

# Progressive Growth: Comparing Cross-Sectional and Panel Approaches

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*How has U.S. economic growth been distributed since 1980? A number of studies take increases in annual income inequality as evidence of regressive growth. These cross-sectional comparisons, however, provide an incorrect measure of which individuals benefit from growth because of a failure to account for income mobility. A panel approach, in comparison, controls for mobility. A tax return panel shows that those starting at the bottom of the income distribution earned the largest percentage gains, while those starting at the top had the largest losses—implying progressive growth.*

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How is U.S. economic growth distributed? This question is important because increases in aggregate output may not reflect many people’s economic situation (Stiglitz, Sen, and Fitoussi, 2009). A number of studies have tried to answer this question by taking the increase in annual income inequality as evidence of regressive growth (Dew-Becker and Gordon, 2005; Piketty, Saez, and Zucman, 2018), but these cross-sectional comparisons ignore reranking effects from income mobility. This paper shows that a panel approach reveals a pattern of progressive growth.

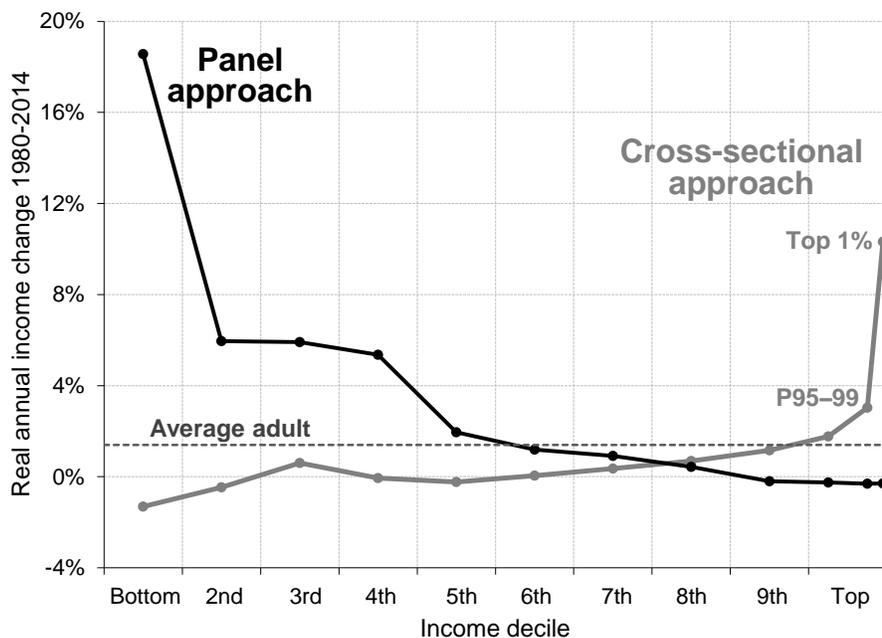
The conventional cross-sectional approach compares relative income groups in different years. Following this approach, Figure 1 suggests the top of the distribution had the largest percentage income increases between 1980 and 2014. Using the cross-sectional approach for the same years, Piketty, Saez, and Zucman (2018) argue that the top of the distribution earned a disproportionate share of economic growth. However, mobility reshuffles adults across income groups, meaning cross-sectional comparisons provide an incorrect measure of which individuals benefit from growth.

The panel approach accounts for this reshuffling. To isolate the effect of moving from the cross-sectional to the panel approach, one change is made—rather than final-year incomes being based on an observation’s final-year income group, they are based on their initial-year income group.<sup>1</sup> This holds constant the members of the initial income group and follows them over time, capturing the effects of intragenerational mobility across income groups. With this approach, the pattern reverses. The bottom of the distribution now has the largest growth rates and absolute income gains and the top the largest losses, suggesting economic growth since 1980 was earned disproportionately by those starting with lower incomes. A similar pattern is seen in more recent decades and is not merely a result of short-term or age-related mean reversion. Other U.S. panel studies, using both survey and tax data, found a progressive pattern of income changes (de Fontenay, Gorgens, and Liu, 2002; Jenkins and Van Kerm, 2006; Auten and Gee, 2009).

