

Poverty and Inequality in Israel: Trends and Decompositions

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Abstract

This study examines trends in inequality and (relative) poverty rates between 2002 and 2014. Most of the analyses relate to the working age population, whose contribution to income inequality and to long-term changes in that inequality is greater than the contribution of the older population. The method used in this analysis allows for discrete estimates of the contribution of three core population groups – Haredim (ultra-Orthodox Jews), Arab Israelis and non-Haredi Jews – make to changes in the poverty and inequality indices over time. This analysis gives a clearer picture of the processes within these subgroups and the interactions among them. The findings show that the overall poverty level among the working age population did not change between 2002 and 2014, though the composition of the poor population did change substantially: in 2002, the share of poor Haredi and Arab Israeli households out of all poor households stood at 44 percent; in 2014, they comprised 54 percent of poor households. This represents an exceptional rise relative to the increase of these two subgroups in the overall population of working age households.

The chapter also presents findings relating to the over age 60 population. There has been a decline in the inequality index and poverty in market income among the older population. However, segmenting this population into three subgroups (long-term residents, new immigrants and Arab Israelis) indicates that among these subgroups there are substantial income gaps as well as differences in their disposable income poverty rates.

* Haim Bleikh, Researcher, Taub Center. The author wishes to thank those who read and commented on this work: Prof. Claude Berrebi, Gilad Brand, Prof. Joseph Deutsch, Hadas Fuchs, Shavit Madhala-Brik, Kyrrill Shraberman, Prof. Jacques Silber, and Prof. Avi Weiss.

Introduction

The heterogeneity of Israeli society, and its social gaps, pose complex social, economic and political challenges for the country's decision makers. Studies conducted in Israel show that demographic characteristics, differences in labor force participation, and differences in education level are the main factors behind Israel's high degree of income disparity and the poverty rate differences between the country's various population subgroups (*Poverty and Social Gaps Report*, 2014; *Bank of Israel Annual Report*, 2016a). Beyond the income gaps between subgroups, overall inequality in Israeli society also stems from disparities between the households within them.

The question regarding the degree to which income gaps between subgroups affect overall inequality in Israel has been examined in a number of works. Overall, they have found that only a small portion of total inequality is the result of income disparities between subgroups. For example, Deutsch and Silber (2007) studied differences between the Jewish and Arab populations in the years 1990 and 1998, and found that, at most, 10.4 percent of total inequality can be traced to income gaps between the subgroups. Kimhi and Shafir-Tidhar (2012) looked at different population cross-sections and showed that Israeli inequality levels, and growth in inequality over time, cannot be explained by disparities between subgroups. Their study found that, at most, 20 percent of total inequality is due to income gaps between the subgroups. The Bank of Israel (2013) found that although there was a rise in inequality of market income (work, occupational pension and capital income, before obligatory deductions) between the country's geographic districts between 1998 and 2011, no more than 8 percent of total inequality (over time) can be explained by inter-district disparities. The rest is due to inequality originating within the districts.

The aim of the present work is to explore the trends in inequality that have emerged over time, and to determine the degree to which these trends are influenced by changes in inequality **between** the various subgroups, and the degree to which they are influenced by changes **within** them (i.e., between households belonging to the same subgroup). In particular, using Shapley decomposition techniques (Shorrocks, 1999), this study will examine the subgroups' absolute contributions to changes in inequality over time. Also examined are poverty rates over time and their sources: changes that occurred in the poverty rates of each subgroup versus demographic changes, that is, changes in the subgroups' relative size. Decomposition of poverty and inequality by population subgroups plays a major role in shaping effective

policy tools, due to its importance in estimating the impact of certain policy programs on sectors, geographic regions and other population subgroups.

The analyses were carried out by population cross-section. First the population was divided between the older population (ages 60 and over) and the working age population (59 and under).¹ It is the working age population on which our examination will largely focus, with decomposition of inequality and poverty indices by population cross-section, especially non-Haredi Jews, Haredim (ultra-Orthodox),² and Arab Israelis. The final section will be devoted to a discussion of the older population, with particular focus on long-time resident Jewish Israelis,³ immigrants (people who arrived in Israel from 1990 on), and the Arab Israeli sector.

It should be noted that groups other than those on which the present work focused could have been studied, meaning that additional research is warranted.

1. General trends in poverty and inequality

This study looks at developments in Israeli poverty and inequality between the years 2002 and 2014. The developments, and the policy measures that were taken during that period, reflect recovery from the recession into which Israel's economy sank in the early 2000s, as well as effects of the global economic crisis that erupted in 2008. At the beginning of the period, benefits were cut and direct tax rates lowered. This was seen as a means to encourage labor force participation and eliminate dependence on benefits. During the period under study, the share of public expenditure in GDP trended downward, while the tax burden (the sum of tax revenues as a percent of GDP) remained quite stable, despite the fact that between 2003 and 2008 direct taxes were reduced. This was made possible by an increase in the tax collection rate, which exceeded even the robust pace of growth that characterized those years. In contrast, the years 2008-2009 witnessed a sharp decline in the tax burden, due to an

1 Working age households were defined as households headed by people no older than 59; for coupled households, the head of household's partner must also be no older than 59. For example, a household headed by someone aged 58, whose spouse is 63, would be included in the older adult population. Ages 60 and over: head of household or partner (if there is one) is not younger than 60.

2 Haredi are defined as those living in households headed by men whose most recent study institution was a yeshiva, or households headed by a woman whose husband's most recent study institution was a yeshiva.

3 Jews who were born in Israel or who arrived before 1990.

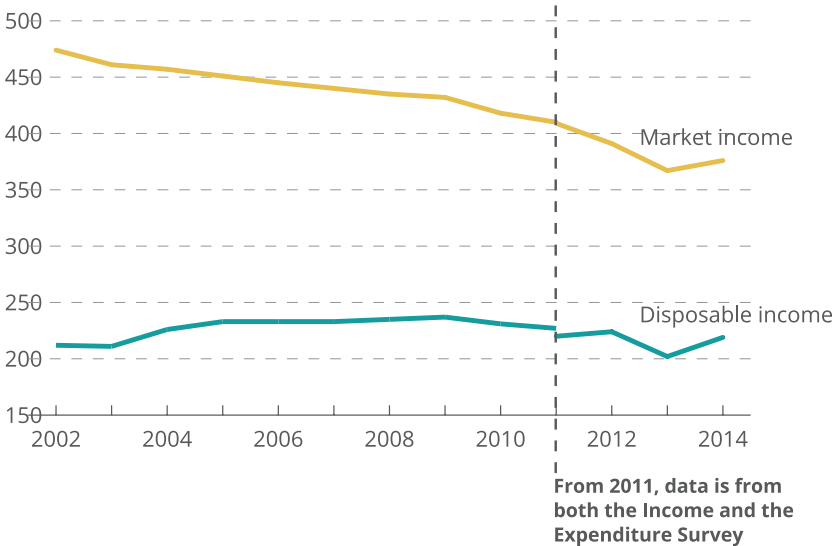
additional reduction in direct taxes and a slowdown of economic activity in the wake of the worldwide economic crisis (Report of the Committee for Social and Economic Change, 2011). The crisis was followed by economic recovery, but the level of GDP growth rates was lower compared to the years that preceded the crisis (Bank of Israel, 2016b).

Major parts of this study examine the changes in indices over time. This situation entails comparing sets of years. For example, we can look at differences between successive years, or choose other intervals. In the absence of a clear reason for selecting some other kind of breakdown, the present analysis divides the total period into four equal subperiods: 2002-2005, 2005-2008, 2008-2011, and 2012-2014. In 2012, the Central Bureau of Statistics moved from using the Income Survey to the Expenditure Survey making it difficult to properly compare the years prior to 2012 with successive years. For this reason, the final period starts in 2012 rather than 2011.⁴

Figure 1 presents the development of income inequality over time using the Theil index,⁵ while Figure 2 presents the development of poverty rates among households.⁶ As can be seen in Figure 1, during the 2002 to 2014 period, there was a steady decline in market income inequality, while disposable income (market income plus transfer payments, with direct taxes deducted) showed a change in direction: a rise in the early years, a few years of stability, then decline.

