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UNDERSTANDING CHANGES IN THE DISTRIBUTION AND REDISTRIBUTION OF INCOME: A UNIFYING DECOMPOSITION FRAMEWORK

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In recent decades income inequality has increased in many developed countries but the role of tax and transfer reforms is often poorly understood. We propose a new method allowing for the decomposition of historical changes in income distribution and redistribution measures into: (i) the immediate effect of tax-transfer policy reforms in the absence of behavioral responses; (ii) the effect of labor supply responses induced by these reforms; and (iii) a third component allowing us to explore the effect of changes in the distribution of a wide range of determinants, including the effect of employment changes not induced by policy reforms. The application of the decomposition to Australia reveals that the direct effect of tax-transfer policy reforms accounts for half of the observed increase in income inequality between 1999 and 2008, while the increased dispersion of wages and capital incomes also played an important role.

JEL Codes: D31, H23, J22

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1. Introduction

In recent decades, income inequality has increased in many developed countries. Although fiscal policies are the main institutional tools available to policymakers to address income distribution issues, there is mounting evidence that taxes and transfers have become less effective in redistributing income (OECD, 2011; Bastagli *et al.*, 2012). Yet, there is currently no available tool allowing analysts to explore the many potential factors underlying income distribution changes while explicitly recognizing the role of tax and transfer policies.

This paper aims to fill this gap by proposing a new unifying decomposition framework. The proposed approach combines the strengths of inequality

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decomposition techniques based on counterfactual distributions (DiNardo *et al*., 1996; Bover, 2010) and more recent decomposition approaches based on microsimulation techniques (Kasten *et al*., 1994; Bargain, 2012). The integration of these approaches into a single framework offers a valuable analytical tool that provides insight into the contributions of tax-transfer policy reforms and changes in socioeconomic factors to overall trends in income distribution and redistribution. Unlike microsimulation decompositions, the new decomposition allows analysts to explore the role of changes in the distributions of a wide range of population characteristics. Furthermore, in contrast to earlier inequality decompositions, the new method provides a comprehensive assessment of the contribution of policy reforms, accounting for their direct effects and some of their indirect effects via labor supply responses.

Inequality decompositions based on shift-share analysis or based on the semi-parametric procedure originally proposed in DiNardo *et al*. (1996), and further developed by Bover (2010), have been widely used in the income distribution literature. These methods enable the derivation of counterfactual distributions that are particularly useful for assessing how changes in the distributions of particular population characteristics (e.g., ethnicity, age, or education) can affect wage and income distributions. However, these approaches are essentially descriptive, as they provide non-causal estimates. Moreover, they provide no information on the role of tax-transfer policy changes.

Notably, the mere observation that taxes and transfers have become less effective in redistributing income does not necessarily stem from changes in policies. Indeed, the redistributive capacity of the tax-transfer system depends on both the properties of the system and the shape of the distribution of market income to which it is applied, which poses significant challenges for the analyst. To date, there exists a range of decomposition techniques to assess the role of fiscal policies in the distribution and redistribution of income while controlling for changes in the distribution of market income. Arguably, the main contributions are those of Kasten *et al*. (1994) and Dardanoni and Lambert (2002), who apply different tax-transfer systems to a base distribution of market income that is used as a reference. A known limitation of these decomposition methods, however, is that they are only able to capture the direct effect of policy changes and neglect the secondary effect of these policies on market incomes, particularly through labor supply.

In a recent article, Bargain (2012) addresses this limitation by proposing a decomposition based on tax-benefit microsimulation techniques. First, he identifies changes in income distribution and redistribution measures that are directly attributable to tax-transfer policy changes. Second, he draws on a behavioral microsimulation model to evaluate the indirect contribution of policy changes through labor supply responses. The approach, however, is limited to the identification of the contributions of these two factors, which in practice leads to a sizeable residual component when the method is applied to the UK (Bargain, 2012) or to Australia (Creedy and Herault, 2014).

