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Detecting a change in wealth concentration without the knowledge of the wealth distribution

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Abstract Consumption is commonly used as a proxy for permanent income. We go a step further by establishing the link between the distribution of consumption and that of permanent income in terms of dominance orderings. We introduce two new dominance orderings, the Generalized Top Lorenz test and the related affluence ordering. If consumption is a concave function of permanent income, we get an indirect and robust method to detect a change in permanent income concentration when the full stream of income receipts along the life cycle is unknown and only consumption data are available. Our application on US data for the period 1980–2002 points out the difficult start in life of people belonging to the "Baby loser generation" (people born in the sixties) with respect to the previous and following cohort.

Keywords Concavity · Wealth · Affluence orderings · Consumption

JEL Classification D31 · D63 · D91

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1 Introduction

There is a renewed interest in the dynamics of wealth concentration in developed countries. For instance, Piketty et al. [31] document that the very rich in France do not succeed in recovering from the shocks that took place between 1914 and 1945 (see [2] for a survey about top incomes). Considering the US economy for the more recent period, Wolff and Zacharias [45] used incomes adjusted for wealth to assess US trends in household well-being from 1980 to 2000. The rise of 48.5% for the mean value contrasts with that of 17.9% for the median. This spread is even magnified by net worth data: Wolff [44] records an increase of about 74% for the mean and 23% for the median value. Despite this marked interest for wealth inequality, we still lack information since changes in the wealth distribution are much less documented than changes in income or earnings distribution. Data on wealth are more difficult to collect and, when they exist, to work with than data on income distribution because of measurement errors. In this paper we propose a non-parametric methodology to detect a change in wealth concentration without the knowledge of the wealth distribution.

Our analysis rests on Friedman's [16] permanent income[1] hypothesis, i.e households base their spending plans on their expected lifetime income. However, the exact expected value of total lifetime resources for an individual at a given time is very difficult to assess empirically. It requires the knowledge of the income stream along all the life cycle that may be affected by uncertainty and which is only available in long panels. Previous articles such as Bavier [5] and Meyer and Sullivan [24, 25] rely on the permanent income hypothesis to indicate consumption as the best proxy available for lifetime resources. We go a step further in linking the distribution of consumption with that of permanent income and in establishing their joint properties in terms of stochastic orders.

We first introduce a new stochastic order of the Lorenz type, called "Generalized Top Lorenz" (GTL), which cumulates the relevant variable from the top, as the Generalized Lorenz test [35] cumulates from the bottom. We show that the GTL quasi ordering is also equivalent to an "*affluence ordering*" similar to the poverty ordering introduced by Foster and Shorrocks [15]. More precisely, we say that a person is "affluent" with respect to a given attribute if her value in this attribute exceeds a given threshold (an "affluence line") in the same way as a person is deemed poor if her income is smaller than a given poverty line. The comparison of two distributions in terms of affluence is then performed by cumulating "affluence excess" from the top (as one cumulates poverty gaps from the bottom in measuring poverty). It is not clear beyond which threshold a person is affluent, $1 M, $10 M, or more. We probably would like to have a measure that does not depend too much on the choice of the threshold. To get a robust ranking, we introduce affluence orderings, where the ranking must be true for any threshold.

The link between affluence orderings established in terms of consumption and those established in terms of permanent income relies on the concavity property of the relation between consumption and wealth established in consumption theory. Assuming that this property holds, it is proved that the results obtained comparing

[1] In the following, the two expressions wealth and permanent income are used interchangeably.

consumption distributions through the GTL or the affluence test extend to the associated distributions of permanent income. In other terms, we show how to detect a change in the concentration of the latent variable "permanent income", when consumption data are available but when the full stream of income receipts along the life cycle is unknown. The fact that consumption data convey information about the concentration of permanent income is not fully surprising. But it should be noticed that consumption data provide information about permanent income concentration when the relevant variable is cumulated from the top but not from the bottom. In other words, looking at the evolution of the affluence excess in terms of consumption is informative of the evolution of the affluence excess in terms of permanent income. An equivalent statement does not hold in usual welfare and poverty comparisons where the relevant variable (income or poverty gaps) is cumulated from the bottom.

To illustrate the usefulness of the method, we revisit the issue of the pattern of economic affluence concentration for several recent US generations. In our empirical application we focus on the period 1980 to 2002 and compare consumption distributions of equally aged individuals belonging to different cohorts. To document this problem, we use data drawn from the Consumption Expenditure survey (CEX) and elaborated by Krueger and Perri [20]. To tackle the main problems that affect the relation between consumption and wealth in the life cycle model, we control for the influences pointed out by Attanasio and Browning [3]. We divide the population into four age groups to control for life cycle effects, and distinguish between four types of household to control for heterogeneity. We also control for fluctuations in consumption series due to real business cycles. Since the compared distributions of consumption are samples drawn from a larger population, the statistical inference is performed through a methodology inspired by Davidson and Duclos's [11] non-parametric stochastic dominance tests. As expected, we find a general increase of economic affluence over time. We also provide evidence of stable affluence within the baby boom generation (people born between 1940 and 1960). We cannot say the same for the more recent "generation X" (people born from 1960 to 1980) where significant differences emerge between people born between 1960 and 1970 and people born in the following decade. The cohort 1960–1970 starts in life more badly than elder and younger cohorts. This finding confirms and extends previous results [27, 28] by resorting to a new methodology. We can then be more confident in applying this methodology to developing countries to detect changes in the distribution of affluence. Indeed, consumption data of good quality can be available in these countries but income panels are generally missing.

We proceed as follows: in Section 2, we introduce the GTL dominance criterion and the new affluence tests. In Section 3 we design the statistical methodology able to implement our theoretical results. In Section 4 we carry out the empirical analysis on US data. Section 5 summarizes the main results and provides suggestions for further developments. The last section concludes the paper and provides suggestions for further developments.

2 Affluence measurement

Given a population composed of n households, indexed by $i = 1, ..., n$, with $n \geq 2$ and endowed with a quantitative variable y_i defined on the finite and positive support $K = [0, k]$, we denote by $\mathbb{D}_n = \{\mathbf{y} \in K^n | y_1 \le y_2 \ldots \le y_n\}$ the set of feasible distributions of such a variable ordered in an increasing way. The partial order we are going to introduce has not been considered until now in the economic literature and reflects the idea that distribution $\mathbf{y}$ dominates $\mathbf{y}'$ if any top quantile of the population is richer in $\mathbf{y}$ than in $\mathbf{y}'$.[2]

Definition 1 *For all* $\mathbf{y}, \mathbf{y}' \in \mathbb{D}_n$
$\mathbf{y}$ *dominates* $\mathbf{y}'$, *according to the Generalized Top Lorenz criterion* ($\mathbf{y} \succcurlyeq_{GTL} \mathbf{y}'$), *if*:

$$\frac{1}{n}\sum_{i=n-k}^{n} y_i \ge \frac{1}{n}\sum_{i=n-k}^{n} y_i' \text{ for } k = 0, .., n-1.$$

For our purposes, it is fundamental to understand under which conditions the partial order $\succcurlyeq_{GTL}$ is *preserved* after application of the same function f to the elements of the two distributions. The following proposition clarifies this issue.