4 In 2012, the Central Bureau of Statistics stopped publishing its Income Survey and started publishing the Household Expenditure Survey only. The analyses presented in this work were based on the Income Survey for the years before 2012, and on the Expenditure Survey for 2012 on (although some of the figures will also include an Expenditure Survey for 2011). In theory, it would have been possible to rely on income surveys only in order to maintain consistency throughout the research period, since expenditure surveys also exist for the earlier years. However, for purposes of this study it was deemed preferable to rely on the income survey for two important reasons: (1) The income survey sample is larger and allows more focused segmentation that encompass larger numbers of observations; (2) Other official bodies, such as the National Insurance Institute and the Central Bureau of Statistics itself, use the income survey data for the years preceding 2012, making it possible to compare and maintain consistency. There is an explanation in the this chapter's online appendix regarding the definition of the recent period as 2012-2014 and not 2011-2014 as might be expected.

5 The Theil index (Theil, 1967) will be used in this study to measure inequality. The index ranges between 0 and $\ln(n)$, where n is the household size. The higher the values, the higher the level of inequality it indicates. The advantage of the Theil index over the Gini index commonly used to measure inequality lies in the simpler option it provides of decomposing inequality into different components. Appendix Figure 1 presents the Theil index's development relative to the Gini index; there we can discern that the two indices describe similar trends. For more information on the Theil index, see this chapter's online appendix.

Figure 1. Income inequality**Theil index (multiplied by 1,000)**

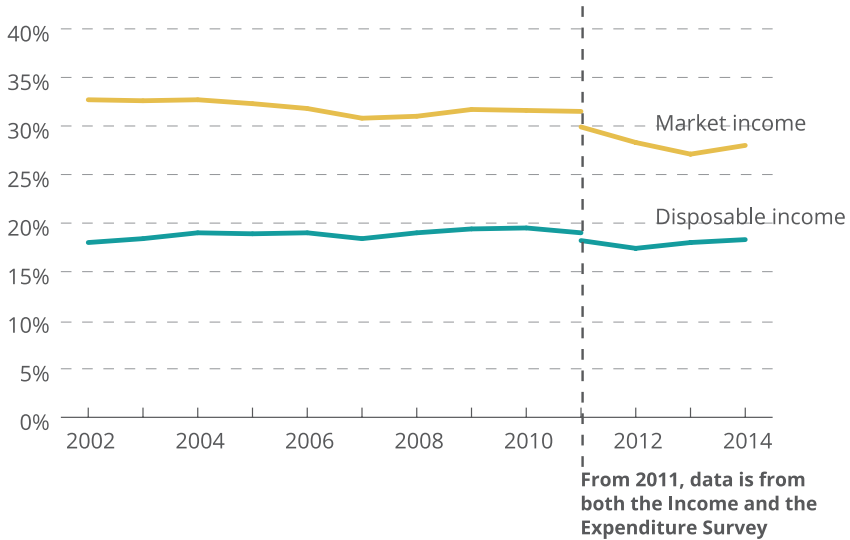
Calculated using the OECD method.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2011-2014).

Figure 2 shows that the market income poverty rates ranged between 31 and 33 percent between 2002 and 2011; however, in the last few years they have fallen below the 30 percent mark, to 27-28 percent. The disposable income poverty rates have returned in recent years to the levels of the period's early years, after a slight increase in between.

6 The poverty line is defined as half of the median disposable monetary income per standardized person. Monetary income does not include the value of additional services (such as discounts) provided as assistance to various groups. Nor does it include the value of non-monetary income arrived at by estimating housing services and household-owned vehicles. Poverty rates were measured using the OECD method. First, households are ranked by individual's weights, not by household weights. Second, income was standardized according to the equivalence scale based on the square root of the number of individuals per household. This method has many more economies of scale than the equivalence scale used in Israel. Thus, the relative marginal addition to household income required in order to meet a particular level of income per standardized person (e.g., the poverty-line income level) when each individual is added, is lower according to the OECD equivalence scale, which gives rise to differences in the composition of the population living in poverty. For example, according to the OECD method a higher weight would be given to smaller households (such as elderly households), while a lower weight would be given to larger households.

Figure 2. Share of households below the poverty line

Calculated using the OECD method.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2011-2014).

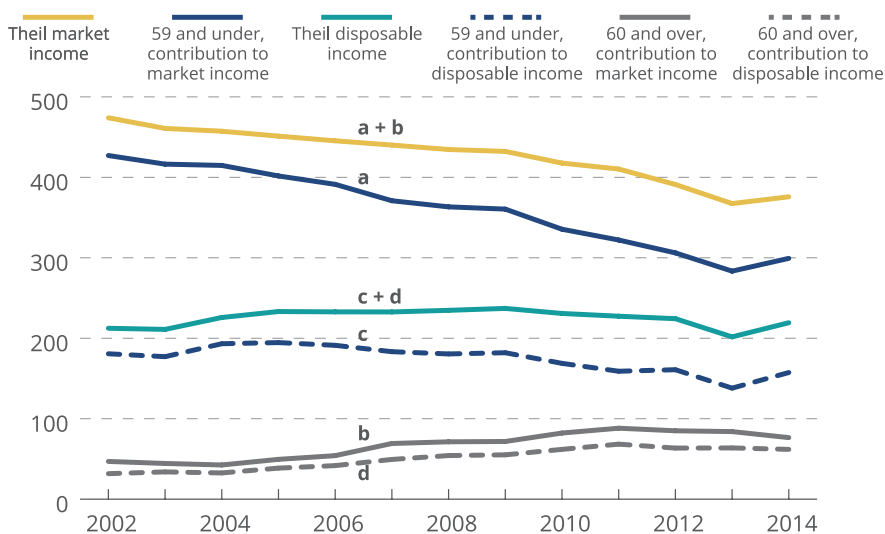
2. Income inequality

This section presents changes in inequality broken down into two main age groups: ages 59 and under (working age), and ages 60 and over (older adults). Figure 3 shows the inequality index presented in Figure 1 and its breakdown by the absolute contributions of both groups to the total index.⁷ In general, the share of the working age group in the overall population is larger, meaning that its contribution to income inequality is more substantial as well. However, the changes in absolute contribution over time are inconsistent. For example, between 2005 and 2011 the absolute contribution of the older population to market income inequality rose, while that of the working age group continued to decline.

⁷ In the Theil index, the absolute contribution adjusts for relative population size, mean income and inequality level within the subgroup. For a more in-depth discussion, see this chapter's online appendix.

The fact that the older population's absolute contribution to inequality rose does not necessarily testify to negative processes within the subgroup. The explanation lies in the method used to calculate absolute contribution, which takes into account not only the intra-group inequality index but other factors as well. For example, between 2005 and 2009, there was a gradual rise in the retirement age that contributed to an increase in employment and growth in income from work among the older population. Due to this, the intra-group inequality index for the older age group dropped (see Appendix Figure 2). In theory we might have expected that this population's absolute contribution would also decline, but the opposite was the case, as can be seen in Figure 3. The reason for this is that there was an increase in the weight of the older population's income within the total market income, due both to an increase in this sector's relative size and to its higher growth of market income relative to the working age population. In the total weighting, the rate of increase in the older adult population's share of income weight exceeded the decline in inequality within the group, meaning that its absolute contribution to total inequality rose.

These data indicate that in relative terms (the subgroup's contribution to inequality as a percent of the total index), the older adult population's contribution to total inequality doubled over the course of the research period, both in terms of market income (from 10 to 20 percent) and in terms of disposable income (from 15 to 28 percent).

Figure 3. Absolute contribution to inequality**Theil index (multiplied by 1,000), by age group**

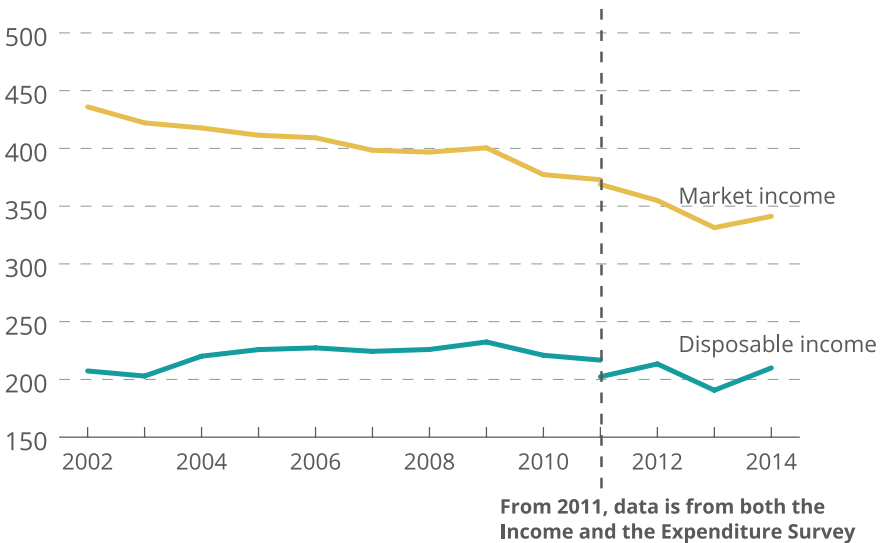
Calculated using the OECD method. Ages 59 and under: head of household and partner (if there is one) are age 59 and under. Age 60 and over: head of household or partner (if there is one) is age 60 and over.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2012-2014).

