Intragenerational Mobility of the Top Earners in Israel before and after the 2008 Global Financial Crisis

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Abstract

In this study we explore how macroeconomic shocks affect the intragenerational mobility of the top income earners. We analyze a panel data on the income levels of 22,601 individuals in Israel for the period between 1999-2013, and use the Global Financial Crisis of 2008 as a case study, as it occurred in the middle of our analyzed period. We use the common intragenerational mobility measurements used in the literature. However, since these are usually descriptive, we improve them by using different statistical tests, which enable us to estimate the statistical significance of these measurements. Our results show that the Global Financial Crisis had a minor and transitory effect, if any, on the intragenerational mobility of the top income earners in Israel. The implications of the expected global economic crisis due to the coronavirus pandemic, for the top income earners is discussed.

Keywords: Income Distribution, Inequality, Economic Crises, Social Mobility, Methodology

JEL Classification: E320 Business Fluctuations; Cycles, J690 Mobility, Unemployment and Vacancies: Other, D310 Personal Income, Wealth and Their Distributions

1 Introduction

Income inequality has risen in many advanced economies in the past several decades (OECD, 2011). Due to this ongoing rise in inequality, accompanied by the Global Financial Crisis of 2008, different protest movements such as Occupy Wall Street have shifted their attention to social and economic mobility of the top income earners.

Indeed, the income concentration of this segment of the population attracted much research attention (e.g., Atkinson, 2007; Dell, 2007; Saez and Veall, 2005; Salverda and Atkinson, 2007; Piketty et al., 2018; Piketty, 2014). Yet, research regarding its mobility patterns remains scarce (e.g., Jenderny, 2016; Auten et al., 2013; Saez and Veall, 2005; Jantti et al., 2010). Moreover, we know little about the impact of macroeconomic shocks on intragenerational mobility in general and on the upper fractiles in particular (see, for example, El Herradi and Leroy, 2019 and Yu, 2010). The importance of studying the consequences transitory economic crises for economic inequality and mobility is amplified by the likely economic crisis the world is facing due to the Coronavirus epidemic.

Several arguments indicate the importance of understanding intragenerational mobility of the top fractiles. First, mobility of the top income earners offsets some of the problems arising from income concentration, such as the political power of those who have economic power and the fact that the benefits of growth are enjoyed by a smaller group. When the top income earners are mobile, economic and political power shifts between individuals, and a bigger portion of the population benefits from growth (Jenderny, 2016). Second, there is no reason to believe that the mobility patterns of different income groups are similar (Bjorklund et al., 2012); therefore, shedding light on a specific income group can deepen our understanding of the mobility in a society.

In this paper, we analyze whether the intragenerational mobility of the top fractiles in Israel was affected by the Global Financial Crisis of 2008. To do so, we use longitudinal income data of 22,601 individuals who were born in Israel between 1963 and 1973, and were traced from 1999 to 2013. The data include both employment and business incomes. Such a long period is quite unique in the intragenerational mobility literature of top income earners, where the period analyzed ranges between six years (Jenderny, 2016) and ten (Auten and Gee, 2009), with one exception of nineteen years (Saez and Veall, 2005). Furthermore, The Global Financial Crisis of 2008 is in the middle of our period, enabling us to be among the first to look at intragenerational mobility in permanent income and how it is affected by transitory shocks to income.

The fact that our research population includes only a few birth cohorts (11) who are followed from the beginning of their economic life cycle (ages 26-36 in 1999) enables us to overcome some of the problems associated with measuring intragenerational mobility in cross-sectional data. In particular, since the individuals in our cohort are close in age, they experience the same life-cycle events simultaneously. Thus, our mobility measures are less affected by life cycle patterns.

We measure intragenerational mobility using two of the most frequently used measures of income mobility in the literature. The first measure we use is the persistence rate. This measure estimates the probability that an individual who belonged to a specific fractile at a certain year, belongs to it also after a given number of years. The second measure we use is the Top Income Mobility (TIM) curve. This measure, introduced by Shorrocks (1978b), exploits the equalizing effect mobility has on top income concentration. The TIM curve is measured by comparing the annual income distribution of the top fractiles to their permanent income distribution.[1]

These measures, however, provide only a descriptive depiction of trends in income mobility. We improve on these measures by developing methodologies that enable us to test the degree to which changes in intragenerational mobility that are indicated by these measures are also statistically significant. This way we can better document change over time in intragenerational mobility.

2 Literature Review

The research regarding top income earners is mainly focused on their income shares, based on annual tax records. Such studies were conducted in many countries, including France (Atkinson and Piketty, 2007), Germany (Dell, 2007), Canada (Saez and Veall, 2005), the United Kingdom (Atkinson, 2007), the Netherlands (Salverda and Atkinson, 2007) and the U.S (Atkinson and Piketty, 2007). The evolution of the shares of the top income earners in the vast majority of the countries was strikingly similar: a substantial fall in the first half of the 20th century, followed by a rise since the 1980s. The U.S has experienced the most significant increase in top earners' income shares, whereas the income concentration increase was less severe in European countries.

Studies concerning the intergenerational mobility of the top fractiles are less common since intergenerational panel data on those fractile members are hard to obtain. For this reason, the available research on the mobility of the top fractiles is mainly concerned with intragenerational mobility. There are two main mobility measurements relevant for this study that are used in the literature. The first is the persistence rate. Studies using this method were conducted in Canada (Saez and Veall, 2005), France (Landais, 2008), the U.S (Auten et al., 2013; Auten and Gee, 2009), Norway (Aaberge et al., 2013) and Germany (Jenderny, 2016). We add to this literature in two ways: First,

we provide a statistical tool to test the evolution of the persistence rate over time. Second, we use data on Israeli income earners for a long period of time, thus contribute to the understanding of intragenerational mobility of the top fractiles in another advanced economy. The second mobility measure is the Top Income Mobility (TIM), which is based on the Shorrocks effect (Shorrocks, 1978a,b). This method was used to measure mobility in Canada (Saez and Veall, 2005), Norway (Aaberge et al., 2013) and Germany (Jenderny, 2016). We extend this method by introducing a formal statistical test to assess differences between the income distributions that produce the TIM curve. Moreover, we use these two measures to examine the effect of the Global Financial Crisis of 2008 and the Dot.com crisis on intragenerational mobility.

Although mobility has attracted much attention from researchers in recent years, we know little about the impact of different macroeconomic events on mobility. One of the few studies that explore the relation between mobility and macroeconomic events was conducted by Yu (2010), who analyzed how the economic stagnation in Japan affected job mobility. Yu finds that voluntary job turnover among male workers increased and that the gender gap in economic instability shrank. Another study was conducted by El Herradi and Leroy (2019), who examined the impact of monetary policy on top income shares in 12 advanced countries. They find that monetary tightening has a negative effect on income concentration at the top. Glover, Krueger and Ríos-Rull (2020) also explored this issue by analyzing how welfare costs of a recession are distributed between generations. They found that asset prices decline impact older individuals more severely compared to younger individuals.

While research regarding top income shares and mobility is becoming more and more common, in Israel it remains scarce. Most of the research regarding mobility in

Israel concerns intergenerational mobility across the entire income distribution (Aloni and Krill, 2017; Frish and Zussman, 2009; Beenstock, 2002). Only two studies on intragenerational income mobility in Israel were conducted, one by Romanov and Zussman (2003) and one by Ben-Naim and Belinsky (2012). Whereas Romanov and Zussman (2003) studied intragenerational income mobility across the entire income distribution, Ben-Naim and Belinsky (2012) studied the mobility of the top income earners in Israel between 1999-2009 based on persistence rate only. The latter found that the one-year persistence rate was 86% for the top 10%, 70% for the top 1% and 50% for the top 0.1 percentiles. They also found that 33.4% of those who belonged to the top 1 percent in 1999 were also a part of that fractile in 2009.

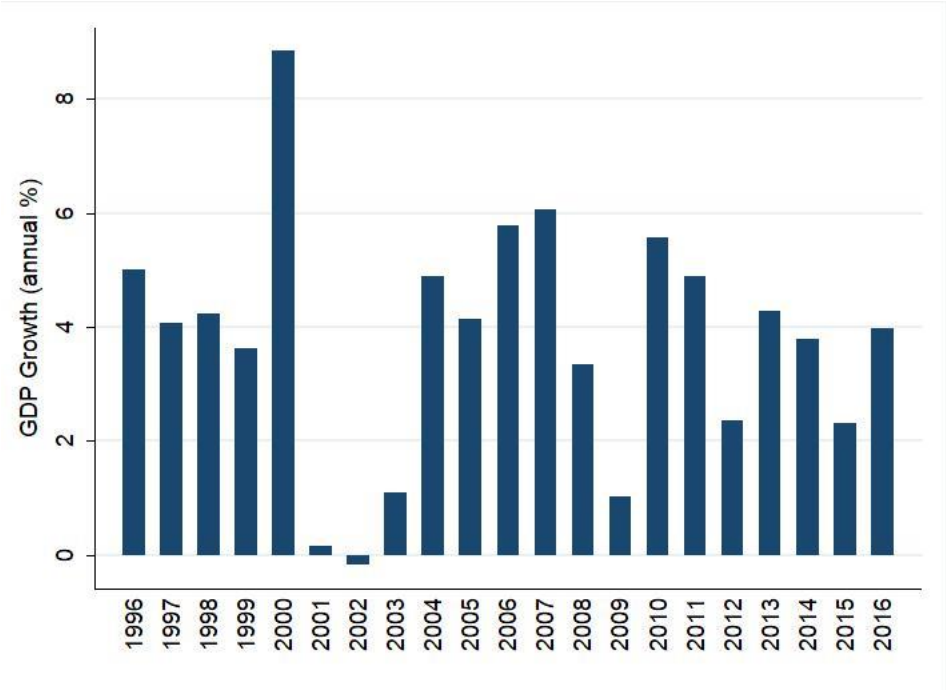
Our results on persistence rates are largely identical, however, we differ from their study by using an additional measures pertaining to Israeli data that were never used before. Particularly, we apply the TIM curve, as well as introducing formal tests to examine whether the results are statistically significant. Just as important, we follow a cohort over a long period of time, before and after the Global Financial Crisis of 2008, thereby enabling assessing the degree to which, if at all, macroeconomic shocks affect income mobility. These additional procedures further deepen our understanding of the mobility of the top fractiles in general, and those in Israel in particular.

3 Macroeconomic Shocks and their Impact on Israel and the top fractiles

In the period analyzed Israel endured two macroeconomic shocks: the Dot.com crisis in 2000, followed by the *Second Intifada,* and the Global Financial Crisis of 2008. These macroeconomic shocks can be clearly seen in Figure 1: the GDP growth was substantially low during these two shocks, in the years 2001-2003 and 2009. As can be

also seen from the figure, the GDP growth quickly recovered in the years following the crises. The fact that the time period of our dataset includes the crises, as well as the years after recovery, enables us to examine the impact of these macroeconomic shocks on intragenerational mobility among the top income earners. We focus on the Global Financial Crisis of 2008, because the years in our sample, cover both the period before, during and after the crisis, whereas our sample does not include the years before the Dot.com crisis.

Figure 1: Annual real GDP growth.



Source: Israel Central Bureau of Statistics.

The Global Financial Crisis hit Israel, though its impact was not as severe as in other advanced economies: As can be seen in Figure 1, GDP growth rates were low during the peak of the crisis around the world. Furthermore, the unemployment rate rose during this period from 7.7 in 2007 to 9.5 in 2008. The crisis triggered an aggressive expansionary monetary policy in Israel, which materialized by both a sharp

decline in the nominal interest rate (from 4.25% at the eve of the crisis to a historically low level of 0.5% during and a year after the peak of the crisis), as well as by a strong intervention of the Bank of Israel in the foreign exchange market, in order to alleviate the sharp appreciation the Israeli currency suffered during this period.[2]

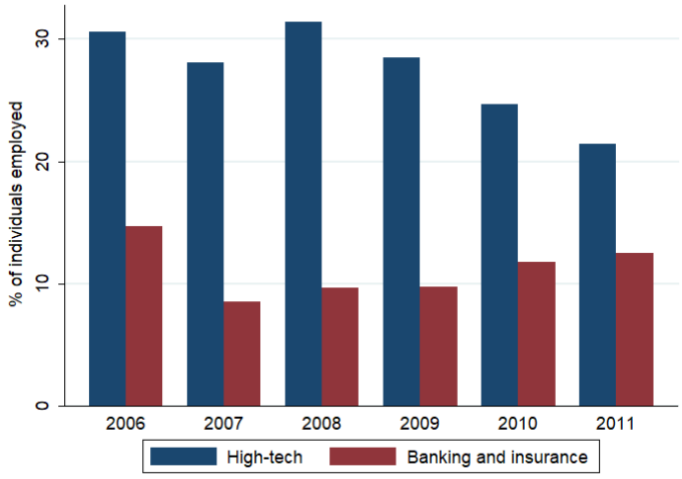
Yet as can be seen in Figure 1, the Israeli economy recovered relatively fast from the crisis: GDP growth rate returned to its before-crisis levels by the end of 2009. While the recovery still cannot be seen in all macroeconomic variables – nominal interest rate is still historically low and the exchange rate has not recovered yet its levels before the crisis – the economic variables which are important to our analysis, GDP growth and employment, recovered already by 2009.

There are several reasons to presume why the Global Financial Crisis should have affected the intragenerational mobility of the top income earners. As evident from Figure 2, a large number of the top fractiles in Israel were employed in the financial or high-tech sectors before and during the global financial crisis. The top 1% is also characterized by a large proportion of managers, with more than a third of the fractile's members are employed as managers. 35% of those managers are employed in the high-tech and banking sectors. The crisis could have affected wages in these sectors either directly, due to the losses the financial sector encountered[3], or indirectly, as funds for investment in the high-tech sector were lower during the financial crisis. Finally, since the high-tech sector relies on exports, it could have been negatively affected also due to the appreciation of the Israeli Shekel. As can be seen in figure 3, the export-to-GDP ratio fell by 17.3% during the financial crisis, from 38.8% to 32%. Moreover, the export of services, which includes the high-tech sector, continued to fall by 10.8% in 2009.[4]

Indeed, Figures 4 and 5 show that the average incomes of the top fractiles declined dramatically during the crisis.