Proposition 1 *Let* $f : \mathbb{R}_+ \to \mathbb{R}$ *be a continuous function. The two following conditions are equivalent:*

i) f is *decreasing and convex*;
ii) $\mathbf{y} \succcurlyeq_{GTL} \mathbf{y}' \implies (f(y_1), \ldots, f(y_n)) \succcurlyeq_{GTL} (f(y_1'), \ldots, f(y_n'))$ for all $\mathbf{y}, \mathbf{y}' \in \mathbb{D}_n$.

Proof Marshall and Olkin [22], Theorem A.2 (i), p. 116 prove that *i*) $\implies$ *ii*); The converse can be established by reasoning as in the necessity part of Theorem 1 in Peluso and Trannoy [30]. □

If the consumption function $c(y)$ (where y is permanent income) is strictly increasing and concave, we can apply the previous result with $f = c^{-1}$, which is strictly increasing and convex, to infer GTL dominance between permanent income distributions from GTL dominance between the corresponding consumption distributions $c(\mathbf{y})$ and $c(\mathbf{y}')$. The old conjecture that marginal propensity to consume is higher for low wealth households than for high wealth households has been supported by several important works. In the framework of the life cycle consumption model, Zeldes [46] derives the properties of the optimal consumption function by using a numerical technique. Under uncertainty on labor income, the consumption function is shown to be concave with respect to the sum of financial wealth and the present value of expected future income. More recently, Dynan et al. [13] provide similar results after introducing uncertainty or bequest motive in the standard consumption model. They also find empirical evidence in favor of a concave relationship between consumption and proxies for permanent income on American data: estimated saving rates range from zero for the bottom 20% of the income distribution to more than 25% of income for the top 20%. More importantly, they present evidence in favor of a marginal propensity to save increasing with household permanent income.

Our favorite interpretation of the concavity relation is between consumption and permanent income. But formally, the above result can also be applied to the relation

[2]In mathematics, this ranking is known as "submajorization" (see [22]). Related concepts in statistics are studied by Shaked and Shanthikumar [34].

between consumption and net worth. Indeed, Carroll and Kimball [7] adds income uncertainty in the standard version of the life cycle consumption model and proves a decreasing marginal propensity to consume out of wealth or transitory income with respect to the level of wealth, if the consumer is prudent and the utility function belongs to the HARA class.[3]

We show now how to test GTL in a statistical framework. Since affluence can be seen as the opposite phenomenon of poverty, we may set an "affluence line" z such that the *affluence excess* of the household i is defined by $w_i = w(y_i, z) = \max(y_i - z, 0)$. The resulting vector for the whole population is $\mathbf{w}(z, \mathbf{y}) = (w_{1,} \ldots, w_n)$. Let q_z be the number of households with $y_i \geq z$, then two immediate measures of affluence are the *headcount affluence ratio* $A_1(\mathbf{y}, z) = \frac{q_z}{n}$, that is the proportion of affluent households in the population and the *per capita affluence excess* $A_2(\mathbf{y}, z) = \frac{1}{n}\sum_i w_i(z)$, which mirrors the poverty gap ratio.[4] Since these indices depend on the chosen threshold, and so is the result of the comparison of two income distributions based on such measures. The result may be reversed by considering different values of z. In order to secure the independence of comparisons from z, we introduce a couple of *affluence orderings*: $\succcurlyeq_{A_1}$ and $\succcurlyeq_{A_2}$.

Definition 2 *For all* $\mathbf{y}, \mathbf{y}' \in \mathbb{D}_n$,

$$\mathbf{y} \succcurlyeq_{A_1} \mathbf{y}' \iff A_1(\mathbf{y}, z), \geq A_1(\mathbf{y}', z), \quad \text{for all} \quad z \geq 0$$
$$\mathbf{y} \succcurlyeq_{A_2} \mathbf{y}' \iff A_2(\mathbf{y}, z) \geq A_2(\mathbf{y}', z), \quad \text{for all} \quad z \geq 0.$$

Distribution $\mathbf{y}$ is said to dominate distribution $\mathbf{y}'$ in the sense of the *first degree affluence ordering* $\succcurlyeq_{A_1}$ if for any positive affluence line, the headcount affluence ratio A_1 is higher in $\mathbf{y}$ than in $\mathbf{y}'$. Similarly, if for any richness line the *per capita affluence excess* A_2 is greater than that in $\mathbf{y}'$, then $\mathbf{y}$ dominates $\mathbf{y}'$ in the sense of the *second degree affluence ordering* $\succcurlyeq_{A_2}$.

It is immediate to see that $\mathbf{y} \succcurlyeq_{A_1} \mathbf{y}' \Leftrightarrow \mathbf{y} \geq \mathbf{y}'$, where $\geq$ is the usual componentwise comparison among vectors. A Pareto improvement of an income vector increases the headcount affluence ratio. The following proposition clarifies the less obvious link between the Generalized Top Lorenz dominance and $\succcurlyeq_{A_2}$.

Proposition 2 *For all* $\mathbf{y}, \mathbf{y}' \in \mathbb{D}^n$,

$$\mathbf{y} \succcurlyeq_{GTL} \mathbf{y}' \iff \mathbf{y} \succcurlyeq_{A_2} \mathbf{y}'.$$

[3]As pointed out by a referee, the strict monotonicity of the consumption function could be questioned for top wealth. If the consumption is not strictly increasing for top wealth, meaning that the consumption is flat for the richest individuals and the consumption bunches at some threshold, we cannot retrieve properties of the wealth distribution from properties of the consumption data beyond this threshold.

[4]Previous analyses on affluence indexes are due to Sen [33] and more recently to Medeiros [23] and Peichl et al. [29]. Kanbur and Mukherjee [18] contrast cumulative affluence excess and poverty gap to assess the ability to eradicate poverty in a given society.

Proof

$\Longrightarrow$ Let **e** the n-dimensional vector with unitary elements. From $\mathbf{y} \succcurlyeq_{GTL} \mathbf{y}'$ we get $\mathbf{y}-z\mathbf{e} \succcurlyeq_{GTL} \mathbf{y}' - z\mathbf{e} \forall z \geq 0$. Since $\max(x, 0)$ is increasing and convex, the result follows from Proposition 1.

$\Longleftarrow$ By setting $z = 0$, from $\mathbf{y} - z\mathbf{e} \succcurlyeq_{GTL} \mathbf{y}' - z\mathbf{e} \forall z \geq 0$, we immediately get the result. □

Testing for the second order affluence dominance is equivalent to test for GTL dominance. Notice that $\succcurlyeq_{A_1}$ is equivalent to first-order stochastic dominance and consequently implies second order affluence dominance.