Decomposition of working age inequality

As noted, the working age population's absolute contribution to total inequality is of the greatest weight. Figure 4 shows the development of inequality within this group over time. A drop in market income inequality between 2002 and 2009 was not reflected in a similar decline in disposable income inequality. Since 2009, declining market income inequality has also been reflected, if inconsistently, in a reduction in the disposable income index.

Figure 4. Income inequality for ages 59 and under****Theil index (multiplied by 1,000)**

Calculated using the OECD method. Head of household and partner (if there is one) is age 59 and under.

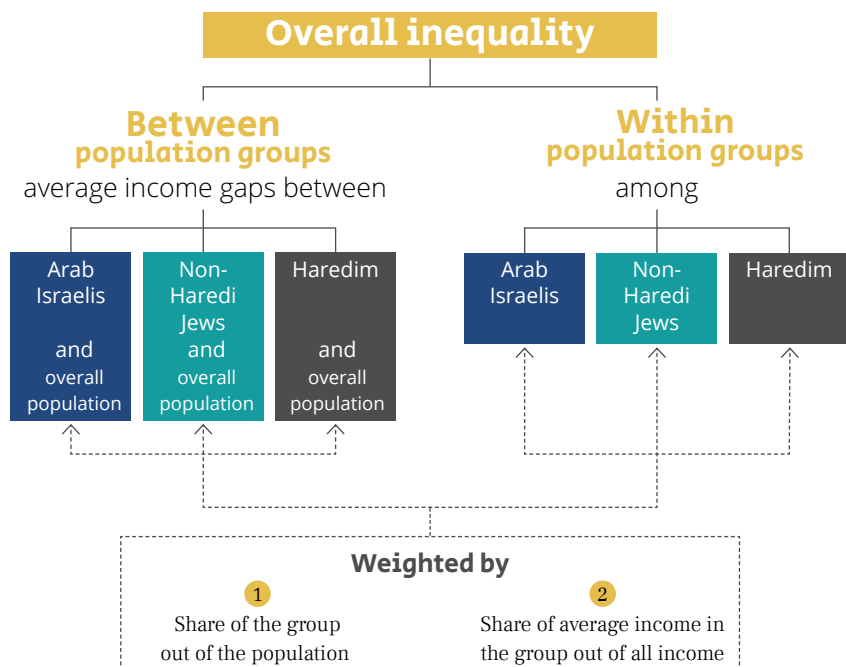
Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2011-2014).

Now the contribution to inequality will be estimated through a breakdown into three subgroups: non-Haredi Jews, Haredim and Arab Israelis. It should be clarified that, as our discussion is focused on the effects of subgroups on total inequality, we must take into account that the total contribution to inequality can be explained through two components:⁸

1. Inequality **within** population groups – inequality whose source lies in income differences between households belonging to the same subgroup. In terms of calculation, this is the weighted sum of inequality levels within the subgroups, after using weights to adjust for the relative sizes and mean incomes of the subgroups.
2. Inequality **between** population groups – inequality whose source lies in the mean income differences between the subgroups. In terms of calculation, this is the weighted sum of disparities between the mean incomes of each subgroup and the mean income of the population as a whole.

⁸ For a more in-depth discussion, see this chapter's online appendix.



These components may explain the inequality level in a given year, but the present study is also concerned with changes in inequality over time. To estimate each subgroup's marginal absolute contribution to the total inequality, the Shapely decomposition method (Shorrocks, 1999) is used.⁹ This method enables changes in total inequality to be explained through three effects:

1. **The net inequality effect.** The changes in total inequality that result solely from changes in income inequality levels within subgroups.
2. **The income effect.** The changes in total inequality that result from changes in the mean income of each subgroup.
3. **The population effect.** The changes in total inequality that result from changes in the relative size of each subgroup.

It should be noted that both the income and the population effects embody changes in the weightings of all three subgroups, meaning that they affect both inequality within the groups and inequality between them.

⁹ For more information on the Shapely decomposition, see this chapter's online appendix.

Tables 1 and 2 show the decomposition findings for inequality changes that occurred over time in market income and disposable income within the working age population. Each row represents the changes produced by the three effects during the period specified at the top of the column, broken down by source: changes within the groups and changes between the groups. Within each type of change there is a secondary decomposition into the change components according to Shapely, making it possible to trace the contribution of each component. For example, in order to isolate the net inequality effect (which is part of the inequality within the groups), we must deduct the change in weights due to changes in mean income and population composition.

The tables' three lower levels show the absolute contributions of all of the subgroups to the total change, so that for each period the total contribution of the three populations is equal to the total change in inequality, displayed in the upper level.

Market income inequality in the working age population: main findings

In the first line of Table 1, we find that the entire time period is characterized by a steady decline in market income inequality. Decomposition by inequality source shows that most of the decline is the result of the inequality effect, that is, changes in income distribution within each subgroup. It is interesting to note that, in the two first subperiods, the inequality decline within the subgroups was greater than the drop in total inequality – i.e., the inequality increase between the subgroups is what moderated the decline in total inequality.¹⁰ In the two later subperiods, inequality between the subgroups also declined.

When examining the between group inequality component by effects, the increase during the earlier periods proves to have resulted from changes in the population subgroups' relative sizes, while the inequality decline of the later years resulted from a narrowing of income gaps between the subgroups. Indeed, market income per standardized person rose in the later years by a more substantial degree among the weaker populations. Between 2008 and 2011, the Haredi sector's average income increased at an average annual rate of 11.6 percent versus 2.2 percent for the Arab Israeli sector and

¹⁰ This is not an exceptional situation, that is, there can be situations in which inequality within the groups declined, but the mean incomes of the higher-income subgroups increased more rapidly than those of the lower-income ones, thereby raising the inequality component between the groups.

2.3 percent among non-Haredi Jews. Between 2012 and 2014, the Arab Israeli sector's average income increased at an average annual rate of 10.9 percent compared to 2 percent for Haredim and 6.1 percent for non-Haredi Jews.

Looking at the subgroups' individual contributions to inequality (cells 2 to 4 of Table 1), there are some interesting findings. Except for the years 2005 to 2008, the main source of the changes in total inequality was the non-Haredi Jewish population, and if we remove the weight effects (i.e., looking only at the net inequality effect), then this is true for all of the periods. This finding is not surprising, as this is the largest subgroup and changes in it have greater weight. Another notable finding is the steady decline in net inequality across nearly all of the subgroups and in all of the time periods, except for a rise in net inequality in the Arab Israeli sector during the most recent period. Additionally, when we look at intra-group inequality among Arab Israelis and Haredim, we find that in some of the periods the impact of the net inequality decline was reduced or disappeared due to changes in the weights — that is, because of changes in the subgroups' mean incomes and in their relative weights within the total population.