The new decomposition method presented in this paper comprises three layers. The first layer relies on a tax-benefit calculator to evaluate the immediate effect of tax-transfer policies. The second (optional) layer is based on a behavioral

microsimulation model and allows the analyst to assess the role of labor supply responses at both the extensive and intensive margins induced by these reforms. Based on counterfactual methods, the third layer allows the analyst to explore a wide range of other factors potentially contributing to the observed changes in income distribution and redistribution measures. Hence, while isolating the effects of tax-transfer policies, it is possible to assess the role of changes in the distributions of various population characteristics, such as age, education, or household structure. Perhaps more importantly, the method also allows the analyst to assess the contributions of changes in the distribution of employment at both the extensive and intensive margins or in the distributions of capital income and wages.

Given that labor income constitutes the main source of income for most families and given that welfare payments are conditional on meeting low-income criteria in many tax-transfer systems, we suggest that this third layer is particularly useful for examining how changes in the employment distribution affect income distribution and redistribution measures. One novelty of the decomposition method presented in this paper is that it can identify the contribution of changes at the extensive and intensive margins of employment beyond the labor supply responses to tax-transfer reforms (and identified in the second layer).

To illustrate its usefulness, we apply the new decomposition framework to analyze changes in income distribution and redistribution in Australia. Similar to a number of other countries, Australia has experienced an increase in income inequality and a reduction in the redistributive effect of the tax-transfer system in recent decades. This application focuses on the period between 1999 and 2008, which was a period of strong economic growth characterized by important changes in labor force participation rates as well as income distribution and redistribution. Our results show that the direct effect of tax-transfer policy reforms accounts for half of the observed increase in disposable income inequality over the period. Slightly more than one-fifth of this direct effect was offset by labor supply responses to these policy reforms. Interestingly, tax-transfer reforms explain only 17 percent of the sharp reduction observed in the redistributive effect of the tax-transfer system, and these reforms are not responsible for the observed reduction in tax progressivity. The main contributor to both of these reductions lies in changes at the extensive and intensive margins of employment and, in particular, the increased employment rates recorded during this period. Further analyses suggest that the contributions of changes in educational attainment, age distribution, and household structure were limited, while the increased dispersion of wages and capital incomes played a substantial role in the increase in income inequality.

The remainder of the paper is structured as follows. Section 2 describes the decomposition method. Section 3 reports the results for Australia. Conclusions are discussed in Section 4.

2. Decomposition Approach

Let M denote the index of interest, which can be any inequality or redistributive measure. The latter type of measure generally involves the comparison of

distributions of market income (g), income taxes (tax), and benefit payments (ben). Let us denote this set of variables as $A = \{g, tax, ben\}$.

Let $\tau_t = (T_t, B_t)$ be the vector with all relevant information on taxes, T_t, and benefits, B_t, at time t. This information includes all rates, thresholds, and eligibility rules embedded in the tax-transfer system. Let P_t denote the set of socioeconomic and demographic characteristics of the population in period t. Let L_t denote any variable in P_t whose distributional effect is of interest to the analyst. Given its important role in the distribution of income, we assume in the following discussion, with no loss of generality, that this variable of interest is employment. Thus, vector L_t provides information on employment status at both the extensive and intensive margins.

Assuming that all variables in $A = \{g, tax, ben\}$ depend on τ, P, and L, we can write the value of any index, M, at time t as follows:

$$M_t = M(P_t, L_t, \tau_t).$$

We are interested in understanding changes in this index between two periods, 0 and 1. Let $M(P_1, L_0, \tau_1)$ denote the value of the index of interest in period 1 assuming the distribution of employment at both the extensive and intensive margins of period 0. To derive this value, we estimate the counterfactual distributions of the variables in $A = \{g, tax, ben\}$ that are needed to compute the index M. The derivation of counterfactual distributions follows the methods developed by DiNardo *et al.* (1996) and Bover (2010) and is discussed in detail in Appendix A. The observed changes in M between periods 0 and 1 can be then decomposed as follows:

$$\begin{aligned} \Delta &= M_1 - M_0 \\ &= M(P_1, L_1, \tau_1) - M(P_0, L_0, \tau_0) \\ &= M(P_1, L_1, \tau_1) - M(P_1, L_0, \tau_1) \qquad (1) \\ &\quad + M(P_1, L_0, \tau_1) - M(P_0, L_0, \tau_0) \qquad (2) \end{aligned}$$