The next proposition explains the link between GTL dominance and the dominance criterion based on the usual Lorenz curve. Let μ_y be the mean of vector **y**. We designate by $\succcurlyeq_{RL}$ the *relative Lorenz* dominance on $\mathbb{D}_n$.[5]

Proposition 3 *For all* $\mathbf{y}, \mathbf{y}' \in \mathbb{D}_n$, *such that* $\mu_y \geq \mu_{y'}$

$$\mathbf{y}' \succcurlyeq_{RL} \mathbf{y} \implies \mathbf{y} \succcurlyeq_{GTL} \mathbf{y}'.$$

Proof From $\mathbf{y}' \succcurlyeq_{RL} \mathbf{y}$ we know (see [22]) that $\frac{1}{\mu_y}\mathbf{y} \succcurlyeq_{GTL} \frac{1}{\mu_{y'}}\mathbf{y}'$. Since $\mu_y \geq \mu_{y'}$, by the very definition of $\succcurlyeq_{GTL}$ we get $\mathbf{y} \succcurlyeq_{GTL} \mathbf{y}'$. □

As expected, since GTL cumulates the attribute from the top, growth with an increase of inequality in terms of the Lorenz curve implies GTL dominance. Suppose now that the population is split into several groups. The following proposition says that GTL dominance for each subgroup implies GTL dominance for the whole population.

Proposition 4 *Let* $\mathbf{y} \succcurlyeq_{GTL} \mathbf{y}'$ *on* $\mathbb{D}_m$ *and* $\mathbf{x} \succcurlyeq_{GTL} \mathbf{x}'$ *on* $\mathbb{D}_p$. *Then* $(\mathbf{y}, \mathbf{x}) \succcurlyeq_{GTL} (\mathbf{y}', \mathbf{x}')$ *on* $\mathbb{D}_{m+p}$

Proof See Proposition A.7 p. 121 in Marshall and Olkin [22]. □

The statistical procedure we use to test GTL dominance on consumption survey data is based on the non-parametric approach developed by Davidson and Duclos [11]. To check GTL dominance between two distributions of consumption **c** and **c**′ we start testing first order affluence dominance of **c** over **c**′ (and vice-versa); If none of them dominates the other, we check second order affluence dominance. If even at the second order we cannot conclude, we look for affluence dominance above some absolute cutoff, concluding that a distribution dominates another only above some absolute threshold (for instance 5,000 US$ of quarterly consumption). The next section provides more details on the non-parametric test.

[5] The reader can refer to Davidson and Duclos [11] for a short introduction to inequality and poverty measurement.

3 Statistical tests

We now provide more details about the statistical procedure adopted in the paper. Let $\mathbf{c}$ be a distribution of consumption expenditures with support in K.

For a given wealth line z, an unbiased and asymptotically normal estimator for the wealth index at the order s, A^s, is as a mirror image of the one introduced by Davidson and Duclos [11] for a poverty index and it is given by

$$\widehat{A}_c^s(z) = \frac{1}{N_c(s-1)!}\sum_{i=1}^{N_c}(c_i - z)^{s-1} I(c_i \geq z), \tag{1}$$

where i denotes the ith individual, N_c is the sample size of the distribution $\mathbf{c}$, and $I(\cdot)$ is an indicator function equal to 1 when its argument is true and 0 otherwise.

Given two consumption distributions $\mathbf{c}$ and $\mathbf{c}'$, for some fixed set of k non-stochastic thresholds $\{z_1, \ldots, z_k\}$, we define the difference of the vectors of affluence indices at the order s, $\mathbf{\Delta}^s = \widehat{\mathbf{A}}_c^s - \widehat{\mathbf{A}}_{c'}^s$, with $\widehat{\mathbf{A}}_c^s = (\widehat{A}_c^s(z_1), \ldots, \widehat{A}_c^s(z_k))$ and $\widehat{\mathbf{A}}_{c'}^s = (\widehat{A}_{c'}^s(z_1), \ldots, \widehat{A}_{c'}^s(z_k))$. The null hypothesis is defined by a set of k constraints and can be expressed as

$$h_0 : \mathbf{\Delta}^s = 0.$$

The k constraints are verified using t statistics for the k non-stochastic thresholds up to an arbitrarily defined highest affluence line. We first test for first order affluence dominance ($s = 1$). In cases where the null hypothesis is rejected for each test point, and the sign on all of the t statistics are the same, then affluence dominance is declared.[6] If the null hypothesis is rejected and first order affluence dominance does not hold, we move at the second order of affluence dominance and repeat the test for $s = 2$. If even at the second order the test is not conclusive, to refine second order affluence dominance we look for affluence dominance at the top of the consumption distributions. If the sign on all of the t statistics above some threshold are the same for a relevant confidence level, then affluence dominance is declared up to the minimum threshold respecting this condition.

4 Application to US data

We apply our approach to data drawn from the Consumer Expenditure (CEX) Survey of the USA for the years 1980–2002. The data set provides information on the buying habits of American consumers, including data on their expenditures, income, and consumer unit (families and single consumers) characteristics. Expenditures consist of fourteen main categories: Food, alcoholic beverages, housing, apparel and services, transportation, health care, entertainment, personal care products and services, reading, education, tobacco products and smoking supplies, miscellaneous, cash contributions, and personal insurance and pensions. They are not a measure of consumption in the economic sense because no attempt is made to measure flows of services provided by durable goods. The CEX survey records what families spend

[6] The methodology implemented to test the null is analogous to that proposed by Sahn and Stifel [32] to test poverty dominance.

for consumption, not what they actually consume. To get an adequate measure of consumption, we adopt the measure proposed by Krueger and Perri [20] who use the same survey. Their definition, summarized in Table 2, includes quarterly expenditures on nondurable goods and services plus imputed services from houses and cars. Expenditures on nondurable comprise food, alcoholic beverages, tobacco, utilities, personal care, household operations, public transportation, gasoline and motor oil, apparel, education, reading, health services and miscellaneous expenditures. The imputed values of consumption services from vehicles were obtained by Krueger and Perri [20] by regressing expenditures for vehicle purchases on a set of covariates such as income, expenditure on gasoline, etc. The predicted expenditures on vehicles are then multiplied by the number of cars the consumer unit owns and by 1/32, assuming that a vehicle completely depreciates after 32 quarters on average. The imputation procedure applied to quantify services from primary residence is very similar to the one used for vehicles.[7] Each expenditure component is deflated by expenditure-specific, quarter-specific consumer price index. Measures of consumption are expressed in 1982–1984 constant dollars. As we are interested in the distribution of resources per capita, we divide household consumption by the number of adult equivalents in the household using the Census equivalence scale.[8]

The reliability of the CEX data base has been questioned repeatedly (see for instance [4]). In particular, the fact that, in aggregate, the expenditures reported in CEX represents a decreasing fraction of the consumer expenditures according to national accounts is a source of concern particularly for an exercise of comparison of living standards between generations. This issue has been investigated in depth by several authors such as Slesnick [38–40] and Triplett [41] and more recently by Garner [17]. A substantial part of the gap comes from definitional differences. For instance, health expenditures are not well covered since only out-of-pocket expenditures are reported in the survey. Moreover, according to Garner [17], "some CEX estimates are likely to suffer from proxy reporting (e.g., suspected for apparel and private health insurance) and occasional lying about certain products (e.g., tobacco and alcohol)". However the same authors add that "many estimates are considered of high quality (e.g., new automobiles, housing dwelling services, gasoline)".[9] The interest to use the Krueger and Perri [20] figures comes from the fact that their series displays a "growth trend over time that matches up better with national accounts data".[10] Then as they argue, if underreport exists, it is likely to be less severe for their measure than for others coming out from CEX.

