Letter

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Explaining the Equalising Effect of Panel-Income Changes

DOI 10.1515/bejeap-2016-0025

Published online June 28, 2016

Abstract: Panel-income changes tend to be equalising but existing approaches provide little insight on the nature of this equalising process. I present a new decomposition framework showing explicitly how the equalising effect of panel-income changes depends on the respective size and distribution of panel-income gains and losses. One of the new insights gained from the application to US data for the 1970/2009 period is that most of the equalising effect occurs through income gains rather than income losses even in times of recession.

Keywords: income inequality, income mobility, income growth, panel-income changes, inequality decomposition

JEL Classifications: D31, D63

1 Introduction

Duval-Hernández, Fields, and Jakubson (2014, 1) indicate that “when we follow the same people over time, those who earned the least to begin with gained more in dollars than those who started at the top of the earnings distribution.” This phenomenon is known as income convergence or the equalising effect of panel-income changes or of income growth. These authors also show that it is possible, and indeed common, to have rising inequality along with equalising panel-income changes.

Jenkins and Van Kerm (2006) – hereafter referred to as JVK – propose an analytical framework explaining this apparently counterintuitive result in the special case of the widely used Gini index. They show that rising inequality can arise along with pro-poor income growth in the presence of large reshufflings in the income distribution (i. e. reranking).

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However, their approach does not distinguish between the size and the distribution of panel-income changes, a crucial distinction to explain why the income growth process is equalising. Indeed, different growth processes may have the same equalising effect but with very different welfare implications due to differences in the size and distribution of the underlying income changes. For instance, a growth process can be equalising because income gains (losses) are small on average but highly concentrated on the poor (rich), while another growth process can have the same equalising effect but with large income gains (losses) only weakly concentrated on the poor (rich). Distinguishing these growth processes and teasing out these welfare implications requires an approach that can disentangle the size and progressivity of panel-income changes.

By explicitly distinguishing the effects of income gains and income losses while building on the JVK's framework, I propose a new decomposition capable of shedding light on the equalising effect of panel-income changes. The new framework clearly shows that the consequences of panel-income changes in terms of inequality depend on four factors identifying the respective size and progressivity of income gains and losses. Hence it becomes possible to characterise growth processes with the same equalising effect but with different welfare implications due to the different distributions of income gains and losses. This distinction between the respective effects of income gains and losses on income distribution is particularly relevant from a social welfare perspective as there is evidence that people do not treat income changes symmetrically.¹

An application to US data for the 1970/2009 period illustrates the usefulness of the approach. One of the major new insights is that most of the equalising effect of income growth occurs through income gains rather than income losses, a finding that persists even in times of recession when income losses tend to grow.

2 A New Decomposition to Explain Inequality Changes

JVK establish a parallel between observed inequality changes and Kakwani's (1984) proposed decomposition of the redistributive effect of a tax. A change in inequality – either the observed change over time in JVK or the change due to the implementation of a tax in Kakwani (1984) – can be decomposed into a

¹ See the literature on prospect theory (e. g. Jantti et al. 2013 or Wodon 2001, 451).

vertical and a reranking effect. Let G_i denote the Gini coefficient of year i incomes and C_i^j denote the concentration coefficient for year i incomes calculated using year j rankings.² JVK show that

$$\Delta G = G_1 - G_0 = R - V$$

where $R = G_1 - C_1^0$ and $V = G_0 - C_1^0$

They interpret V as a measure of the equalising effect of the income changes and R as an index of mobility in the form of reranking. In the context of the income tax literature, V is the vertical effect of the income changes as it depends both on the size and progressivity of the income changes. R is a relative-income-weighted average of changes in social weights. It follows that $M = R/G_1$ is the asymmetric Gini mobility index discussed in Wodon (2001) and Yitzhaki and Wodon (2004).

