	0.38123	0.38446	0.39351	0.40828	0.42826

Table 6. Correlation Coefficients of Income and Number of Children (by household size)

Household type	2009	2010	2011
All households	-0.0917	-0.0836	-0.0759
Households with 2 people	-0.0494	-0.0553	-0.0727
Households with 3 people	-0.1112	-0.0993	-0.0839
Households with 4 people	-0.1585	-0.1324	-0.1117
Households with 5 people	-0.1884	-0.2248	-0.2278
Households with 6 people	-0.2862	-0.3128	-0.2192
Households with 7+ people	-0.2413	-0.2951	-0.2307

In order to assess the relationship between measured inequality and θ in the two-parameter equivalence scale form, the covariance between effective household size and equivalent income can be evaluated similar to the one-parameter form because the weights attached to the children for reweighting the families are fixed values rather than random ones. When covariance values between effective household size and equivalent income (Table 7) is examined, it is seen that they fall below zero mostly at higher values of θ relative to one parameter form of the equivalence scale, where α =1 (except α=0.75 in 2009 and 2010). Therefore, the dominance of the re-ranking effect weakens with the decrease of α from 1.

Table 7.Covariance between effective household size and equivalent income

cov (y, log(A+αC))/μ(y)											
	Θ	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**
					2010						
α= 0.25	0,0005	0,0003	0,0002	-0,00001	-0,0002	-0,0004	-0,0006	-0,0008	-0,0010	-0,0012	-0,0014
α= 0.50	0,0004	0,0002	0,00005	-0,0001	-0,0003	-0,0005	-0,0007	-0,0010	-0,0012	-0,0014	-0,0016
α= 0.75	0,0004	0,0002	-0,0001	-0,0003	-0,0005	-0,0007	-0,0010	-0,0012	-0,0014	-0,0017	-0,0019
					2010						
α= 0.25	0,0005	0,0003	0,0001	-0,00004	-0,0002	-0,0004	-0,0006	-0,0007	-0,0009	-0,0011	-0,0013
α= 0.50	0,0004	0,0002	0,0000	-0,0002	-0,0003	-0,0005	-0,0007	-0,0009	-0,0012	-0,0014	-0,0016
α= 0.75	0,0004	0,0001	-0,0001	-0,0003	-0,0005	-0,0007	-0,0009	-0,0012	-0,0014	-0,0016	-0,0019
					2011						
α= 0.25	0,0005	0,0003	0,0002	-0,00002	-0,0002	-0,0004	-0,0006	-0,0007	-0,0009	-0,0011	-0,0013
α= 0.50	0,0004	0,0002	0,0001	-0,0001	-0,0003	-0,0005	-0,0007	-0,0009	-0,0011	-0,0013	-0,0016
α= 0.75	0,0004	0,0002	0,0000	-0,0003	-0,0005	-0,0007	-0,0009	-0,0012	-0,0014	-0,0016	-0,0019

Figures 2a/b, 3a/b, and 4a/b show the curves, with each α value denoting the relationship between measured inequality and θ for all years. The weakening re-ranking effect is clear based on the U-shaped curves flattening rapidly at the higher levels of θ. Only GE(2) indices in 2010 and 2011 have a J-shaped curve, implied by Tables 4 and 5.

Figure 2a. Sensitivity of GE Family Inequality Indices to the changes in θ
Year 2009