We carry out the analysis comparing consumption of equally aged individuals over time. To this end, we distinguish between four age groups (21–30, 31–40, 41–50, and 51–60). We pick out three waves Jan.1980–Sept.1981, Jul.1990–Mar.1992, and Apr.2001–Dec.2002. Sample size are 8,028 for the first wave; 8,856 for the second one; and 15,499 for the last. Top-consumption shares and density plots are reported in Table 3 and Fig. 1 (see Appendix) give a rough picture of the relative affluence trends for different family groups over the three decades under exam. These tables show

[7]For further details see Krueger and Perri ([19], Appendix A.2.2 and A.2.3).

[8]The Census equivalence scale reflect the country's specific circumstances and is used in calculating the official poverty statistics (see [10]).

[9]p.45.

[10]p.167.

that young singles become more and more disadvantaged in getting rich, the opposite seeming true for families with old heads of household, while a substantially stable picture emerges for other groups. These patterns will be rigorously investigated in section 5, where we will use the robust statistical procedures described in the previous section.[11]

A crucial point to apply our theoretical result is that the function mapping consumption on lifetime resources must be stable between any couple of waves for which we have supposed a given mapping f in the theoretical analysis. Then, to develop our empirical analysis correctly, we have to control for the main factors affecting the consumption function. According to Attanasio and Browning [3], these factors are mainly *life cycle effect*, *business cycle effect*, and *heterogeneity*. Life cycle effect includes influences on consumption due to family composition, labour supply, labour market participation, and saving to bequeath. To mitigate such potential bias, we restrict our analysis to individuals aged between 21 and 60 working full-time. We exclude younger individuals since their consumption may depend on wealth of their relatives. We also discard elder individuals because their consumption decisions are more exposed to factors which are difficult to control for, as pointed out by Attanasio and Browning [3]. Furthermore, we make comparisons between equally aged individuals across cohorts in different decades, for example consumption of thirty-year-old individuals in the 80s is compared with that of thirty-year-old individuals in the 90s. With the choice of the span of age groups (ten years), we secure that individuals belonging to a given age group in a given wave cannot appear in the same age group in the following wave.[12]

Fluctuations in consumption due to business cycle may introduce a significant bias in our analysis. To control for cyclical effects we consider waves composed of several quarters. Including a large part of a real business cycle in a wave, we smooth the effects of temporary shocks. The waves are Jan.1980–Sept.1981, Jul.1990–Mar.1992, and Apr.2001–Dec.2002. The first period of each cycle (Jan. 1980–Jul. 1980; Sept. 1990–Mar. 1991; May 2001–Nov. 2001) is of contraction. July 1980, March 1991 and November 2001 are the troughs. After the trough the contraction turns into a twelve-months period of expansion (see Table 4 in the Appendix for the US business cycle expansions and contractions over the period 1980 to 2001). Figure 2 in the Appendix shows the trend of the main macroeconomic variables over the twenty-three years. The first indicators of economic conditions are the per capita gross domestic product (GDP) and the aggregate consumption in chained 2000 dollars (chart *a*). According to these measures, the three waves, highlighted in grey, experienced almost zero growth. GDP and aggregate consumption grew at a quarterly rate of about 0.09% and −0.08% in the first wave, −0.1% and −0.04% in the second and 0.072% and 0.41% in the third. Another macroeconomic indicator is the unemployment rate (see chart *b*) that shows a decline of nearly 2 percentage points from the first wave to the third one (the average quarterly rate is 7.3 in the first wave, 6.7 in the second, and 5.4 in the third). To check the robustness of our results, we repeat the analysis replacing

[11] Notice that GTL dominance does not necessarely reflect the comparison of top consumption shares. The top-shares used in Table 3 can be seen as points from relative Lorenz curves. Proposition 3 clarifies the link between the Lorenz curve and the GTL dominance.

[12] If we observed the same individuals across different waves, we would observe differences in consumption due to life-cycle effect or to realizations of exogenous shocks.

the three waves by three years with very similar real interest rates, i.e. 1980, 1993, 2003, without relevant differences in our results.

Even if we cannot control for the heterogeneity due to possible difference in preferences among individuals of the same age belonging to different cohorts, we refine our analysis by distinguishing individuals belonging to a same age group by household composition. In particular, we consider four types of household, single and couple both with and without children.[13] A last remark concerns the potential impact on consumption and saving decisions of the increasing diffusion of credit cards and other payment methods able to finance short-term consumption. The remarkable evolution of these tools from 1980 to 2002, jointly with the increasing share of e-commerce could introduce a further bias. However, this "technological change" could have been partially contrasted by the parallel introduction of new financial instruments attracting households' saving. The net effect of these innovations over the shape of consumption function could be different all over the life-cycle, and its evaluation goes beyond the objectives of this paper.[14]

5 Results

The results of the affluence dominance tests are summarized in Table 1. Each row of the table compares different generations for a given age group. Over the twenty-three years (1980–2002) we focus on, we observe six age cohorts, from G20 (people between 1920 and 1930) to G70 (people born from 1970 to 1980). Of the oldest cohort, G20, (resp. youngest, G70) we observe only people belonging to the fourth age group, 51–60, (resp. first age group, 21–30) which is compared with the two following cohorts (resp. the two previous cohorts). For the other generations, we observe more age groups and we compare each cohort either with the previous and the following cohorts. The results are presented distinguishing by household type. We only retain results for the household types sufficiently represented at each age group (for instance, the number of singles of the oldest age group is too limited, so we focus only on couples and couples with children).[15]

The comparisons are expressed in terms of first or second degree of affluence dominance. The good news is that in many cases the test is not plagued by non-comparability. Only five comparisons out of 33 are indecisive. In these cases, we try to go a bit further by investigating the cutoff in terms of affluence limit from which one distribution dominates the other. In this case, the figures in brackets indicate that the cutoff point corresponds approximately to the top X% of richest households. For instance, we document that the cohorts G30 and G50 of couples

[13] In addition, we recall that we use consumption corrected by equivalence scales in all cases.

[14] See Browning and Lusardi [6] for a survey on saving patterns in the US. We point out that if the decrease of saving rates for US households over the last 30 years was partially due to a change in preferences (more precisely, to a rise in the shape of the consumption function) our results would overestimate the affluence of recent generations. This is due to an elementary property of the inverse function. However, Lusardi and Beeler [21] recently show that preferences on saving planning in the US are rather stable across cohorts.