If there is no change in the ranking of the income units, then the mobility index equals zero. For instance, this may arise if the loss (or gain) in mean income is equally shared by all income units in proportion of their initial income level. By contrast, maximum mobility occurs if there is a total reversal in the ranks. As noted by Wodon (2001, 454), the advantage of this mobility index is that it takes into account both the level of income of the individuals and their ranking in the distribution of income, with the changes in rankings which traditionally define mobility being weighted by the changes in income levels. Hence, in the absence of reranking, the reduction in inequality is entirely determined by the size and progressivity of the income changes as measured by V . In other words, inequality is reduced by equalising panel-income changes unless more than offset by concomitant income mobility.

If there is a change in mean income μ from year 0 to year 1, V can be rewritten as

$$V = \frac{\pi}{1 + \pi} K \quad [2]$$

where $\pi = (\mu_1 - \mu_0)/\mu_0$ is the proportionate change in the population's average income and K is an index of the proportionality of the income changes defined in a similar fashion as the tax progressivity index introduced by Kakwani (1977). More specifically, K is defined as the concentration index of income changes minus the Gini coefficient for year 0 incomes. In this framework, K is an index of

² JVK show how the approach can be extended to allow for different degrees of inequality aversion by using the generalized Gini coefficient. This extension can be applied in a similar fashion to the approach laid out below.

the progressivity of the income changes while the ratio $\pi/(1 + \pi)$ captures the relative size of the income changes.

However, Lambert (1985, 2001) shows that the proportionality of bidirectional income changes, K defined in eq. [2], is unstable for small average income changes. Hence, JVK do not distinguish between the magnitude and the progressivity of the income changes but focus instead on the index V , which subsumes both of these aspects. Yet, such a distinction has proved useful in the income tax literature as the same level of redistribution can be achieved through a small but highly progressive income tax or through a large but barely progressive income tax. Similarly, one would expect that the same reduction in inequality could be achieved by either limited income growth disproportionately concentrated among the poor or substantial income growth only mildly concentrated among the poor.

To circumvent this limitation I introduce an explicit distinction between the distributional effects of income gains and losses. Let P_g and P_l denote the Kakwani's disproportionality indices relating to income gains and income losses respectively. P_g and P_l are defined in the usual sense as the concentration index of absolute income gains and losses, respectively, minus the Gini coefficient for year 0 incomes. By drawing on the treatment of net taxes in the income tax literature (Lambert 1985), V can be rewritten as

$$V = \underbrace{\frac{l}{1-l+g}P_l}_{VE_l} - \underbrace{\frac{g}{1-l+g}P_g}_{VE_g} \quad [3]$$

where l is the average income loss as a share of year 0 income and g is the average income gain as a share of year 0 income. More specifically, let x_{it} denote the income of individual i in period t , then l and g are

$$l = \frac{1}{N} \sum_{i=1}^N \frac{|x_{i1} - x_{i0}|}{x_{i0}} I_{x_{i1} < x_{i0}} \quad [4]$$

$$g = \frac{1}{N} \sum_{i=1}^N \frac{|x_{i1} - x_{i0}|}{x_{i0}} I_{x_{i1} > x_{i0}} \quad [5]$$

where $I_{(\cdot)}$ is an indicator equal to 1 if $(\cdot)$ is true and 0 otherwise.

The difficulty mentioned above in the definition of K is avoided as income gains (and income losses) all imply unidirectional income changes. Equation [1] still applies and eq. [3] now provides a meaningful interpretation of V . More specifically, the equalising effect, V , achieved by panel-income changes depends on (i) the size of the income gains, (ii) the extent to which they are

more concentrated among poorer individuals than among richer individuals (i. e. their regressivity), (iii) the size of the income losses and (iv) the extent to which they are more concentrated among richer individuals than among poorer individuals (i. e. their progressivity). The vertical effect of income gains VE_g encompasses (i) and (ii), while VE_l summarises (iii) and (iv).