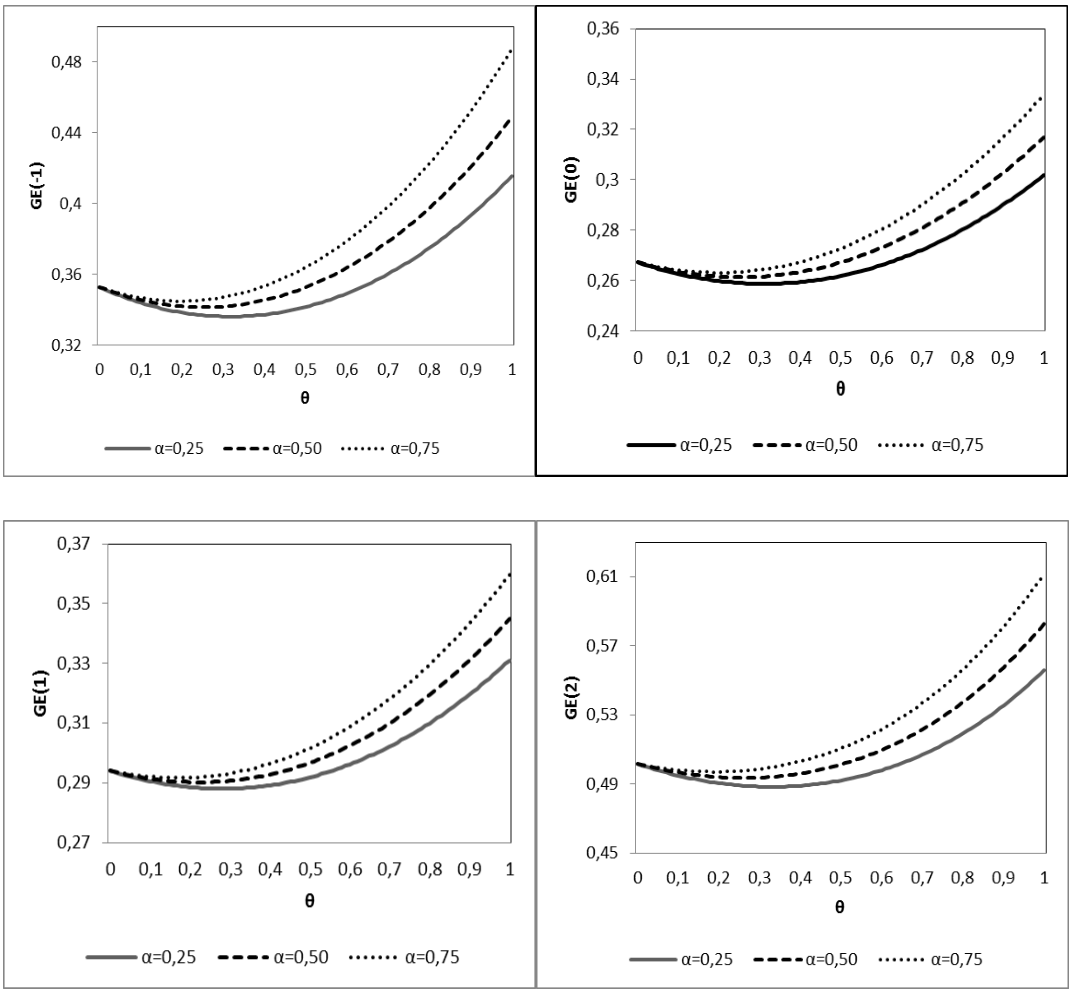


Figure 2b. Sensitivity of GINI Coefficient to the changes in θ

Year 2009

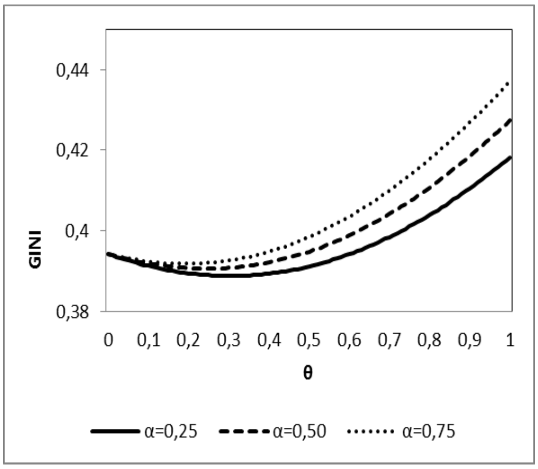


Figure 3a. Sensitivity of GE Family Inequality Indices to the changes in θ
Year 2010