[15] The smallest group for which we present results is couples with children born in the 50's in Wave 2 (size 304). The size of the largest (couples without children born in the 50's in Wave 1) is 1,362.

Table 1 Affluence comparison among generations, period 1980–2002

Gener. / Age group	G20 (born 1920–30)	G30 (born 1930–40)	G40 (born 1940–50)	G50 (born 1950–60)	G60 (born 1960–70)
I (21–30)	–	–	–	G50 vs. G60 singles $>_2$** sing + ch =** couples =** G50 vs. G70 singles =** sing + ch =* couples $<_2$***	G60 vs. G70 singles $<_1$* (~top 10%) sing + ch =* couples $<_2$***
II (31–40)	–	–	G40 vs. G50 singles =** sing + ch =** couples =** G40 vs. G60 singles $>_2$** sing + ch =** couples $<_2$***	G50 vs. G60 singles =** sing + ch =** couples $<_2$*** coup. + ch $\leq_2$* (~top 5%)	
III (41–50)	–	G30 vs. G40 couples =* coup + ch =** G30 vs. G50 couples $\leq_2$* (~top 25%) coup. + ch $\leq_1$* (~top 30%)	G40 vs. G50 singles =** sing + ch =** couples =** coup + ch =**		
IV (51–60)	G20 vs. G30 couples $<_2$* coup + ch =** G20 vs. G40 couples $<_2$*** coup+ch $\leq_2$ (~top 10%)	G30 vs. G40 couples $<_2$* coup + ch $\leq_2$*			–

$>_i$ The older generation dominates the younger for order i affluence dominance

$<_i$ The younger generation dominates the older for order i affluence dominance

= The two distributions are not significantly different

(~top X%) The relation holds above a threshold that approximately corresponds to the top X% of the dominant distribution

*Significance at the 90% level of confidence

**Significance at the 95% level of confidence

***Significance at the 99% level of confidence

with children at the third age class are not comparable. However, by looking more carefully to the data, it emerges that the two distributions cannot be ranked below a cutoff corresponding approximately to the top 30% of richest households, while above this line G50 dominates at the second order G30.

In half of the cases (18/33), the two distributions are statistically equivalent in terms of affluence. So the general impression is that of a global stability which comes at variance with the increasing trend of GDP or net worth of US households (see

Fig. 2 and discussion below). For example, we do not find significant difference in affluence between people born from 1940 to 1950 and people born in the following decade (1950–1960) for the available age groups (from 30 to 50). This indicates a substantial homogeneity of affluence within the baby boomer generation. In addition, the affluence of 41–50 years old individuals (group age III) of the generation born between 1930 and 1940 (G30) is similar to that of the following cohort, G40, at the second order.

Now, it still occurs that one cohort dominates strictly the other. It happens in almost 1/3 of the cases. It is more frequent that the more recent generation dominates the previous one than the opposite (10 occurrences out of 12).

The most relevant exception to this general trend is represented by the cohort born between 1960 and 1970 (G60). Looking at the first row of Table 1 (age group 21–30) we see that single people of this cohort, constituting the first wave of the so called “generation X” in the US and labeled “baby-losers” in Europe [8, 9] get worse both than their predecessor “baby boomers” born in the 50’s (G50) and than people born in the 70’ and belonging to the second wave of the generation X. Moreover, this decrease of standard of living also affects the older single (group II) when comparing the generation X and the generation of baby boomers born in the 40’s (G40). Economic reasons have to be called for to explain this misfortune, from a pure demographic point of view, there were fewer than the baby-boomers, which represents an advantage according to the Easterlin hypothesis [14]. Though, when they entered the labor market, they faced the second oil shock and the early 1980’s recession. The monthly average unemployment rate computed by decade is higher than in the eighties than for the previous and next decade, respectively 7.29% instead of 6.22 and 5.78%. Then the most plausible explanation of the difficult start of the first wave of the X generation is that they faced harsh conditions when entering in the labor market with some long-standing effects in terms of confidence and wealth.

It is interesting to compare our results with some previous works by Wolff [42], who completed US tax statistics by data drawn from several household surveys to explain the evolution of net worth inequality from 60’s to 80’s in terms of variations of income inequality, stock prices and housing prices. Analyzing net worth by age group, people aged between 45 and 69 appear the “winners” over the two decades 70’s and 80’s. Several papers by the same author [43, 44] update these results. The decrease in the share of net worth of the younger age group from 21 to 14% in twenty years [44, Table 11] fits with our results on “generation X”, which are also consistent with the findings of Paulin and Riordon [27] and Paulin [28]. These latter researches consider periods of economic expansion, confirming that our findings are robust to the specific choice of the waves. The investigation of the causes of this phenomenon goes beyond the scope of the article since it would involve the study of many factors such as obtainment of degrees, the functioning of the labor and housing market among others. It is clearly an avenue for further research.

6 Conclusion

Since the birth of the permanent income hypothesis, consumption expenditures have been used as a proxy for permanent incomes. We go a step further by establishing the link between the distribution of consumption and that of permanent income in terms of dominance orderings. We introduce two new dominance orderings, the GTL test and the related affluence ordering. We show that if a concavity property holds between consumption and permanent income, then a change in the affluence distribution detected in consumption data translates into an equivalent change in the wealth distribution.

We apply this methodology to track changes in the US wealth distribution from the observation of the change in US consumption data from 1980 to 2002. The increase of economic affluence we infer from consumption data seems less impressive than the increase of US households's wealth documented for the same period using net worth data, which may be more sensitive to changes in prices of households' real and financial assets. Our analysis also confirms the difficulties of the cohort born in the 60's, when aged between 20 and 30 years. If the first observation may be affected by a growing under-reporting problem over time in CEX, the second observation should be immune to that possible weakness of the data. Indeed, in that case, the older cohort is dominated by the more recent one, while the underestimation bias would presumably be more important for that generation.

From the methodological side, our contribution goes beyond the application developed in this paper. The US was chosen as a benchmark since it is likely the economy for which we are the most informed about the change of the wealth distribution at the top. Once we have checked that our methodology is robust, i.e., we can obtain results that seem in tune with what is known for this benchmark economy, it can be applied in other contexts. In particular, retrieving affluence from consumption data could be helpful to study developing countries, for which changes in wealth are usually much less documented than changes in consumption (e.g., [12]). Hence, despite this illustration on an advanced economy, our methodology seems well suited to obtain insights into the evolution of wealth concentration in developing countries. Another important follow-up could investigate the impact of the 2008 crisis on wealth distribution.

Notice that our procedure cannot be replicated to make indirect inference on welfare measures like the generalized Lorenz test and its equivalent poverty ordering [36]. Consumption data do not help to assess poverty in terms of permanent income. The reason is that GL dominance is preserved only after concave transformations (see [26]), while in this paper we use convexity of permanent income with respect to consumption to infer affluence indirectly.