3 Application to the United States for the 1970–2009 Period

The data source for this application is the US Panel Study on Income Dynamics (PSID), as released in the Cross National Equivalence File (CNEF) (Burkhauser et al. 2001). The measure of income for each individual is based on the post-tax post-transfer annual income of the household to which they belong. Household income is adjusted for differences in household size by dividing by the square root of the number of household members. All incomes are converted to 2009 dollars using the consumer price index, negative incomes are recoded to zero, individuals of all ages are included and all calculations use sample weights. Standard errors for all estimates are obtained by using the bootstrap resampling methods described in Van Kerm (2013) and Saigo, Shao, and Sitter (2001).

The data cover the period from 1970 to 2009 with yearly data between 1970 and 1997 and biennial data after 1997. The decompositions are carried out over successive 2-year periods with one exception – the 1984–1987 period – to allow for the switch from even to odd years.³ The period of analysis is marked by six recessions in 1973–1975, 1980, 1981–1982, 1990–1991, 2001 and 2007–2009 according to the National Bureau of Economic Research (NBER).

Table 1 shows how the new approach explains the equalising effect of the panel-income changes that is summarised by V in JVK's framework. Figure 1 provides a graphical representation of inequality changes, the reranking index R and the vertical effects of the income gains, VE_g , and income losses, VE_l . Figure 2 shows the evolution of the regressivity of the income gains ($-P_g$) and of the progressivity of the income losses P_l .

One important finding is that most of the equalising effect of the panel-income changes occurs through income gains rather than income losses. Moreover, this finding is not sensitive to the business cycle. This is despite the

³ In contrast to JVK, income is not averaged over 3 years in order to better assess the influence of short-term fluctuations, and in particular of the business cycle, on inequality and mobility.

Table 1: Decomposition of changes in income inequality in the United States, 1970–2009.

Initial year	Final year	Gini coefficient		Reranking R	Mobility $M(R/G_t)$	Vertical effect V	Income gains		Income losses				
		Initial year (G_0)	Final year (G_1) Change (ΔG)				Vertical effect VE_g	Progressivity P_g	Av. gain $g^{(*)}$	Vertical effect VE_l	Progressivity P_l	Av. loss $l^{(*)}$	
1970	1972	30.58 (0.24)	30.67 (0.24)	0.09 (0.20)	6.14 (0.17)	0.200 (0.01)	6.05 (0.25)	4.73 (0.17)	-28.69 (1.02)	17.85 (0.30)	1.32 (0.14)	15.19 (1.25)	9.45 (0.26)
1972	1974	30.42 (0.25)	29.96 (0.25)	-0.46 (0.20)	6.45 (0.22)	0.215 (0.01)	6.91 (0.27)	5.00 (0.21)	-46.56 (1.58)	10.39 (0.26)	1.91 (0.14)	13.51 (0.80)	13.67 (0.24)
1974	1976	29.75 (0.25)	30.28 (0.24)	0.53 (0.21)	7.62 (0.27)	0.252 (0.01)	7.09 (0.31)	5.36 (0.24)	-36.38 (1.39)	15.25 (0.32)	1.73 (0.16)	15.40 (1.16)	11.65 (0.28)
1976	1978	30.14 (0.24)	29.51 (0.23)	-0.63 (0.21)	7.64 (0.33)	0.259 (0.01)	8.27 (0.34)	6.62 (0.29)	-49.02 (1.68)	13.72 (0.35)	1.65 (0.13)	13.78 (0.91)	12.16 (0.25)
1978	1980	29.33 (0.23)	30.42 (0.47)	1.09 (0.43)	6.12 (0.17)	0.201 (0.01)	5.03 (0.47)	3.07 (0.41)	-28.79 (4.98)	10.05 (0.54)	1.96 (0.15)	11.76 (0.77)	15.74 (0.26)
1980	1982	30.49 (0.46)	32.03 (0.59)	1.55 (0.32)	5.65 (0.15)	0.176 (0.01)	4.10 (0.35)	3.03 (0.28)	-21.36 (2.33)	14.73 (0.43)	1.07 (0.14)	10.13 (1.12)	10.97 (0.25)
1982	1984	32.09 (0.60)	32.12 (0.31)	0.03 (0.54)	5.73 (0.17)	0.178 (0.01)	5.70 (0.55)	3.99 (0.22)	-24.65 (1.46)	17.21 (0.39)	1.72 (0.42)	16.81 (3.07)	10.85 (0.68)
1984	1987	32.24 (0.32)	33.27 (0.37)	1.03 (0.29)	6.94 (0.18)	0.209 (0.01)	5.91 (0.34)	4.27 (0.24)	-23.87 (1.56)	19.26 (0.43)	1.64 (0.17)	15.29 (1.24)	11.56 (0.32)
1987	1989	33.26 (0.37)	36.06 (0.72)	2.80 (0.50)	5.65 (0.18)	0.157 (0.01)	2.85 (0.57)	2.08 (0.51)	-11.46 (3.12)	20.10 (0.83)	0.77 (0.14)	8.80 (1.36)	9.64 (0.26)
1989	1991	36.11 (0.70)	34.91 (0.39)	-1.20 (0.57)	5.78 (0.20)	0.165 (0.01)	6.97 (0.57)	4.01 (0.22)	-31.49 (1.89)	12.47 (0.33)	2.96 (0.45)	19.83 (1.96)	14.61 (0.71)
1991	1993	34.99 (0.40)	36.03 (0.42)	1.05 (0.35)	6.97 (0.23)	0.193 (0.01)	5.92 (0.38)	4.41 (0.29)	-28.77 (2.15)	15.69 (0.48)	1.51 (0.19)	11.63 (1.19)	13.31 (0.34)