where term (1) is the part of the variation in M that results from all changes in employment distribution, whereas (2) represents the portion of the change explained by other factors. The contribution of employment changes can be further decomposed to identify the specific contribution of the variations in labor supply induced by changes in the tax-transfer policy between the two periods. Term (1) is decomposed as follows:

$$\begin{aligned} &M(P_1, L_1, \tau_1) - M(P_1, L_0, \tau_1) \\ &= M(P_1, L_1, \tau_1) - M\left(P_1, L_1^{\tau_0}, \tau_1\right) \qquad (3) \\ &\quad + M\left(P_1, L_1^{\tau_0}, \tau_1\right) - M(P_1, L_0, \tau_1) \qquad (4) \end{aligned}$$

where $L_1^{\tau_0}$ refers to the distribution of labor supply choices that one would observe in period 1 if the population of that period had believed that the tax-transfer

regime would be τ_0 rather than τ_1. $M\left(P_1, L_1^{\tau_0}, \tau_1\right)$ represents the corresponding value of the index of interest.[1] Following Bargain (2012), we derive these two elements by using a behavioral microsimulation model, preferably one based on a structural labor supply model. This model is used to estimate labor supply responses to changes in tax-transfer policies at both the extensive and intensive margins. Term (3) accounts for the contribution of labor supply responses resulting from changes in τ, whereas (4) represents the effect of changes in employment not explained by modifications in the tax-transfer regime.

Some caution is needed when interpreting the behavioral effects obtained from such a model. Tax microsimulation models are partial equilibrium supply side models. Thus, such models are able to simulate the effect of a change in the tax-transfer system on each individual's labor supply, but they do not allow for demand-side factors or for potential general equilibrium effects on wage rates. In addition, tax-transfer policy changes may affect other behaviors, such as fertility, household formation, tax evasion or avoidance, benefit take-up rates, migration, and educational choice, which become subsumed under the residual component of the decomposition in the present approach (the term (5) below).[2]

Term (2) is the part of the change in M that is not explained by differences in the labor supply and can be further decomposed as follows:

$$M(P_1, L_0, \tau_1) - M(P_0, L_0, \tau_0) = M(P_1, L_0, \tau_1) - M(P_0, L_0, \tau_1) \tag{5}$$

$$+ M(P_0, L_0, \tau_1) - M(P_0, L_0, \tau_0) \tag{6}$$

where $M(P_0, L_0, \tau_1)$ is the value of M assuming that the population from period 0 would face the tax-transfer regime τ_1 from period 1 without being able to adjust their behavior as a consequence. Term (6) thus captures the direct or immediate effect of a change from the tax-transfer regime of period 0, τ_0, to that of period 1, τ_1, in the absence of behavioral responses.

Term (5) can be regarded as a residual capturing the part of the variation in M that results from changes in other population characteristics, including a wide range of factors such as changes in the age, occupational, educational, and demographic structure, as well as the effect of differential income growth, for instance, by occupation, sector, region, or income source. As indicated above, term (5) also includes non-labor supply responses to tax-transfer reforms, such as tax evasion or avoidance and changes in benefit take-up rates, which might be sizeable. However, as we illustrate in the application, an adaptation of the counterfactual methods used to derive $M(P_1, L_0, \tau_1)$ in (1) allows us to explore the contributions of some of these factors. Essentially, rather than considering the contribution of changes in

[1]In the following analysis, the vector of tax thresholds, transfer parameters, and incomes for period 0 is always assumed to be adjusted in nominal terms to period 1 values using an uprating factor. The choice of an appropriate uprating factor is important, and we return to this point in the application.

[2]See Saez *et al.* (2012) for a discussion of the elasticity of taxable income with respect to marginal tax rates.

the conditional distribution of employment in term (4), we can examine the role of changes in the distributions of the age structure of the population, educational attainment, the size and composition of the tax units, capital income, or wages.