A panel approach also shows progressive growth for Britain (Jenkins and Van

<sup>1</sup>For real incomes and any group  $A$  in  $1\dots N$ , define  $y_{0,A\rightarrow 1\dots N}$  and  $y_{T,A\rightarrow 1\dots N}$  as the sum of initial- and final-year incomes of all observations starting in initial-year income group  $A$  and in any final-year group. For the cross-sectional approach,  $y_{T,1\dots N\rightarrow A}$  is final-year income of all observations starting in any group and ending in final-year group  $A$ . Then for years  $0,\dots,T$ :  $\text{Cross-sectionalChange}_{T,A} = (y_{T,1\dots N\rightarrow A} - y_{0,A\rightarrow 1\dots N})/T y_{0,A\rightarrow 1\dots N}$  and  $\text{PanelGrowth}_{T,A} = (y_{T,A\rightarrow 1\dots N} - y_{0,A\rightarrow 1\dots N})/T y_{0,A\rightarrow 1\dots N}$ .

FIGURE 1. REAL ANNUALIZED INCOME GROWTH RATES AND CHANGES, 1980–2014



*Note: Income growth (panel approach) and changes (cross-sectional approach) are annualized real income changes by income group. Identical tax returns are used for both approaches. Primary filers must be at least 20 years in 1980 and non-deceased in 2014 and file in 1980 or 2014. Income is adult-level fiscal income excluding capital gains, bottom-coded to zero, and indexed with the CPI-U-RS.*

Kerm, 2016), Greece, Ireland, Italy, and Portugal (Van Kerm, 2009) and can be important for understanding the distribution of global growth. The Lakner and Milanovic (2016) “elephant curve” for global incomes relied on the cross-sectional approach. While they also estimated a country-based panel approach, this still fails to account for observation-level mobility within each country. Kharas and Seidel (2018) controlled for compositional changes, estimating a global growth incidence curve appearing mildly progressive.

Other studies have emphasized the importance of following the same observations over time. For example, Bourguignon (2011) discussed how mobility can cause differences in “anonymous” (cross-sectional) versus “non-anonymous” (panel-based) growth incidence curves. Jenkins and Van Kerm (2006, 2016) and Van Kerm (2009) make similar points. This paper makes three contributions. First, it directly compares rates of income change for the cross-sectional and panel approaches. Second, it shows that panel-based results are robust to various measures and controls. Finally, while most mobility studies have relied on surveys or earnings, this study uses administrative tax data, which should have less measurement error and captures

important sources of income missing from earnings mobility studies.

### I. Data, Sample Selection, and Income Definition

Incomes come from the Continuous Work History Sample, a panel of individual tax returns. This panel is embedded in confidential annual files from the Internal Revenue Service and includes returns randomly selected by the last four digits of primary filers' Taxpayer Identification Numbers. Primary filers (the first individual listed) must be 20 years or older and not deceased in the final year considered.<sup>2</sup> After these restrictions, Figure 1 includes about thirty thousand primary filers. For subsequent figures, primary filers must file at least three years between 2000 and 2010, resulting in about one seventh of observations not filing each year, which approximates the annual non-filer share.

Income is *fiscal income excluding capital gains*: adjusted gross income, plus adjustments, less taxable government transfers and realized capital gains. This captures income from self-employment, pensions, and investments—which are missing from earnings mobility studies. Some observations do not consistently file tax returns. Incomes for these non-filers are set to 30 percent of average income of filers in that year, equal to the underreporting-inclusive estimate of Auten and Splinter (2018). Results are robust to alternative non-filer income levels. The unit of observation is individual adults.<sup>3</sup> For married filing jointly returns, weights are doubled and, applying a per-adult equivalence scale and equal-sharing assumption, incomes are divided by two if a tax return is married in a given year.

