

Growth of income and welfare in the U.S, 1979-2011
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Abstract: We estimate growth rates of real income in the U.S. by quintiles using the CBO's estimates as our basis. We make some adjustments by including only those items of income that increase utility and discount those incomes that will accrue in the future. In addition, we use the CPI as the upper bound and the Personal Consumption Expenditure price index as the lower bound of the income growth rate estimates, 1979-2011 and 2000-2011. We also estimate growth in welfare assuming a diminishing marginal utility of income with independent and interdependent utility functions. The major consistent findings are what in the colloquial is referred to as the "hollowing out" of the middle class as well as the tremendous increase in the income of the top 1%. The income of the latter relative to the 1st quintile increased from a factor of 21 in 1979 to 51 in 2011.

JEL classification: D69, I31, N10, O49

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Introduction

While the concept of income and its distribution—amongst the most salient variables in economics—is theoretically straightforward, the empirics associated with them are complicated and controversial. As a consequence, a consensus view has failed to emerge on how to measure them, insofar as the data gathered by various institutions charged with the task define them quite differently. For instance, the Census collects data on cash income which is deemed fairly accurate but it has shortcomings as well, because it neglects taxes paid to and benefits received from the government or transfers in kind, such as food stamps. The Congressional Budget Office (CBO) does make a periodic effort to redress these limitations but at the same time introduces some of its own making as we are about to see. Furthermore, the complex of problems associated with the estimates of the rate of inflation is a can of

worms in and of itself. To say that it is particularly challenging, and that measurement errors abound would be an understatement.

This paper sets itself the goal of improving upon the estimated growth rates of household income for two periods: 1970-2011 and 2000-2011 and in the process point to lacunae in the empirical evidence. Perhaps one of the strongest conclusions to emerge from this exercise is the proverbial call for further research in this important area. The paper takes the CBO data as its starting point, because it is the most complete estimate of disposable household income and its distribution (CBO, 2014). A further aim of the paper is to explore the implications of the obtained growth rates of real income on welfare which, after all, is one of the main variables of interest in applied economic analysis. An overlooked shortcoming of the literature associated with this complex of issues is that it is generally assumed that welfare growth is identical to income growth, even though one of the fundamental tenets of economic theory is the diminishing marginal utility of income. Hence, we shall incorporate such non-linear functions into our estimates of welfare after we re-estimated real incomes and their distribution.

Defining income

The CBO's main goal is to estimate the incidence of taxes whereas our goal here is to estimate the increases in real income in such a way that we can gauge the gains welfare along the income distribution. This difference dictates some deviation from the CBO procedure as far as the income transfers are concerned.¹ We modify the CBO data in three ways:

¹ Another variant, referred to as comprehensive income, focuses on consumption and changes in net wealth (Armour et al., 2013). Formally this definition is $I = C + \Delta NW$, where I is income, C is consumption and ΔNW is the change in net worth. We eschew this formulation on account of the fact that paper wealth might well be based on unrealistic prices as many home owners found out in the midst and aftermath of the financial crisis of 2008. In addition, the problem of accuracy of net worth, there is the problem associated with the riskiness of the asset position of the individual that the above formulation does not consider.

1) We exclude those items that do not increase utility such as the CBO's estimate of "Corporate tax born by labor". The rationale of this "income" is that part of the taxes levied on corporations induces them to pay lower wages and therefore the assumption is that labor's income would have increased by this amount of money in the absence of corporate taxes. So, in effect, labor foregoes this amount or "pays" this part of the tax. While this procedure is appropriate for understanding tax incidence it is not so for estimating only those components of income that enhance utility, because employees never see or even know about these amounts. Insofar as it is not shown on their paychecks, it does not increase their utility or welfare. Hence, this amount is subtracted from the CBO data.

The same argument applies to "Corporate tax born by Capital", except it pertains to shareholders rather than to employees. This is the incidence of corporate taxes paid by shareholders, but again this is not utility enhancing, so it will also be subtracted from the CBO data. Hence, these two items are excluded from the analysis to follow.

2) We calculate and add only the present value of those incomes that will accrue in the future. Insofar as this is standard practice, there is no warrant for adding the full amount to cash incomes. The present value of future incomes such as "Employer's Share of Payroll Taxes" are estimated by assuming that the discount rates vary by income quintile from the lowest to the highest as follows: 0.25, 0.20, 0.15, 0.10, and 0.05. To be sure, these values, chosen for convenience, are arbitrary but the reason for using them nonetheless is that the "the large empirical literature devoted to measuring discount rates has failed to establish any stable estimate. There is extraordinary variation across studies" (Frederick et al 2002). Given the necessity of discounting these incomes, taking such plausible numbers is the best we can do at this time. It does seem plausible that the discount rate would be inversely related to income, insofar as one would be more anxious to increase current income the less income one has. These discount rates imply that the present value of \$1 to be received (with certainty) in

retirement (averaged over the forty age groups between the ages of 25 and 65) in the five quintiles in increasing order is: \$0.08, \$0.10, \$0.14, \$0.21, and \$0.39.² These approximations are then used to calculate the present value of “Employer’s Share of Payroll Taxes.”³

3) Then there are three items for health insurance which we do not consider in total income on account of the fact that the actual benefits themselves most likely have not increased meaningfully over time and, even if they had, they would have to be discounted, because the benefits will accrue in the future (with uncertainty). The items subtracted include “Employer’s Contributions to Health Insurance,” which increased between 1979 and 2011 slightly from 3.1% to 4.3% of labor income and “Medicare and Medicaid payments” which increased from 2.5% to 8.8% of total income. These increased shares were caused most likely by the fact that the price of medical services has increased faster than the rest of the price index and moreover that the aging population necessitates higher Medicare expenditures. This consideration points to one of the shortcomings of all of these estimates, namely that they are not standardized for the age structure of the population.⁴

Because of the large number of problems associated with these health insurance series, my belief is that it is appropriate to leave them out of consideration: they were most likely neither increasing disposable income nor experienced utility noticeably more in 2011 than they did in 1979. The inherent inaccuracies and uncertainties associated with these items include the fact that the price indexes are not available for the various income quintiles, the age structure of the society changed substantially and the demand for medical services is age-sensitive, these benefits accrued in the future and therefore it would be appropriate to

² The average of these five discount rates is \$0.18, which is used for the median income.

³ There is an additional complication that is neglected here, namely, that in principle the calculation would need to consider also the probability that one does not live long enough to collect these benefits.

⁴ The share of the population over the age of 65 increased from 11.3% to 13.0 between 1980 and 2010. <https://www.census.gov/population/age/data/2012comp.html>, accessed November 27, 2015.

discount them, they also accrued with uncertainty insofar as the beneficiary would have to become sick prior to needing the insurance, and finally the actual coverage is unlikely to have changed substantially over time. As a consequence of all these issues, I believe that a more accurate estimate of the growth rate of income and welfare will be obtained if these items are left out of consideration for now until these uncertainties are better understood.

Lower- and Upper-Bound Price Indexes

In addition to the question of what should be considered “income,” approximating the rate of inflation is likewise a crucial, complicated, and controversial issue. The CBO converts nominal into real income using the personal consumption expenditures (PCE) price index calculated by the Bureau of Economic Analysis (BEA) while the Bureau of Labor Statistics (BLS) uses the consumer price index (CPI) for all urban consumers instead. Actually, there are innumerable difficulties with both indexes and it is not at all clear which one is more accurate (Boskin et al., 1998; Whelan, 2002; Hausman, 2003). As it turns out, which index is used to convert nominal into real incomes does make a substantial difference to the estimates, because “the average annual inflation rate of the 1979-2009 period was about 0.2 percentage points lower as measured by the PCE price index than as measured by the CPI” (CBO 2012, p. 21).

Although both indexes are good faith approximations, that is all they are: approximations. They differ in a multitude of large and small ways; for instance, the PCE uses weights derived from business surveys, whereas the CPI uses weights derived from household surveys. The minutiae of differences include the fact that the BEA imputes prices for “financial services furnished without payment,”⁵ that is to say, services for which banks do not charge explicitly, such as processing of checking accounts. For such services the BEA includes an imputation (Hood 2013) but for about three quarter of the items it does itself use

⁵ BEA, “What is the “market-based” PCE price index?
http://www.bea.gov/faq/index.cfm?faq_id=83 Accessed September 23, 2015.

the CPI as a baseline (Moyer, 2006). The CPI has some advantages insofar as the PCE includes expenditures made on behalf of households such as by insurance companies, whereas CPI uses only out-of-pocket expenditures made by consumers, which seems more appropriate if one wants to deflate personal income in order to obtain an idea of the cost of living.⁶ Moreover, the main focus of the PCE is calculating the U.S. national income and product accounts. This implies that the PCE includes purchases not only by households but also by non-profit institutions (McCully et al., 2007) as well as by intermediaries which may or may not pass price changes onto consumers. However, the CPI also has disadvantages insofar as it is confined to the urban population and unabashedly leaves the prices faced by the rural population entirely out of consideration. This is not a complete list of differences by any means but should give one an idea of the intricacies and challenges of estimating price indexes.⁷

The upshot of all of the differences is that the inflation rate measured by the CPI tends to exceed its PCE counterpart implying that if the PCE is used to correct for inflation one will attribute less of the increases in nominal income to changes in prices and consequently real income growth will be greater using the PCE than when using the CPI. Hence, one could consider the growth rates obtained using the CPI as the lower-bound growth rates and those

⁶ Other differences include the fact that the PCE uses weights that change from quarter to quarter while the CPI market basket is updated every two years. The PCE uses a chained Fisher index formula whereas the CPI uses a Laspeyres-type formula. The PCE uses the CPI for 74% of its items, the producer price index (PPI) for 9%, input-cost indexes 10% and other 7%. The PPI is the price of products for the first commercial transaction which makes it more like a wholesale price index and was called just that until 1978. The weights also differ. Shelter and transportation get a substantially higher weight in the CPI Index than in the PCE index, 32.7% vs 15% and 17.4 vs 11.9% respectively. On the other hand medical care receives only 6.1% in the CPI but 20.3% in the PCE index. The big difference in the medical care weights is due to the fact that the PCE includes payments made not only by households but also by employers and government programs (Moyer, 2006).

⁷ BLS, "Comparison of BLS Price and Spending Measures," http://www.bls.gov/cex/oplc_program_comparisons.htm accessed December 27, 2015.

obtained with the PCE as the upper-bound ones. This is the procedure we follow below although there is no guarantee at all that the “true” price index is bounded by these two approximations, because of the many assumptions, interpolations, and estimates that go into such calculations and because the standard errors of the indexes are by no means negligible.⁸ Because these errors could well accumulate over time, the longer is the time that separates the end dates of the growth rate calculation, the less reliable are the price indexes.