In summary, using (3) to (6), we can express the variation in the index of interest M between two periods as follows:

$$\begin{aligned} & M(P_1, L_1, \tau_1) - M(P_0, L_0, \tau_0) \\ & \quad = M(P_1, L_1, \tau_1) - M\left(P_1, L_1^{\tau_0}, \tau_1\right) \qquad \text{(TLS)} \\ & \quad + M\left(P_1, L_1^{\tau_0}, \tau_1\right) - M(P_1, L_0, \tau_1) \qquad \text{(E)} \\ & \quad + M(P_0, L_0, \tau_1) - M(P_0, L_0, \tau_0) \qquad \text{(T)} \\ & \quad + M(P_1, L_0, \tau_1) - M(P_0, L_0, \tau_1) \qquad \text{(O)} \end{aligned}$$

where (TLS) is the part of the variation that results from changes in labor supply induced by changes in the tax-transfer system, (E) is the variation attributed to other changes in employment, (T) is the effect of a change in the tax-transfer regime in the absence of labor supply responses, and (O) is a residual that captures the effect of all other changes in the population.

Notably, each of these four components can be computed in alternative ways. For example, the effect (T) of a switch in the tax-transfer regime in the absence of labor supply responses can be computed using the population from period 1 rather than that from period 0. Similarly, the residual term can be computed using the tax-transfer regime of period 1 rather than that of period 0.

In principle, 24 decomposition paths are possible. In practice, however, only eight decompositions are relevant. Indeed, the O, E, and TLS components must be positioned consecutively, as they correspond to a division of the initial "other effects" after the effect of a change in the tax-transfer regime (T) is evaluated (see Bargain, 2012, p. 713). These eight decompositions account for all possible interactions between the various components of the decomposition, thus eliminating the need to introduce a separate interaction term. As there is no particular reason to prefer one ceteris paribus condition, one could argue on the grounds of symmetry that an appropriate measure of each component is obtained by averaging all possible values. Following Shapley (1953) and Shorrocks (2013), we measure the effect of each component by their arithmetic mean values over all possible decompositions (that is, attributing the same probability to each):

$$\overline{TLS} = \frac{2}{8} \sum_{i=0,1} \sum_{j=0,1} \left(M\left(P_i, L_i^{\tau_1}, \tau_k\right) - M\left(P_i, L_i^{\tau_0}, \tau_k\right) \right.$$

$$\bar{E} = \frac{1}{8} \sum_{i=0,1} \sum_{j=0,1} \sum_{k=0,1} M\left(P_i, L_1^{\tau_j}, \tau_k\right) - M\left(P_i, L_0^{\tau_j}, \tau_k\right)$$

$$\bar{T} = \frac{4}{8} \sum_{i=0,1} M\left(P_i, L_i^{\tau_i}, \tau_1\right) - M\left(P_i, L_i^{\tau_i}, \tau_0\right)$$

$$\bar{O} = \frac{1}{8} \sum_{i=0,1} \sum_{j=0,1} \sum_{k=0,1} M\left(P_1, L_j^{\tau_k}, \tau_i\right) - M\left(P_0, L_j^{\tau_k}, \tau_i\right)$$

where $L_k^{\tau_k} = L_k$.

3. Empirical Application: Australia from 1999 to 2008

As an illustration of the decomposition method, we analyze the changes in the distribution and redistribution of income in Australia between the financial years 1999/00 and 2007/08, a period characterized by significant policy reforms and important changes in labor force participation. These two years also mark the beginning and end of the period of decline in the redistributive capacity of the tax and transfer system (Herault and Azpitarte, 2014). Moreover, this period has the advantage of avoiding distortions from business cycle variations, as it represents a peak-year to peak-year comparison.[3]

Section 3.1 provides greater detail regarding the variables and definitions used in the empirical application. We then present, in Section 3.2, the primary changes in labor force participation and in the distribution and redistribution of income that occurred during the period under analysis. The main results from the decomposition analysis are presented in Section 3.3. In Section 3.4, we illustrate the flexibility of the approach by quantifying the contribution of other potential factors to the observed trends.

3.1. *Data Sources and Definitions*

Our analyses are based on the full samples from the 1999/00 and 2007/08 editions of the Australian Survey of Income and Housing (SIHC). This nationally representative survey is designed to collect detailed information on the income sources and socioeconomic characteristics of households and household members. In particular, SIHC provides rich information on the various components of labor and capital income that we use to generate our measure of market income. The values of taxes and benefits are based on the calculation of entitlements by the Melbourne Institute Tax and Transfer Simulator (MITTS), as described briefly in Appendix B, rather than actual receipts. MITTS allows the derivation of all major social security transfers, family payments, rebates, and income taxes to ensure a reasonable approximation of disposable income. Labor supply responses to a change in the tax-transfer regime are estimated using the behavioral component of MITTS, which is based on a structural model of labor supply.