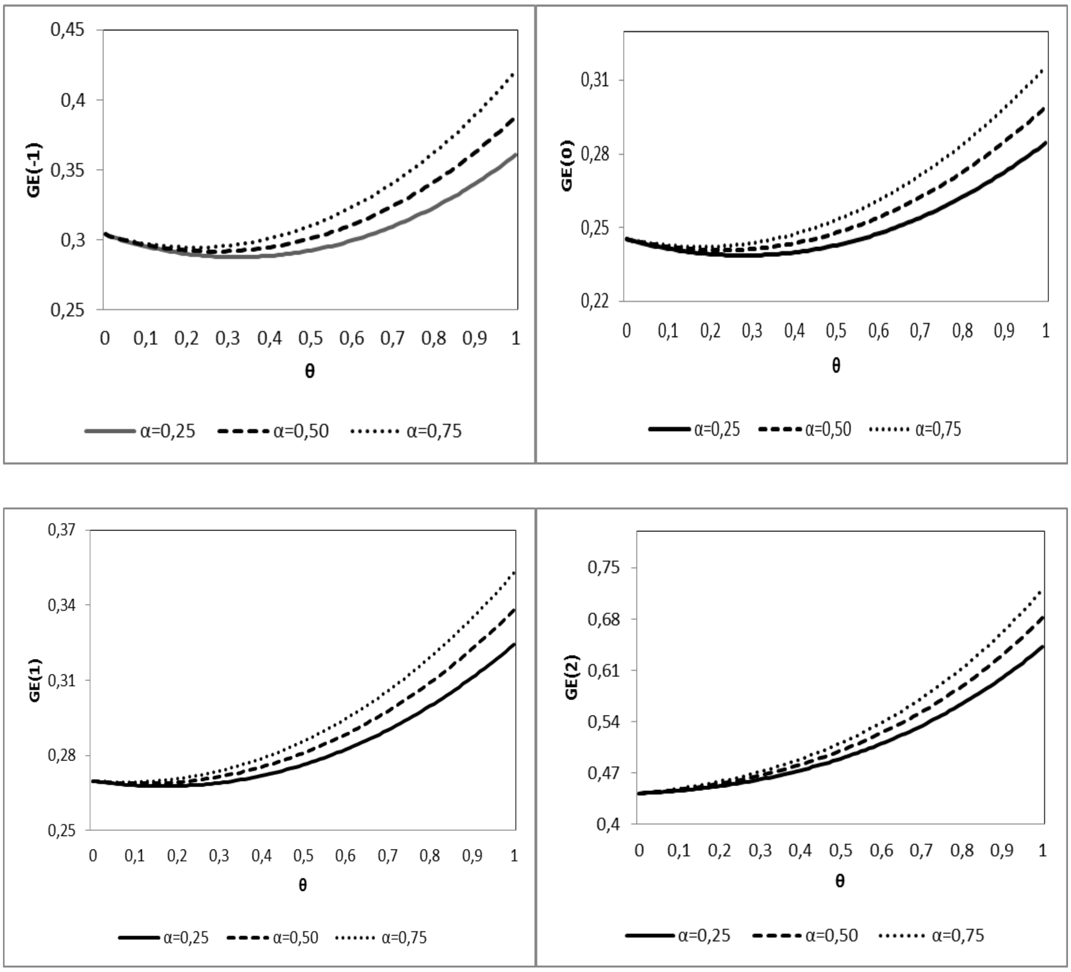


Figure 3b. Sensitivity of GINI Coefficient to the changes in θ

Year 2010

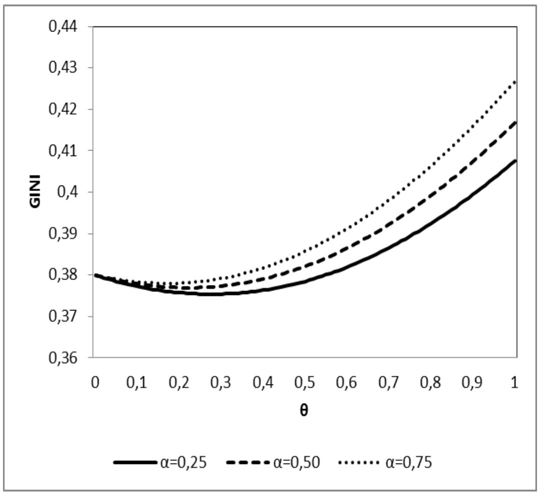


Figure 4a. Sensitivity of GE Family Inequality Indices to the changes in θ
Year 2011