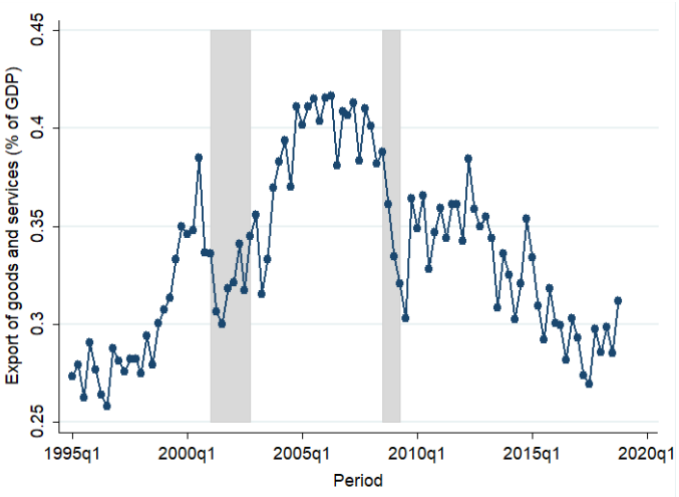
We analyze the impact of the global financial crisis on intragenerational mobility basing on the two the measures we presented above: the persistence rate and the TIM. Using both measures, we show that the effect of the Global Financial Crisis on the top fractiles intragenerational mobility was minor and temporary.

Figure 2: Percentage of the top 1% who were employed in the financial and high-tech sectors.



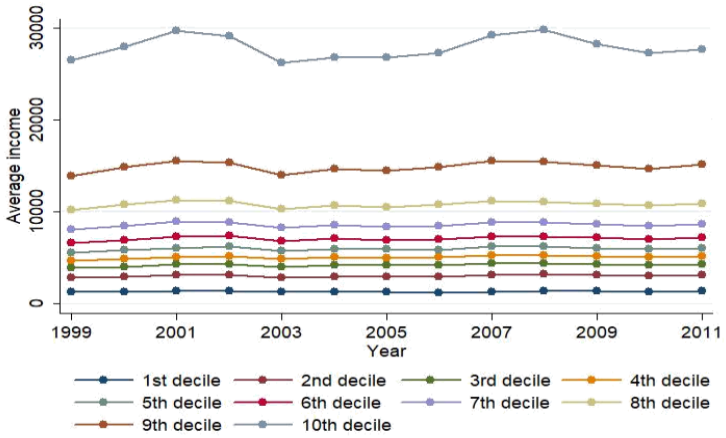
Source: Own computation, based on data from the household expenditure surveys conducted by Israel Central Bureau of Statistics.

Figure 3: Export of goods and services as percentage of GDP



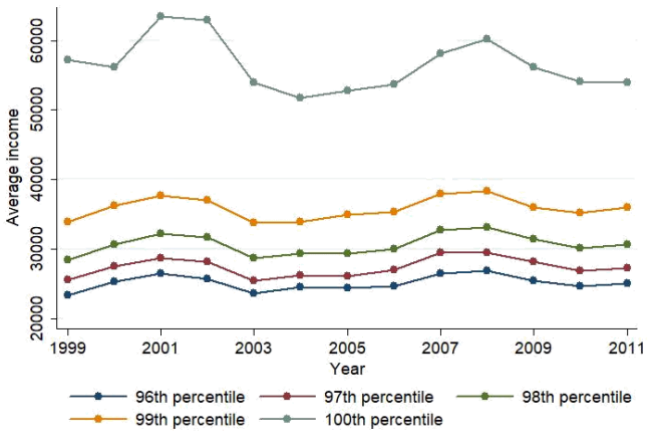
Source: Own computation, based on data from the Israel Central Bureau of Statistics and the Bank of Israel.

Figure 4: Average employment incomes by deciles.



Source: Own computation, based on data from the household expenditure surveys conducted by Israel Central Bureau of Statistics.

Figure 5: Average employment incomes of the top 5 percentiles.



Source: Own computation, based on data from the household expenditure surveys conducted by Israel Central Bureau of Statistics.

4 Data

To answer our research question, we use a panel of individuals born in Israel between 1963 and 1973. This panel is a part of a larger dataset constructed by the Israel Central Bureau of Statistics that merges data of parents and their offspring. The parents were surveyed in the 1983 census, when their offspring were in their parental home, and their children were then traced in the 1995 census by their unique national ID number. Since this paper is focused on intragenerational mobility,[5] we use a sample of the children alone, which consists of 25,085 individuals. Because each census consists of 20% of the population, the sample constitutes 4% of Israel's population in 1983.[6] This cohort of individuals in the census data is then merged with another dataset from the Israeli Tax Authority, which reports the annual gross business and employment incomes of

each individual in the sample for the years 1999 to 2013. The employment incomes are based on registered annual gross earnings as reported by the employer. The business incomes are based on registered annual gross earnings that originated from self-employment. Both the employment and business earnings in the dataset are before personal income taxes and all deductions. In addition, all incomes were normalized to 2014 New Israeli Shekels (NIS) as a base year.[7] We followed a standard practice in analyzing such data and excluded individuals from the sample whose average earning from either business or labor was lower than NIS 1000 a year. These small amounts might be some form of tax returns, and not actual income from employment or business. Additionally, these individuals might have had another source of income not included in our dataset, and therefore considering them as low-income earners could bias our results. After excluding the very low-income earners, our sample contains 22,601 individuals for whose income we have data on for the entire period.

We analyze mobility for two main concepts of income: employment income and total income, which is defined as the sum of employment and business incomes. To assure that the existence of individuals with zero incomes does not bias our results, we also use as a robustness check a sub-sample, which consists only of individuals who reported positive incomes in the entire period we analyze. This sub-sample contains 10,533 individuals. The summary statistics of the different income concepts in the different samples are presented in Table 1. For each of these types of income, we calculate the permanent income, which is defined as the arithmetic mean of annual incomes over a specific time period. In particular, we calculate the permanent income for periods of three, five and fifteen years. Finally, for each individual, we assign the fractile to which he/she belongs, based on his/her position relative to all other individuals in the sample.

This is done both for annual and permanent income. The permanent income for the entire sample and the top fractiles is presented in Table 2. Surprisingly, the permanent incomes over 3, 5 and 15 years are almost identical, suggesting that even a 3 year period is long enough to be considered as permanent income. These results corroborate a common practice to proxy permanent income by averaging out three annual incomes (Solon, 1992; Lee and Solon, 2009).

Table 1: Summary statistics.

	Observations	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Entire sample					
Permanent total income	25,085	99,243	112,974	0	4,340,400
Permanent employment income	25,085	84,119	96,920	0	3,623,900
Sample excluding permanent total incomes smaller than 1,000					
Permanent total income	22,601	110,140	113,871	1,000	4,340,400
Permanent employment income	22,601	93,183	97,947	0	3,623,900
Sample containing positive incomes only					
Permanent total income	10,533	153,828	120,064	8,550	1,990,100
Permanent employment income	8,665	142,257	104,652	7,550	1,245,800

Note: The permanent income corresponds to the mean income over 15 years.

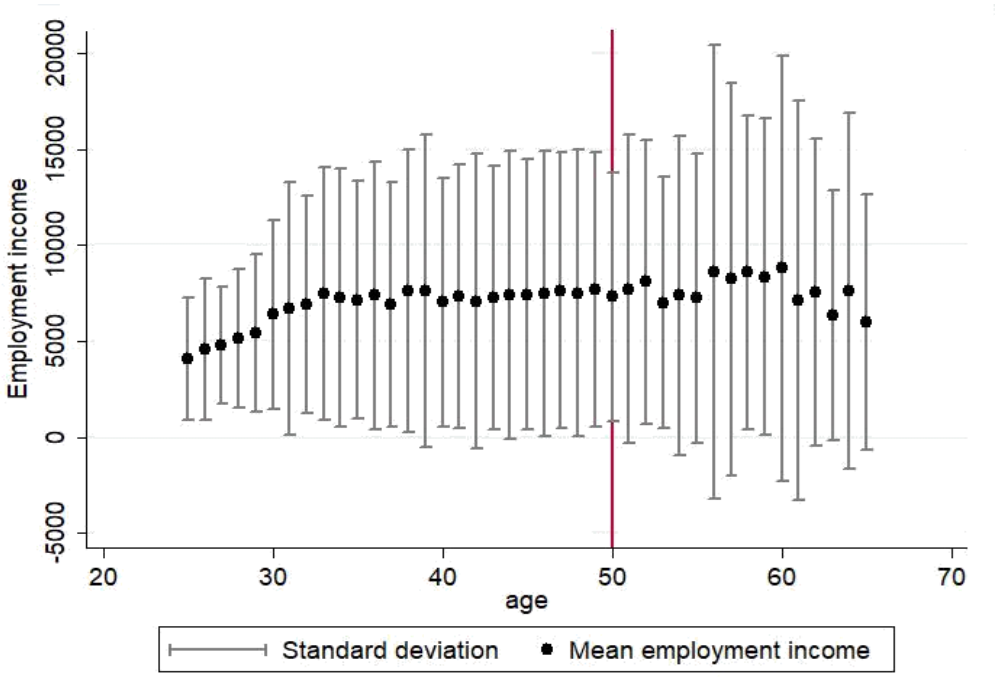
Table 2: Permanent incomes.

	3 years	5 years	15 years	Observations
Entire sample	110,639	110,470	110,140	22,601
Top 10%	365,340	367,686	360,695	2,260
Top 5%	459,347	462,789	452,630	1,130
Top 1%	720,046	726,116	710,262	226

Note: The permanent income over x years is calculated as the average of all x years permanent incomes.

In most previous studies, scholars have included individuals in different stages of the life cycle in the analysis. This might bias the estimation of intragenerational mobility, as individuals may experience different economic conditions at fixed ages (Ben-Porath, 1967; Solon, 1992). Young individuals tend to experience an upward trend in their income as they accumulate human capital through learning-by-doing, whereas older individuals may experience different trends. These different trends may be the consequence of either sorting into different career paths, or due to tasks that deteriorate health and are performed by only a segment of the population. Indeed, empirical studies that followed life-cycle earnings found supporting evidence for these different trends (Heckman et al., 2003; Lagakos et al., 2018). Moreover, this effect can be observed in the Israeli data as well. Figure 6 presents the mean and standard deviation of employment income by age in Israel in the year 2005 (which is in the middle of the period we analyze). It can be seen that the mean employment income increases with age for ages 25-35 and decreases for ages 60-65. Older ages are also characterized by larger standard deviation, meaning that incomes are more dispersed for older individuals. Consequently, such a trend might bias mobility measures upwards when using cross-sectional data. Fortunately, this problem is only marginal in our analysis, as we study a cohort of only 11 birth years, thereby any life course events affect our population at the same time.

Figure 6: Mean employment income by age, 2005.



Source: Own computation, based on data from the 2005 household expenditure survey conducted by Israel Central Bureau of Statistics

As mentioned above, our sample comprises only individuals who were in their parental home in 1983, and thus excludes all immigrants who immigrated to Israel during the 1990s. Immigrants usually have low income levels in the first years in their new country and relatively high mobility in the following years, as they acquire the necessary human and social capital (Cardoso, 2006). These two effects might bias downward mobility measures. Thus, focusing only on Israeli-born individuals helps in overcoming this potential bias.

5 Methodology

In this section we present the mobility indicators we use in the paper: The Persistence Rate and the TIM. Each measure sheds light on a different angle of mobility and

overcomes hurdles from the other measure. Thus, for example, the persistence rate enables following the change in mobility over time since it can be calculated for different starting points and periods of different lengths. Nonetheless, the persistence rate estimates the extent to which the top income earners were prone to rank changes. Thus, we add also the TIM curve, which estimates the extent of income variations experienced by the top income earners. Since income inequality at the top is typically larger than in the rest of the income distribution,[8] individuals at the top may experience large income changes without any rank movement. The TIM curve enables us to estimate this mobility, which is not visible in rank-based indicators such as the persistence rate. Taking both measures, then, should provide a fuller depiction of trends in intragenerational income mobility

Both of those measurements are, however, statistically descriptive. We improve them by using statistical tools which allow us to examine whether our results are statistically significant. First, we employ a linear probability model to measure the persistence rate. Second, we test the TIM curve by using the Kolmogorov-Smirnov test.

By analyzing the Persistence rate and the TIM curve before, during and after the Global Financial Crisis of 2008, we examine the impact of a macroeconomic shock on intragenerational mobility of the top fractiles. In what follows, we explain in greater detail how we calculated each measure.

5.1 The Persistence Rate

Persistence rate is the probability of individuals who belonged to the top fractile in a specific year to stay in the same fractile in the consecutive year(s). This measure is common in the literature (e.g., Jenderny (2016); Jantti et al. (2010); Auten et al. (2013)).

A common descriptive procedure to compute the persistence rate between t and $t+\tau$ is to divide the number of individuals who belonged to the analyzed fractile in both t and $t+\tau$ by the number of individuals who belonged to this fractile in time t. Such a procedure might be vulnerable for statistical inference, as one cannot test if the persistence rate is statistically significant. To overcome this problem, we introduce an alternative method to estimate the persistence rate, using a simple linear probability model.[9]

Consider the following model:

$$Per_i^{t+\tau} = \alpha + \beta \cdot Per_i^t + \epsilon_i, \qquad (1)$$

where Per_i^t is a dummy variable that equals 1 if individual i belonged to fractile ϕ at time t and zero otherwise, and ϵ_i is a random noise. Note that such a model is based on two dummies, and as such its coefficients have an economic significance, which enables us to calculate the persistence rate.