The unit of analysis throughout this section is the individual, where each individual in an income unit is assigned the total income of the unit per adult equivalent. Following Banks and Johnson (1994) and Jenkins and Cowell (1994), we obtain the adult equivalent size, s, using the following parametric scales:

$$s = (n_a + \theta n_c)^{\delta} \tag{7}$$

where n_a and n_c are the number of adults and children in the unit, respectively; θ is the weight attached to children; and δ represents the extent of economies of scale. The weight attached to children, θ, was set at 0.6, and the economies-of-scale parameter was set at $\delta = 0.8$. These values produce scales that are similar to the

[3]Quarterly GDP growth was negative in the fourth quarters of 2000 and 2008 (OECD Quarterly National Accounts).

OECD scales. All results are aggregated at the population level using the household weights provided with SIHC.

Tax thresholds, transfer parameters, and incomes are all adjusted in nominal terms to 2007/08 values using a common uprating factor. We use a wage index based on average earnings for full-time workers provided by the Australian Bureau of Statistics.[4] The index increased by 44 percent during this period. Hence, any failure of the tax thresholds or transfer parameters to maintain pace with wage growth is attributed to a policy choice. Thus, for the case of Australia, the typically slower growth in benefit payment rates relative to wage growth is attributed to a policy decision.

3.2. *Background*

The period from 1999 to 2008 was a period of strong economic growth marked by important changes in the distribution of income and in labor force participation (Greenville *et al*., 2013; Whiteford, 2013) as well as policy reforms with potentially large effects on the redistributive capacity of taxes and transfers. The net redistributive effect of taxes and transfers, as measured by the difference in the Gini indices for market and disposable incomes (i.e., income after taxes and transfers), decreased by nearly 25 percent between 1999/00 and 2007/08 (Table 1). As shown in Herault and Azpitarte (2014), this decline was steady from 1999/00 to 2007/08, the year in which the index reached its lowest level since 1994.

The overall rate of labor force participation steadily increased between 1999/00 and 2007/08, largely driven by increased participation rates among females and older workers. The data indicate that the participation rate for those aged 25 to 54 steadily increased from 80.5 percent to almost 85 percent, whereas it increased from 57 to 68 percent for those aged 55 to 59. Meanwhile, participation increased from 69 to 78 percent among females aged 45 to 54.

Important policy reforms were implemented during this period. With regard to the income tax, the various reforms led to a substantial reduction in income tax rates and to an increase in the top tax thresholds, which affected the total amount of taxes paid and its distribution by income groups (see Herault and Azpitarte, 2014, for details). Furthermore, various tax offsets, such as the Low-Income Tax Offset, were extended to protect low-income families from potential bracket-creeping resulting from the reduction in real terms of the tax-free threshold (see Appendix Table C.1).

Welfare benefits were also subject to important reforms. This period witnessed the implementation of policy reforms that clearly aimed to reduce welfare dependency and to promote self-reliance through paid work (Goodger and Larose, 1999; Australian Senate, 2012). The Australians Working Together package of 2003 and the 2006 Welfare to Work reform introduced policy initiatives to increase the conditionality of welfare payments and to strengthen the incentives to work, which likely contributed to the rise in participation rates observed during the period.

[4]See the Australian Bureau of Statistics (cat. no. 6302.0, table 3, series ID A2734023X).

TABLE 1
INCOME DISTRIBUTION AND REDISTRIBUTION MEASURES 1999/00 AND 2007/08

	1999/00	2007/08	Percentage Change
Gini (market income)	0.507	0.471	–7.1
Gini (disposable income)	0.285	0.304	6.5
Redistributive effect (RE)*	0.221	0.167	–24.5
Tax progressivity (PG)	0.256	0.237	–7.2
Transfer regressivity (RG)	1.124	1.086	–3.4
Average tax rate	0.232	0.209	–10.0
Average transfer rate	0.151	0.110	–27.1
Disposable income percentile ratios			
P90/P10	3.40	3.86	13.5
P90/P50	2.02	1.94	–4.2
P50/P10	1.68	1.99	18.5

Note: *RE is the Gini coefficient of market income minus the Gini coefficient of disposable income.