### II. Robustness Checks

The results in Figure 1 are robust to alternative initial years. When starting in 1990 or 2000, rather than 1980, the cross-sectional approach still results in a regressive pattern (see online data). Top one percent increases, however, are less pronounced for more recent starting years because they miss the one-time increase following the Tax Reform Act of 1986 (Auten and Splinter, 2018). For the panel approach, the progressive pattern persists. Moreover, the Jenkins and Van Kerm

<sup>2</sup>These restrictions create a balanced panel that cannot account for all income growth. An unbalanced panel including cohorts aging into adulthood and new immigrants should result in even more progressive growth.

<sup>3</sup>Using individuals as the unit of observation and after-tax/after-transfer income would be more appropriate for welfare analyses.

(2006) Lorenz curve-based method suggests similar progressivity of income growth for all three decades (see online data). More recent starting years, however, show larger top one percent losses. For example, between 2000 and 2014 real incomes of adults starting in the bottom half increased by one trillion dollars, while top one percent incomes decreased by half a trillion dollars.

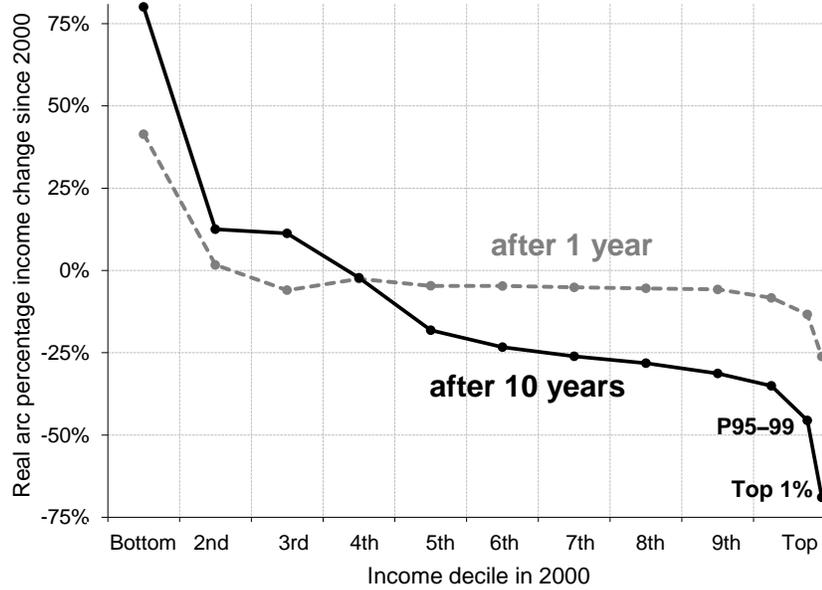
The progressive pattern persists when controlling for life-cycle effects and short-term mean reversion. For changes of residuals from a quadratic in age, bottom-half increases are half as large and top-half changes are relatively unchanged. When replacing annual incomes with 3-year average incomes in both initial and final years, bottom-decile growth rates are one third lower but otherwise does not affect the pattern of progressive growth.

### III. Individual-level Mobility Measures

The income changes discussed so far have been aggregated at the income-group level before estimating changes between years. Individual-level mobility measures also show a progressive pattern. I first examine arc percentage changes (a measure of absolute mobility) and then percentile changes (a measure of relative mobility). While conventional percentage changes are asymmetric because they are bounded by  $-100$  percent below and unbounded above, arc percentage changes are symmetric, bounded by  $-200$  and  $200$  arc percent and defined as  $2 \cdot (x_{final} - x_{initial}) / (|x_{final}| + |x_{initial}|)$ .