Our population has two groups. The first one consists of all individuals who did not belong to fractile ϕ at year t. For this group $Per_i^t = 0$. The other group, whose individuals were in fractile ϕ at year t, is the one for which $Per_i^t = 1$. The intercept, α, equals the mean of $Per_i^{t+\tau}$ among those who were not in fractile ϕ in time t. Hence, the intercept provides us the upward mobility to fractile between years t and $t+\tau$.

Next, note that the persistence rate is the probability that an individual who belonged to fractile ϕ in year t, also belonged to the same fractile in year $t+\tau$. This is the mean of the second group (i.e., those whose $Per_i^t = 1$). In our model, this mean is $\alpha + \beta$. Hence, our linear probability model provides a useful tool to measure both the upward mobility into the top fractiles and the persistence rate, as well as to test its statistical significance. We test to show that both α and β are statistically different from

zero. Furthermore, we wish to show that $\alpha + \beta \neq 1$, which implies no intragenerational mobility. To do so, we use the statistical rule that: $var(\alpha + \beta) = var(\alpha) + var(\beta) + 2cov(\alpha, \beta)$. We compute the variance of both α and β, and use the idea that $cov(\alpha, \beta) < 0$. This last idea stems from the fact that α represents the upward mobility (and thus the downward mobility), and is an increasing function of the persistence rate (as we show in Appendix B). Thus, a higher persistence rate implies a higher β and at the same time a lower α. As a result, we compute $var(\alpha)$ and $var(\beta)$ and use $var(\alpha) + var(\beta)$ as an upper bound for $var(\alpha + \beta)$. Following Jenderny (2016), Jantti et al. (2010) and Auten et al. (2013), we set τ to 1, 3 and 5 years.

The persistence rate discussed above is unconditional of survival in the years between *t* and *t+τ*. We also derive the conditional persistence rate: the probability of an individual who belonged to the top fractile in year *t* to stay in the same fractile in all of the years between *t+1* and *t+τ*. We do so by estimating the same linear probability model described in equation (1), where $Per_i^{t+\tau}$ equals one if the individual belonged to fractile ϕ in all years between *t+1* and *t+τ,* and 0 otherwise. As explained above, $\alpha + \beta$ equals the mean value in $Per_i^{t+\tau}$, of the individuals who belonged to fractile ϕ in *t*, which in this case equals the conditional persistence rate.

5.2 Top Income Mobility Measure

This mobility measure is based on Shorrocks (1978a,b), who showed that in a more mobile economy, the concentration of top income earners tends to decline as the analyzed period increases. Intuitively, since in a mobile society individuals experience income changes throughout the years, the permanent income distribution is more concentrated than the annual income distribution. Thus, the higher the mobility, the higher the difference between these two distributions.

Following Aaberge and Mogstad (2013), we measure the mobility of the top 1, 5, and 10 fractiles of income earners by the change in the annual income shares of those fractiles and their permanent income shares. In particular, for each sub-period of three and five years between the years 1999 and 2013, we calculate the permanent income of each individual. Based on the permanent incomes, we calculate the permanent income share of the 1, 5, and 10 top income fractiles. Then we calculate the annual income share of those fractiles. Finally, we calculate the Top Income Mobility (TIM) curve, defined as the difference between the two income shares. Let Z_t denote the annual income share of the fractile at stake and let $Z_{\tau,T}$ denote the permanent income share between the years and T of the same fractile. Then, the TIM is given by:[10]

$$TIM = \frac{1}{T}\sum_{t=\tau}^{T} Z_t - Z_{\tau,T} \qquad (2)$$

A higher TIM implies more mobility, because if individuals move between income groups, average annual top income concentration ($\frac{1}{\mathrm{T}}\sum_{t=\tau}^{\mathrm{T}} Z_t$) is higher than the concentration of the average income ($Z_{\tau,T}$). Note that the TIM curve does not enable us to compare groups of different sizes, because it is an absolute and not a relative measure. In order to compare the mobility of the top fractiles to the results found in other studies, we follow Jenderny (2016) and compute the TIM in relative terms:

$$TIM_t^{rel} = \frac{\frac{1}{T}\sum_{t=\tau}^{T} Z_t - Z_{\tau,T}}{\frac{1}{T}\sum_{t=\tau}^{T} Z_t} \qquad (3)$$

While the TIM curve provides us a useful tool for measuring mobility, it is descriptive and does not enable determining the statistical significance of our results. To overcome this problem, we use the two-sample Kolmogorov-Smirnov test, which checks whether two distributions differ and calculates the distance between the two distributions. If the

distance is greater than 0, the two distributions are not equal, and one has greater values than the other. This test enables us to verify that the permanent income distribution among the top fractiles is indeed more concentrated than their annual income distribution, thus include smaller values and whether this difference is significant. Since it is desirable that the Kolmogorov-Smirnov test results to be consistent with the TIM, we need to compare the permanent income distribution to a distribution that is consistent with the average annual top income concentration ($\frac{1}{T}\sum_{t=\tau}^{T} Z_t$). To do so, we calculate the average rank income: For each rank (the relative position among the income earners), we calculate the arithmetic mean of incomes earned in this specific rank in all the years of the given sub-period. We calculate the Kolmogorov-Smirnov to compare the distribution of permanent income of the top 1%, 5% and 10% and the distribution of the average rank income of the same fractiles between the years *t* and *t + 4*.

6 Results

6.1 Persistence Rate

Figures 7, 8 and 9 present the persistence rate after one, three and five years for the top 1%, 5% and 10% of total income earners. As explained in section 5.1, the persistence rate is derived by the linear probability model described in equation (1), and calculated as $\alpha + \beta$. The lower and upper bounds in these figures correspond to the confidence interval, calculated by $var(\alpha) + var(\beta)$. Each year in the horizontal axis represents year *t*, the first year of the analyzed sub-period. As can be seen in the figures, $\alpha + \beta$ is significantly lower than 1 (that is, no mobility) and higher than 0 (that is, almost full mobility) for all fractiles and for one, three and five years.

As evident in Figures 8 and 9, both the top 5% and top 10% show an increasing trend in their persistence rate after one, three and five years. The persistence rate of the top 5% was 72% after one year, 53.2% after three years and 53.4% after five years in 1999 and rose by the end of the period to 79.8%, 66.2% and 59%, respectively. The persistence rate of the top 10% in 1999 was 74.8% after one year, 63.3% after three years and 59.8% after five years, and they rose by the end of the period to 83.1%, 73.5% and 66.4%, respectively. Note that the lower bound of the persistence rate of the top 5% and 10% in the latest two years is higher than the upper bound in the first two years, suggesting that this upward trend is significant. The persistence rate after one and five years of the top 1%, presented in Figure 7 shows an increasing trend as well. The persistence rate after one year rose from 62.8% to 66.3%, and the persistence rate after five years rose from 36.7% to 43.3%. However, its persistence rate after three years does not show an upward trend. Except for a fall in 2000 and a rise in 2009, the persistence rate after three years of the top 1% is relatively stable, at around 50%.[11]

Comparing our results to the ones obtained in previous studies which estimated the persistence rate in the U.S, Germany and Finland, Jenderny (2016) found that between the years 2001 and 2006, the persistence rate of the top 1% in Germany was 75% after one year and 65% after three years, and for the top 5% it was 85% after one year and 75% after three years. Thus, the German persistence rate for both fractiles and time lags are higher than the persistence rate of the corresponding Israeli fractiles. In Finland, on the other hand, the persistence rate after one year of the top 1% was 64.7% in the years 2001-2002 (Jantti et al., 2010), a similar persistence rate to its counterpart in Israel in the same year.

The persistence rate of the 1% between the years 1999-2009 in the U.S. was calculated conditionally.[12] The conditional persistence rate of the top fractiles in Israel is reported in Appendix Figures C.7, C.8 and C.9. The conditional persistence rate of the top 1% in the U.S ranged from 52% to 66% after one year, 29% to 43% after three years and 21% to 32% after five years (Auten et al., 2013). Our calculations for the Israeli top 1% shows that its persistence rate after one year is higher and the persistence rate after three years is lower than the corresponding fractile in the U.S. Hence, for longer time intervals, the top 1% is characterized by a higher mobility.

Figure 7: Persistence rate of the top 1% total income earners.

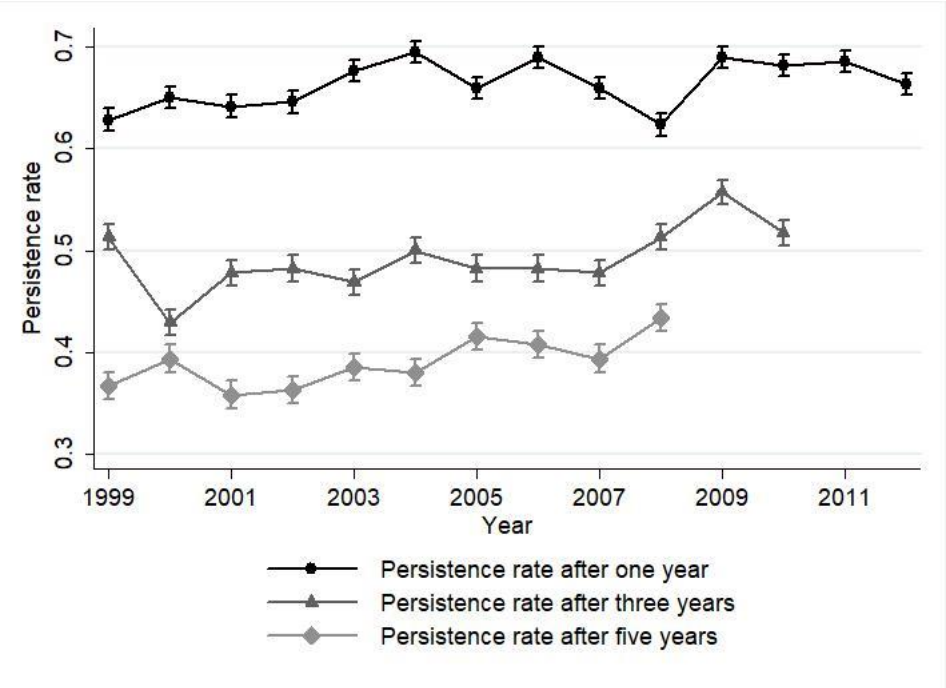


Figure 8: Persistence rate of the top 5% total income earners

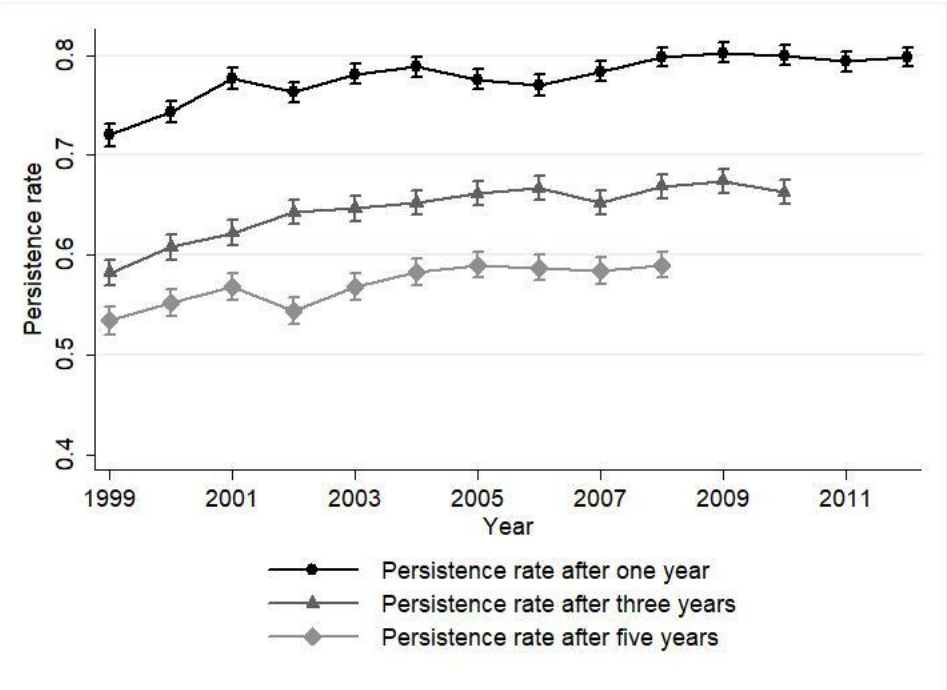
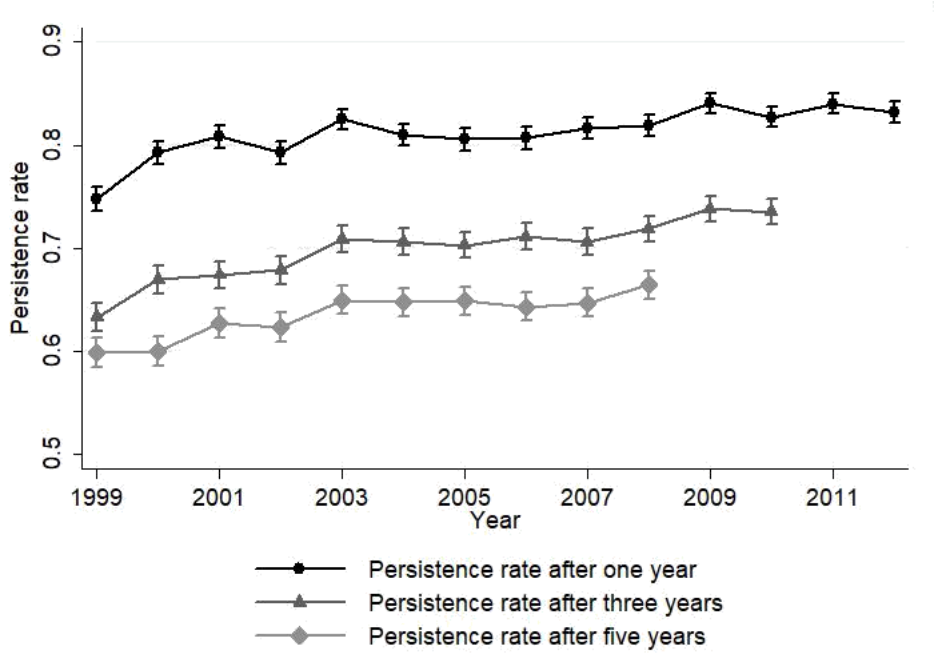


Figure 9: Persistence rate of the top 10% total income earners.