Source: Authors' calculations based on MITTS and SIHC data.

However, the extent to which these policy reforms contributed to the decline in the net redistributive effect of taxes and transfers remains unclear. We use the new decomposition technique presented above to address this question and to explain the changes in income distribution.

Table 1 presents summary statistics on the distribution of income and estimates of standard redistributive measures. The period from 1999/00 to 2007/08 was marked by a reduction in market income inequality as measured by the Gini coefficient and an increase in disposable income inequality. The income percentile ratios suggest that disposable income inequality increased partly because those at the bottom of the distribution failed to maintain pace with those near the middle. While income differences in the upper part of the distribution were slightly reduced, differences at the lower end significantly widened as the poorest percentiles fell further behind the median. The decline in the redistributive effect of income taxes and transfers was particularly pronounced, decreasing by nearly 25 percent from 0.22 to 0.16.

Table 1 also presents estimates of the size and progressivity of taxes and transfers as well as the net redistributive effect. This can be decomposed into the progressivity (or regressivity) index and the average rates of taxes and benefits (Lambert, 1985). Larger values of the progressivity (or regressivity) measures and of the average rates contribute positively to the net redistributive effect. Tax progressivity is measured by the disproportionality index introduced by Kakwani (1977), which is equal to the concentration coefficient of income taxes minus the Gini coefficient of pre-tax income (i.e., market income plus transfers). Lambert (1985) shows that in contrast to the measures of the redistributive effect, the Kakwani progressivity index does not satisfactorily extend to net taxes (defined as transfers received minus taxes paid), as it does not satisfactorily account for a combination of positive, negative, and zero values. The regressivity of transfers is measured using the index proposed by Lambert (2001, p. 270) and is defined as the difference between the Gini coefficient of market income and the concentration coefficient of benefit payments. The more transfers are targeted to low-income individuals, the more regressive they are.

Between 1999/00 and 2007/08, Australia witnessed a reduction in the average tax rate, which is defined as the income tax as a proportion of pre-tax income. Taxes also became less progressive. Similarly, average benefit payments declined sharply (even faster than the average tax rate) and became slightly less regressive. The next section examines the extent to which these changes can be accounted for by tax-transfer policy reforms, by labor supply responses to these reforms, and by other factors.

3.3. *Decomposition Analysis*

Table 2 presents the decomposition of the changes in the Gini coefficients of market and disposable incomes, the progressivity and redistributive measures, and the average tax and transfer rates. Interestingly, the results indicate that the observed decline in tax progressivity did not result from changes in the tax-transfer system between 1999/00 and 2007/08. On the contrary, these changes were progressive and contributed to limiting the decline in tax progressivity, which would have been substantially larger if the tax-transfer system had remained unchanged. Indeed, when we control for changes in the distribution of market income, the tax-transfer system in 2007/08 exhibits a higher level of tax progressivity than the 1999/00 system.

The results suggest that changes in market income contributed to the decline in the progressivity of the income tax. In particular, we find that this decline is largely accounted for by the employment changes that occurred during the period. Labor supply responses to tax-transfer policy reforms represent only a small proportion of these employment changes. In total, all of the changes in employment, which primarily consisted of increases in employment rates, accounted for more than 84 percent (20 plus 64.1) of the observed reduction in tax progressivity. The rise in employment led to an increase in the proportion of taxpayers in the population, which in turn reduced the concentration of income taxes.

Tax-transfer policy changes are clearly the main contributor to the great decline in the average tax rate. Policy reforms alone contributed to a reduction in the average tax rate in the order of four percentage points (or twice the size of the observed reduction). Appendix Table C.1, which presents the income tax schedules for both years, clearly shows that income tax rates were substantially reduced during the period, while the top three tax thresholds increased, leading to a lower average tax rate. This trend was reinforced by the extension of various tax offsets (e.g., the Low-Income Tax Offset) designed to ensure that low-income households would be protected from potential bracket-creeping occurring as a result of the reduction in real terms of the tax-free threshold.