However, we could reverse the exercise and make indirect inference in the opposite direction, that is from wealth to consumption distributions. More precisely, given the concavity of the consumption function, checking GL dominance on wealth data allows to infer GL dominance among the corresponding consumption distributions. This exercise could be helpful when good data are available for wealth distributions (as in [37]). There is a caveat here. Generally wealth data are about net worth. The methodology requires then that consumption is concave with respect to net worth, that is, the result obtained by Carroll and Kimball [7]. All in all, our paper introduces a methodology able to provide insights either on affluence (in terms of permanent income) or on poverty (in terms of consumption) starting respectively from data on consumption or wealth. It does not mean that we should expect similar results from both approaches. Indeed, GTL test (used in affluence analysis) and GL test (used in welfare or poverty analysis) do not coincide when the considered distributions do not have the same mean.

Appendix

Table 2 The measure of consumption

Category
Food
Alcoholic beverages
Tobacco
Personal care
Fuels, utilities and public services
Household operations
Public transportation
Gasoline and motor oil
Apparel
Education
Reading
Health services
Miscellaneous expenditures*
Entertainment
Household equipment
Other lodging expenses**
Other vehicle expenses***
Rented dwellings
Imputed services from owned primary residence
Imputed services from vehicles

*These are mostly fees for services such as banking or legal assistance

**It includes mostly expenditures on vacation homes

***It includes expenditures on maintenance, repairs, insurance and finance charges

Table 3 Top 1% and 5% consumption shares, period 1980–2002, for age groups

Age group \ Wave	Singles			Singles with children		
	Wave I (1980–81)	Wave II (1990–92)	Wave III (2001–02)	Wave I (1980–81)	Wave II (1990–92)	Wave III (2001–02)
I	5.46	3.83	4.33	4.81	4.18	4.95
(21–30)	15.04	12.58	13.85	15.12	13.26	14.68
II	7.27	4.95	4.10	5.98	5.08	4.62
(31–40)	16.24	14.32	13.20	15.14	14.80	14.02
III	–	7.00	4.56	–	4.86	5.55
(41–50)		16.78	13.76		14.03	15.18
IV	–	–	–	–	–	–
(51–60)						
	Couples			Couples with children		
I	3.83	3.73	3.54	–	–	–
(21–30)	12.16	12.21	12.69			
II	4.32	3.74	3.85	4.51	6.25	–
(31–40)	12.92	12.39	13.19	13.05	15.24	
III	4.99	4.85	5.65	5.35	4.22	4.40
(41–50)	14.94	13.83	14.56	13.89	13.53	14.08
IV	4.82	4.64	5.42	4.72	5.49	6.01
(51–60)	13.70	13.73	15.01	14.40	14.84	15.71