Table 1. Shapely decomposition of market income inequality
Working age population, absolute change, Theil index (multiplied by 1,000)

	2002-2005	2005-2008	2008-2011	2012-2014
Overall contribution				
Total change (W + B)	-24.6	-14.6	-23.9	-13.7
Within group (W)	-30.0	-18.6	-19.3	-8.2
Population effect	1.8	1.1	0.4	-0.2
Income effect	-0.2	0.0	1.3	0.4
Net inequality effect	-31.7	-19.7	-21.0	-8.4
Between groups (B)	5.4	4.0	-4.6	-5.5
Population effect	5.7	4.0	1.9	-0.6
Income effect	-0.3	0.0	-6.5	-4.9
Contribution of non-Haredi Jews				
Total change (W + B)	-19.8	-3.5	-20.0	-17.5
Within group (W)	-29.7	-11.6	-19.4	-8.6
Population effect	-2.2	-1.6	-1.4	0.5
Income effect	-0.3	0.1	-1.3	-1.7
Net inequality effect	-27.2	-10.1	-16.7	-7.3
Between groups (B)	9.9	8.2	-0.6	-8.9
Population effect	11.0	8.0	4.8	-1.6
Income effect	-1.1	0.2	-5.4	-7.4
Contribution of Haredi Jews				
Total change (W + B)	-3.3	-2.3	-1.1	-4.2
Within group (W)	0.3	0.3	0.2	-4.3
Population effect	2.3	1.3	0.2	-0.1
Income effect	-0.9	0.2	2.9	-0.8
Net inequality effect	-1.2	-1.2	-2.9	-3.4
Between groups (B)	-3.6	-2.6	-1.3	0.2
Population effect	-3.9	-2.5	-0.3	0.1
Income effect	0.4	-0.1	-0.9	0.0
Contribution of Arab Israelis				
Total change (W + B)	-1.5	-8.8	-2.8	8.0
Within group (W)	-0.6	-7.3	-0.1	4.7
Population effect	1.7	1.4	1.6	-0.6
Income effect	1.0	-0.2	-0.3	3.0
Net inequality effect	-3.3	-8.5	-1.4	2.3
Between groups (B)	-0.9	-1.5	-2.7	3.2
Population effect	-1.4	-1.4	-2.5	0.9
Income effect	0.5	-0.1	-0.2	2.4

Small deviations are due to rounding.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2012-2014).

Disposable income inequality in the working age population: main findings

As can be seen in Table 2, the change in trends in disposable income inequality is not identical to the market income trends. The period 2002 until 2014 was characterized by a sharp rise in inequality in the first subperiod, stability in the second subperiod and decline in the following subperiods. Ultimately, the situation between the start of the period and its end did not change greatly. Interestingly, except for the years 2008 to 2011, the changes in inequality between the groups were greater in absolute value than the changes that originated within the groups. In other words, unlike market income, the subgroups' changes in relative size and market income growth rate were the main source of changes in disposable income inequality in most of the subperiods.

Looking at the subgroups' individual contributions (cells 2 to 4 in Table 2), it can be seen that, regarding disposable income, the non-Haredi Jewish population is again the primary source of changes in total inequality. What this means is that, in most of the subperiods, gaps in mean income emerged between this subgroup and the other two. By contrast, between 2008 and 2011, total inequality declined due mainly to a steep drop in net inequality among non-Haredi Jews.

These results suggest that policy measures taken in the early 2000s (benefit cutbacks and a reduction in direct taxes) contributed to an increase in employment and, as a result, to a steady decline in market income inequality. However, the drop in disposable income inequality manifested only five or six years later. That is, in the years just following the policy changes, the relative increase in market income among Haredim and Arab Israelis was higher than among non-Haredi Jews, yet failed to compensate for the loss of income from government allowances. By contrast, the highest cumulative increase in disposable income was found among non-Haredi Jews, and is attributable to growth in income from work and to a reduction in direct tax rates (Bleikh, 2015).

Additionally, the analysis conducted shows that, at most, 20 percent of inequality (in both market income and disposable income) among working age population is explained by income disparities between the population subgroups. Thus, for a more complete picture on inequality and changes over time, it is not enough to focus on changes in the mean income of each subgroup; it is important to look at all of the changes: the change in each subgroup's relative size, changes in mean income, and changes in the inequality within each subgroup.

Table 2. Shapely decomposition for disposable income inequality
Working age population, absolute changes, Theil index (multiplied by 1,000)

	2002-2005	2005-2008	2008-2011	2012-2014
Overall contribution				
Total change (W + B)	18.5	0.1	-9.1	-3.5
Within group (W)	8.2	-4.6	-9.1	-1.3
Population effect	0.0	0.0	0.1	-0.1
Income effect	0.0	0.0	0.0	0.2
Net inequality effect	8.3	-4.6	-9.1	-1.5
Between groups (B)	10.3	4.7	0.0	-2.1
Population effect	2.4	2.1	1.2	-0.4
Income effect	7.9	2.6	-1.2	-1.7
Contribution of non-Haredi Jews				
Total change (W + B)	23.3	6.4	-8.3	-6.4
Within group (W)	4.4	-2.9	-10.9	-2.2
Population effect	-1.7	-1.2	-0.9	0.3
Income effect	1.8	0.6	-0.2	-0.4
Net inequality effect	4.2	-2.2	-9.8	-2.1
Between groups (B)	19.0	9.3	2.6	-4.2
Population effect	7.1	5.7	3.7	-1.3
Income effect	11.8	3.7	-1.2	-2.9
Contribution of Haredi Jews				
Total change (W + B)	-4.7	-2.3	1.2	-1.9
Within group (W)	0.3	0.4	0.6	-1.2
Population effect	1.0	0.6	0.1	0.0
Income effect	-0.7	-0.2	0.6	-0.3
Net inequality effect	0.0	0.0	0.0	-0.9
Between groups (B)	-5.0	-2.7	0.6	-0.7
Population effect	-3.7	-2.4	-0.3	0.1
Income effect	-1.3	-0.3	0.8	-0.8
Contribution of Arab Israelis				
Total change (W + B)	0.0	-4.0	-2.0	4.8
Within group (W)	3.6	-2.1	1.2	2.1
Population effect	0.7	0.7	0.9	-0.3
Income effect	-1.1	-0.4	-0.4	1.0
Net inequality effect	4.0	-2.4	0.7	1.5
Between groups (B)	-3.7	-2.0	-3.2	2.7
Population effect	-1.0	-1.2	-2.2	0.8
Income effect	-2.7	-0.8	-0.9	1.9

Small deviations are due to rounding.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2012-2014).

3. Decomposition of the poverty rate trends

Decomposition of the entire population's poverty rate trends through an examination of the subgroups' contributions (a process similar to that described in the preceding section) should be of some help in determining how the composition of the population living in poverty has changed. As in the previous examination of inequality, in order to obtain a more precise picture, it is necessary to weight two simultaneous processes: changes in the relative size of subgroups, and changes in each subgroup's poverty rate.

Figures 5a and 5b present the poverty rates by market income and disposable income for the years 2002 to 2014, broken down into two age groups — working age (59 and under) and older adults (60 and over). Among the older population, there was a substantial drop in the market income poverty rate. One possible reason for this is a gradual rise in the retirement age during the period in question, which contributed to this group's increased employment and income from work.¹¹ The disposable income poverty rate also declined for the older population until 2011. However, beginning in 2012, there was a split: disposable income poverty rose while market income poverty continued to drop. For the working age population, market income poverty was quite stable between 2002 and 2011 (27-28 percent), but declined slightly thereafter. The picture is different regarding disposable income: between 2002 and 2009, the poverty rate rose by 2.5 percentage points, after which it fell to its 2002 level (16 percent).

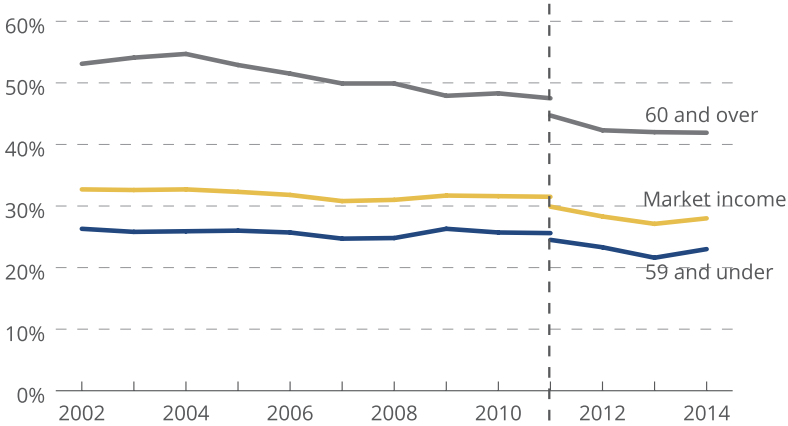
A comparison between these trends and poverty rate data for the population as a whole, taking into account changes in the relative sizes of both age groups, may explain a number of developments. For example, the relative stability of the total market income poverty rate from 2004 to 2011, despite a major decline in the market income poverty rates among older adult Israelis, can be explained by the fact that the relative weight of older population households grew from 24 percent at the start of the period to 26 percent at its end. This means that the increase in weight of this age group (which still has the higher poverty rate of the two age groups, despite the decline) offset its contribution to a drop in the total poverty rate. A similar development explains the stability of the disposable income poverty rate that characterized the years 2004 to 2011. On the one hand, there was a rise in the poverty rate among working age Israelis, accompanied by a drop in this population's relative weight; on the other hand, there was a decline in the older population's poverty rate, accompanied by an increase in its relative share of the population as a whole. In any event, switching from the poverty rate of the population as a whole to the poverty rates of subpopulations (and vice

¹¹ Figure 6 indicates a rise in the percent of those eligible for occupational pensions among immigrants, another contributor to increased market income among the older adult population.

versa) entails attention to changes in the composition of the population of those living in poverty, as will be presented in the next section.