Welfare

Applied welfare analysis has to assume that utility can be somehow aggregated into a social welfare function. Otherwise, the whole notion of living standards and aggregating incomes at the population level makes little sense, insofar as it requires the summation of individual utilities (Sen, 1970). “Our social welfare function will always tend to take the form of a sum (or mean) of individual utilities” (Harsanyi, 1955). If the profession insists on ordinal utility functions which cannot be aggregated and does not allow interpersonal comparisons of utility than we should be consistent and expunge concepts such as living standards, social costs, and progress from our canon. In short, in the real world such comparisons are unavoidable; indeed, they are central to applied economic analysis.⁹ In any event, Harsanyi argues that “economists and philosophers influenced by *logical positivism* have greatly exaggerated the difficulties we face in making interpersonal utility comparisons” (2008).

Thus, we estimate trends in welfare in the spirit of a Bergson-Samuelson social welfare function that translates the average income within a quintile into the welfare of a representative agent assuming a declining marginal utility of income. This bears some

⁸ In 2014, for instance, when the inflation rate was 1.66%, its standard error was 0.08, so that its 95% confidence interval was between 1.5% and 1.82% which is quite a wide range (Shoemaker, 2015).

⁹ For example, Samuelson and Nordhaus discuss “the net social cost” of tariffs by adding the gain of producers to the losses of consumers assuming “counting each of these dollars equally”, as though their utility functions and income were identical (2009, p. 353).

similarity to the strategy of Jones and Klenow (2010) who compare welfare across countries using the technical apparatus of a logarithmic utility function on consumption. Becker et al. (2005) compare utility across countries and continents once augmenting income with the value of the gains in life expectancy. Similarly, per capita GDP also has diminishing impact on the Human Development Index as well as on the Happiness indexes (Easterlin, 1974; Fleurbaey and Blanchet, 2013). Moreover, a comparable problem arises in “the literature on sustainable development [which] has taken human wellbeing to be the object to be sustained (Arrow et al., 2012).” In such cases the tacit assumption is that the utility function of future generations will be similar—if not identical—to that of the current generation. Nordhaus and Tobin also draw a distinction between welfare and monetary measures of economic activity: “GNP is not a measure of economic welfare.... Economists all know that, and yet their everyday use of GNP as the standard of measure of economic performance apparently conveys the impression that they are evangelistic worshippers of GNP (1973, p. 512).” In other words, in practice one can hardly avoid making some assumptions beyond pure theory: “if one wants to say anything specific about social welfare, one must introduce explicit value judgements (Pattanaik, 2008).” The associated concepts are also part of the optimal taxation literature (Mirrlees 1971; Diamond and Mirrlees, 1971; Saez and Stantcheva, 2016).

Although the form of the utility function is difficult to determine empirically, it is clear that the relationship between income and welfare is non-linear insofar as the diminishing marginal utility of income is one of the mainstay concepts of economics.¹⁰ Hence, in addition to calculating growth rates of income, we convert income into welfare estimates in order to gauge the growth in welfare during the intervening years. In the absence

¹⁰ Aggregating welfare has similar conceptual problems as aggregating incomes.

of a consensus of the form of the utility function, we first assume that $W=y^\alpha$ where W is welfare, y is the estimated income, and α is an exponent.¹¹

In addition to the above specifications, we assume that welfare is not only a function of one's own income but also of relative income (Duesenberry, 1949; Boskin and Sheshinski, 1978). Insofar as there is no consensus on how relative income should be formulated, we experiment with several functional forms as explained below (Alvarez-Cuadrado and Long 2011; Ljungqvist and Uhlig 2000).

Results: Existing Estimates

Note that whenever we refer to the income of the whole population we have the median for all households in mind; however, when we refer to incomes of the quintiles or percentiles we have the average of the incomes within that group in mind.

Note also that the CBO adjusts incomes “for differences in household size by dividing income by the square root of the average number of people in the household (CBO, 2014, p. i)” and we follow this procedure although this adjustment makes only slight difference to the growth rates, insofar as average household size changed but slightly in this period.¹² (In order to increase the accuracy of these adjustments one would have to use quintile-specific household size which is unavailable.)

In order to save space, our results are reported as follows: whenever we report the dollar values of incomes we use the original values before adjusting for household size. However, when we report growth rates, we report those rates that were obtained after we divided the original values by the square root of household size which values are not reported here.

¹¹ In such a function the marginal utility of income is inversely proportional to income. The estimates of Layard et al. imply that marginal utility falls even faster than that but we use this approximation for illustrative purposes in any event (2008).

¹² Average household size was 2.76 in 1979, 2.56 in 2000 and 2.55 in 2011. The CBO assumed the same household size for all income quintiles.

The baseline growth rates

We first report the original data from the Census and from the CBO in order to compare them. (The latter are not yet changed as outlined above). To reiterate: the former reports pre-tax pre-transfer incomes, whereas the latter reports post-tax post-transfer incomes. They also use different price indexes to convert nominal into real values. Consequently, there are considerable differences between the two estimates although the median incomes for 1979 are almost identical; for 2000 they are reasonably close but for 2011 the Census estimate of the median is \$17,000 lower than the CBO's estimate (Tables 1 and 2 Panel A).

Table 1. Disposable Household Income as Calculated by the Congressional Budget Office (2011 dollars)

| Panel A | Median | Average within quintile | | | | |
|---------------------|---|-------------------------|--------|--------|--------|---------|
| | All | 0-20% | 21-40% | 41-60% | 61-80% | 81-100% |
| 1979 | 48,000 | 18,400 | 30,700 | 43,600 | 57,000 | 100,500 |
| 1999 or 2000 | 59,500 | 25,700 | 37,200 | 53,000 | 74,400 | 177,500 |
| 2011 | <u>67,200</u> | 31,600 | 42,100 | 59,000 | 82,600 | 188,200 |
| Panel B | Growth in the Period Indicated (%) | | | | | |
| 1979-2011 | 46 | 79 | 43 | 41 | 51 | 95 |
| 2000-2011 | 14 | 24 | 14 | 12 | 12 | 7 |
| Panel C | Rates of Growth per annum during the period indicated | | | | | |
| 1979-2011 | 1.2 | 1.8 | 1.1 | 1.1 | 1.3 | 2.1 |
| 2000-2011 | 1.2 | 2.0 | 1.2 | 1.0 | 1.0 | 0.6 |

Note: In these and other tables incomes are not adjusted for household size but growth and growth rates are adjusted. Thus, the growth panels do not pertain to the dollar values reported above which are the raw values before adjustment for household size. Income for the first quintile refers to 1999 instead to 2000 because it peaks earlier.

Source: CBO Supplemental tables Table 5.

Table 2. Household Income as calculated by the U.S. Census (2011 dollars)

| Panel A | Median | Average within quintile | | | | |
|---------------------|---|-------------------------|--------|--------|--------|---------|
| | All | 0-20% | 21-40% | 41-60% | 61-80% | 81-100% |
| 1979 | 47,500 | 11,659 | 28,633 | 47,277 | 69,254 | 123,644 |
| 1999 or 2000 | 54,844 | 13,265 | 33,122 | 55,158 | 85,746 | 185,811 |
| 2011 | 50,054 | 11,239 | 29,204 | 49,842 | 80,080 | 178,020 |
| Panel B | Growth in the Period Indicated (%) | | | | | |
| 1979-2011 | 10 | 0 | 6 | 10 | 20 | 50 |
| 2000-2011 | -8 | -15 | -11 | -9 | -6 | -4 |
| Panel C | Rates of Growth per annum during the period indicated (%) | | | | | |
| 1979-2011 | 0.3 | 0.0 | 0.2 | 0.3 | 0.6 | 1.3 |
| 2000-2011 | -0.8 | -1.4 | -1.1 | -0.9 | -0.6 | -0.3 |

Note: see Table 1; Source: De Navas-Walt, et al., 2012, p. 39.

The baseline estimates of growth rates 1979-2011

During the 32 years that elapsed between 1979 and 2011 the increase in median real household income was 46% according to the CBO whereas the Census estimate implies a tepid increase of merely 10% (Tables 1 and 2, Panel B, and Figure 1). The large difference between the two estimates is due to the use of the different price indexes (as mentioned above) and the fact that 2011 was a year in which the economy was in the doldrums but there were unusually large transfer payments for unemployment benefits and for food stamps which increases the CBO data. In 2007 the transfer payments for food stamps amounted to \$31 billion whereas in 2011 it was \$73 billion.¹³ Thus, 2011 is not a representative year, particularly as far as the lowest quintile is concerned. Because of the humongous federal government deficit (\$1.3 trillion in 2011)¹⁴, the transfers were actually financed by generations yet unborn.

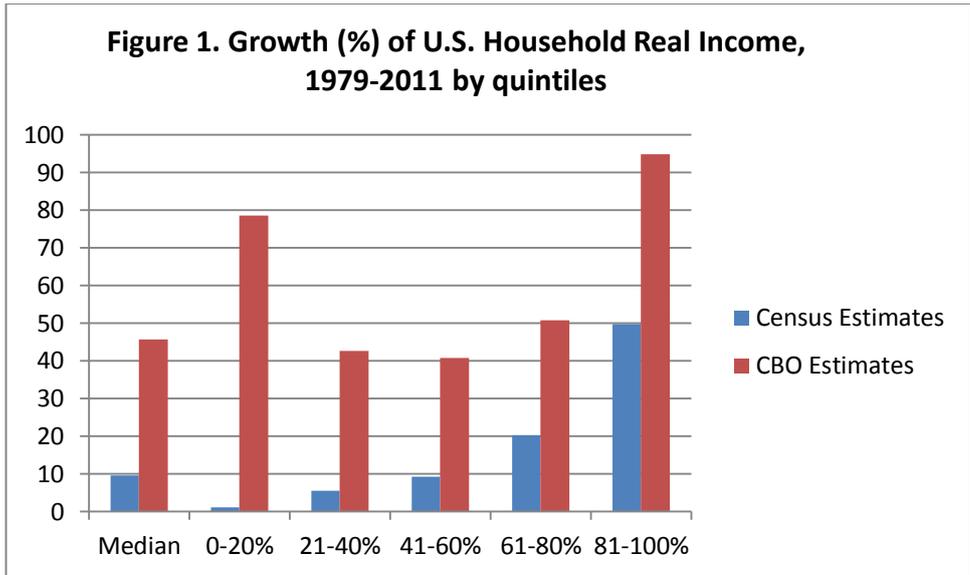
As far as growth in the five quintiles is concerned, according to the CBO the lowest and the top quintiles made significant advances but the middle three quintiles also grew quite nicely during this 32-year period: growth rate was above 1.1% per annum in all quintiles (Table 1, Panel C). In stark contrast, the Census's estimate shows no increase at all within the lowest quintile, and only the income of the top quintile exceeded 1%. Moreover, the middle three quintiles hardly grew at all (0.0-0.3%) (Table 2, Panel C and Figure 1). If one were to consider the additional issue of the standard error of the price index, as discussed above, these growth rates would be in negative territory (Shoemaker 2015).