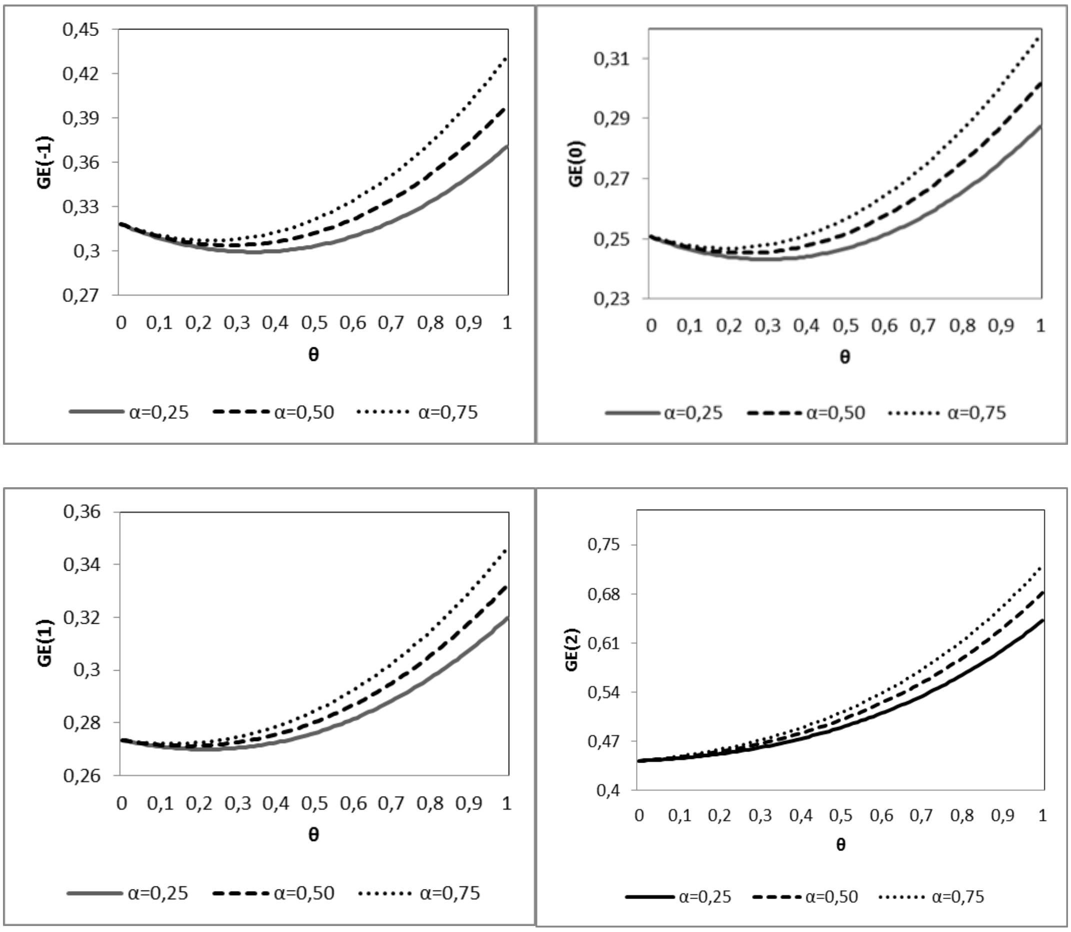
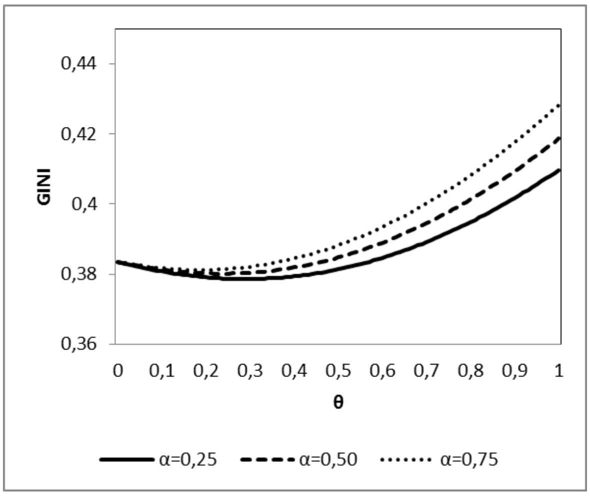