We now turn to examine the effect of the Global Financial Crisis on the persistence rate. As Figures 7 shows, during the crisis the top 1% experienced a sharp decline in its

persistence rate after one year (from 65.9% to 62.3%). While this decline is statistically significant, the persistence rate recovered during the following year.

Another indication for the temporary effect of the Crisis on the persistence rate can be seen when one looks at the persistence rate for a longer period of three or five years (instead of one year). These persistence rates are displayed in Figure 7, and unlike the one-year persistence rate, they do not display even a temporary decline during the crisis.

We extend our analysis to the top 5% and 10% in Figures 8 and 9. These figures show that the pattern observed for the 1%, the persistence rates of these fractiles were not affected by the Crisis. Instead, they continued their upwards trend during and after the Global Financial Crisis. This result is valid if one analyzes the persistence rate of these fractiles for any period we analyze: one year, three years or five years. The only exception is a moderate decline in the 1-year persistence rate of the top 10% in the year 2010. However, this decline is not statistically significant, as one can see the lower and upper bounds of the confidence interval for the years 2009 and 2010. This suggests that the Global Financial crisis had little effect, if any, on the intragenerational mobility of the top earners, and that this effect was transitory.

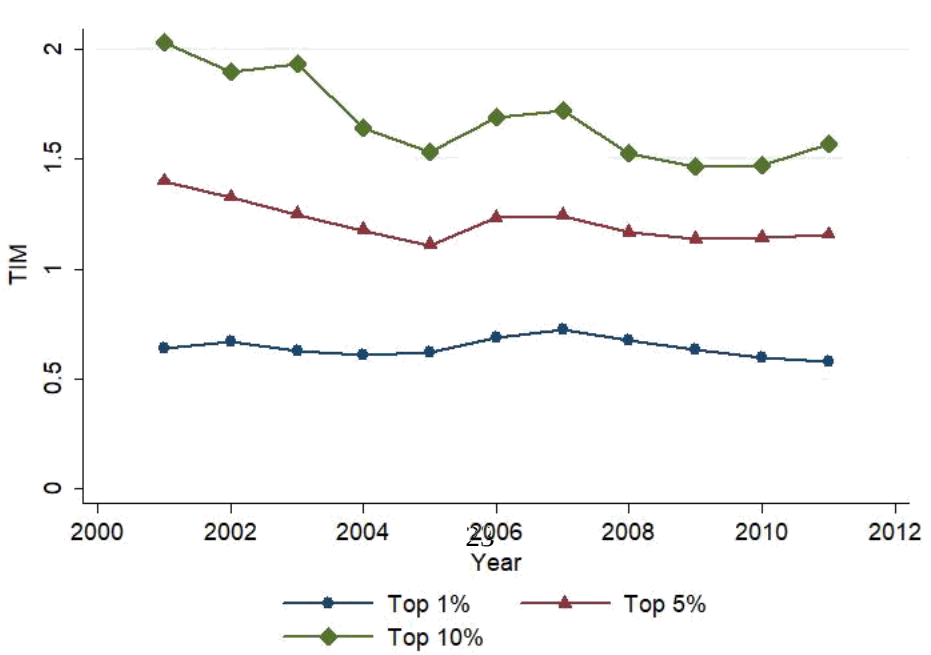
As explained in section 4, our dataset does not include the years prior to the Dot.com crisis. However, our dataset does cover the years of the crisis and the years following it. Therefore, although we cannot provide a full analysis, we can provide some insights regarding the effect of this crisis. As evident from Figures 7, 8 and 9, the persistence rate of the top fractiles was unaffected by the Dot.com crisis, except for a decline in the persistence rate of the top 5% and 10% in 2002, which recovered the following year. This suggests that the Dot.com crisis also had only a temporary impact on the intragenerational mobility of the top income earners.

6.2 Top Income Mobility

Figure 10 presents the TIM curve of the top 1%, 5% and 10%, calculated for sub-periods of 5 years. Each year in the horizontal axis represents year *t*+2, the median year of the analyzed sub-period. The annual and permanent income shares on which the TIM is based are presented in Appendix Figures D.2, D.3 and D.4. It is evident from the figure 10 that the TIM curve of the top 5% and 10% was decreasing during the period: from 2.02 and 1.4 in 2001, to 1.6 and 1.1 in 2011, respectively. The TIM curves of these two fractiles increase in 2006 and 2007, followed by a decrease. This increase is driven by a transitory rise in annual income shares in 2005, which increased the left part of the right-hand side of the TIM, as described in equation (2).

This downward trend in the TIM curve indicates that the mobility of the top 5% and 10% is decreasing. However, the mobility of the top 1% was relatively stable: between the years 2001 and 2011, the TIM curve of the 1% ranged from 0.58 to 0.68, with minor up and down movements.[13]

Figure 10: Mobility curve of top total income earners, calculated for sub-periods of 5 years.



Comparing our results to those from studies conducted in other countries, we find that for both the absolute and relative TIM, the mobility of the top 1%, 5% and 10% in Israel was higher than the mobility of the corresponding fractiles in Germany (Jenderny, 2016). In addition, while the top 10% in Israel is more mobile than its Norwegian counterpart throughout the period, the mobility of the top 1% and 5% in Israel is higher in the first two sub-periods, but lower at the end of the period (Aaberge et al., 2013).[14]

For all of the top fractiles, the Kolmogorov-Smirnov test results show that the permanent income distribution is significantly more concentrated than the annual income distribution in all of the sub-periods, suggesting that mobility has an equalizing effect on income concentration at the top.[15]

When analyzing the effect of the Global Financial Crisis of 2008 on the TIM curve, we reach similar conclusions as in section 6.1. As Figure 10 shows, the TIM curve continues its downward trend during and after the crisis and does not show any special response to the crisis. This is surprising since the top fractiles experienced a sharp decline in incomes during the crisis, as explained in section 3. The only exception is the TIM curve of the top 10%, which displays a moderate increase prior to the Crisis, and a sharper decline during the Crisis itself. This suggest that this income shock in incomes did not affect the intragenerational mobility of the top income earners.

As explained before, we can only provide a limited analysis of the Dot.com crisis. Similar to the persistence rate, The TIM curve is also unaffected by the Dot.com crisis, except for a rise in the TIM curve of the top 10% in 2003, followed by a decline in the following year. Analyzing the TIM curve indicates that the Global Financial

Crisis of 2008 and the Dot.com crisis had only a transitory impact on the intragenerational mobility of the top income earners.

7 Conclusions

The Global Financial Crisis and the rising income inequality have shifted the attention to intragenerational mobility of the top fractiles. We contribute to this strand of the literature in several ways: First, we employ new methodologies to measure intragenerational mobility of the top income earners. These methodologies help us to better estimate the persistence rate and the distributional changes between annual income and permanent incomes. Second, in focusing on a specific cohort whose members are all in the same stage in the life cycle, we estimate only the part of the mobility which is the result of market forces, rather than the selection to different career paths or other distortions that occur over the life cycle. Finally, we exploit the Global Financial Crisis to analyze how a major macroeconomic event affects intragenerational mobility among top income earners.

Examining a panel of incomes of 22,601 individuals for the period between 1999 and 2013, we present several results: First, using different measures of mobility, we show that the top income earners have undergone a decline in their mobility in the period analyzed. This result is robust to different income concepts and different sub-periods that we analyze. Second, by analyzing the persistence rate and the TIM we show that in spite of transitory changes in income levels, the relative position of the upper fractiles persisted in being higher and increasing over time, even during the Global Financial Crisis of 2008. This suggests that the crisis had a very minor effect, if any, on

intragenerational mobility in Israel, even though a large portion of the top fractiles was employed in the financial and high-tech sectors.

These results imply that the social polarization of the Israeli society is getting deeper. Not only did the inequality in Israel increase in the last decades, but the top income fractiles are also more stable. This suggests that the adverse effects of income concentration, such as the fact that growth may not reach the majority of the population and that those with economic power might accumulate political power, are more severe, as mobility is lower.

Moreover, we find that although the incomes of the top fractiles declined during the Global Financial Crisis of 2008, they recovered from it quickly and their mobility was not affected. Today, the world is likely to face a severe crisis caused by the Coronavirus epidemic. Unlike the Global Financial Crisis of 2008, the current crisis is more likely to affect the lower income fractiles: the social distancing that is used to reduce the Coronavirus transmission requires adjusting to on-line working, the top fractiles are employed in job and sectors that are more easily adjusted to such work, compared to lower-income fractiles. Hence, there are reasons to believe that the current crisis will have little, if any, impact on the mobility of the top income fractiles.

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Appendix

A Gini coefficient for inequality, calculated for income decile

Table A.1: Gini coefficient by decile, 2005

Income decile	Gini coefficient
1	0.26033
2	0.08863
3	0.03741
4	0.02724
5	0.02644
6	0.02927
7	0.03345
8	0.04629
9	0.06488
10	0.18645

Note: The Gini coefficient is calculated for employment income.

Source: Own computation, based on data from the 2005 household expenditure survey conducted by Israel Central Bureau of Statistics

B Deriving β

Let λ denote the persistence rate and ϕ the analyzed fractile (ϕ=0.01 when analyzing the top 1%, for example). Then,

$$\hat{\beta} = \frac{cov(per_i^{t+\tau}, per_i^t)}{var(per_i^t)^2} = \frac{\sum_i (per_i^{t+\tau} - \overline{per}_i^{t+\tau})(per_i^t - \overline{per}_i^t)}{\sum_i (per_i^t - \overline{per}_i^t)^2} = \frac{\lambda - \phi}{1 - \phi} \quad (5)$$

where the last equality stems from the definition of the persistence rate, and a fractile. Note that with no mobility (that is, a persistence rate of 1), the estimated coefficient equals 1, whereas with full mobility (that is, a persistence rate of 0), the estimated coefficient is negative. Hence, an estimated coefficient of 0 implies a high rate of mobility, in which λ= ϕ. Clearly, one can derive λ from $\hat{\beta}$ for any chosen ϕ.