¹³ That alone added some \$1,800 to the income of each of the 22 million low-income households in the first quintile.

<https://research.stlouisfed.org/fred2/series/TRP6001A027NBEA>

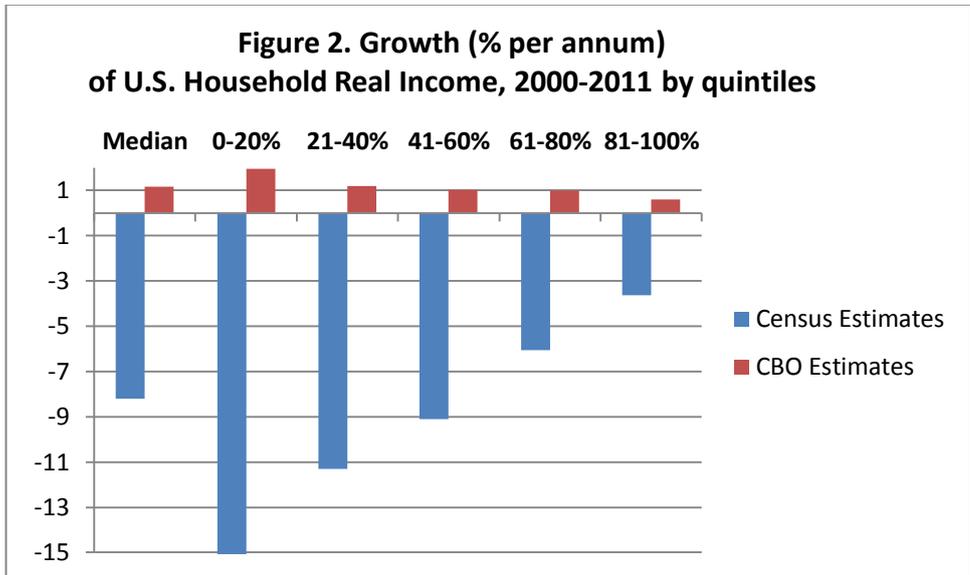
¹⁴ St. Louis Fed, FRED, "Federal government budget surplus or deficit,"

<https://research.stlouisfed.org/fred2/series/M318501A027NBEA> accessed December 26, 2015.



The baseline estimates of growth rates 2000-2011

The two sets of estimates diverge even more for the 21st century. While the CBO estimate does not indicate a slowdown at all as most growth rates exceed 1.0% per annum, the Census estimates indicate not only a substantial diminution in growth rates but a sinking into negative territory for the median as well as for all quintiles with the first quintile declining the most: -1.4% per annum (Tables 1 and 2, Panel C and Figure 2). So they could



hardly be more different. It is as though they were not referring to the same country at all. The difference is due to the increase in transfers (by 56%) and decline in taxes (by 22%) and the concomitant increase in budget deficit.¹⁵

Improved Growth Rate Estimates

As mentioned above, this exercise strives to improve upon the CBO baseline estimates in order to approximate the growth in welfare. Thus, we include only those earnings that can be assumed to increase current utility. Hence, we take the CBO post-tax estimates as the basis, insofar as they pertain to disposable income and, in addition, include cash transfers which the census figures exclude but modify them to include only those items that generate utility. The CBO data include in-kind transfers such as food stamps as well as the Employee's Contributions to Deferred Compensation Plans. We differ from the CBO estimates insofar as we include only the present value of earnings that will accrue to the employees in the future. To reiterate, the upper-bound estimates use the modified CBO data (which is deflated with the PCE price index) while the lower-bound estimates use the same the modified CBO data but deflated with the CPI.

Improved upper-bound growth rate estimates, 1979-2011

The upper bound values are not changed markedly from the original CBO estimates. The 1979-2011 median growth increases somewhat from 46% to 57% but the estimates of the median growth during the period 2000-2011 declines strikingly from 14% to 4% (Tables 1 and 3, Panel B). In addition, the growth rates of incomes in the first four quintiles decline

¹⁵ In order to calculate the growth rates of welfare more accurately, one would have to consider the extent to which Ricardian equivalence, i.e., the increase in budget deficit impacted on the welfare of the population. This is not possible at the present circumstances due to the lack of empirical evidence. While empirical studies tend to disprove that validity of Ricardian equivalence as far as the economic sphere is concerned (Stanley, 1998), in the current U.S. situation it did have a large impact on the politics insofar as the substantial increase in government debt led to the “Tea Party” movement which then blocked further government action on economic matters.

markedly. The lower the quintile the greater is the decline with the first quintile's growth rate declining the most from 1.8% to 1.0% or by 44% (Tables 1 and 3, Panel C).

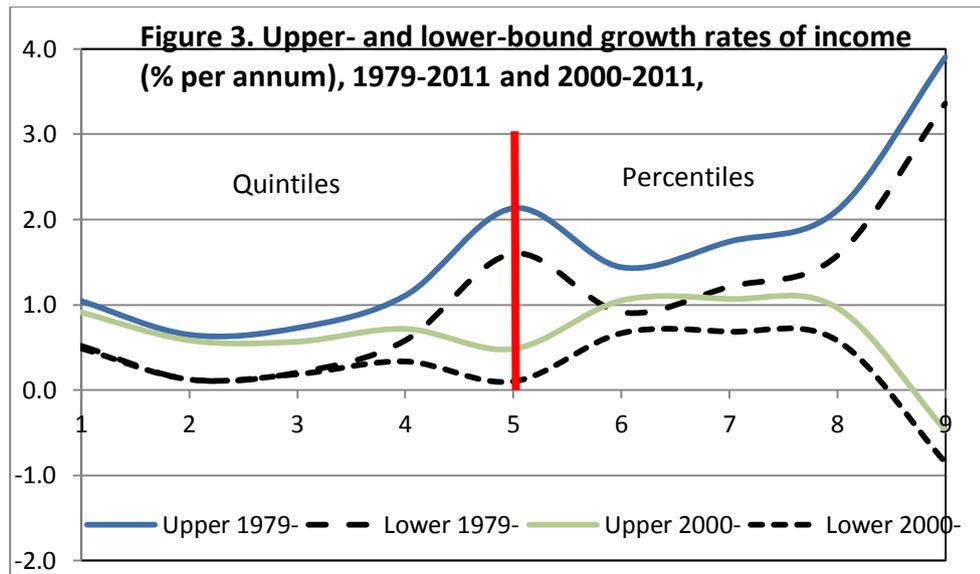
Moreover, the rather robust annual growth rate of the median of 1.4% masks the

Table 3. Improved Upper Bound estimates of real household income (000 dollars) based on CBO estimates

| Panel A | All | Average within group | | | | | | | | |
|---|--|----------------------|------|------|------|-------|------|-------|-------|-------|
| | Median | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1979 | 42.2 | 13.4 | 26.3 | 37.9 | 49.9 | 87.7 | 64.2 | 77.4 | 108.2 | 280.6 |
| 1999 or 2000 | 61.6 | 16.2 | 29.3 | 43.4 | 63.5 | 157.9 | 87.4 | 115.6 | 183.6 | 972.8 |
| 2011 | 63.6 | 17.9 | 31.1 | 46.0 | 68.3 | 165.5 | 97.5 | 129.2 | 202.8 | 918.2 |
| Panel B | Growth during the period indicated (%) | | | | | | | | | |
| 1979-2011 | 57 | 39 | 23 | 26 | 42 | 96 | 58 | 74 | 95 | 240 |
| 2000-2011 | 4 | 11 | 7 | 6 | 8 | 5 | 12 | 12 | 11 | -5 |
| Rates of Growth per annum during the period indicated (%) | | | | | | | | | | |
| 1979-2011 | 1.4 | 1.0 | 0.6 | 0.7 | 1.1 | 2.1 | 1.4 | 1.7 | 2.1 | 3.9 |
| 2000-2011 | 0.3 | 0.9 | 0.6 | 0.6 | 0.7 | 0.5 | 1.0 | 1.1 | 1.0 | -0.5 |

Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%; see also notes to Table 1.

considerable variation across the income distribution (Table 3, Panel C and Figure 3). The lowest quintile did quite well, growing at 1.0% per annum although the dollar value of its income is a meager \$17,900 for the average household, which was barely the poverty threshold for a family of three. Moreover, their income grew at a much slower rate than that of the upper class (5th quintile) during this 32-year period. Hence, the income of the 1st quintile declined from 15% of the income of the upper quintile to just 10%. In addition, the growth in income of the lower-middle class (2nd quintile) and that of the middle class (3rd quintile) was the slowest, growing at a rate of 0.6% to 0.7% per annum, thereby reinforcing the general impression of a floundering middle class. However the upper-middle class (quintile 4) did better, growing at 1.1% per annum, but it also fell behind the 5th quintile which grew almost twice as fast, at a rate of 2.1%. Moreover, there were noteworthy differences even within the upper class, insofar as the income of the top 1% grew at an “astronomical” pace of 3.9% per annum, so that in the course of this period it grew from 7 times to 14 times the value of the median income (Table 3 and Figure 3).



Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%

Table 4. Improved Lower Bound estimates of Household income (000 dollars) based on CBO estimates

| | All | Average within group | | | | | | | | |
|--------------|--------|---|-----|-----|-----|-----|-----|-----|-----|------|
| | Median | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1979 | 50 | 16 | 31 | 45 | 59 | 104 | 76 | 91 | 128 | 332 |
| 1999 or 2000 | 64 | 17 | 31 | 45 | 66 | 165 | 91 | 121 | 191 | 1014 |
| 2011 | 64 | 18 | 31 | 46 | 68 | 166 | 97 | 129 | 203 | 918 |
| | | Growth during the period indicated (%) | | | | | | | | |
| 1979-2011 | 33 | 18 | 4 | 7 | 20 | 66 | 34 | 47 | 65 | 188 |
| 2000-2011 | 0 | 6 | 1 | 2 | 4 | 1 | 8 | 8 | 7 | -9 |
| | | Rates of Growth per annum during the period indicated (%) | | | | | | | | |
| 1979-2011 | 0.9 | 0.5 | 0.1 | 0.2 | 0.6 | 1.6 | 0.9 | 1.2 | 1.6 | 3.4 |
| 2000-2011 | 0.0 | 0.5 | 0.1 | 0.2 | 0.3 | 0.1 | 0.7 | 0.7 | 0.6 | -0.8 |

Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%; see also notes to Table 1.