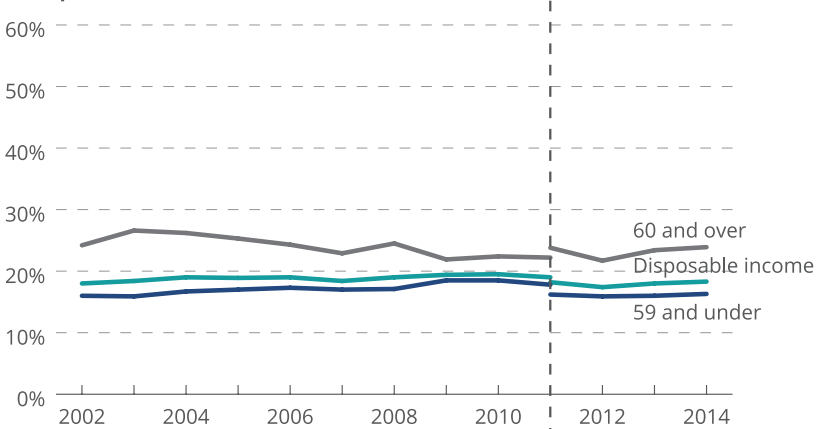
Figure 5. Share of households below the poverty line, by age group

a. Market income



From 2011, data is from both the Income and the Expenditure Survey

b. Disposable income



From 2011, data is from both the Income and the Expenditure Survey

Calculated using the OECD method. Ages 59 and under: head of household and partner (if there is one) are age 59 and under. Age 60 and over: head of household or partner (if there is one) is age 60 and over.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2011-2014).

Decomposition of the working age poverty rate

This section will focus on the working age population, with particular attention to changes that have occurred within groups and to the relationship between them. Tables 3 and 4 summarize the findings of Shapley decomposition for the changes in market income and disposable income poverty rates.¹² This decomposition method isolates subgroups' absolute contributions to the total poverty rate, by measuring two effects:

1. **The poverty effect**, which expresses the change in the total poverty rate that originated in changes in the poverty rates within subgroups;
2. **The population effect**, which reflects the change in the total poverty rate that originated in changes in the subgroups' relative sizes.

Decomposition of the market income poverty rate: main findings

The period under study was characterized by a slight cumulative decline in the total poverty rate for working age people (Table 3). The poverty effect (in terms of its absolute value) was a dominant contributor to changes in this age group's total poverty rate. A look at the subgroups' contributions reveals that the largest share in the total decline can be ascribed to the non-Haredi Jewish population, especially between 2002 and 2008. Most of this subgroup's impact on the total poverty rate stemmed from a drop in its group-specific poverty rate, not from a change in its population share. By contrast, the Arab Israeli population's absolute contribution raised the total poverty rate throughout the period, especially from 2008 to 2011. In this instance, the population effect had a greater impact, that is, most of the contribution to the rising total poverty rate (except for 2008 to 2011) was due to an increase in the Arab Israeli sector's share of the total working age population. The Haredi subgroup contributed to the poverty rate increase during the two first subperiods, due primarily to a rise in its share of the population. From 2008 on, the Haredi sector's impact on the total poverty rate tended toward reduction.

Looking at the composition of the population living in poverty by market income indicates that the share of Arab Israeli and Haredi households within the working age poor population increased over the 2002 to 2014 period

¹² For more information on the Shapley decomposition of poverty rates, see this chapter's online appendix.

from 37 percent (9 percent for Haredim and 28 percent for Arab Israelis) to 45 percent (12 percent for Haredim and 33 percent for Arab Israelis). During this period the percent of households belonging to these sectors rose from 18 percent to 20 percent.

Table 3. Shapley decomposition for market income poverty rates
Working age population, absolute change (in percentage points)

	2002-2005	2005-2008	2008-2011	2012-2014
Overall contribution				
Total change	-0.31	-1.20	0.79	-0.36
Poverty effect	-0.90	-1.65	0.61	-0.40
Population effect	0.59	0.45	0.18	0.04
Contribution of non-Haredi Jews				
Total change	-1.16	-1.81	0.31	-0.23
Poverty effect	-0.90	-1.59	0.42	-0.19
Population effect	-0.26	-0.21	-0.11	-0.04
Contribution of Haredi Jews				
Total change	0.77	0.23	-0.41	-0.22
Poverty effect	0.14	-0.05	-0.32	-0.10
Population effect	0.63	0.28	-0.09	-0.13
Contribution of Arab Israelis				
Total change	0.08	0.37	0.89	0.09
Poverty effect	-0.14	-0.01	0.51	-0.11
Population effect	0.23	0.38	0.37	0.20

Small deviations due to rounding.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2012-2014).

Decomposition of the disposable income poverty rate: main findings

Disposable incomes throughout the research period were characterized by an increase in the total poverty rate.¹³ The first subperiod (notable for cuts to benefits and tax rate reductions) displayed the sharpest increase in poverty. The overall picture for this period indicates that the impact of these changes on poverty rates was slightly higher than effect of the population subgroups' relative sizes. Also, in this subperiod, the Haredi and Arab Israeli populations contributed to the rise in the total poverty rate. Within the Arab Israeli population, the primary reason for this was an increase in their poverty rate. In contrast, among Haredim there was a greater influence of a change in their relative share in the overall population.

Looking at the composition of the poor population in disposable income terms, indicates that the share of Arab Israeli and Haredi households in the working age poor population increased over the years from 44 percent (10 percent for Haredim and 34 percent for Arab Israelis to 54 percent (12 percent for Haredim and 42 percent for Arab Israelis). As noted, during this period, the percent of households belonging to these subgroups rose from 18 percent to 20 percent of the entire working age population.

13 According to Figure 5b, the poverty rate for the working age population did not change between 2002 and 2014. This is due to the change in the data in 2012 (see footnote 4) which meant that the poverty rate in 2012 was lower than the rate in 2011. Table 4 shows, though, that when divided into subperiods, there is a continuous rise in the poverty rate over time. For this reason, the overall period data as presented in Figure 5b should be regarded with caution.

Table 4. Shapely decomposition for disposable income poverty rates**Working age population, absolute change (in percentage points)**

	2002-2005	2005-2008	2008-2011	2012-2014
Overall contribution				
Total change	1.00	0.11	0.66	0.41
Poverty effect	0.55	-0.28	0.47	0.34
Population effect	0.46	0.39	0.18	0.07
Contribution of non-Haredi Jews				
Total change	-0.36	-0.38	0.03	-0.20
Poverty effect	-0.22	-0.26	0.10	-0.17
Population effect	-0.14	-0.12	-0.07	-0.02
Contribution of Haredi Jews				
Total change	0.72	0.17	-0.28	0.20
Poverty effect	0.30	-0.03	-0.21	0.28
Population effect	0.42	0.20	-0.06	-0.08
Contribution of Arab Israelis				
Total change	0.65	0.32	0.90	0.41
Poverty effect	0.47	0.01	0.59	0.23
Population effect	0.18	0.31	0.31	0.18

Small deviations due to rounding.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2002-2011), Expenditure Survey (2012-2014).

4. Issues relating to the older population

The preceding sections examined the working age population in depth. This section will now proceed to a discussion of the older population, which is essential for a full picture. It should be noted, however, that this section differs methodologically from the previous ones. It will not provide a decomposition of inequality and poverty indices, but rather a general discussion of several core issues pertaining to inequality and poverty among the older population.

Demographic developments that are causing a steady increase in the older population's relative share of total population place a number of major dilemmas on the public agenda: raising the retirement age, employment among senior citizens and, of course, the degree of generosity of the social security system.¹⁴ Most individuals of retirement age do not participate in the labor market, meaning that their income is based largely on their savings (particularly, occupational pensions and capital savings), or on state support (allowances and other governmental transfers). This section looks at different population subgroups than the working age population: Jews and long-term resident Israelis, immigrants who arrived in Israel from the 1990s onward, and Arab Israelis.¹⁵

Figure 6 presents a distribution of households headed by older adults by homeownership and eligibility for occupational pension for selected years between 2003 and 2014. The data give rise to several notable observations:

- Within the population as a whole there has been a decline in the share of older adults that are not homeowners and who are also not eligible for occupational pensions (from 19 percent to 15 percent). The decline is particularly notable among immigrants (from 52 percent to 34 percent). In contrast, the Arab Israeli sector actually displayed an increase (from 9 to 12 percent).
- There are substantial disparities between the groups in terms of homeownership rates: the percent of homeowners among immigrants is substantially lower than among long-term resident Israelis and Arab

14 The Central Bureau of Statistics forecasts (for all scenarios) indicate that the weight of the 65-and-over population in 2035 will be 13 to 16 percent of the total population, compared with 10 percent today, www.cbs.gov.il/www/hodaot2013n/01_13_170t1.pdf.