C Persistence rate for different concepts of income

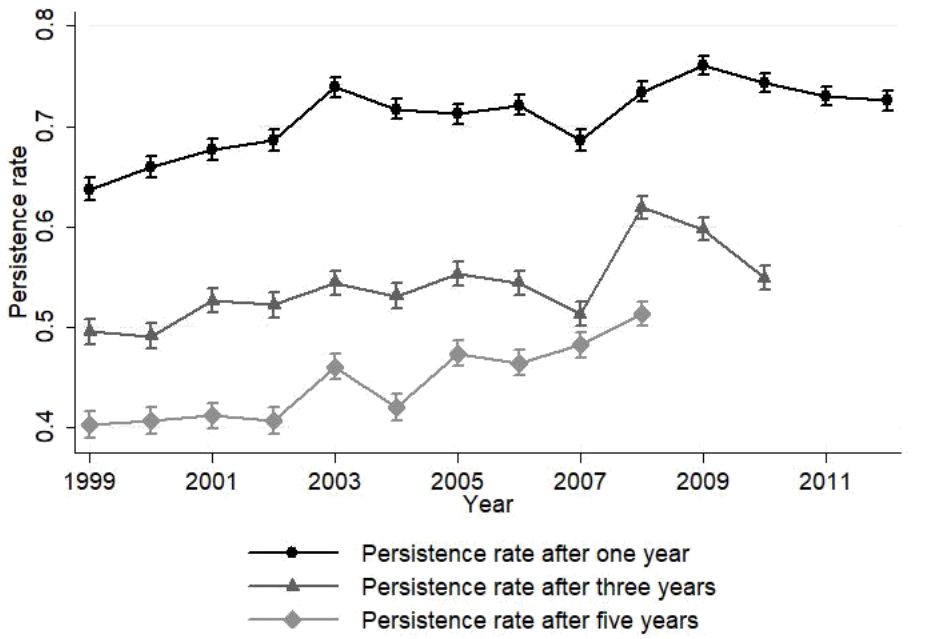

Figure C.1: Persistence rate of the top 1% employment income earners

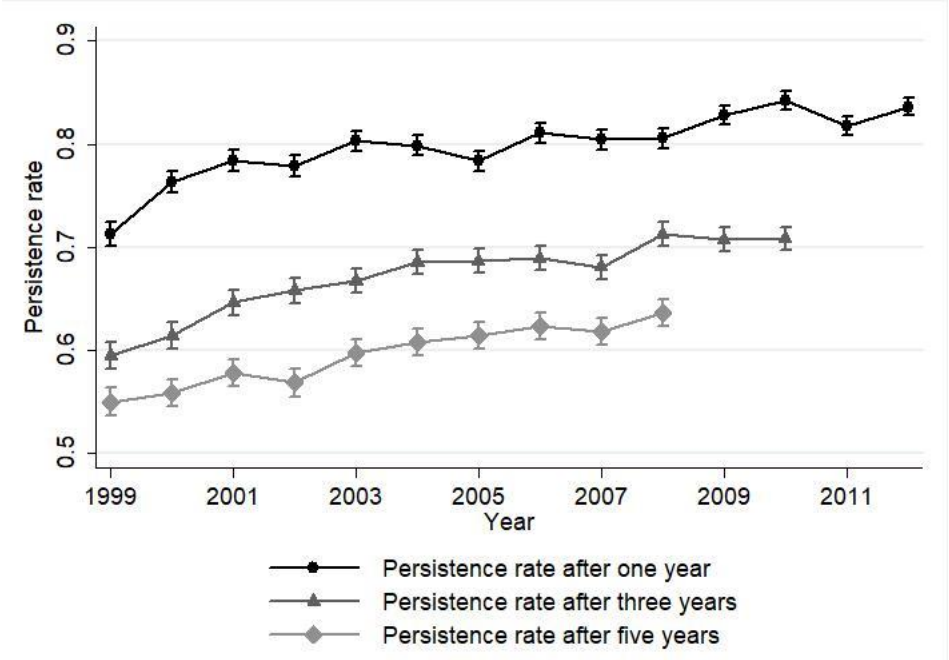

Figure C.2: Persistence rate of the top 5% employment income earners

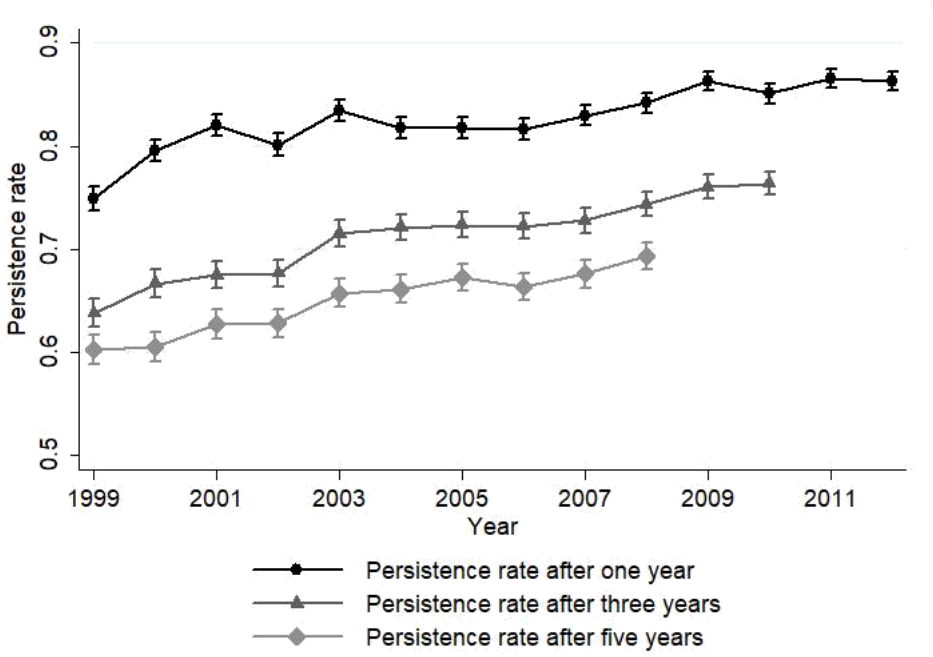

Figure C.3: Persistence rate of the top 10% employment income earners

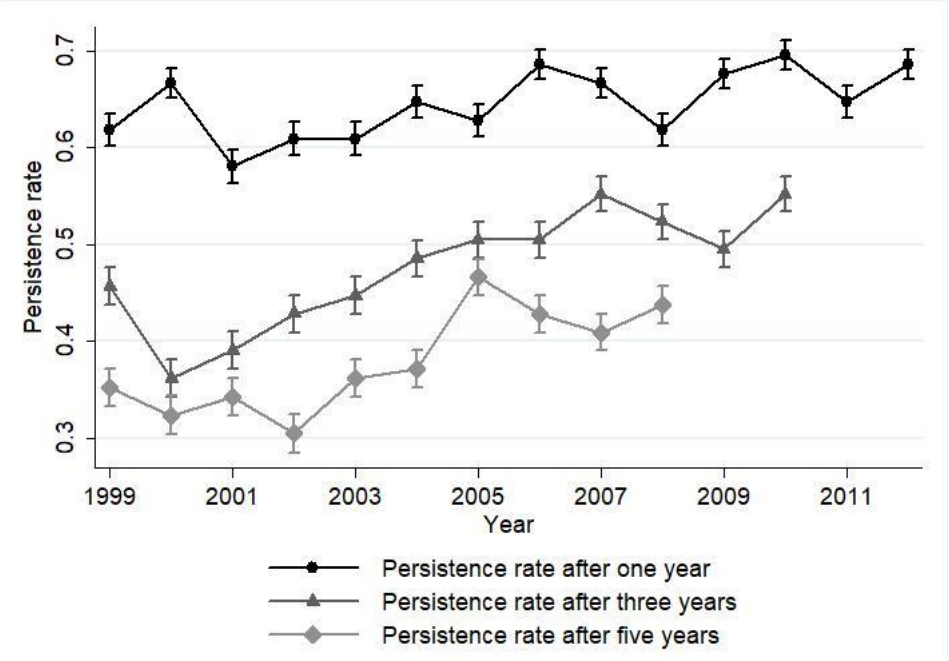

Figure C.4: Persistence rate of the top 1% total positive income earners

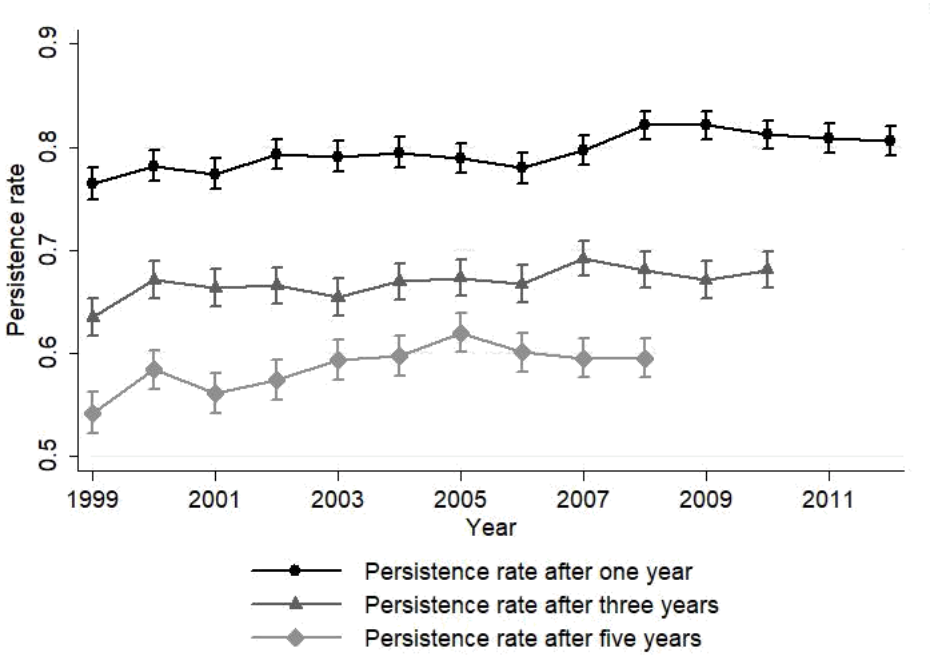

Figure C.5: Persistence rate of the top 5% total positive income earners

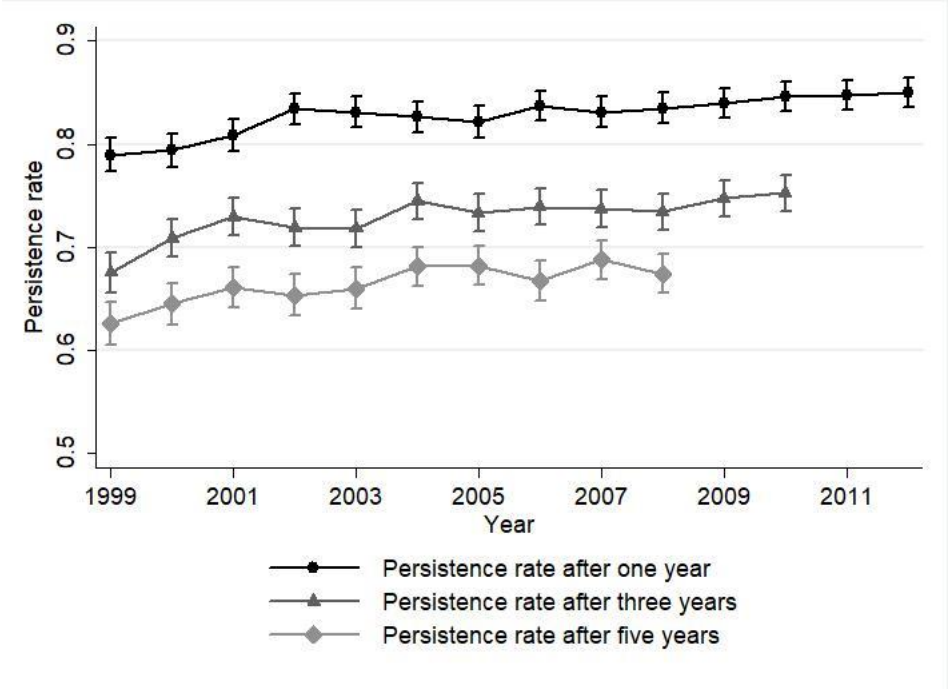

Figure C.6: Persistence rate of the top 10% total positive income earners

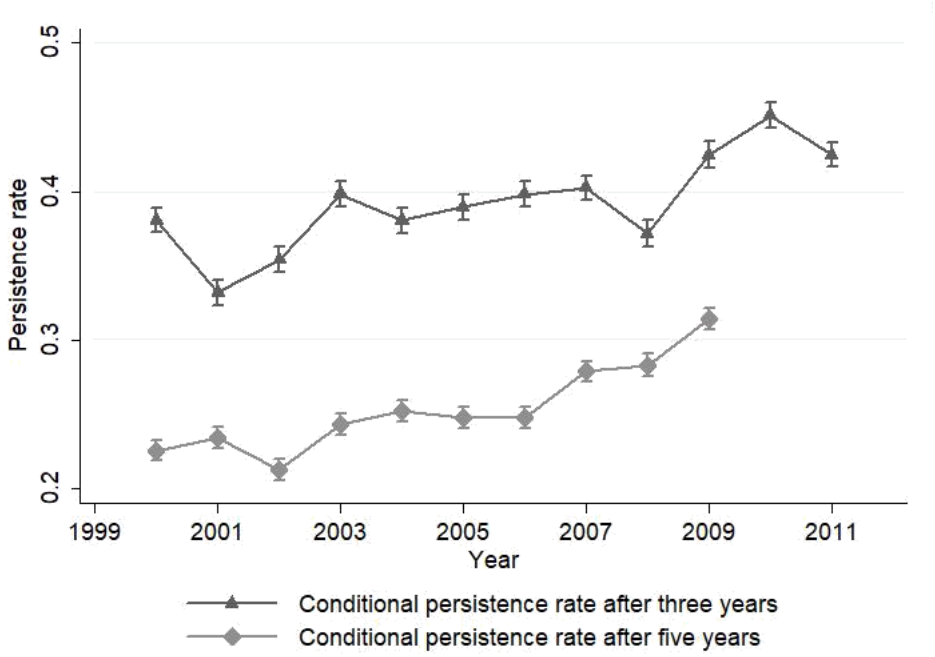

Figure C.7: Conditional persistence rate of the top 1% total positive income earners

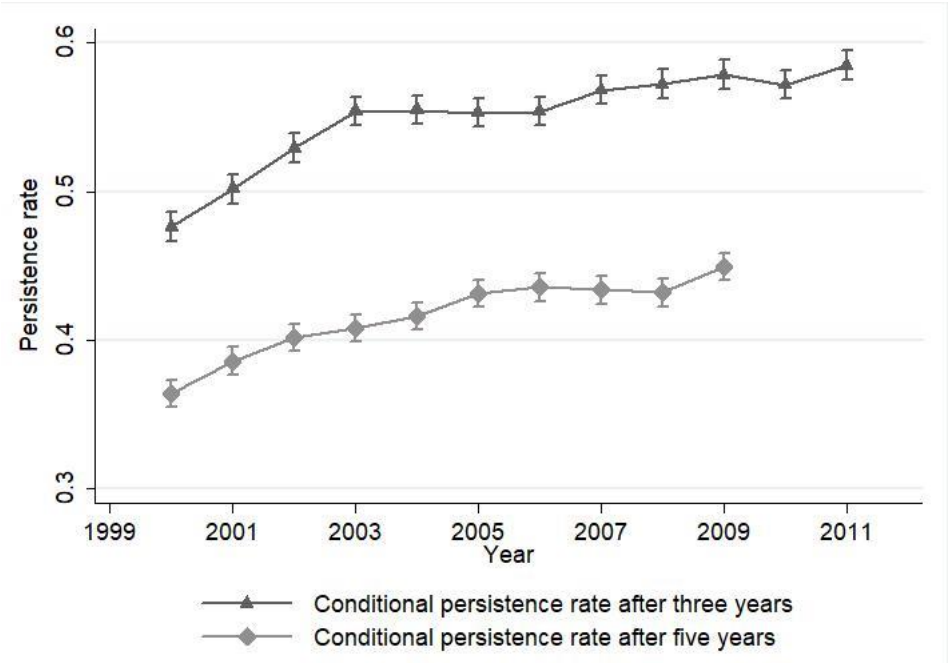

Figure C.8: Conditional persistence rate of the top 5% total positive income earners

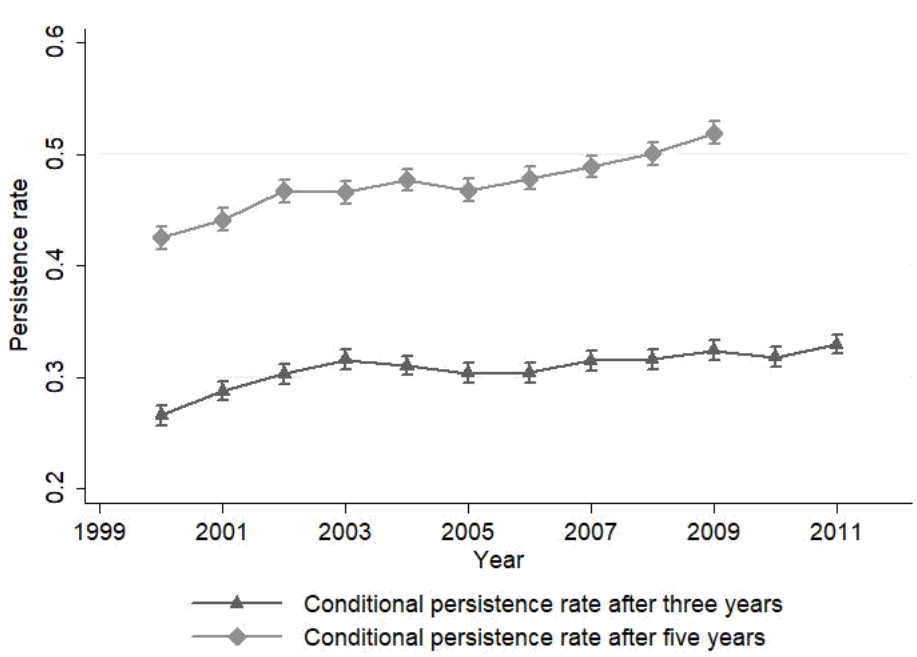

Figure C.9: Conditional persistence rate of the top 10% total positive income earners