Improved lower-bound growth rate estimates, 1979-2011

Measured from the base of 1979, the lower-bound growth rates were subdued especially in the 2nd and 3rd quintile whose growth rate was near zero (0.1%-0.2% p.a.) (Table 4, Panel C). In fact, only quintile 5 registered an exceptional performance of 1.6% as did the top 1% (3.4%). In the main, the middle class was left very far behind with only quintile 4 advancing slightly at a rate of 0.6% per annum (Table 4 and Figure 3). (Note, that if one considers the standard error of the price index then the estimated lower-bound incomes could be as much as 8% less than the ones estimated for 2011 (Table 4); that would diminish the

estimated growth rates for the two middle-class quintiles 2 and 3 sufficiently so that they would become slightly negative.¹⁶⁾

Improved upper-bound growth rate estimates, 2000-2011

In the 21st century even the upper-bound growth in median income slowed markedly from 1.4% to 0.3% per annum (Table 3, Panel C). However, the growth rates of the first three quintiles remained approximately the same as those for the whole period under consideration (Figure 3). This implies that the 1st quintile continued to have relatively decent growth, whereas the growth in the two middle-class quintiles remained weak. The 4th and 5th quintile joined the ranks of the snail-paced growth ones and the top 1% even experienced a decline in income by about \$54,000 from close to a million dollars to closer to \$900,000 per annum. In other words, the only groups that experienced above average growth rates were the poor, but, of course, income still remained near the poverty level of just under \$18,000 per annum (Table 3). The percentiles between 81% and 99% were also doing well.

Improved lower-bound growth rates estimates, 2000-2011

In the 21st century the lower-bound growth of median income came to a complete standstill; growth was also slower in all quintiles as the sluggish growth spread to the upper-middle class as well as to quintile 5 (Table 4 and Figure 3). The rate of growth in the three middle class quintiles is estimated to have been a negligible 0.1% to 0.3%.¹⁷ The upper 1% experienced a decline in average income to just over \$900,000 per annum.

Discussion of improved growth rate estimates

This exercise underlines the sensitivity of the income estimates and their growth rates to items included in the income measures and especially to the price index used to convert the

¹⁶ The growth rate of the 1st and 4th quintile would become 0.3% p.a..

¹⁷ Note that growth within each quintile is positive while the growth of the median is zero. While this might appear odd, the reason is that the growth within the quintiles is that of the average in that quintile and not that of the median. Hence, the higher incomes within a quintile have a larger impact on the average than they would have if the medians of the quintiles were reported by the CBO.

nominal to real values. The range of revised estimates is substantial. The range for the median growth rate during the 32 year period is between 0.9% and 1.4% per annum (Tables 3 and 4, Panel C). While these growth rates might well be considered reasonable for a developed economy, it is noteworthy that practically all of it was obtained prior to 2000 as growth decelerated practically to a standstill thereafter. The lower- and upper-bound estimates of the growth in median income in the 21st century are between 0% and 0.3%, that is to say negligible (Tables 3 and 4, Panel C). Admittedly, 2011 was hardly a representative year, insofar as the Great Recession ended only in June of 2009. So perhaps the tepid performance should be taken with a grain of salt but the growth between 2000 and 2007 (not reported here) was also less than spectacular with upper-bound rates just over 1% in the first four quintiles and lower-bound ones just under it. Moreover, the growth in that period was based on bubble prices and unstable finance so it is not representative of economic performance in the longer run (Summers, 2014). Another reason that the year 2011 is not representative is that market incomes were supported by government transfers on the basis of \$1.3 trillion deficit.

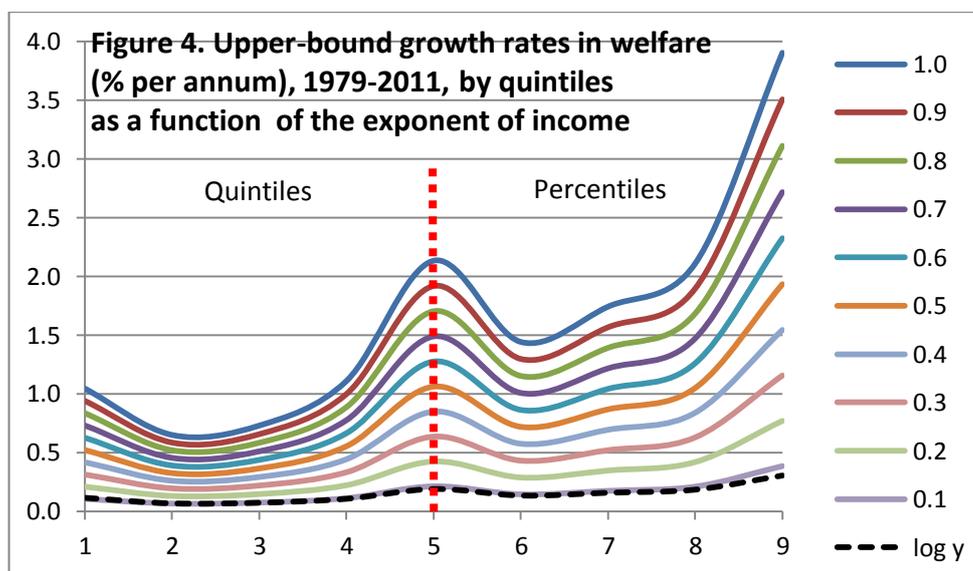
It is crucial to note that the growth experience varied substantially across the quintiles in both the post 1979 and the post 2000 periods. Quintiles 2 and 3 fared the worst in both periods with annual lower-bound growth rates in the range of 0.1% and 0.2% and upper-bound growth rates in the range of 0.6% and 0.7%. The poorest 1st quintile and the upper-middle-class 4th quintile did fairly well but only as far as the upper-bound estimates are concerned. The lower-bound estimates in these quintiles are also rather modest. The only group whose income grew remarkably was the 5th quintile and especially the top 1%, which registered a growth rate of between 3.4% and 3.9% per annum for the whole period even if its income declined in the 21st century in wake of the financial crisis. The general slowdown in

the 21st century is quite evident (Tables 3 and 4 and Figure 3) although incomes were supported by substantially increasing the budget deficit.

Growth in Welfare

Income growth is of interest to the extent it is welfare enhancing. Hence, we next convert incomes into an index of welfare and calculate its growth rate assuming independent utility functions. We first assume the functional form $W=y^\alpha$ where W is welfare, y is the estimated income, and α is an exponent such that $0.1 \leq \alpha \leq 1.0$. Because we do not have a reasonable empirical estimate of α , we let it vary in increments of 0.1. We also calculate W using a logarithmic function of income as, for example, in Jones and Klenow (2010).¹⁸

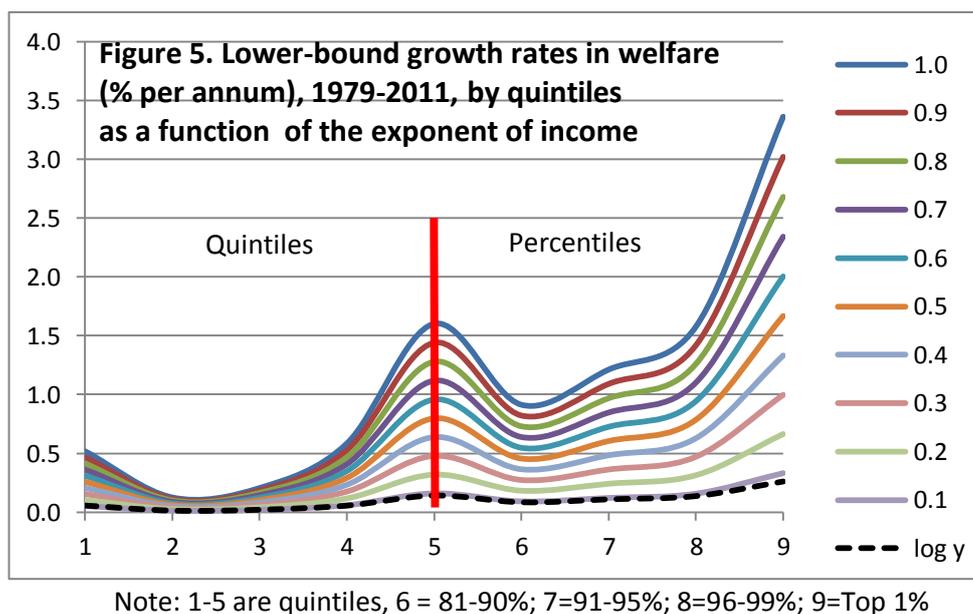
The estimated growth in welfare depends clearly on the exponent of income (Figure 4). Generally, the growth rates approach zero as the exponent of income decreases. The range in growth rates is substantial with the middle class 2nd and 3rd quintiles experiencing the slowest increase in well-being while the 5th quintile and especially the top 1% holding the lead by quite a margin. (The linear case ($\alpha = 1$) is the one analyzed above inasmuch as in



Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%

¹⁸ In such a function the marginal utility of income is inversely proportional to income. The estimates of Layard et al. imply that marginal utility falls even faster than that but we will use this approximation for illustrative purposes (2008).

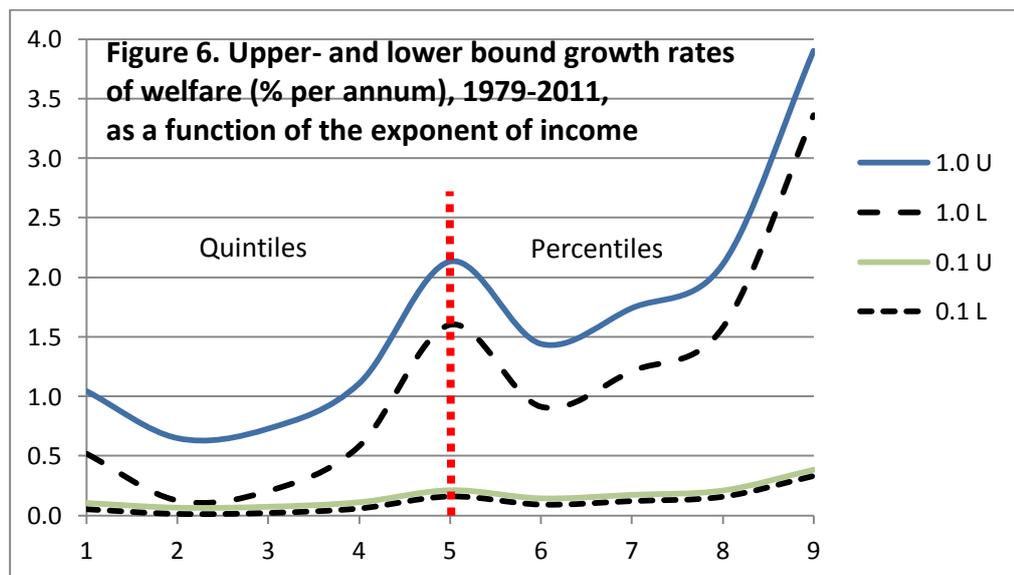
that case $W=Y$). This example illustrates the extent to which the implicit assumption of $\alpha = 1$ in most of the literature overstates growth rates of welfare. Both upper- and lower-bound estimates clearly trace a “U” shaped pattern across the five quintiles with a longer right arm, a shape that is frequently referred to in the colloquial as the “hollowing out” of the middle class (Stiglitz 2011). This 40% of the population experienced the slowest growth rates; even the upper-bound growth rates for this roughly 120 million people remain at or below 0.5% per annum as long as $\alpha \leq 0.6$ and are as low as 0.1% with the logarithmic utility function (or with $\alpha=0.1$). This pattern implies that even among the upper-bound growth rates of W there are possibly some very slow-growth scenarios with small α 's (Figure 4). In contrast, W of the top 1% of income earners grew consistently at a rate above 1% per annum as long as $0.3 \leq \alpha$ and as fast as 3.9% with $\alpha=1$ (Figure 4).