The small reduction in transfer regressivity is largely attributable to changes in transfer policies over the period. However, the primary change with respect to transfers concerns their overall level, which decreased by more than 27 percent (or 4.1 percentage points as a share of market income). The decomposition shows that tax and transfer policy changes alone would have led to an increase in the average transfer rate, equivalent (in size) to one-third of the observed reduction. However, these policy effects were more than offset by other changes affecting the

TABLE 2

Decomposition of Changes in Income Distribution and Redistribution between 1999/00 and 2007/08

	Tax Progressivity (PG)	Transfer Regressivity (RG)	Average Tax Rate	Average Transfer Rate	Redistributive Effect (RE)	Gini		Disposable Income Percentile Ratios		
						Market Income	Disposable Income	P90/P10	P90/P50	P50/P10
1999/00 base value	0.256	1.124	0.232	0.151	0.221	0.507	0.285	3.40	2.02	1.68
1999/00 to 2007/08 change										
Relative (in percent of base value)	−7.2	−3.4	−10.0	−27.1	−24.5	−7.1	6.5	13.5	−4.2	18.5
Absolute	−0.018	−0.038	−0.023	−0.041	−0.055	−0.036	0.019	0.460	−0.085	0.310
Contributions to historical changes (in percent)										
T	−86.9	136.6	208.1	−33.7	16.9	0.0	49.6	46.2	22.4	40.1
TLS	20.0	−0.5	−6.5	17.0	11.5	23.1	−11.0	−3.0	12.9	0.9
E	64.1	−5.6	−16.5	41.2	29.0	53.6	−18.8	−1.6	57.3	13.3
O	102.8	−30.6	−85.1	75.5	42.6	23.3	80.1	58.4	7.5	45.7
Total	100	100	100	100	100	100	100	100	100	100

Notes: T: tax and transfer policy changes; TLS: labor supply responses to changes in the tax and transfer system; E: other employment changes; O: all other population changes. RE is the Gini coefficient of market income minus the Gini coefficient of disposable income.

Source: Authors' calculations based on MITTS and SIHC data.

distribution of market income. In particular, employment changes accounted for most of the observed reduction in average transfer rates.

The increase in labor force participation during this period reduced reliance on the income support system as a source of income. Some of this greater self-reliance through paid work is directly attributable to the changes in the financial incentives built into the new tax-transfer system. The results in Table 2 show that this factor accounts for 17 percent of the observed decline in the average transfer rate.

However, most of the reduction in the average transfer rate attributable to employment changes results from other factors, which accounted for 41.2 percent of the observed change. Likely high on the list of these potential factors is the increased reliance of the transfer system on activity-tested payments. The precise effect of this type of reform is difficult to measure and is not included in the TLS component of the decomposition, as it does not directly alter financial incentives.

The decomposition of changes in the redistributive effect of the tax-transfer system is a reflection of the results discussed above and reflects changes in the distribution of market income during this period. The results show that more than three-quarters of the observed reduction in market income inequality is accounted for by changes in employment, approximately one-third of which is attributed to labor supply responses to tax-transfer policy reforms. In other words, the increase in employment rates over the period, which was partially driven by changes in the tax-transfer system, largely explains the observed reduction in market income inequality.

However, the decline in the average tax and transfer rates, in the progressivity of taxes, and in the regressivity of transfers prevented this reduction in market income inequality from translating into a reduction in disposable income inequality, which actually increased. Indeed, the decomposition of changes in income percentile ratios shows that tax-transfer reforms largely explain why the incomes of those at the bottom of the distribution failed to maintain pace with the incomes of other segments of the population.

Overall, the observed decline in the redistributive effect of the tax-transfer system is attributable for one-sixth to tax-transfer policy changes, 11.5 percent to the labor supply responses to these changes, 29 percent to other changes in employment, and 42.6 percent to other population changes. This last term encompasses all factors apart from those resulting from employment changes and the direct effect of tax-transfer policy reforms. The next section explores the effects of some of these potential factors.