D Distribution analysis and share of top fractiles

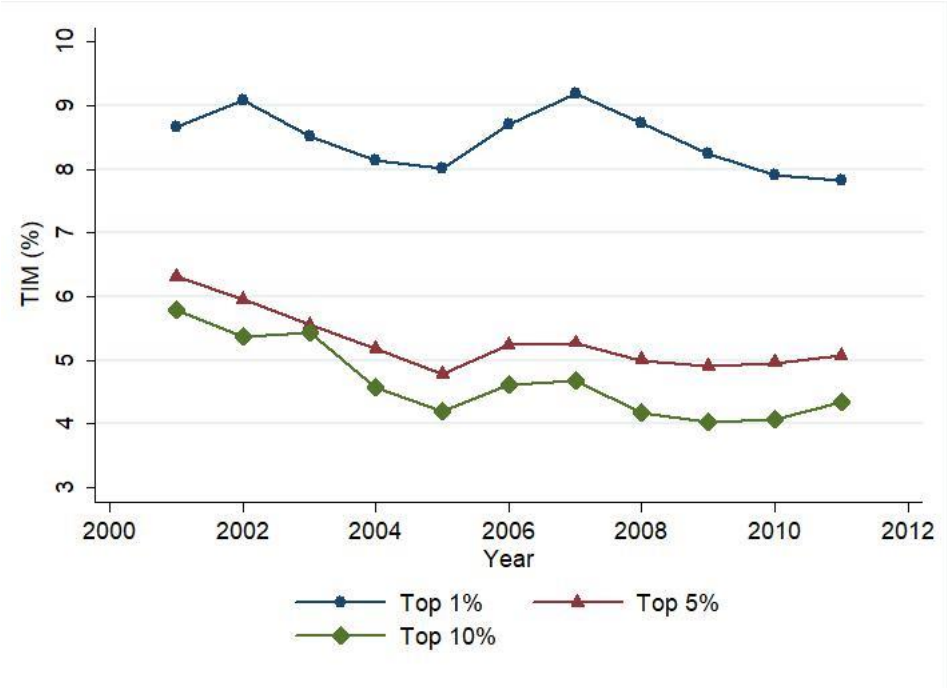

Figure D.1: Relative mobility curve of top total income earners, calculated for sub-periods of 5 years

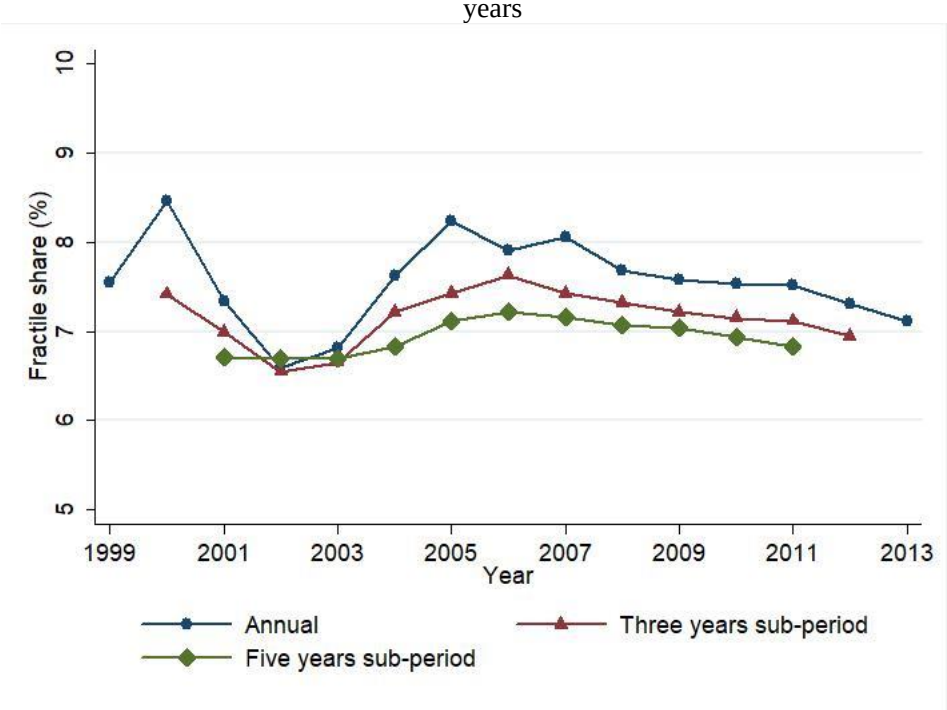

Figure D.2: The share of the top 1% from total income, calculated for annual and permanent income

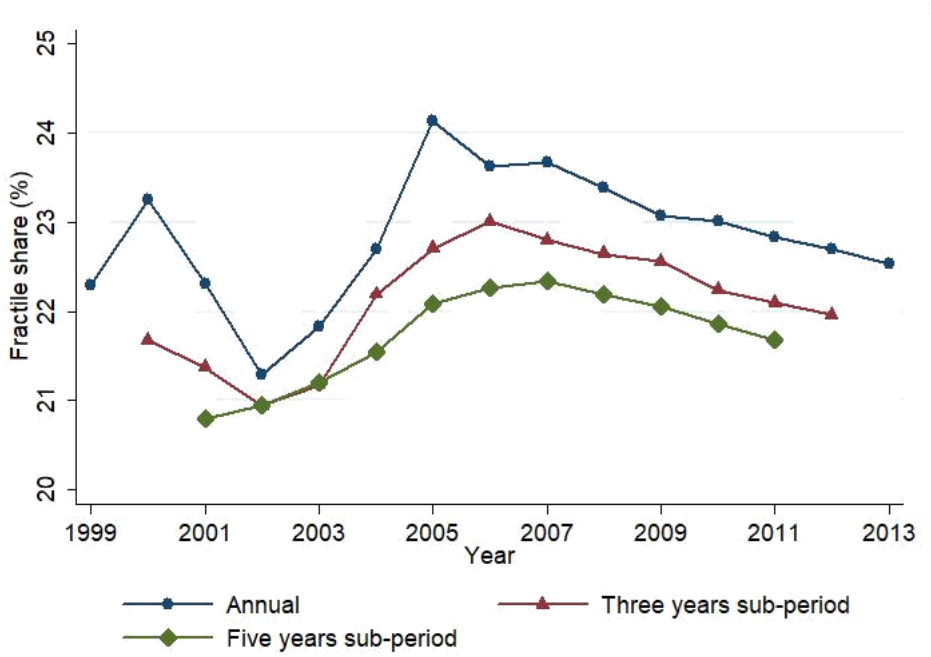

Figure D.3: The share of the top 5% from total income, calculated for annual and permanent income

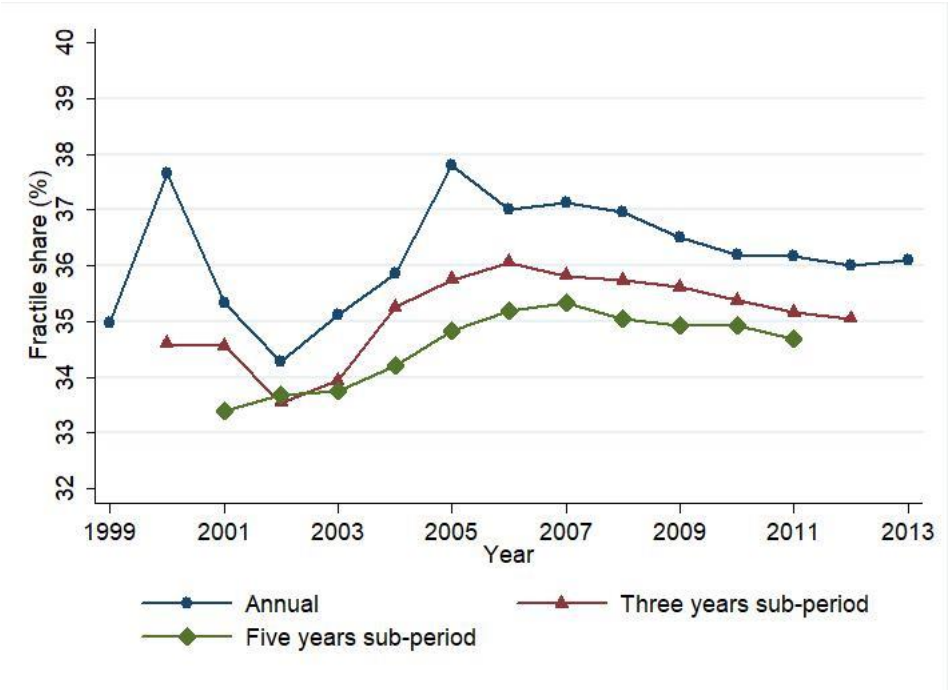

Figure D.4: The share of the top 10% from total income, calculated for annual and permanent income

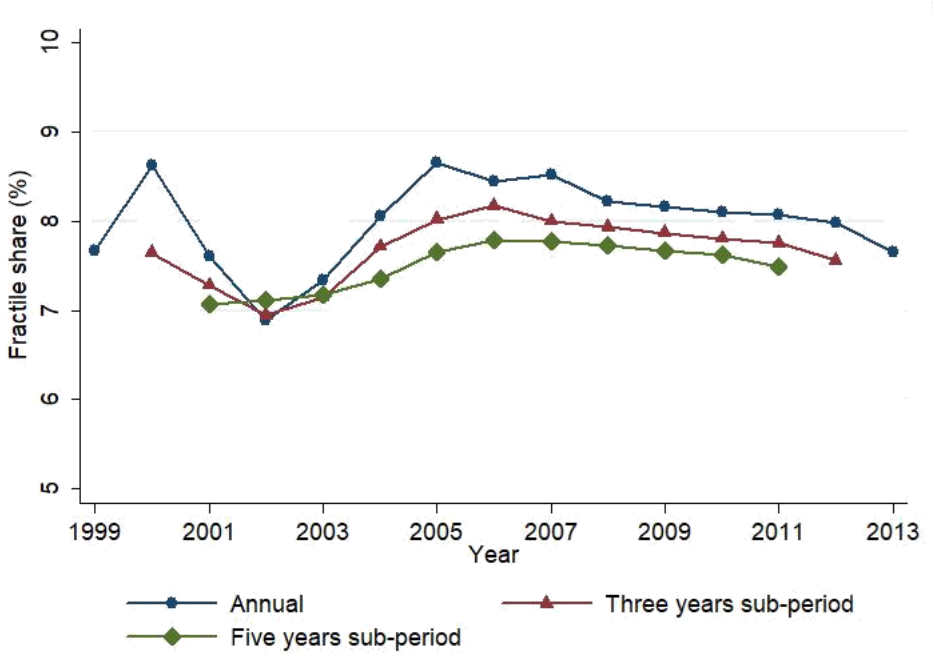

Figure D.5: The share of the top 1% from employment income, calculated for annual and permanent income

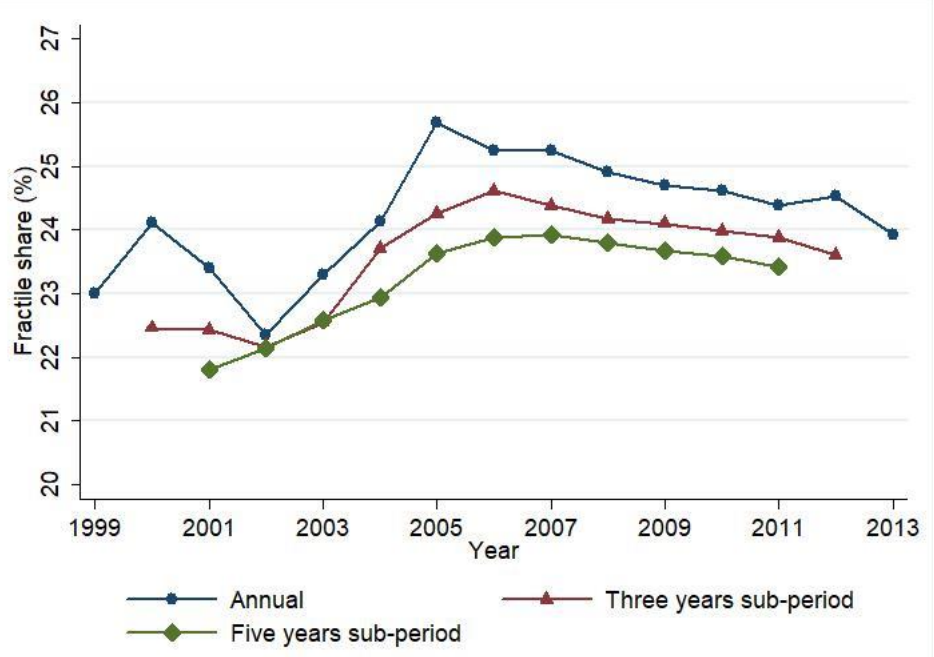

Figure D.6: The share of the top 5% from employment income, calculated for annual and permanent income