The lower-bound results (Figure 5) are quite similar in shape and substance to the upper-bound ones: these also indicate the “hollowing out of the middle class” as well as the asymmetric “U” with a longer right arm. The only major difference between figures 4 and 5 is that the growth rates in quintiles 2 and 3 (0.01%-0.20%) are much smaller than in the

upper-bound estimates (0.06%-0.73%). That implies that the “hollowing out” effect is more pronounced with the lower-bound estimates (Figure 5).

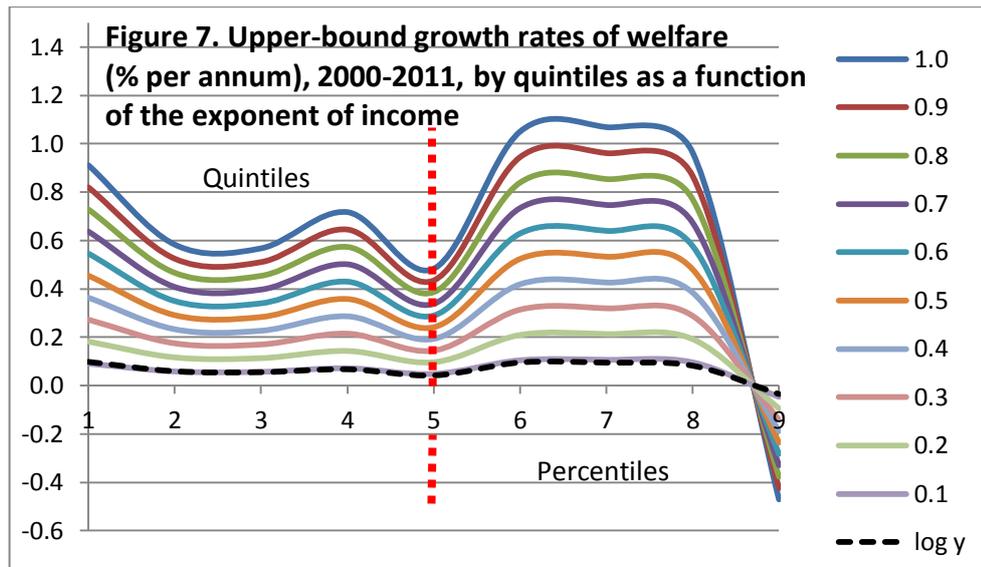
Figure 6 displays the estimated range of the upper- and lower-bound growth rates of welfare with high and low exponents of income (either 0.1 or 1.0) for the period 1979-2011 in order to show the range of estimates. The lower-bound estimates are barely negligible from zero for quintiles 2 and 3 regardless of α .



Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%; U = upper bound; L= lower bound.

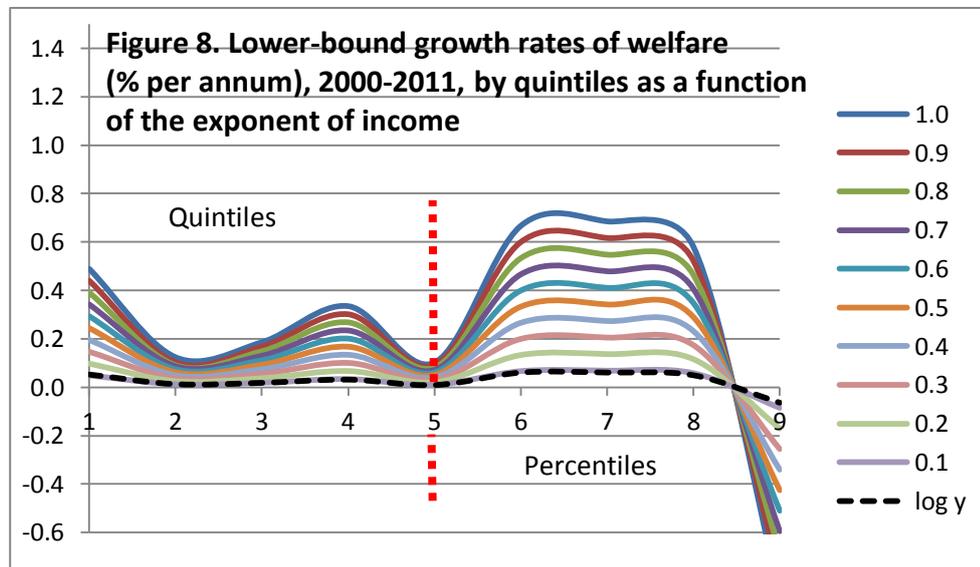
Analogously, the upper- and lower-bound growth rate estimates of W for the 21st century are displayed in Figures 7 and 8. The “U” shape, signifying the “hollowing out” effect, is retained to some degree—more pronounced for the lower-bound estimate—with the difference that the long right arm of the “U” disappears inasmuch as the 5th quintile grows at a slower pace on account of the fact that the top 1% of income earners experienced a decline in income. In this period even the upper-bound estimates are almost all below 0.5% (Figure 7). Only the 1st quintile and those between the 81st and 99th percentile experienced a growth in real income near 1%.

The lower-bound estimates are below 0.5% per annum for all quintiles and substantially lower for most exponents (Figure 8). The shapes of both set of estimates



Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%

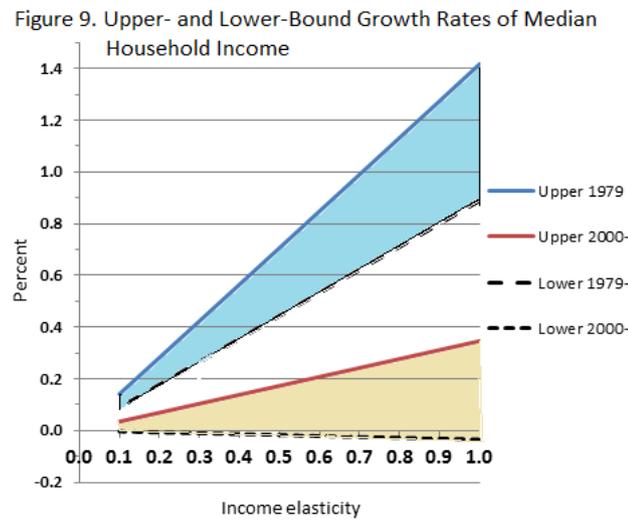
resemble one another with the difference that the lower-bound ones are squeezed closer together near zero than the upper-bound ones. Growth of W in quintiles 2 and 3 are all below 0.2% per annum regardless of the value of α . In contrast to the period beginning with 1979, the growth rates are highest for the 81-99 percentiles as in the upper-bound estimates.



Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%

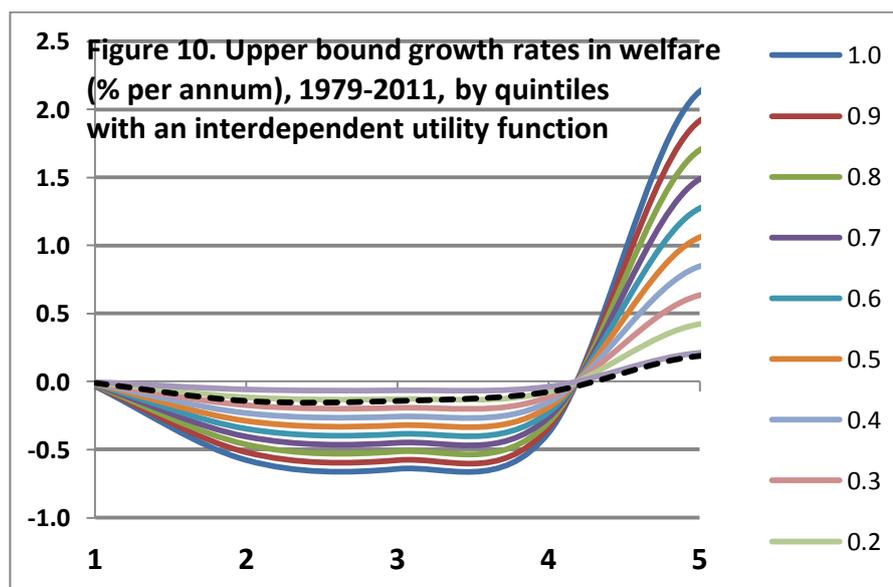
The estimates of the growth of welfare associated with median income are shown in Figure 9. It indicates the wide range between lower- and upper bound estimates both of which approach zero as the income elasticity declines. The estimates for the 21st century are

considerably lower at all income elasticities. The lower bound estimates in the 21st century are, in fact, slightly in the negative territory for all elasticities.