Figure 4b. Sensitivity of GINI Coefficient to the changes in θ
Year 2011



Weighting the family with a parameter attached to children changes the relationship between measured inequality and scale parameter in a way that increases the θ value where covariance between household size (in this case, effective household size) and inequality drops to zero. In other words, it increases the magnitude of the concentration effect, which brings together the equalized incomes of larger families and the equalized income of smaller families by reducing the income of larger families. To balance between the concentration effect and re-ranking effect, including the weights attached to the children in the analysis denotes that household composition is important along with household size.

Lastly, within group inequality indices of each household type are examined in order obtain robust conclusions independent of the equivalence scale choice. As Coulter et al. (1992a) explained in detail, equation (5) implies that contamination arising from using the wrong equivalence scale only affects the between-group inequality component. Comparison of within-group inequality components allows us to make healthy evaluations regarding the sub-comparisons of household types. Table 8 shows the within-group generalized entropy inequality indices for different household size groups.

Table 8. Within-group Generalized Entropy Inequality Indices ($I_{\alpha j}$)

Household Size	1	2	3	4	5	6	7+
				2009			
GE(-1)	0.35128	0.31131	0.35374	0.31714	0.31079	0.31911	0.40758
GE(0)	0.27946	0.25358	0.27735	0.25287	0.22719	0.25666	0.23324
GE(2)	0.45091	0.45838	0.48774	0.56308	0.40999	0.47800	0.26611
				2010			
GE(-1)	0.28111	0.26607	0.27420	0.33885	0.38936	0.31653	0.23751
GE(0)	0.23140	0.21840	0.21681	0.25808	0.32613	0.25875	0.19982
GE(2)	0.36676	0.31519	0.33417	0.40427	0.87503	0.50096	0.27664
				2011			
GE(-1)	0.28346	0.29110	0.35957	0.30424	0.35362	0.30843	0.26355
GE(0)	0.23409	0.23098	0.28086	0.24211	0.25872	0.24843	0.22157
GE(2)	0.39269	0.37430	0.57010	0.36973	0.39492	0.41754	0.39138

According to the GE(-1) (bottom-sensitive GE index) and GE(0) (mean logarithmic deviation), inequality decreases significantly from 2009 to 2010 before showing a small increase in 2011 for households with 1, 2, and +7 person. Inequality among 3-person households decreases from 2009 to 2010 before increasing to a higher level than 2009 figures. In 4- and 5-person households, inequality increases from 2009 to 2010, then decreases in 2011.Inequality among 6-person families decreases constantly from 2009 to 2011 according to the GE(-1), but the GE(0) index shows a small increase in 2010 before decreasing slightly in 2011. Inequality among the top- income class (GE(2)) follows the same pattern with the GE(-1) and GE(0) indices over the years for 1-, 2-, and 5-person families. The magnitude of the increase and decrease of the GE(2) index among 5-person families is quite large. GE(2) drops constantly for 4-person families and increases from 2009 to 2010, and then decreases in 2011 for 6-person families. According to the GE(2) index, inequality among households with more than 7 people increases over the years. These estimates are independent of the choice of the scale relativity. Equivalence scale choice only affects the between-group inequality, which is expected to drop from 2009 to 2010 and rise slightly in 2011, following the overall inequality trends.