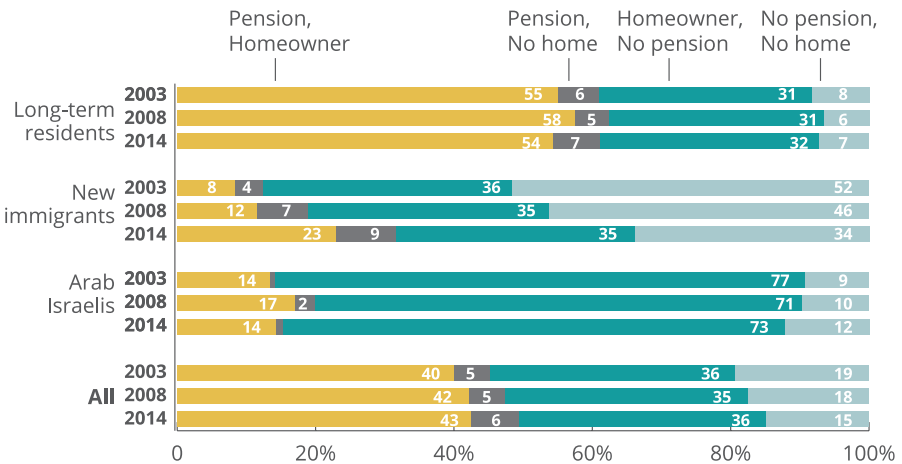
15 The percentage of Haredim within the total older population is very low, meaning that this subgroup does not appear separately but is included in the long-term resident Jewish population instead.

Israelis. Over the years, there was a slight decline in homeownership in the Arab Israeli sector. By contrast, the homeownership rate increased among immigrants. Within the immigrant subgroup, there are gaps in ownership rates between younger and older cohorts – in particular, the younger cohorts have higher homeownership rates (Table 5).

- There are large gaps between long-term resident Israelis and Arab Israelis and the immigrant subgroup in terms of eligibility for occupation pensions. Long-term resident Israelis and Arab Israelis do not display major or consistent changes over time in their occupational pension eligibility rates. By contrast, immigrants show a rise in the eligibility rate that is consistent with their number of years' residence in Israel and with accumulation of rights. It should be noted that most occupational pension payments are made today on the basis of pension arrangements that preceded the 2008 reform, and that most of today's older population is affected to a limited degree, if at all, by the Mandatory Pension Arrangements expansion order.

Figure 6. Distribution of older age households

By subgroups, homeownership and qualification for occupational pension



Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Income Survey (2003, 2008), Expenditure Survey (2014).

Figure 7 and Table 5 show additional data on the various components of the older population's economic disparities: income composition, poverty rate, employment and housing. A few notable points:

- Income differences between the long-term resident Israeli population and the immigrant and Arab Israeli populations stem mainly from a market income gap, in particular, the occupational pension component. This is true for all cohorts, and the absolute disparity grows in the older cohorts. Another cause of gaps, discernible among all cohorts, is differences in income from work between subgroups. Also, Arab Israeli households are larger on average than Jewish households, making them even more likely to occupy a low place in terms of income ranking.
- Among those aged 60-64, there are large disparities between Jews and Arab Israelis in terms of the number of household wage earners (1.5 for long-time resident Israelis, 1.4 for immigrants, and 0.8 for Arab Israelis, see Table 5). Most of the gap is explained by a higher employment rate among older Jews (Kimhi and Shraberman, 2013), but the data point to yet another explanation: a high percent of Jewish households have more than two wage earners (generally the third one is an adult child living with the parents). This phenomenon is concentrated among households headed by couples (which account for 70 percent of all households aged 60-64)¹⁶ – 21 percent of which have more than two wage earners.¹⁷
- In general, as age rises, so does the probability of living under the poverty line, but there are several differences in this regard among the population and age groups. For long-time resident Israelis, the poverty rate surges from 8 percent in the 60-64 age group to 15-16 percent at ages 65-74, while those aged 75 and over have more than a 20 percent probability of living below the poverty line (Table 5). Arab Israelis have the highest poverty rates of all, and these rates increase with age (42 percent for those aged 60-64 and 85 percent for those aged 75 and over). For immigrants, the probability of being under the poverty line rises substantially with age up to the 70-74 age group (69 percent), but among those aged 75 and over the poverty rate is actually lower – about half of immigrants in this age range live under the

16 Households headed by couples, with no limit on the number of individuals in the household.

17 For immigrants the figure is more than 19 percent, but the number of observations is small.

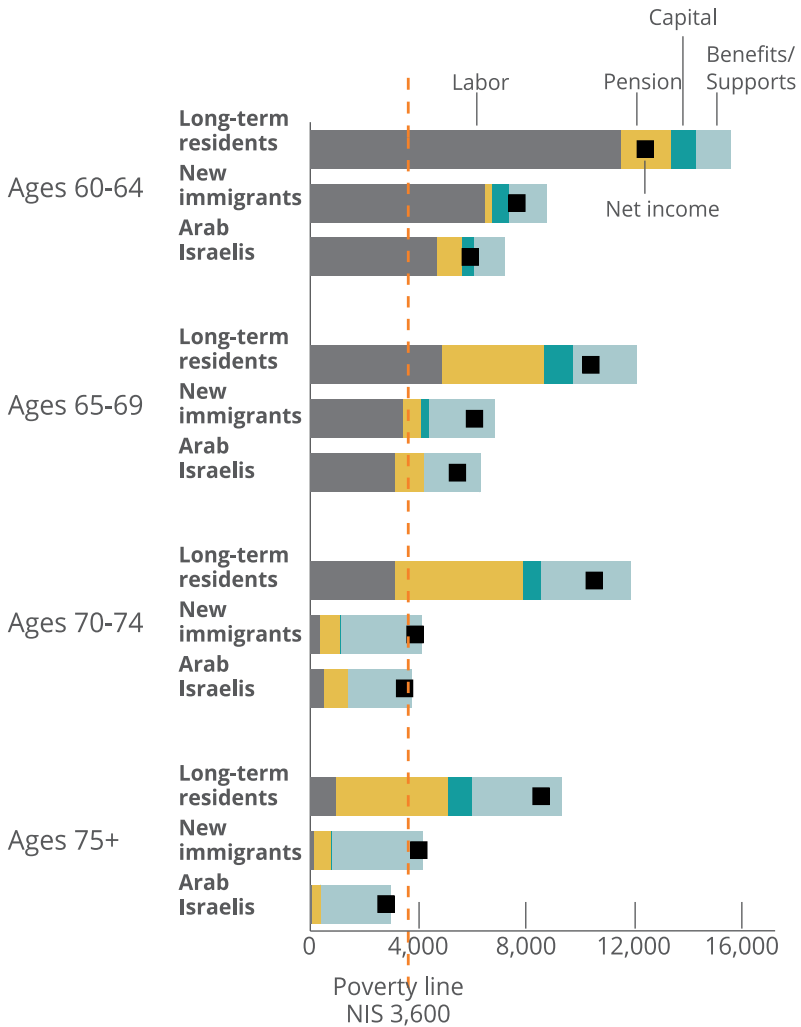
poverty line. The explanation for this appears to lie in the relationship between government assistance to immigrants and homeownership. The homeownership rate among immigrants declines with age (for example, 70 percent of those aged 60-64 versus 24 percent of those aged 75 and over), while the level of financial assistance that the state provides to immigrant families that do not own homes is higher than that provided to home-owning families (Appendix Figure 3). It is therefore not surprising that those aged 75 and over have a higher average disposable income than do those aged 70-74 (NIS 370 above the poverty line versus NIS 250 above the poverty line, respectively).

To conclude, although our discussion in this section has focused on income gaps between groups, the decomposition by the Theil index indicates that only a small portion of total inequality among older population is explained by income gaps between subgroups. For example, only 15 percent of total market income inequality among those aged 65 and over, and 18 percent of disposable income inequality, can be explained by income disparities between the various subgroups.