Welfare as a function of relative income

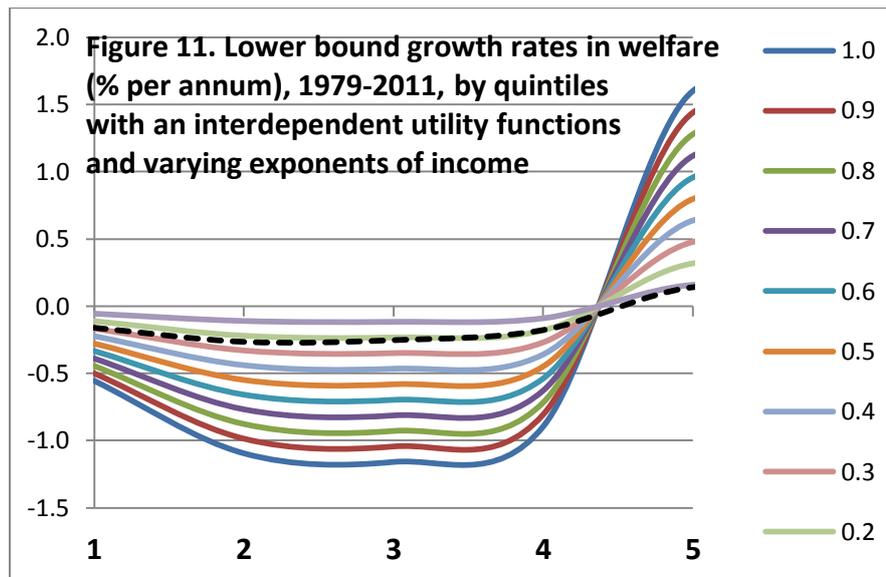
We next turn to exploring the growth in welfare in cases in which it is a function of relative income. We first assume that $W(i) = \left[\frac{y(i)}{\sqrt{y(5)-y(i)}} \right]^\alpha$; where y is the estimated income¹⁹ in quintile (i), $i=1, \dots, 4$, α is an exponent such that $0.1 \leq \alpha \leq 1.0$ and takes on values in increments of 0.1. For the fifth quintile the denominator is set equal to one. In this



Note: 1-5 are quintiles

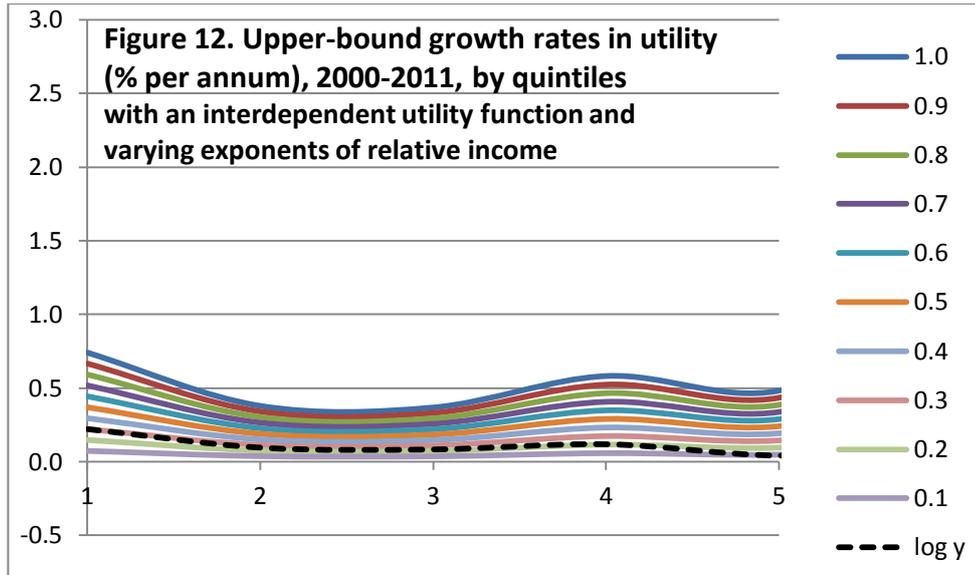
¹⁹ Income adjusted for family size is used for these exercises.

formulation of interdependent utility functions the highest quintile is the reference group and income is divided by the square root of the difference between the fifth quintile and the other quintiles in the income distribution. In this case the growth in welfare between 1979 and 2011 is confined exclusively to the fifth quintile with both the lower and upper-bound estimates. All other quintiles experienced a decline in welfare with all exponents (Figures 10-11).

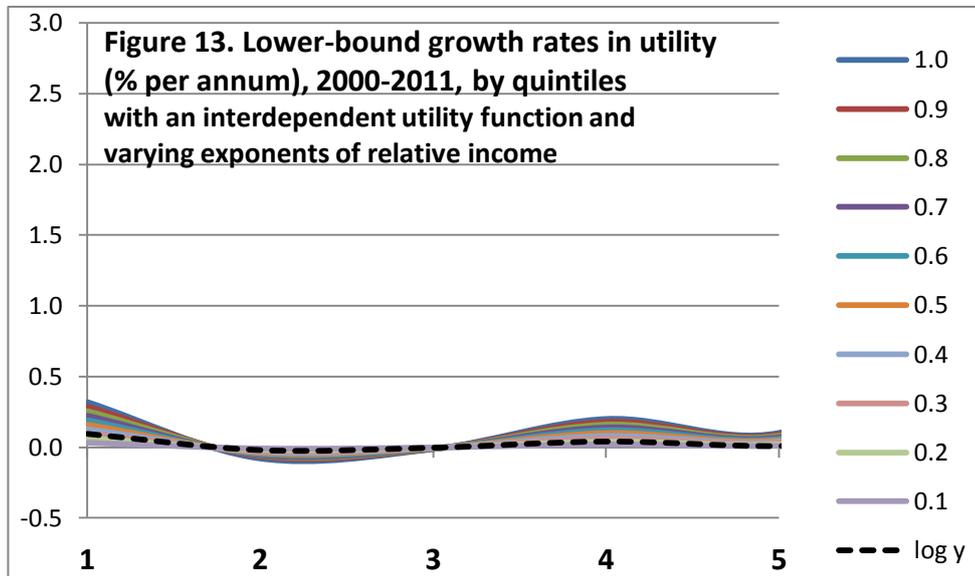


Note: 1-5 are quintiles

However, for the period 2000-2011 the upper-bound estimates indicate some positive growth in welfare, albeit near 0.5% per annum, with the middle-class quintiles 2 and 3 growing again at the slowest pace among all the quintiles (Figure 12). The lower-bound estimates of growth in welfare in this period are negligible or even negative for quintiles 2 and 3 (Figure 13).



Note: 1-5 are quintiles



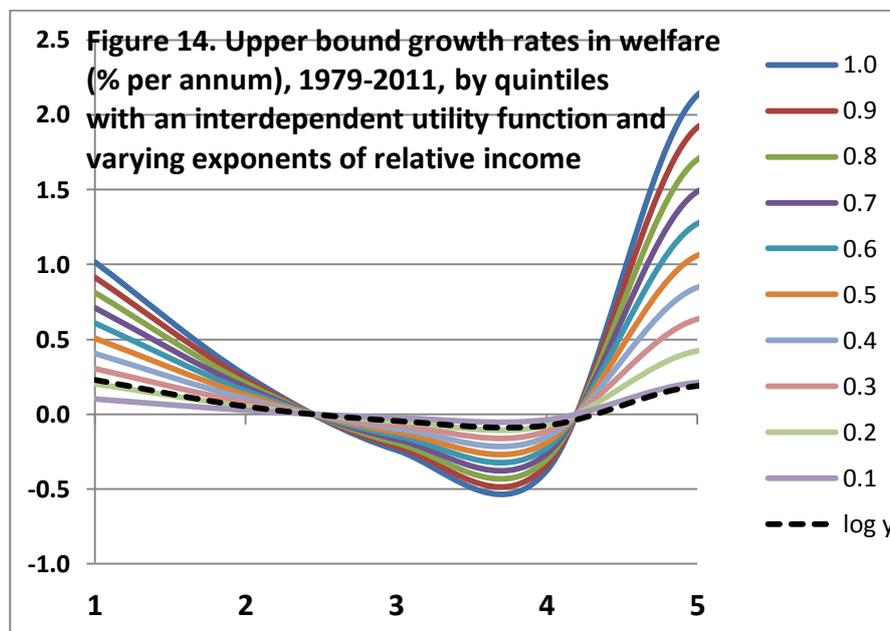
Note: 1-5 are quintiles

We next assume that the functional relationship between welfare and income is given

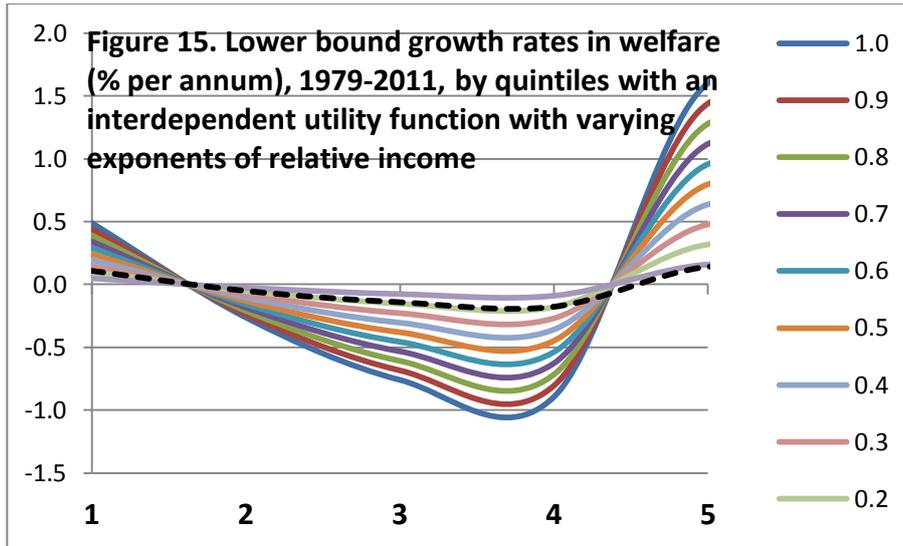
by: $W(i) = \left[\frac{y(i)}{\sqrt{y(i+1) - y(i)}} \right]^\alpha$, where y is the estimated income in quintile (i), $i=1, \dots, 4$, α is an

exponent such that $0.1 \leq \alpha \leq 1.0$ and takes on values in increments of 0.1. The reference group in this version is the next higher quintile except for the fifth quintile, for which the denominator is again set equal to one. In this case the both the upper- and the lower-bound estimates are positive for the 1st quintile inasmuch as it grew faster than the 2nd quintile in both periods (Figures 14-17). Growth in the 2nd quintile is slightly positive in the upper-