IV. CONCLUSION

This paper has studied the sensitivity of the generalized entropy (GE) family inequality indices and the Gini coefficient to the choice of equivalence scale by using Turkish SILC data from 2009 to 2011.As suggested by Coulter et al. (1992b), the sensitivity of the indices are examined by using a wide range of scale relativity values. Meanwhile, the whole distribution is decomposed into household-size groups to obtain within-group inequality terms that are independent of the scale relativity choices, thus inferring robust conclusions. Both one-parameter and two-parameter parametric equivalence scale forms are employed to capture the effects of household size and composition.

Calculations from the one-parameter form suggest that increasing scale relativity has a disequalizing impact derived from the changing of rankings in equivalent income distributions. This disequalizing “re-ranking” effect is apparent in the covariance between equivalent income and log household size. The relationship between measured inequality and scale relativity is reflected in more flattened curves with no minimum points apart from the initial value for GE(2) in 2010 and 2011 and GE(1) in 2010. The other curves are J-shaped with minimum points close to zero, and they remain unchanged over years.

For the two-parameter equivalence scale, measured inequality reduces when the weight attached to children is decreased from 1 to pre-determined values (0.75, 0.50, and 0.25). This reduction occurs because there is a negative covariance between disposable income and number of children in each household size group, according to Banks and Johnson (1994). The analysis with the two-parameter scale suggests that weighting the family by assigning a parameter to the children weakens the dominance of the re-ranking effect, as seen through more U-shaped curves. Only the top-sensitive GE indices in 2010 and 2011 maintain a J-shaped curve in the two-parameter scale case. The equalizing impact of using the two-parameter form indicates the sensitivity of the distributional ranking to household composition.

According to the within-group inequality terms derived from the decomposition of the GE(-1), GE (0), and GE(-2) indices into family size groups, only 1- and 2-person households follow the same pattern with overall inequality. Although the results are not as clear cut for other household size groups, the huge fluctuations among 5-person households with top income should draw our attention.

REFERENCES

Banks, J. and Johnson, P. (1994) Equivalence scale relativities revisited. *Economic Journal* (104), pp. 883-890.

Buhmann, B., Rainwater, L., Schmaus, G. and Smeeding, T. M. (1988) Equivalence scales, well-being, inequality, and poverty: Sensitivity estimates across ten countries using the Luxembourg income study (LIS) database.*Review of Income and Wealth(34),* pp. 115-142.

Coulter, F. A. E., Cowell, F. A. and Jenkins, S. P. (1992a) Differences in needs and assessment of income distributions.*Bulletin of Economic Research*(44), pp. 77-124.

Coulter, F. A. E., Cowell, F. A. and Jenkins, S. P. (1992b) Equivalence scale relativities and the extent of inequality and poverty.*The Economic Journal* (102), pp. 1067-1082.

Cowell, F. A. and Mercader-Prats, M. (1997) Equivalence scales and inequality .Distributional Analysis Discussion Paper, 27, STICERD, LSE, Houghton St., London, WC2A 2AE.

Creedy, J. and Sleeman,C. (2004) Adult equivalence scales, inequality and poverty in New Zealand. New Zealand Treasury Working Paper 04/21. Wellington, New Zealand

Cutler, D. M. and Katz, L. (1992) Rising inequality? Changes in the distribution of income and consumption in the 1980s.*American Economic Review*(82), pp. 546-551.

Figini, P. (1998) Inequality measures, equivalence scales and adjustment for household size and composition. LIS Working Paper No. 185

Hunter, B.H., Kennedy, S. and Smith, D. (2001) Sensitivity of Australian income distributions to choice of equivalence scale: Exploring some parameters of Indigenous incomes. CAEPR Working Paper No. 11, CAEPR, ANU, Canberra,

Jenkins, S. P. and Cowell, F. A. (1994) Parametric equivalence scales and scale relativities, *Economic Journal* (104), pp. 891-900.

Okamoto, M. (2012) The relationship between the equivalence scale and the inequality index and Its impact on the measurement of Income Inequality," MPRA Paper 37410, University Library of Munich, Germany.

Shorrocks, A. F. (1984) Inequality decomposition by population subgroups. *Econometrica* (52), pp 1369-1388.