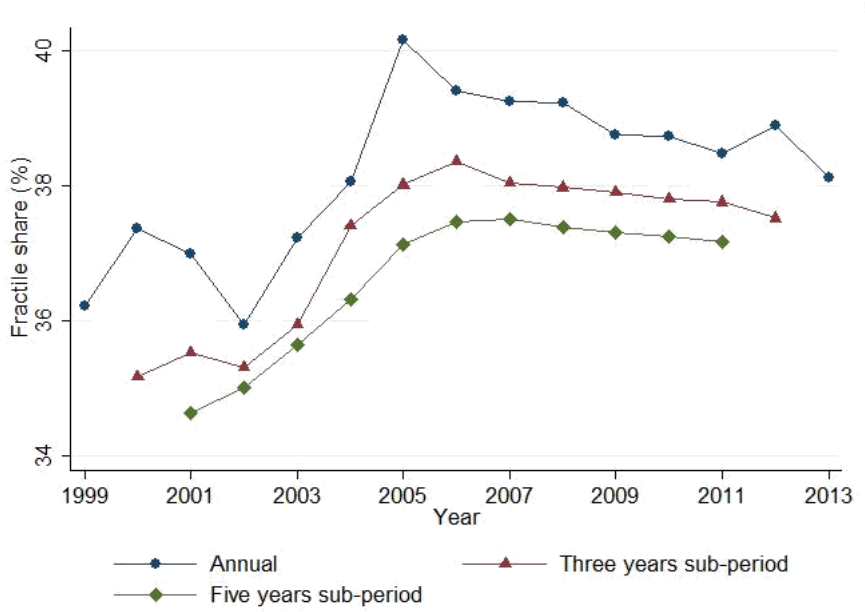

Figure D.7: The share of the top 10% from employment income, calculated for annual and permanent income

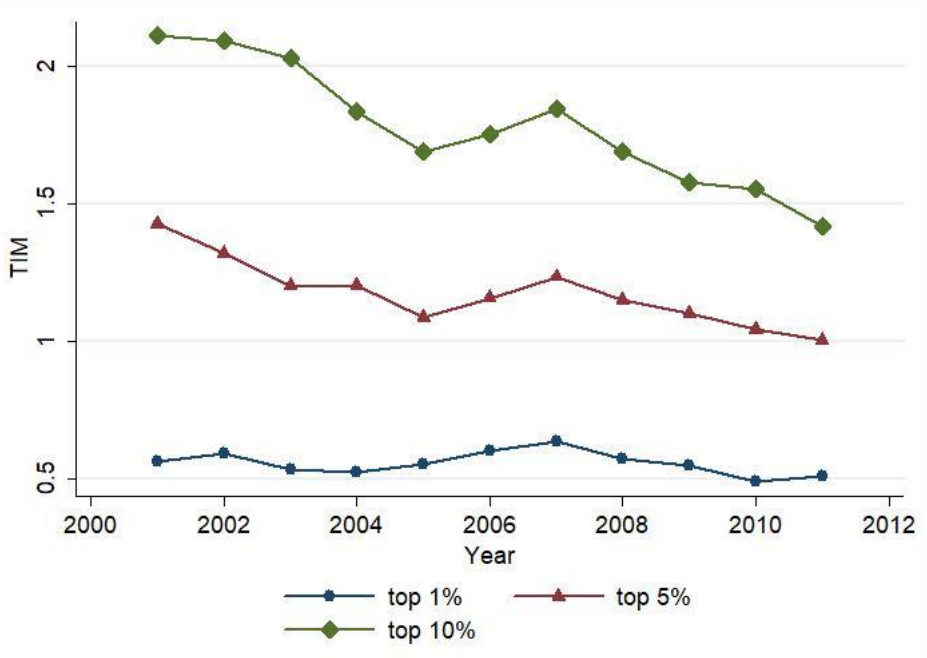

Figure D.8: Mobility curve of top employment income earners

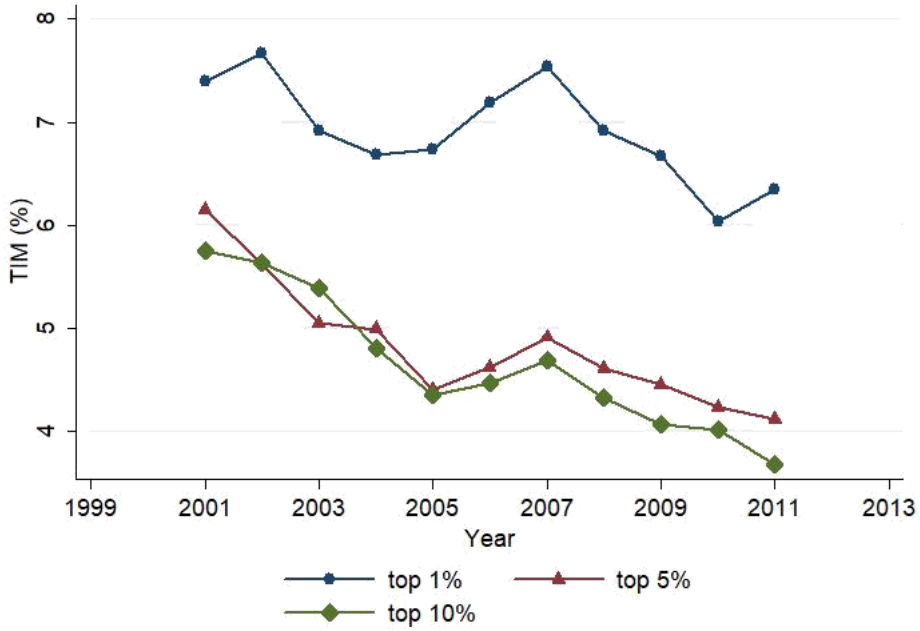

Figure D.9: Relative mobility curve of top employment income earners

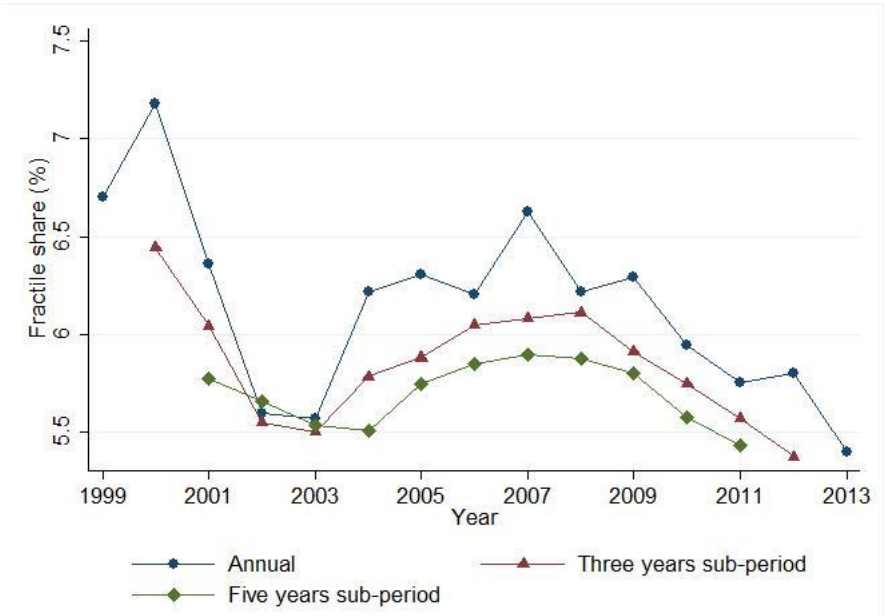

Figure D.10: The share of the top 1% from total positive income, calculated for annual and permanent income

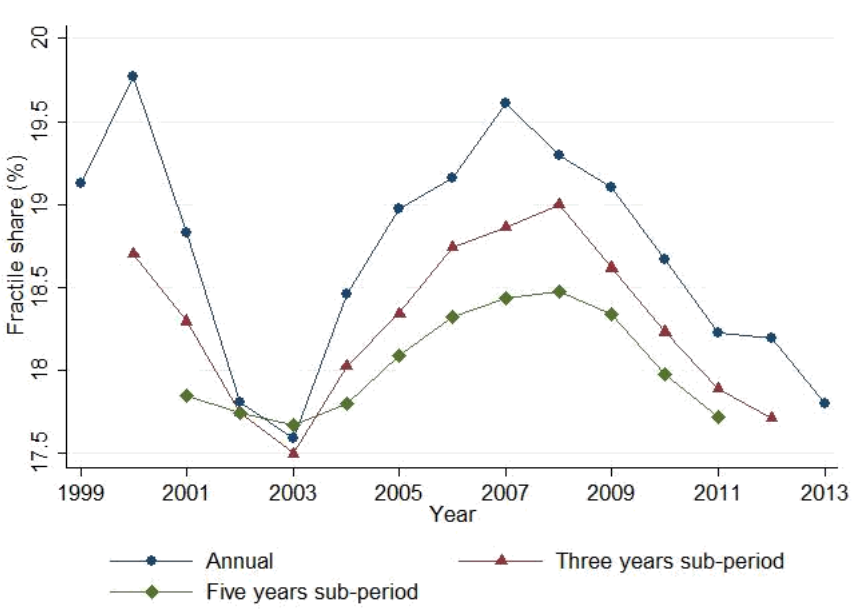

Figure D.11: The share of the top 5% from total positive income, calculated for annual and permanent income

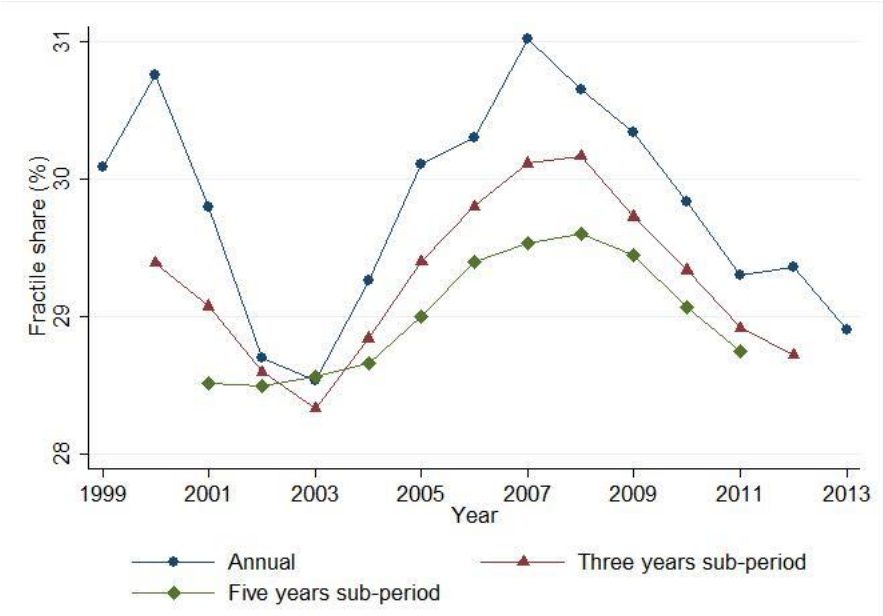

Figure D.12: The share of the top 10% from total positive income, calculated for annual and permanent income

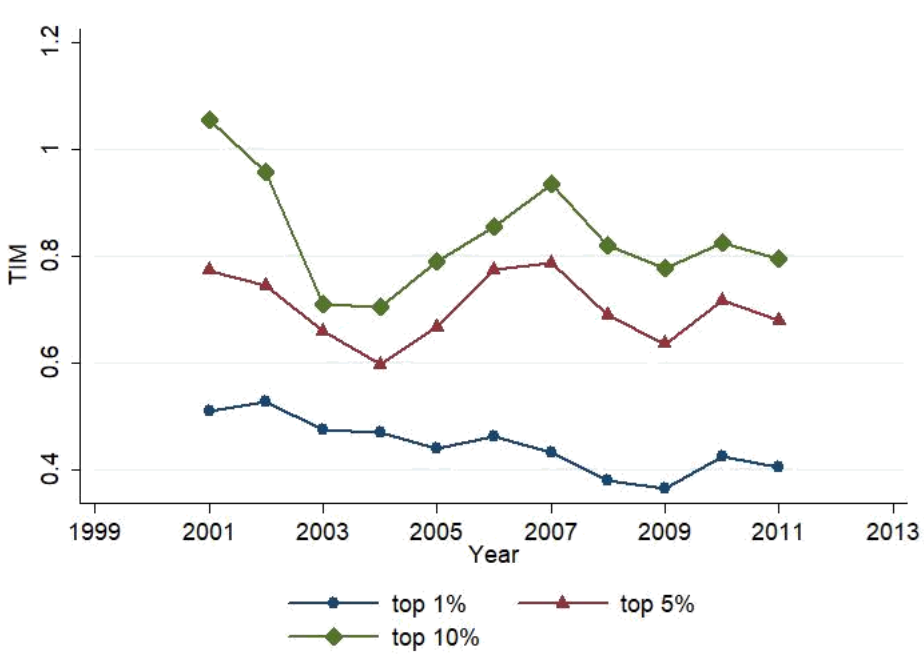

Figure D.13: Mobility curve of top total positive income earners

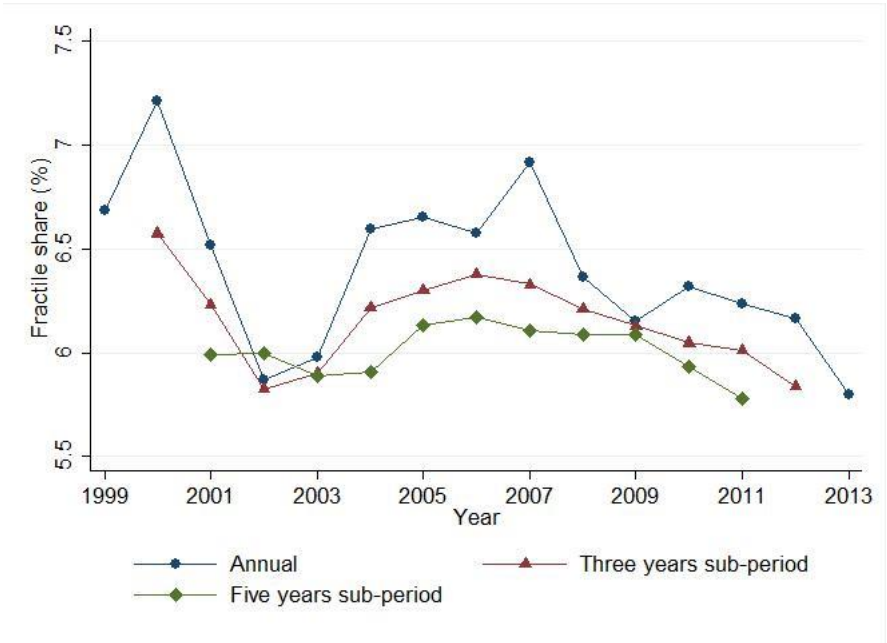

Figure D.14: The share of the top 1% from employment positive income, calculated for annual and permanent income