Moreover, there are myriad benefits provided to the older adult population that are not reflected in monetary income but rather in discounts and exemptions, such as funding of medications and discounts on arnona (property tax), public transportation and electricity bills.¹⁸ Since these benefits do not show up in Central Bureau of Statistics data, they were not included in our analysis. They do, however, represent another facet of government assistance that merits attention. They complete the picture of the Israeli older adult population's income structure.

18 For more on this topic, see the Kol Zchut website.

Figure 7. Household income, 2014
 By income source, population and age groups, NIS



Calculated using the OECD method.
 Source: Haim Bleikh, Taub Center.
 Data: Central Bureau of Statistics, Expenditure Survey (2014).

Table 5. Household characteristics of the older adult population, 2014

Subgroup	Poverty rate*	Homeownership rate	Household size	Average number of wage earners in household
Ages 60-64				
Long-time residents	8%	84%	2.3	1.5
New immigrants	19%	70%	2.0	1.4
Arab Israelis	42%	86%	2.8	0.8
Ages 65-69				
Long-time residents	15%	86%	1.9	0.7
New immigrants	36%	60%	1.8	0.7
Arab Israelis	53%	98%	2.1	0.5
Ages 70-74				
Long-time residents	16%	88%	1.7	0.5
New immigrants	69%	44%	1.6	0.1
Arab Israelis	79%	93%	2.1	0.1
Ages 75 and over				
Long-time residents	20%	84%	1.5	0.1
New immigrants	50%	24%	1.4	0.1
Arab Israelis	85%	88%	1.7	0.0

* Calculated using the OECD method.

Source: Haim Bleikh, Taub Center.

Data: Central Bureau of Statistics, Expenditure Survey (2014).

Conclusion

This work looked at changes in Israeli poverty and inequality rates from 2002 on, broken down by age group (working age versus older population) and population subgroups (within the working age population), using the Shapley decomposition method, to more identify prevailing trends within the groups and their interactions. The data show that, for the older population, inequality and market income poverty declined significantly, and that raising the retirement age was one of the factors that contributed to this. Regarding income-level differences between population subgroups within the older population, large disparities were found, mainly between the long-term resident Jewish Israeli group and the immigrant and Arab Israeli groups. Most of the gap is explained by differences in occupational pension income and in income from work in each subgroup, although there was a rise in the percent of those eligible for occupational pensions among immigrants. Alongside the differences in monetary income, there are large homeownership rate differences between the groups: high rates among long-term resident Israelis and Arab Israelis, versus a low rate among immigrants.

Market income inequality declined steadily among the working age population during the research period, but only in the last few years has this decline been discernable by a drop in disposable income inequality. The decline occurred concomitantly with two major policy measures that were taken after 2003: benefit cutbacks and direct tax reductions. These measures produced a change in the income composition of households (income from work increased at the expense of government allowances). Thus, labor market developments have, in recent years, played a central role in the decline in disposable income inequality.

The breakdown of the working age population by subgroups showed that most of the contribution to declining market income inequality came from the non-Haredi Jewish sector. This fact is not surprising, as this sector accounts for the largest share both of the total population and of total income. What this means is that, although there were significant increases in market income among Arab Israelis and Haredim, the degree to which they are found in changes in income inequality (both market and disposable income) is limited.

Although the drop in market income inequality is good news, it does not justify abandoning efforts to a further reduction. OECD data place Israel near the developed-country average for market income inequality within the total population, but with regard to disposable income Israel ranks among the most unequal countries. However, when we look at market income inequality solely within the working age population, Israel's inequality

figures are high compared with those of the other developed countries (Bleikh, 2015). If Israel wants to approach the level of disposable income inequality that characterizes the OECD countries, it must act to reduce market income inequality among working age people, as this is the subgroup whose weight in the total population and income is highest. Changes in this group would have the greatest impact on total inequality.

Working age poverty rates present a picture that is worthy of note. Although poverty rates between the start of the research period and its end did not change, the composition of the population living in poverty changed significantly. In 2002, the percent of Haredi and Arab Israeli households accounted for 44 percent of the entire working age population living in poverty, compared with 54 percent in 2014 — an increase that exceeds the growth rate of both groups within the working age population. The change in composition of the working age poor takes on special importance given the objective defined by the Committee for the War Against Poverty (the Elalouf Committee): reducing poverty rate among individuals within the total population to the OECD average (11 percent), compared with its current rate of 19 percent.

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Appendix

The switch from the Income Survey to the Expenditure Survey

To ensure consistency between periods, it would have been desirable to compare data for 2011 and 2014, but in 2012 the Central Bureau of Statistics stopped publishing income surveys, meaning that such a comparison could be based on expenditure surveys only. Moreover, due to changes that were made to the Household Expenditure Survey in 2012, even a comparison between the 2011 and 2014 expenditure surveys for purposes of decomposing inequality into population subgroups is problematic. For instance, in the 2011 income and expenditure surveys the Arab Israeli sector's share of the working age population was 16.9 percent and 17.1 percent of all households, respectively (by number of persons: 22.5 percent and 22.9 percent, respectively). The 2012 switch to the Expenditure Survey reduced the sector's share to 15.2 percent of all households (20.5 percent by number of persons) and to 15.6 percent in 2014. For analysis purposes, this is an unreasonable amount of change, and because this study takes into account impacts stemming from the relative sizes of subgroups, it would have been wrong to examine changes in the indices between 2011 and 2014 on the basis of the Expenditure Survey.

The Theil index of inequality

The index used to analyze inequality in this work is the Theil index (Theil, 1967). The index takes positive values (or 0 in situation of complete equality); the higher the index number, the higher the degree of inequality. The index is defined as follows:

$$T = \frac{1}{n} \sum_{i=1}^n \frac{y_i}{\bar{y}} \ln \left(\frac{y_i}{\bar{y}} \right)$$

where n – population size, y_i – individual/household income ($i=1\dots n$) and \bar{y} – population's average income.

One important property of the inequality index is its decomposability, that is, the index makes it possible to decompose inequality into two components: (a) inequality **within** population groups – inequality stemming from income differences **within** each subgroup; (b) inequality **between** population groups – inequality stemming from mean income differences between the subgroups. The equation used to calculate the indices is:

$$\begin{aligned}
 T &= \sum_{k=1}^m w_k \frac{\bar{y}_k}{\bar{y}} T_k + \sum_{k=1}^m w_k \frac{\bar{y}_k}{\bar{y}} \ln \left(\frac{\bar{y}_k}{\bar{y}} \right) = \\
 &= \sum_{k=1}^m s_k T_k + \sum_{k=1}^m s_k \ln \left(\frac{s_k}{w_k} \right) = \\
 &= T_{\text{within}} + T_{\text{between}}
 \end{aligned}$$

where:

T - Theil index for total population

w_k - Relative size of group k

\bar{y}_k - Mean income of group k

T_k - Theil index for group k

s_k - Share of group k income within total income

T_{within} - Inequality within the groups (within)

T_{between} - Inequality between the groups (between)

We can see that the left-hand component of the index (within) is the weighted sum of the inequality levels within the subgroups, and that the weights are represented by an income weight (the product of population size and the ratio between the group's average income and the total average income). The right-hand component of the index (between) focuses on income gaps between the various subgroups. The basic premise of the between component is that all individuals in a given subgroup receive the group's mean income. Thus, the $\frac{s_k}{w_k}$ ratio in the between component has special meaning. When a given subgroup has an income share that is higher than its size within the total population (i.e., the ratio is greater than 1), its contribution to the index will be positive. When the ratio is less than 1, the subgroup's contribution to the index will be negative, and in instances when the ratio is exactly 1, inequality between the groups can be said to not exist. Additionally, the fact that the between inequality component is not negative even though the subgroups' contributions can be negative, has additional significance: the index gives greater weight to subgroups whose income weight is higher than their share in the population, than to subgroups whose income weight is lower than their share in the population.

Shapley decomposition

In order to quantify the various factors' contributions to changes in poverty and inequality over time, Shapley decomposition was used in this work. The

idea is based on the game theory model of the Shapley value (Shapley, 1953). The main idea is to determine group members' bargaining power in coalition-building. The bargaining power of a given actor must be computed in all states of the world that allow the coalition to be built. This kind of weighting constitutes a given actor's average bargaining power (contribution/profit) in a game of this kind.