1st line top 1%; 2nd line top 5%

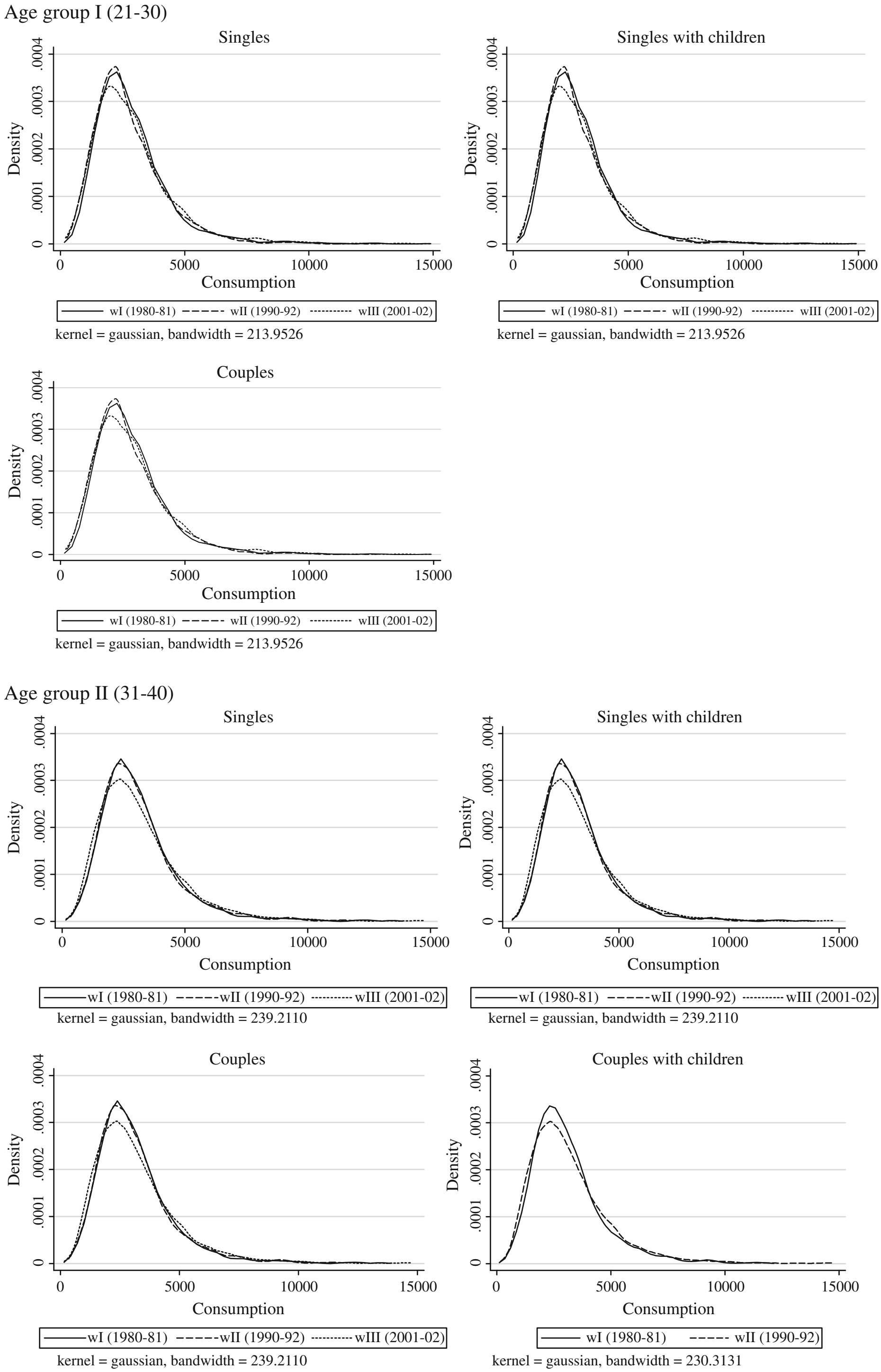

Fig. 1 Quarterly consumption expenditures

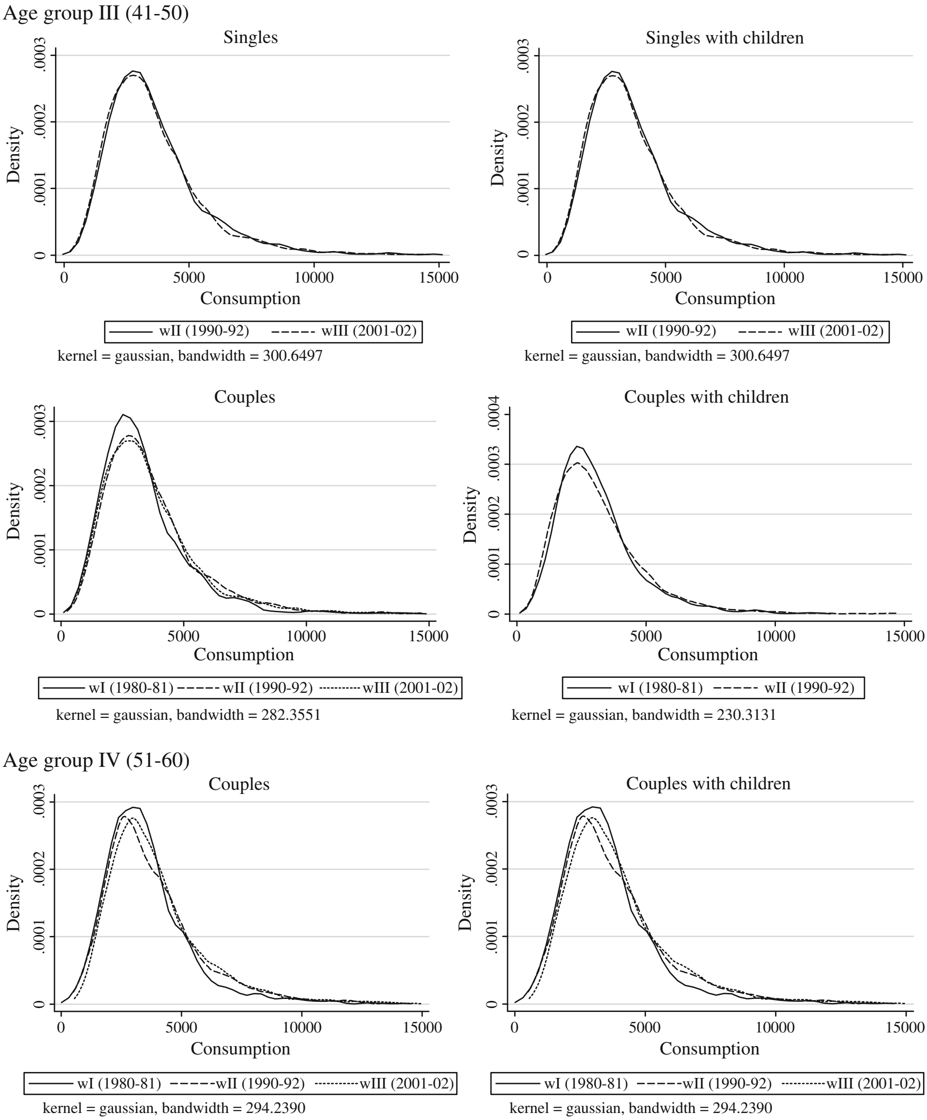

Fig. 1 (continued)

Table 4 Business cycle expansions and contractions

Business cycle					
Reference dates		Contraction	Expansion	Cycle	
Peak	Trough	Peak to trough	Previous trough to this peak	Trough from previous trough	Peak from previous peak
January 1980 (I)	July 1980 (III)	6	58	64	74
July 1981 (III)	November 1982 (IV)	16	12	28	18
July 1990 (III)	March 1991 (I)	8	92	100	108
March 2001 (I)	November 2001 (IV)	8	120	128	128