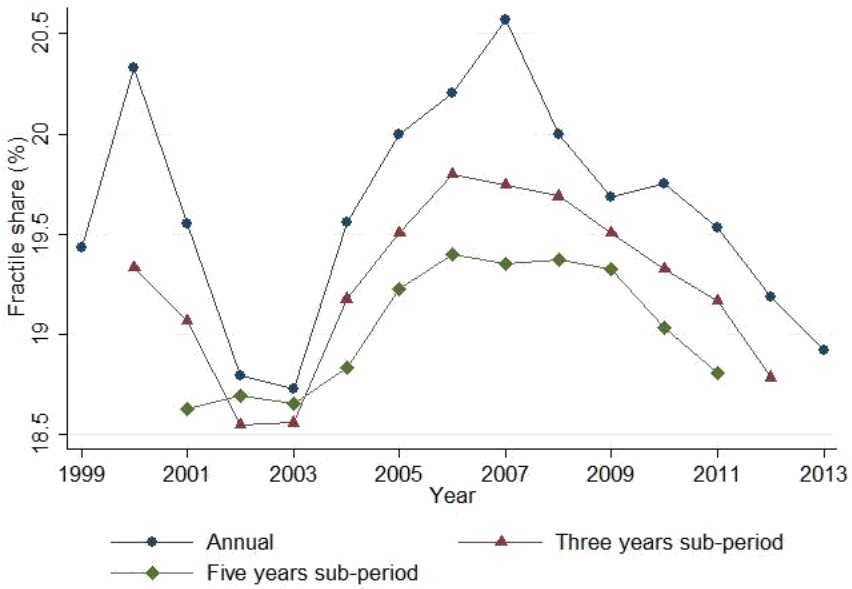

Figure D.15: The share of the top 5% from employment positive income, calculated for annual and permanent income

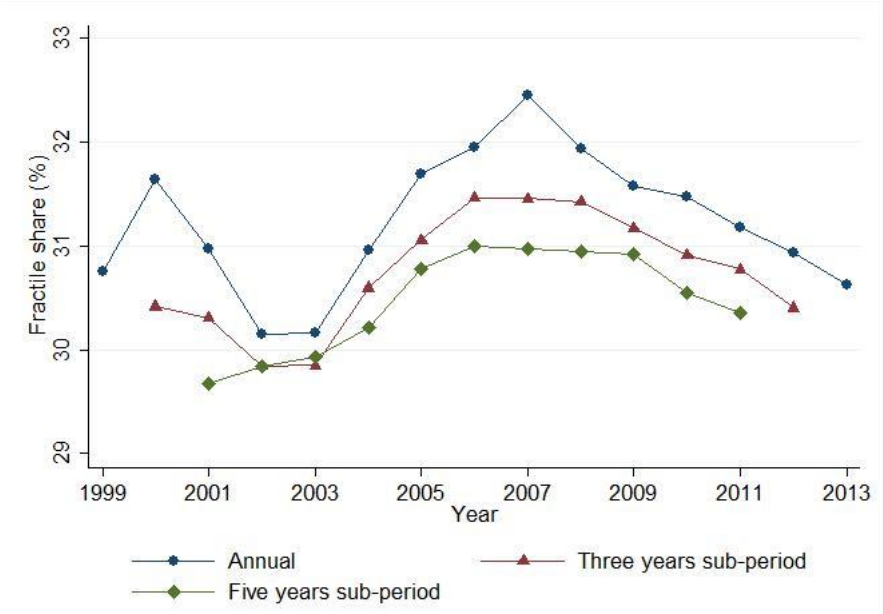

Figure D.16: The share of the top 10% from employment positive income, calculated for annual and permanent income

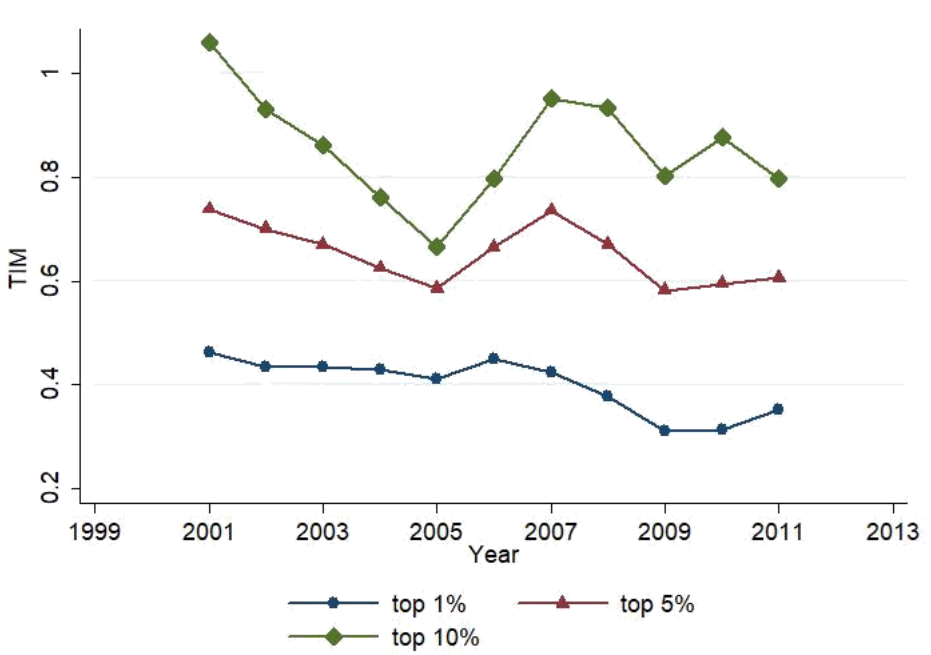

Figure D.17: Mobility curve of top employment positive income earners

Table D.1: Comparison of top income earners' mobility in Israel, Norway and Germany

Israel

	Absolute TIM				Relative TIM (%)			
Year	2001	2002	2003	2004	2001	2002	2003	2004
Top 10%	1.26	1.34	1.10	0.98	3.58	3.86	3.15	2.72
Top 5%	0.92	0.87	0.76	0.70	4.11	4.00	3.48	3.05
Top 1%	0.47	0.37	0.36	0.34	6.35	5.31	5.11	4.54

Norway

	Absolute TIM				Relative TIM (%)			
Year	2001	2002	2003	2004	2001	2002	2003	2004
Top 10%	0.81	0.8	0.81	0.9	2.5	2.37	2.27	2.54
Top 5%	0.73	0.71	0.78	0.91	3.25	2.97	2.96	3.53
Top 1%	0.63	0.62	0.78	0.96	6.04	5.23	5.57	7.37

Germany

	Absolute TIM				Relative TIM (%)			
Year	2001	2002	2003	2004	2001	2002	2003	2004
Top 10%	0.43	0.4	0.41	0.4	1.55	1.46	1.45	1.41
Top 5%	0.37	0.35	0.34	0.34	1.99	1.88	1.8	1.76
Top 1%	0.25	0.23	0.22	0.23	3.18	2.95	2.73	2.66

Source: Germany: Jenderny (2016), Norway: Aaberge et al. (2013)

E Kolmogorov-smirnov test

Table E.1: Top 1% Kolmogorov-Smirnov test results for sub-periods of 5 years

1999-2003			2000-2004			2001-2005		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.1205	0.038	1:00	0.1517	0.006	1:00	0.1513	0.006
2:00	-0.0002	1	2:00	0	1	2:00	0	1
Combined	0.1205	0.076	Combined	0.1517	0.011	Combined	0.1513	0.011
2002-2006			2003-2007			2004-2008		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.1605	0.003	1:00	0.1204	0.038	1:00	0.1427	0.01
2:00	0	1	2:00	0	1	2:00	0	1
Combined	0.1605	0.006	Combined	0.1204	0.076	Combined	0.1427	0.02
2005-2009			2006-2010			2007-2011		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.1471	0.008	1:00	0.2	0	1:00	0.2272	0
2:00	0	1	2:00	0	1	2:00	-0.0045	0.995
Combined	0.1471	0.015	Combined	0.2	0	Combined	0.2272	0
2008-2012			2009-2013					
Smaller group	D	P-value	Smaller group	D	P-value			
1:00	0.196	0	1:00	0.2045	0			
2:00	-0.0001	1	2:00	0	1			
Combined	0.196	0	Combined	0.2045	0			

Note: Group 1 is the permanent income distribution, group 2 is the average rank income distribution.

Table E.2: Top 5% Kolmogorov-Smirnov test results for sub-periods of 5 years

1999-2003			2000-2004			2001-2005		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.1451	0	1:00	0.1265	0	1:00	0.1053	0
2:00	0	1	2:00	0	1	2:00	0	1
Combined	0.1451	0	Combined	0.1265	0	Combined	0.1053	0
2002-2006			2003-2007			2004-2008		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.1106	0	1:00	0.1018	0	1:00	0.0761	0.001
2:00	0	1	2:00	0	1	2:00	0	1
Combined	0.1106	0	Combined	0.1018	0	Combined	0.0761	0.003
2005-2009			2006-2010			2007-2011		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.0752	0.002	1:00	0.0982	0	1:00	0.1	0
2:00	0	1	2:00	0	1	2:00	-0.0009	0.999
Combined	0.0752	0.003	Combined	0.0982	0	Combined	0.1	0
2008-2012			2009-2013					
Smaller group	D	P-value	Smaller group	D	P-value			
1:00	0.0885	0	1:00	0.1035	0			
2:00	0	1	2:00	0	1			
Combined	0.0885	0	Combined	0.1035	0			

Note: Group 1 is the permanent income distribution, group 2 is the average rank income distribution.

Table E.3: Top 5% Kolmogorov-Smirnov test results for sub-periods of 5 years

1999-2003			2000-2004			2001-2005		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.1451	0	1:00	0.1265	0	1:00	0.1053	0
2:00	0	1	2:00	0	1	2:00	0	1
Combined	0.1451	0	Combined	0.1265	0	Combined	0.1053	0
2002-2006			2003-2007			2004-2008		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.1106	0	1:00	0.1018	0	1:00	0.0761	0.001
2:00	0	1	2:00	0	1	2:00	0	1
Combined	0.1106	0	Combined	0.1018	0	Combined	0.0761	0.003
2005-2009			2006-2010			2007-2011		
Smaller group	D	P-value	Smaller group	D	P-value	Smaller group	D	P-value
1:00	0.0752	0.002	1:00	0.0982	0	1:00	0.1	0
2:00	0	1	2:00	0	1	2:00	-0.0009	0.999
Combined	0.0752	0.003	Combined	0.0982	0	Combined	0.1	0
2008-2012			2009-2013					
Smaller group	D	P-value	Smaller group	D	P-value			
1:00	0.0885	0	1:00	0.1035	0			
2:00	0	1	2:00	0	1			
Combined	0.0885	0	Combined	0.1035	0			

Note: Group 1 is the permanent income distribution, group 2 is the average rank income distribution.

1 A third mobility measure, proposed by Jenderny (2016), exists in the literature. This is the Individual Rank Standard Deviation (IRSD), that allows comparing the mobility of groups of different sizes, but does not allow analyzing the mobility patterns over time. Since our paper is focused on the impact of the Global Financial Crisis of 2008 on mobility patterns, we do not use the IRSD.

2 Israel is a small open economy, which relies on exports of final goods and services. Hence, an appreciation of the currency may affect employment seriously. Despite the Bank's intervention in the foreign exchange market, the Israeli Shekel appreciated by 17.2%.

3 For example, the five biggest banks in Israel lost more than 80% of their profits in 2008 (Rabinovich, 2008).

4 For comparison, the export of goods excluding diamonds and tourism export fell by 8.5% and 9.8%, respectively.

5In a future analysis we plan to exploit this unique data set to study changes over time in intergenerational income mobility in Israel.

6 Although Israel is often portrayed as a deeply divided society (Yaish, 2004), in the population we focus on, the top fractiles, there is very little variation in the demographic characteristics, and therefore the analysis based on these characteristics is omitted.

7 1 US Dollars=3.5 NIS in 2014

8 For example, see the Gini coefficient by deciles in Appendix Table A.1.

[9] As will be explained below, our variables are binary, and hence our linear probability model is identical to ANOVA.
[10] The permanent income is calculated as the average income for both three and five years. Thus, for each year we calculate total permanent income as the sum of the permanent income of all individuals, and the total income of the top fractile as the sum of permanent income of all the individuals who belong to this fractile, based on their permanent income. $Z_{;T}$ is defined as the fraction between the two.
[11] To ensure that the results are not biased by choice of income concept, the persistence rate was also calculated for employment income, and for samples that contains only positive incomes. The trends of the persistence rate in all income concepts are similar to the trends in Figures 7, 8 and 9. The results can be found in Appendix C.
[12] For a detailed explanation between the unconditional and conditional persistence rates see section 5.1.
[13] The TIM curve is also calculated for employment income, and for a sample that contains only positive incomes. The results can be found in Appendix D. For all income concepts, there is a downward trend in TIM curve, indicating our results were not biased by choice of income concept.
[14] The full comparison can be found in Appendix Table D.1.
[15] The results of the Kolmogorov-Smirnov test are presented in Appendix Tables E.1, E.2 and E.3.