1993	1995	35.79 (0.41)	37.58 (0.51)	1.79 (0.45)	9.25 (0.52)	0.246 (0.01)	7.46 (0.51)	5.24 (0.43)	-34.11 (2.89)	15.20 (0.65)	2.22 (0.21)	13.48 (1.00)	16.30 (0.37)
1995	1997	37.18 (0.54)	35.95 (0.44)	-1.23 (0.48)	8.35 (0.31)	0.232 (0.01)	9.58 (0.54)	6.90 (0.35)	-33.08 (1.75)	22.92 (0.60)	2.69 (0.32)	22.84 (1.65)	12.93 (0.57)
1997	1999	37.74 (0.41)	39.91 (1.15)	2.17 (1.10)	8.94 (0.33)	0.224 (0.01)	6.77 (1.27)	4.66 (1.19)	-23.35 (7.62)	20.80 (1.86)	2.11 (0.22)	13.30 (1.07)	16.56 (0.42)
1999	2001	40.22 (1.15)	39.63 (0.54)	-0.59 (1.16)	9.79 (0.56)	0.247 (0.01)	10.38 (1.21)	7.51 (0.64)	-32.36 (2.99)	25.66 (1.05)	2.87 (0.77)	20.99 (3.39)	15.12 (1.43)
2001	2003	39.35 (0.54)	38.29 (0.63)	-1.07 (0.66)	8.03 (0.31)	0.210 (0.01)	9.09 (0.74)	4.91 (0.50)	-30.65 (3.98)	15.41 (0.73)	4.18 (0.38)	20.85 (1.12)	19.28 (0.62)
2003	2005	38.26 (0.62)	41.24 (1.25)	2.98 (1.17)	9.59 (0.60)	0.233 (0.02)	6.62 (1.39)	5.06 (1.32)	-24.76 (8.21)	21.83 (2.09)	1.55 (0.20)	11.03 (1.15)	15.04 (0.39)
2005	2007	41.29 (0.95)	43.67 (0.57)	2.38 (0.81)	8.33 (0.28)	0.191 (0.01)	5.95 (0.84)	4.18 (0.39)	-23.17 (2.39)	18.03 (0.64)	1.76 (0.59)	9.69 (2.63)	18.19 (1.03)
2007	2009	43.47 (0.56)	41.47 (0.65)	-2.00 (0.45)	7.37 (0.26)	0.178 (0.01)	9.38 (0.52)	6.70 (0.39)	-35.81 (2.63)	19.44 (0.65)	2.67 (0.24)	17.79 (1.06)	15.60 (0.48)

Notes: The change in the Gini coefficient (ΔG) is equal to R plus V . V is equal to VE_g plus VE_l . Income is defined at the individual level by post-tax post-transfer equivalised household annual income. All estimates have been multiplied by 100. Bootstrap standard errors in parentheses. Reranking and vertical effects are expressed in Gini percentage points. (*) Average income gains and losses are expressed as a percentage of initial income for each period.