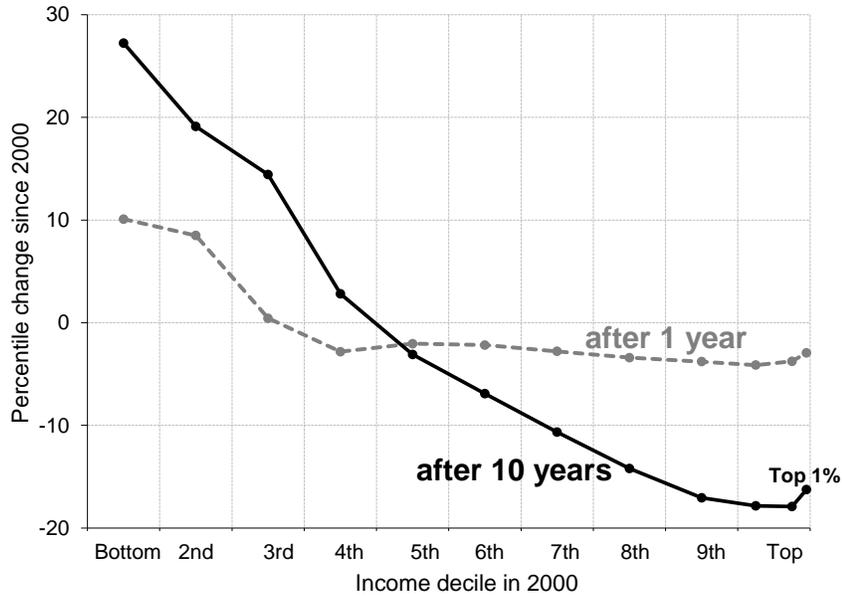
Figure 2 shows one- and ten-year arc percentage income changes since 2000 by initial income group. After one year, those starting in the bottom decile have average increases of 41 arc percent and those starting in the top one percent have changes of  $-26$  arc percent. Over ten years, those starting in the bottom decile have increases of 80 arc percent. Those starting in the top one percent have large losses, with changes of  $-69$  arc percent. Results are similar when deducting federal individual income taxes. The progressive pattern in Figure 2 is not driven by outliers or mechanical effects—for example, about a quarter of the second decile has income decreases. Moreover, progressive changes are observed for other years, various age groups, age-profile residuals, and conventional percentage changes (see online data).

FIGURE 2. REAL ARC PERCENTAGE INCOME CHANGE BY 2000 INCOME GROUP



Note: "After 1 year" shows 2000–2001 changes and "after 10 years" shows 2000–2010 changes. Sample includes non-deceased primaries at least 20 year old and filing at least three years between 2000 and 2010. Income is adult-level fiscal income excluding capital gains indexed with the CPI-U-RS.

FIGURE 3. PERCENTILE CHANGE BY 2000 INCOME GROUP



Note: See Figure 2.

Relative mobility also exhibits a strongly progressive pattern. Figure 3 shows average percentile changes over one and ten years by initial income group. Adults starting in the bottom decile rise an average of 27 percentiles after ten years and those starting in the top one percent fall an average of 16 percentiles. These rank reversals help explain the stark difference between the cross-sectional and panel approaches. As discussed in Jenkins and Van Kerm (2006), progressive growth can occur at the same time as increasing inequality because inequality changes fail to properly account for mobility-related rank reversals.<sup>4</sup>

#### IV. Conclusion

Using a panel of tax returns, this paper shows that income mobility can have large impacts on measures of the distribution of economic growth. As noted by Jenkins and Van Kerm (2016) and Ravallion (2018), mobility between income groups means estimates from the cross-sectional approach do not truly describe “winners” and “losers” as individuals, but only as anonymous fractiles of a distribution. Relative to a cross-sectional approach, the incidence of U.S. income growth reverses with a panel approach. The largest income growth shifts from the top of the distribution to the bottom. Those starting with low incomes in a given year tend to have the largest percentage income gains in later years, while those starting with high incomes tend to have the largest losses in later years, which reflects progressive growth.

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<sup>4</sup>For example, assume initial incomes for  $A$  of \$2 and  $B$  of \$3. In the final period,  $A$  increases to \$4 and  $B$  falls to \$2. Inequality increased, going from (2, 3) to (2, 4), but the net \$1 of growth was progressively distributed: poor  $A$  gained \$2 and rich  $B$  lost \$1.

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