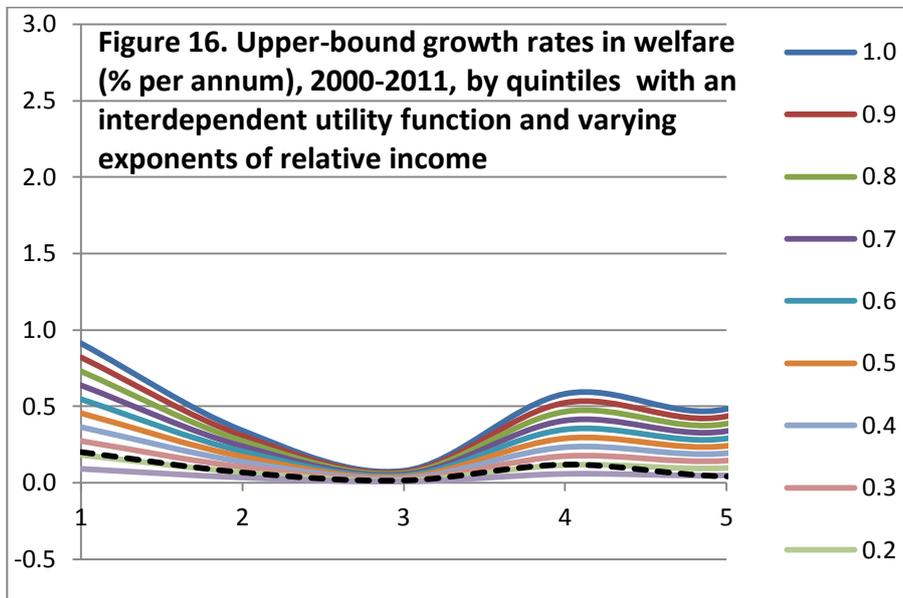
bound estimates in both periods, while the lower bound ones are both negative. Growth in the 3rd quintile is negative or negligible in both periods in both the lower and upper bound estimates. The 4th quintile is negative during 1979-2011 and slightly positive in the post-2000 period in both the lower- and upper-bound estimates. In other words, the middle-class continues to flounder in this specification as well. During the period 1979-2011: the upper-bound estimates yield negligible growth for quintile 2 and negative ones for quintiles 3 and 4 whereas the lower-bound estimates are negative for all three middle-class quintiles (Figures 14-15). Welfare growth for the three middle-class quintiles in the 21st century is mostly small, negative, or negligible (Figures 16-17)



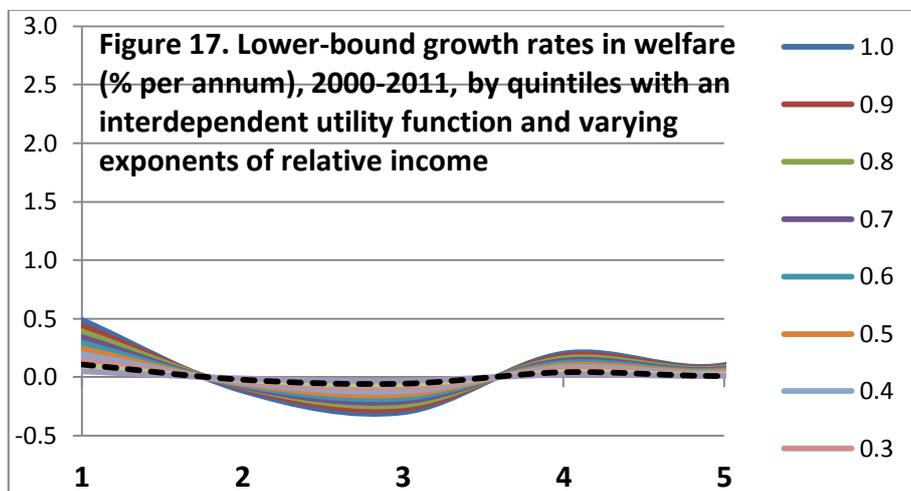
Note: 1-5 are quintiles



Note: 1-5 are quintiles



Note: 1-5 are quintiles



Note: 1-5 are quintiles

Discussion

Economic growth and the accompanying growth in income and welfare are arguably among the most important attributes of economic performance (McFadden 2014). One of the salient upshots of this exercise is that these variables cannot be estimated with great accuracy given our current knowledge of the required empirical evidence. The inconvenient truth is that the lacunae in our knowledge are just too wide, so that there is plenty of work ahead to redress this imbalance. Even if we could agree on the definition of income its conversion from nominal into real values provides the first substantial,--and hitherto unresolved,--obstacle to precision.

The two price indexes currently available provide significantly diverging estimates of the growth rates of real income and of welfare which for convenience we refer to as upper- and lower-bound ones. In fact, there is really little evidence to corroborate this *ad hoc* designation. In actuality they are both inflicted with measurement errors too numerous to mention in detail. Just to mention a few issues, note that they leave out of consideration the rural population, which means that the prices faced by 19.3% (2010) of the population are disregarded. This is not negligible inasmuch as the share of rural population was decreasing over time. In 1980 it was 26.3%.²⁰ That alone introduces an unacceptable element of uncertainty into the accuracy of the inflation rate estimates.²¹ Another shortcoming of the price indexes is that they do not exist by income groups. Hence, we are deflating the nominal

²⁰ The population of urban areas increased between 1980 and 2010 from 73.7% to 80.7%. U.S. Census, "2010 Census Urban and Rural Classification,"

<https://www.census.gov/geo/reference/ua/urban-rural-2010.html>

<https://www.census.gov/population/censusdata/table-4.pdf> accessed December 26, 2015.

²¹ Suppose that urban prices were 20% higher than rural prices and assume that both urban and rural prices had remained unchanged; although prices had not changed at all, the change in population would imply by itself that prices *as they were experienced* had increased by 1.2%. That implies that without considering rural prices the inflation rate is not accurate.

income of the poor with the same index as we use for the wealthy which defies common sense inasmuch as their consumption baskets are extremely different. The price indexes are also not age standardized.

There are other problems as well. The use of hedonic pricing leads to the rapid decline in the price of products characterized by rapid changes in technical characteristics.²² For example, the BLS calculates that the price of television services has declined from 1980=105 to 2011=6!²³ This seems highly exaggerated insofar as the price of color televisions in the 70s and 80s was somewhere in the \$400-\$1,400 range.²⁴ Not very different from what today's television costs. If the 17.5 ratio were accurate we would be able to buy a decent new television today for \$22 but such televisions are unavailable. To be sure, the argument is that today's televisions are smart, have more bells and whistles; have more pixels and more channels. But the other side to this argument is that we are buying entertainment services by watching TV and we still watch one channel at a time and do not obtain more satisfaction out of watching that channel than we did in 1980. At least I do not know of any evidence that would indicate that we're getting more satisfaction out of TV watching now than we did 32 years ago. Most importantly, since the various features of the TV set are bundled, the consumer does not have the choice to pick the ones she prefers. Insofar as the old system is no longer available, the consumer is forced to use the new system and does not have a choice between the old and new. In such cases the assumptions associated with the use of hedonic

²² According to one estimate the decline in the price of television using a hedonic index was 21% just within four years in the mid-1990s (Moulton et al., 1998, Table 5).

²³ I would like to thank Sharon Gibson of the BLS for providing this information.

²⁴ Television History <http://www.tvhistory.tv/tv-prices.htm>, accessed October 16, 2015.

prices do not apply in practice,²⁵ and hedonic regressions do not reflect accurately consumers' willingness to pay for those features.²⁶

In addition, in 1980 we did not have to pay at all for watching TV. Now we do.²⁷ Aside from introductory offers, basic cable services cost about \$64 per month or \$768 per year.²⁸ If we were to subtract this single expenditure from the annual disposable income of the bottom quintile of \$17,948 the upper-bound growth rate would decline by 0.1% from 1% to 0.9% and the lower-bound rate would decline from 0.5% to 0.4%. In other words, such expenses did not exist in 1979 but they make it much more difficult for the poor to maintain the living standards of an earlier epoch. So the incorporation of such hedonic price indexes into the consumer price index biases the cost of living as it is actually experienced in the downwardly direction: they make it appear as though price increase is less than it actually is.

Another inaccuracy creeps into the estimates on account of the way households are defined insofar as the 2.3 million people in jail or the 0.5 million homeless, for example, are left out of consideration without explanation why this should be the case.²⁹ The number of people in jail today is about 1.7 million more than in 1979. Suppose that they were all from

²⁵ Although theoretically one could estimate a "virtual price". In practice, however, this has too many hurdles (Nesheim 2008).

²⁶ "This [hedonic regression model] uses television observations ... and provides an estimate of the value of each of the significant features and components of the sets for which prices are collected. This yields a mechanism for replacing obsolete televisions in the CPI sample with current ones..." BLS, "Using a Hedonic Model to Adjust Television Prices in the Consumer Price Index for Changes in Quality," <http://www.bls.gov/cpi/cpihe01.htm> accessed December 30, 2015.

²⁷ Leichtmann Research Group, 2016. "Press Release: 83% of U.S. households subscribe to a pay-tv service," <http://www.leichtmanresearch.com/press/090315release.html> accessed January 2, 2016.

²⁸ Without taxes or other fees. http://www.ehow.com/about_5385381_average-cable-tv-per-month.html, accessed October 17, 2005.

²⁹ The people left out of consideration include 8 million people who live in group-quarters such as dormitories, nursing homes or military barracks.

the first quintile and let us add their presumably zero incomes to those of the 1st quintile.³⁰ This alone would lower the growth rate in the lowest quintile by 0.2% during the 1979-2011 period and by no less than 0.6% in the 21st century. Together with paying for cable TV, these two factors would lower the income growth of the 1st quintile to 0.7% in 1979-2011 and eliminate it completely in the 21st century. In other words, this rough sensitivity analysis indicates that even though the rate of growth in income of the poor in the 21st century exceeded those of the middle class, all of their gains barely sufficed to pay for cable service if one also considers increases in the number of people in jail. In addition, in spite of the gains, the average income in the bottom quintile hovered around the poverty income between a two and a three person household. In 2011 the average income in the bottom threshold was just \$32 above the poverty rate.³¹

In order to increase the accuracy of the estimates we would need to know household size by quintiles. We would also need to know the composition of the households. A household with two adults has very different needs and expenditures than a household with one adult and a child and such issues are now left out of consideration.

Another question is the extent to which it is rigorous to compare welfare growth between 1979 and 2011 on account of the fact that very roughly half of the people alive in 2011 were not alive in 1979 (Census, 2011).³² In other words, we are comparing welfare of

³⁰ In 2011 there were 119.9 million households or 24 million per quintile.

<https://www.census.gov/hhes/families/files/hh1.csv>,

³¹ The poverty threshold for three people family was \$17,916 compared to an average income of \$17,948.

³² Population in 2010 was 309 million and in 1980 it was 227. That implies that 83 million were not alive at the earlier date. In addition, considering today's life table, roughly one-third of the population dies within a 32 year period. That means that of the people alive in 1980 roughly 75 million probably passed away by 2011. Thus, together, about 158 million were not alive in 2011. This is about half of the 309 million population. U.S. Census, "2014 National Population Projections,"

people with very different utility functions. In any event, most people are not going to be impressed by what has happened since the 1980s. That is outside of the range of experiences for most people today. Instead, they are more likely to compare their current situation with more recent reference periods. So the growth in the 21st century is probably more indicative of the way people feel than the longer epoch 1979-2011.

In any event, the household income has another misleading aspect to it in the sense that it does not take into consideration the number of persons working within the household. This is especially important during the longer time frame inasmuch as female labor force participation increased substantially in the meanwhile. This brought about an increase in the number of market-hours worked on average by a household. In other words, this calculation does not consider the hours supplied by the household in the labor market.