Source: Authors' calculations from the PSID (CNEF release). Separate balanced panels for each period.

Figure 1: Inequality changes, reranking and the vertical effects of income gains and losses (United States 1970–2009, Gini points).

Notes: The change in the Gini coefficient is equal to the reranking index minus the vertical effect of income gains and the vertical effect of income losses. Income is defined at the individual level by post-tax post-transfer equivalised household annual income.

fact that (as expected) average income losses tend to increase and income gains tend to fall in recessions. This shows that whether the economy is growing or contracting, most of the equalizing effect of the panel-income changes is attributable to income gains rather than income losses.

There are two main reasons for the dominance of income gains. First, income gains are larger than income losses on average, a mere reflection of the positive income growth observed over most subperiods. Second, and most importantly, the disproportionality of income gains with respect to initial incomes (i.e. their regressivity) is systematically greater than the progressivity of income losses (see Figure 2). In other words, it is essentially because income gains are disproportionately concentrated in the lower part of the income distribution that panel-income gains reduce inequality to a larger extent than income losses, which tend to be more evenly spread.

Finally, we note that the reduction in mobility, as measured by the normalized reranking index M , observed in the 1980s (and also found by JVK) was only temporary. The decrease in mobility was reversed between the late 1980s and

Figure 2: Progressivity of income gains and losses (United States 1970–2009, Gini points).

Notes: Income is defined at the individual level by post-tax post-transfer equivalised household annual income.

Source: Authors' calculations from the PSID (CNEF release). Separate balanced panels for each period.

the early 1990s. Mobility then plateaued until it started to decline between 2003 and 2009. Overall, there is no clear long-term pattern in income mobility since 1970.

In this application, all panel-income changes taking place in the entire population are taken into account. This implies that the changes in equivalised net income described here can occur for a wide range of factors including direct shocks to household market income (e. g., job loss or gain, retirement, etc.), through changes affecting household composition via their effects on household size (e. g., birth of a child, marriage, divorce, etc.) or through tax and transfer policy reforms. Although it is often difficult to identify the role of one particular factor in any observed individual income change, focussing the analysis on the working-age population (i. e., those aged 25–64) should eliminate most of the income changes due to school-to-work transitions and transitions into retirement. Interestingly, results obtained by restricting the analysis to the working-age population (not reproduced here but available upon request) are very similar to the results for the whole population discussed above. This suggests that these

transitions in and out of the labour play little role in explaining income mobility or the equalising effect of panel-income changes observed at the population level.

4 Conclusion

I build on the method proposed by JVK to shed light on the equalising effect of panel-income changes. The proposed extension is useful to understand the interrelated dynamics of income mobility, inequality and growth. The application to the United States based on data from 1970 to 2009 provides new insights into the dynamics of income distribution. In particular, the results show that if panel-income changes are equalising it is largely due to income gains rather than to income losses, a finding that also applies in times of recession. To some extent the dominance of income gains is due to the fact that they are larger on average than income losses, which is a mere reflection of the positive income growth over the period. Most importantly, however, income gains dominate because they are more concentrated on the poor than income losses are concentrated on the rich.

In this application, no distinction is made on the factors driving panel-income changes. A restriction of the analysis to the working-age population suggests that school-to-work and retirement transitions do not play a major role in explaining mobility patterns and the equalising effect of income growth observed at the population level. A valuable avenue for future research is to examine the role of other factors, such as tax and transfer policy reforms.

Acknowledgements: The author is grateful to Francisco Azpitarte, Stephen Jenkins, Paul Jensen and Moshe Justman for their helpful comments and discussions.

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