Quarterly dates are in parentheses

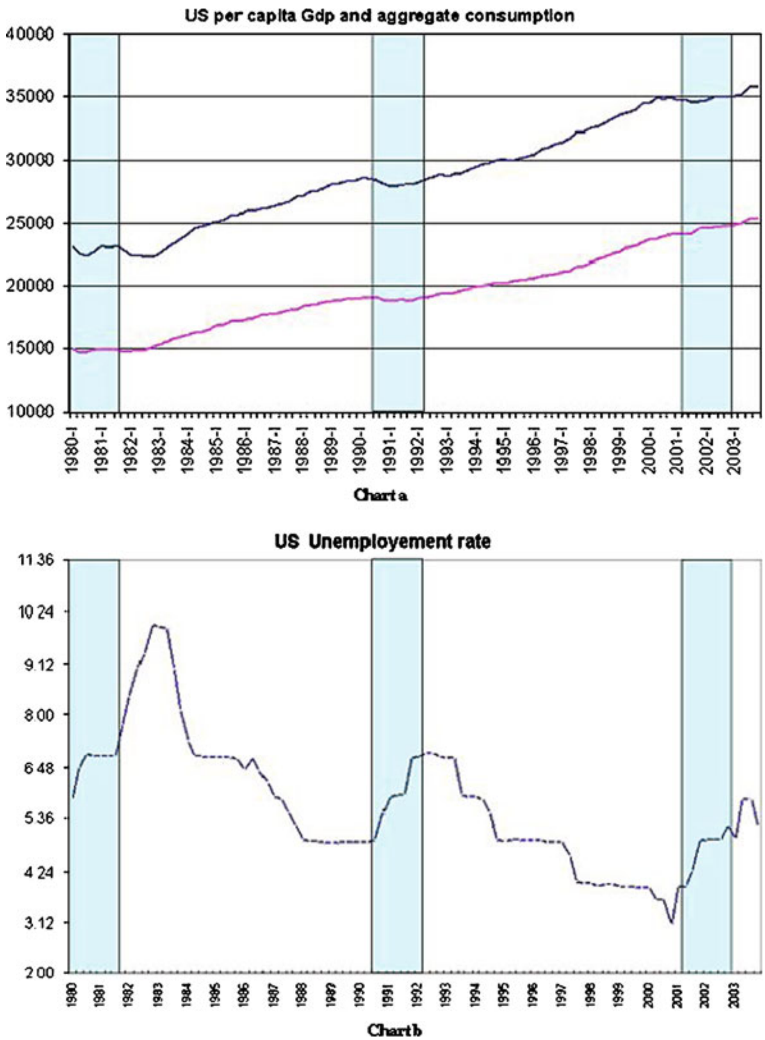

Fig. 2 Macroeconomic factors

References

1. Atkinson, A.B.: On the measurement of inequality. J. Econ. Theory **2**, 244–263 (1970)
2. Atkinson, A.B, Saez, E., Piketty, T.: Top incomes in the long run of history revised January 2010. J. Econ. Lit. (2010, forthcoming)
3. Attanasio, O.T., Browning, M.: Consumption over the life cycle and over business cycle. Am. Econ. Rev. **85**, 1118–1137 (1995)
4. Attanasio, O., Battistin, E., Leicester, A.: From micro to macro, from poor to rich: consumption and income in the UK and the US. Working paper, University College London (2006)
5. Bavier, R.: Reconciliation of income and consumption data in poverty measurement. J. Policy Anal. Manage. **27**, 40–62 (2008)
6. Browning, M., Lusardi, A.: Household saving: micro theories and micro facts. J. Econ. Lit. **34**, 1797–1855 (2006)
7. Carroll, D., Kimball, M.: On the concavity of the consumption function. Econometrica **64**(4), 981–992 (1996)
8. Chauvel, L.: Un nouvel âge de la société am éricaine? Dynamiques et perspectives de la structure sociale aux É tats-Unis (1950–2000). Revue de l'OFCE **76**, 7–51 (2001)
9. Chauvel, L.: Social generations, life chances and welfare states. Working Paper for Transforming the Democratic Balance Among State, Market and Society: Comparative Perspective on France and the Developed Democracies, 17–18 May 2002. Minda de Gunzburg Center for European Studies, Harvard University (2002)
10. Dalaker, J., Naifeh, M.: U.S. Bureau of the Census, Current Population Reports, Series P60-201. Poverty in the United States: 1997. U.S. Government Printing Office, Washington, D.C. (1998)
11. Davidson, R., Duclos, J.-Y.: Statistical inference for stochastic dominance and for the measurement of poverty and inequality. Econometrica **68**(6), 1435–1464 (2000)
12. Deaton, A.: The Analysis of Household Surveys: a Microeconomic Approach to Development Policy, by Angus S. Deaton Softcover. World Bank Publications (1997)
13. Dynan, K.E., Skinner, J., Zeldes, S.P.: Do the rich save more? J. Polit. Econ. **112**, 397–444 (2004)
14. Easterlin, R.A.: Birth and Fortune, 2nd edn. Basic Books, New York (1987)
15. Foster, J.E., Shorrocks, A.F.: Poverty orderings. Econometrica **56**, 173–177 (1988)
16. Friedman, M.A.: A Theory of the Consumption Function. NBER, Princeton University Press (1957)
17. Garner, T., Janini, G., Passero, W., Paszkiewicz, L., Vandemia, M.: The consumer expenditure survey in comparison: focus on personal consumption expenditures. Paper Presented at the Federal Economic Statistics Advisory Committee Meeting, Bureau of Labor Statistics, Washington, DC (2003)
18. Kanbur, R., Mukherjee, D.: Poverty, relative to the ability to eradicate it: an index of poverty reduction failure. Econ. Lett. **97**, 52–57 (2007)
19. Krueger, D., Perri, F.: Does income inequality lead to consumption inequality? Evidence and theory. CFS Working Paper Series 200515 (2005)
20. Krueger, D., Perri, F.: Does income inequality lead to consumption inequality? Evidence and theory. Rev. Econ. Stud. **73**, 163–193 (2006)
21. Lusardi, A., Beeler, J.: Saving between cohorts: the role of planning. In: Mandrian, B., Mitchell, O., Soldo, B. (eds.) Redefining Retirement: How Will Boomers Fare? Oxford University Press (2007)
22. Marshall, A.W., Olkin, I.: Inequalities: Theory of Majorization and its Applications. Academic Press, New York (1979)
23. Medeiros, M.: The rich and the poor: the construction of an affluence line fromthe Poverty line. Soc. Indic. Res. **78**(1), 1–18 (2006)
24. Meyer, B.D., Sullivan, J.X.: Measuring the well-being of the poor using income and consumption. J. Hum. Resour. **38**, 1180–1220 (2003)
25. Meyer, B.D., Sullivan, J.X.: Changes in the consumption, income, and well-being of single mother headed families. Am. Econ. Rev. **98**, 2221–2241 (2008)
26. Moyes, P.: Some classes of functions that preserve the inequality and welfare orderings of income distributions. J. Econ. Theory **49**, 347–359 (1989)
27. Paulin, G., Riordon, P.: Making it on their own: the baby boom meets generation X. Mon. Labor Rev. **121**, 10–21 (1998)
28. Paulin, G.: Expenditure patterns of young single adults: two recent generations compared. Mon. Labor Rev. **123**, 19–50 (2008)

29. Peichl, A., Schaefer, T., Scheicher, C.: Measuring richness and poverty a micro data application to Europe and Germany. Rev. Income Wealth **56**, 597–619 (2010)
30. Peluso, E., Trannoy, A.: Does less inequality among household mean less inequality among individuals? J. Econ. Theory **133**, 568–578 (2007)
31. Piketty T., Postel-Vinay, G., Rosenthal, J.L.: Wealth concentration in a developing economy: Paris and France, 1807–1994. Am. Econ. Rev. **96**(1), 236–256 (2006)
32. Sahn, D.E., Stifel, D.C.: Poverty comparisons over time and across countries in africa. World Dev. **28**, 2123–2155 (2000)
33. Sen, P.K.: The harmonic gini coefficient and affluence indexes. Math. Soc. Sci. **16**, 65–76 (1988)
34. Shaked, M., Shanthikumar, J.G.: Stochastic Orders. Springer (2006)
35. Shorrocks, A.F.: Ranking income distribution. Economica **50**, 3–17 (1983)
36. Shorrocks, A.F., Foster, J.E.: Transfer sensitive inequality measures. Rev. Econ. Stud. **54**, 485–497 (1987)
37. Sierminska, E., Brandolini, A., Smeeding, T.: The Luxembourg wealth study: a cross-country comparable database for household wealth research. J. Econ. Inequality **4**(3), 375–383 (2006)
38. Slesnick, D.T.: Aggregate consumption and saving in the Postwar United States. Rev. Econ. Stat. **74**(4), 585–597 (1992)
39. Slesnick, D.T.: Are our data relevant to the theory? The case Of aggregate consumption. J. Bus. Econ. Stat. **16**(1), 52–61 (1998)
40. Slesnick, D.T.: Consumption and Social Welfare: Living Standards and their Distribution in the United States. Cambridge University Press, Cambridge (2001)
41. Triplett, J.E.: Measuring consumption: the post-1973 slowdown and the research issues. Federal Research Bank of St. Louis Review, May/June **79**(3), 9–42 (1997)
42. Wolff, E.N.: Changing inequality of wealth. Am. Econ. Rev. **82**, 552–558 (1992)
43. Wolff, E.N.: Recent trends in the size distribution of household wealth. J. Econ. Perspect. **12**, 131–150 (1998)
44. Wolff, E.N.: Recent trends in household Wealth in the United States: rising debt and the middle-class squeeze. Working Paper **12**, 131–150 (2007)
45. Wolff, E.N., Zacharias, A.: Household wealth and the measurement of economic well-being in the United States. J. Econ. Inequality **7**(2), 83–115 (2009)
46. Zeldes, S.P.: Optimal consumption with stochastic income: Deviations from certainty equivalence. Q. J. Econ. **104**, 275–298 (1989)