For example, if we want to build a three-actor (x, y, z) coalition with the value $I(x,y,z)$, we have to take into account the following conditions:

- A. "Order of entry" – There are six possible states of the world: (x,y,z); (x,z,y); (y,x,z); (z,x,y); (y,z,x); (z,y,x).
- B. Value adjusted for possible sub-coalitions – $I(x)$, $I(y)$, $I(z)$, $I(x,y)$, $I(x,z)$, $I(y,z)$.

When focusing on Actor x, there are two states of the world in which he enters the room first. In such states, his marginal contribution will be independent of the other two actors' order of entry, meaning that his contribution to the total index will be $I(x)$ and the probability of this will be $2/6$. In a third case, Actor x enters a second room after Actor y. In this instance, his marginal contribution will be equal to $I(y,x)-I(y)$ and the probability of this will be $1/6$. In a fourth case, Actor x enters a second room after Actor z. In a similar manner, his marginal contribution will be equal to $I(z,x)-I(z)$ with a probability of $1/6$. Finally, there are two states of the world in which Actor x enters the room last. In this case, his marginal contribution will be equal to $I(x,y,z)-I(y,z)$, with a probability of $2/6$. Similarly, we can calculate the marginal contributions of actors y and z in such a way as to obtain the following:

$$C(x) = \frac{2}{6}I(x) + \frac{1}{6}[I(y,x)-I(y)] + \frac{1}{6}[I(z,x)-I(z)] + \frac{2}{6}[I(x,y,z)-I(y,z)]$$

$$C(y) = \frac{2}{6}I(y) + \frac{1}{6}[I(x,y)-I(x)] + \frac{1}{6}[I(z,y)-I(z)] + \frac{2}{6}[I(x,y,z)-I(x,z)]$$

$$C(z) = \frac{2}{6}I(z) + \frac{1}{6}[I(x,z)-I(x)] + \frac{1}{6}[I(y,z)-I(y)] + \frac{2}{6}[I(x,y,z)-I(x,y)]$$

From these three expressions it is easy to show that the total index equals the actors' marginal contributions:

$$I(x,y,z) = C(x) + C(y) + C(z)$$

This idea was extended by Shorrocks (1999) to each index or function (linear or not). In particular, this decomposition method can be applied to cases where we want to examine changes over time. In this instance the Theil index can be expressed as a function of three variables:

$$T=f[(\dots,T_k,\dots),(\dots,w_k,\dots),(\dots,\bar{y}_k,\dots)]=f(x,y,z)$$

Thus, we can explain the change in inequality over time by studying the changes in the x, y, z variables, so that:

$$\Delta T=\Delta h[\Delta x, \Delta y, \Delta z]$$

where:

- **The inequality effect (Δx).** The changes in total inequality stemming from changes in inequality within the subgroups (affects inequality within groups).
- **The population effect (Δy).** The changes in total inequality stemming from changes in the relative sizes of subgroups (affects both inequality within groups and inequality between groups).
- **The income effect (Δz).** The changes in total inequality stemming from changes in the average incomes of subgroups (affects both inequality within groups and inequality between groups)

Computation of the marginal contribution of the inequality effect $C(\Delta x)$:

$$\begin{aligned} & \frac{1}{6} \times [\Delta I(\Delta x \neq 0; \Delta y \neq 0; \Delta z \neq 0) - \Delta I(\Delta x = 0; \Delta y \neq 0; \Delta z \neq 0)] + \\ & + \frac{1}{6} \times [\Delta I(\Delta x \neq 0; \Delta z \neq 0; \Delta y \neq 0) - \Delta I(\Delta x = 0; \Delta z \neq 0; \Delta y \neq 0)] + \\ & + \frac{1}{6} \times [I\Delta(\Delta y = 0; \Delta x \neq 0; \Delta z \neq 0) - I\Delta(\Delta y = 0; \Delta x = 0; \Delta z \neq 0)] + \\ & + \frac{1}{6} \times [I\Delta(\Delta z = 0; \Delta x \neq 0; \Delta y \neq 0) - I\Delta(\Delta z = 0; \Delta x = 0; \Delta y \neq 0)] + \\ & + \frac{1}{6} \times [I\Delta(\Delta y = 0; \Delta z = 0; \Delta x \neq 0) - I\Delta(\Delta y = 0; \Delta z = 0; \Delta x = 0)] + \\ & + \frac{1}{6} \times [I\Delta(\Delta z = 0; \Delta y = 0; \Delta x \neq 0) - I\Delta(\Delta z = 0; \Delta y = 0; \Delta x = 0)] \end{aligned}$$

Computation of the marginal contribution of the population effect $C(\Delta y)$:

$$\begin{aligned}
& \frac{1}{6} \times [\Delta I(\Delta y \neq 0; \Delta z \neq 0; \Delta x \neq 0) - \Delta I(\Delta y = 0; \Delta z \neq 0; \Delta x \neq 0)] + \\
& + \frac{1}{6} \times [\Delta I(\Delta y \neq 0; \Delta x \neq 0; \Delta z \neq 0) - \Delta I(\Delta y = 0; \Delta x \neq 0; \Delta z \neq 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta z = 0; \Delta y \neq 0; \Delta x \neq 0) - \Delta I(\Delta z = 0; \Delta y = 0; \Delta x \neq 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta x = 0; \Delta y \neq 0; \Delta z \neq 0) - \Delta I(\Delta x = 0; \Delta y = 0; \Delta z \neq 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta z = 0; \Delta x = 0; \Delta y \neq 0) - \Delta I(\Delta z = 0; \Delta x = 0; \Delta y = 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta x = 0; \Delta z = 0; \Delta y \neq 0) - \Delta I(\Delta x = 0; \Delta z = 0; \Delta y = 0)]
\end{aligned}$$

Computation of the marginal contribution of the income effect $C(\Delta z)$:

$$\begin{aligned}
& \frac{1}{6} \times [\Delta I(\Delta z \neq 0; \Delta y \neq 0; \Delta x \neq 0) - \Delta I(\Delta z = 0; \Delta y \neq 0; \Delta x \neq 0)] + \\
& + \frac{1}{6} \times [\Delta I(\Delta z \neq 0; \Delta x \neq 0; \Delta y \neq 0) - \Delta I(\Delta z = 0; \Delta x \neq 0; \Delta y \neq 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta y = 0; \Delta z \neq 0; \Delta x \neq 0) - \Delta I(\Delta y = 0; \Delta z = 0; \Delta x \neq 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta x = 0; \Delta z \neq 0; \Delta y \neq 0) - \Delta I(\Delta x = 0; \Delta z = 0; \Delta y \neq 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta y = 0; \Delta x = 0; \Delta z \neq 0) - \Delta I(\Delta y = 0; \Delta x = 0; \Delta z = 0)] + \\
& + \frac{1}{6} \times [I\Delta(\Delta x = 0; \Delta y = 0; \Delta z \neq 0) - \Delta I(\Delta x = 0; \Delta y = 0; \Delta z = 0)]
\end{aligned}$$

Similarly, the total poverty rate will be defined as a function of two variables:

$$P = f[(\dots, w_k, \dots), (\dots, p_k, \dots)] = f(x, y).$$

where:

P – the poverty rate in the population as a whole

W_k – the relative size of group k

P_k – Group k's poverty rate

Thus, we can explain the changes in poverty rate over time by looking at changes in the variables x and y, so that: $\Delta P = \Delta h[\Delta x, \Delta y]$

where:

- The “population effect (Δx)” – changes in the total poverty rate stemming from changes in the subgroups' relative sizes
- The “poverty effect (Δy)” – changes in the total poverty rate stemming from changes in the poverty rates within the subgroups

Computation of the contribution of the poverty effect $C(\Delta x)$:

$$\frac{1}{2} \times [\Delta I(\Delta x \neq 0; \Delta y \neq 0) - \Delta I(\Delta x = 0; \Delta y \neq 0)] + \\ + \frac{1}{2} \times [\Delta I(\Delta x \neq 0; \Delta y = 0) - \Delta I(\Delta x = 0; \Delta y = 0)]$$

Computation of the contribution of the population effect $C(\Delta y)$:

$$\frac{1}{2} \times [\Delta I(\Delta y \neq 0; \Delta x \neq 0) - \Delta I(\Delta y = 0; \Delta x \neq 0)] + \\ + \frac{1}{2} \times [\Delta I(\Delta y \neq 0; \Delta x = 0) - \Delta I(\Delta y = 0; \Delta x = 0)]$$