Of course, this increase was not all net income for the family in the sense that there were substantial incremental costs (instrumental expenditures) associated with providing more work in the labor market that are also not considered here (Nordhaus and Tobin 1973). These additional burdens include increased child-care costs, additional costs of transportation, additional costs of wardrobe, the disutility of work, as well as having to cope with living a more harried life style. In other words, the additional income was not all utility enhancing.

Yet another inaccuracy is introduced by the fact that sales taxes, which are not progressive at all, and state taxes and property taxes are not taken into consideration. Growth rates would also look considerably worse if we accounted for economic insecurity.

Conclusion

The goal in this paper is to improve upon the estimates of welfare growth and that of real incomes upon which they are based in the five quintiles of the income distribution for

<https://www.census.gov/population/projections/data/national/2014/summarytables.html>
accessed December 26, 2015.

two periods: 1979-2011 and 2000-2011. There are innumerable challenges in undertaking such an exercise. As a consequence, the above estimates have to be considered *cum grano salis*. Nonetheless, there are a few consistent patterns which do stand out and in which we have confidence that they will survive successive revisions.³³

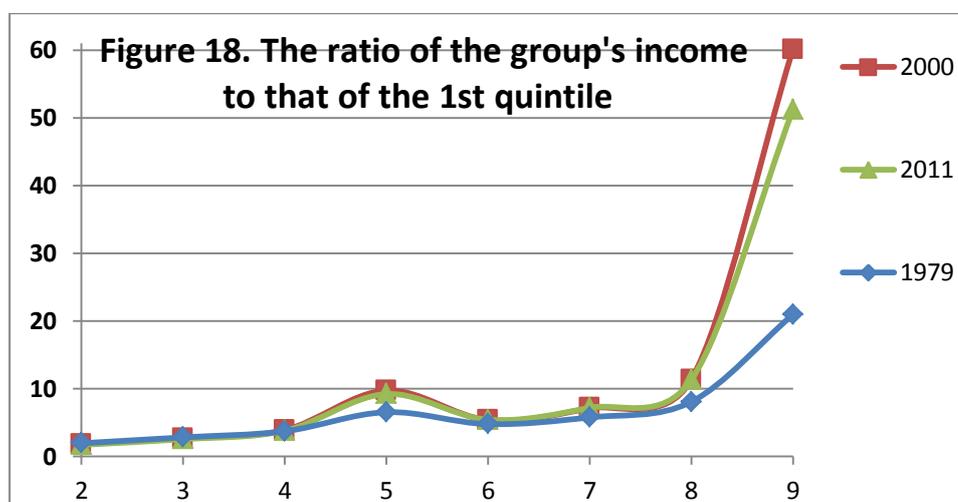
Not surprisingly, both income and welfare of the 5th quintile grew the fastest in all specifications between 1979 and 2011. The rate of growth in real income in this group was between 1.6% and 2.1%, i.e., well above average (Figure 6). And within this group the top 1% did especially well growing at between 3.4% and 3.9% per annum. This result corroborates the well-known skewing of the income distribution. The 5th quintile also does best in welfare growth although its rate is moderated by the income elasticity of welfare. The lower is the elasticity, the lower is the growth in welfare. Taking $\alpha=0.5$ would put the growth of welfare of the top 1% at 1.7%-1.9% per annum³⁴ (Figures 4 and 5).

More surprising at first glance is that the second most consistently positive performance is found among the lowest quintile. The poorest registered an income growth of 0.5%-1%--consistently above that of the 2nd and 3rd quintiles, and most of the time also better than those in the 4th quintile (Figures 3, 5 and 6). At the second glance, however, this should be less surprising, because of the large transfer payments in 2011 that included food stamps and unemployment benefits that led to a government deficit of \$1.3 trillion in that year. This implies that 2011 is not a representative year at all. Another aspect to consider with regard to the 1st quintile is that their income was still at the bare minimum to sustain life. The \$17,900 average in this quintile was the barely at the level of poverty threshold for a family of three.

³³ One could also incorporate the value of the gains in life expectancy during this period as in Becker et al. 2005. Insofar as the value of these gains differs substantially by age more empirical work needs to be done before we could implement such estimates.

³⁴ It is worthy of note in this regard that Becker et al. (2005) assert that the elasticity of utility with respect to consumption is 0.2.

The 4th quintile did as well as the 1st quintile in some of the specifications and much worse than the 5th quintile. These patterns are summarized in Table 5 and Figure 18. These indicate that the ratio of the income in the 2nd and 3rd quintile declined relative to that of the first quintile whereas the 4th quintile increased ever so slightly and that of the 5th quintile improved considerably, but it was the top 1% whose income grew relatively to the spectacular level of 51 times the income of the first quintile. However, it is noteworthy that the other groups in the 5th quintile did not experience such humongous growth. Relative to the 1st quintile the 81-90 percentiles increased its income only marginally from a multiple of 4.8 to 5.4, the 91-95 percentiles increased from 5.8 to 7.2 and the 96-99 percentiles increased only from 8.1 to 11.3. Only the top 1% increased enormously from a factor of 21 to 51. This is not only a clear indication of the skewing of the income distribution accompanying the rise of inequality³⁵ but also that it was only the top 1% whose income grew disproportionately.



Note: 1-5 are quintiles, 6 = 81-90%; 7=91-95%; 8=96-99%; 9=Top 1%

Table 5. Ratio of the income in given quintile to that of the 1st quintile

| | 21-40% | 41-60% | 61-80% | 81-100% | Top 1% |
|------|--------|--------|--------|---------|--------|
| 1979 | 2.0 | 2.8 | 3.7 | 6.5 | 20.9 |
| 2011 | 1.7 | 2.6 | 3.8 | 9.2 | 51.2 |

³⁵ Inequality also increased in the price of housing (Albouy and Zabeck 2016).

Another pattern that really stands out consistently and unmistakably is what in conventional parlance is referred to as the “hollowing out of the middle class” both in the upper- and lower-bound estimates with annual lower-bound growth rates in the range of 0.1% and 0.2% and upper-bound growth rates in the range of between 0.6% and 0.7% (Figure 3 and Table 6). The income and welfare estimates trace a “U” shaped form across the five quintiles with a longer right arm. The lower-bound estimates of income growth of the 2nd and 3rd quintiles are difficult to distinguish from zero (Figure 3 and Table 6). According to the lower-bound estimates, it would take 600 years for incomes in the 2nd quintile to double and 1200 years for welfare to double (Table 6). These are growth rates that are reminiscent of those that prevailed prior to the Industrial Revolution. These are likely to be below the threshold levels needed for the brain to register a positive change in the standard of living.³⁶

Table 6. Annual growth rates (%) of income and welfare of 2nd and 3rd quintiles , 1979-2011

| | Lower Bound | | Upper Bound | |
|--|--------------|--------------|--------------|--------------|
| | 2nd quintile | 3rd quintile | 2nd quintile | 3rd quintile |
| Income | 0.12 | 0.20 | 0.65 | 0.73 |
| Welfare: function of income | | | | |
| $\alpha=0.5$ | 0.06 | 0.10 | 0.32 | 0.36 |
| Logarithmic | 0.01 | 0.02 | 0.07 | 0.07 |
| Welfare: function of relative income | | | | |
| 5th quintile is reference, $\alpha=0.5$ | -0.55 | -0.58 | -0.29 | -0.32 |
| next quintile is reference, $\alpha=0.5$ | -0.13 | -0.38 | 0.13 | -0.12 |

The slowdown in income growth during the 21st century was due to the slowdown in the growth rate in quintile 5 caused primarily to the decline in income among the top 1% (Figure 3). Quintiles 1-3 were able to maintain the growth rates obtained during the 32-year period, although the increase in income in first quintile in the 11 years was a meager \$1,700.

³⁶ As an aside, it would be interesting to find out how fast do incomes have to rise before individuals actually are able to ascertain an increase in their standard of living. Sensory thresholds of real income growth would be the minimum level that a person can detect, perceive, or recognize which is not obvious with thousands of prices changing continuously creating a lot of background noise. Small changes in real income might well be beyond the computing ability of the human brain to detect.

Welfare growth with independent utility functions parallel the growth in incomes with the caveat that its growth rates are likely to be well below the rates estimated for income. Put another way, the estimated rates of income growth are the upper bound growth rates of welfare with $\alpha=1$. The growth in welfare is likely to be roughly half of the rate of income growth (Table 6). With an elasticity of 0.5 a doubling of income would lead to an increase in welfare by a factor of 1.7.

With interdependent utility functions the growth in welfare is decoupled to some degree from the growth in income in the own quintile and is dependent also on the rate of growth in another quintile. Hence, we obtain an entirely different pattern; in the first specification in which quintile 5 is the reference. In that case only quintile 5 experiences positive growth rates during the period 1979-2011 (Figures 10 and 11). The upper bound growth rate of quintile 1 is zero while the growth rates of quintiles 2 to 4 are all negative. The lower-bound growth rates are negative for all quintiles except the 5th quintile. In the 21st century the upper-bound growth rates in welfare are all somewhat positive whereas the lower bound ones are indistinguishable from zero (Figures 12 and 13).

In the second specification with an interdependent utility function in which the reference is the next higher quintile only quintiles 1 and 5 grow meaningfully 1979-2011 (Figures 14 and 15). In contrast, quintiles 2-4 experience mostly negative growth. The only positive growth in the three middle-class quintiles was the upper-bound estimate of the income growth of the 2nd quintile (Figure 14). The middle class quintiles turn in a rather mediocre performance also in the 21st century (Figures 16 and 17). In other words, the “hollowing out” effect is quite evident also in this specification.

In sum, the various estimates do not point to an economy that is able unambiguously to enhance welfare of most of its participants. Rather, the evidence points consistently to the

decline of the middle class which is especially strong to the extent relative incomes matter. As mentioned above, the estimates are imperfect but this is one pattern that was most persistent and evident. The many missing parts of the estimating procedure point to the urgency of devoting more effort to improving our ability to draw more accurate inferences about the rate of growth of income and of welfare. Admittedly, we are at the stage of approximation.

That is why subjective evaluations of economic well-being are probably a more reliable reflection of the welfare of individuals as they really experience the economy. And these surveys do not find a lot of positive emotions when people are asked about their economic situation. For instance, the happiness index in the U.S. has been declining for decades even before the financial crisis (Easterlin, 2015, Figure 13.8; 2016, Figure 2). Moreover, at the time of writing 55% of the population is said to be thriving, 40% suggest that they are struggling, while 4% are suffering (Gallup, 2015). Given the uncertainties associated with estimating growth in welfare, people's own subjective expressions appear more convincing than the income numbers themselves (Scitovsky 1976). As Stiglitz et al., suggest, "one of the reasons that most people may perceive themselves as being worse off even though average GDP is increasing is because they are indeed worse off (2010)."³⁷

³⁷ Inequality has an independent negative effect on life satisfaction (Goff, Helliwell and Mayraz 2016).

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