3.4. *Additional Decompositions: An Exploration of Other Factors*

The size of the residual component in the decomposition results presented in Table 2 indicates that a non-negligible proportion of the changes in the distribution and redistribution of income is explained by factors not explicitly considered in the decomposition. The aim of this section is to exploit the flexibility of our approach to explore how some of the factors that are not considered in Table 2 may have affected the distribution and redistribution of income.

We follow the same approach as described in Section 2, but we now consider other potential sources of variation beyond employment changes. We thus conduct a new series of decompositions in which the contribution of policy reforms (T) and labor supply responses (TLS) remain unchanged and equal to the values reported in Table 2, while the third component (denoted as E above) and the residual term (O) are altered. In particular, we assess the contribution of changes in the distribution of age and education (of the income unit head) and changes in the distribution of the population by income unit type (i.e., couple, couple with children, single, single with children) and income unit size. We also examine the role of changes in wage and capital income distributions. For wages, we distinguish 20 groups according to the real wage rate level of the income unit head for those in work. For capital income, we classify income units according to the level of capital income per adult equivalent into 21 groups: units with negative capital income, units with no capital income, and 19 groups according to the level of capital income (in 2007 dollars) for units with positive capital income.

We quantify the contribution of each of these factors by performing separate decompositions in which changes in the distribution of each factor are considered on an individual basis. For each factor, we derive counterfactual distributions conditional on the employment distribution to exclude changes already accounted for in the employment contributions reported in Table 2.[5] Table 3 presents the results of these decompositions. For each decomposition, we report only the new component (computed rather than (E) in Table 2) pertaining to the variable of interest.[6]

Although changes in demographics contributed to the observed changes in income distribution and redistribution measures (amplifying or mitigating the observed trends), their contributions were limited compared with the effects of tax-transfer policies and employment changes presented in Table 2.

We note that changes in the age distribution, particularly the ageing of the Australian population under the period of analysis, contributed to mitigating the observed decline in both tax progressivity and transfer regressivity. A plausible explanation is that retirees tend to pay less tax and tend to receive larger transfers, particularly in the form of pensions, compared with other age groups.

Another interesting finding is that changes in the population distribution by income unit type and size contributed to an increase in the level of transfer regressivity. Both the share of couples and singles with children and the average income unit size decreased between 1999/00 and 2007/08. Given that large income units, especially those with children, tend to be the primary recipients of transfers, a reduction in the sizes of these population subgroups can increase the concentration of transfers.

[5]As it provides descriptive evidence but not causal evidence, a known limitation of the approach based on semi-parametric counterfactual distributions is that it does not clearly distinguish the respective contributions of changes in the different variables that we consider here. For example, by conditioning on employment when considering changes in the age distribution, we neutralize the potential effect of age on employment (which is subsumed in the employment changes in Table 2). See Huber (2014) for a detailed discussion of the limitations of this type of counterfactual decomposition.

[6]Estimates of the term (O) are not reported in Table 3 but are available upon request. Such estimates can also be obtained by computing the difference between (O) + (E) in Table 2 and the term reported in Table 3 for each new decomposition.

TABLE 3

ADDITIONAL DECOMPOSITION RESULTS

	Tax Progressivity (PG)	Transfer Regressivity (RG)	Average Tax Rate	Average Transfer Rate	Redistributive Effect (RE)[b]	Gini		Disposable Income Percentile Ratios		
						Market Income	Disposable Income	P90/P10	P90/P50	P50/P10
1999/00 base value	0.256	1.124	0.232	0.151	0.221	0.507	0.285	3.40	2.02	1.68
1999/00 to 2007/08 change										
Relative (in percent of base value)	−7.2	−3.4	−10.0	−27.1	−24.5	−7.1	6.5	13.5	−4.2	18.5
Absolute	−0.018	−0.038	−0.023	−0.041	−0.055	−0.036	0.019	0.460	−0.085	0.310
Contributions to historical changes (in percent)[a]										
Changes in the age distribution	−9.8	−8.2	1.0	−3.4	−3.7	−11.2	10.9	5.0	−10.0	1.2
Changes in education attainment	3.5	−1.3	−4.8	−2.3	−2.0	−8.9	11.3	5.7	−3.7	3.4
Changes in the distribution of the population by income unit type and size	4.1	−11.7	0.6	5.1	2.8	−0.2	8.4	7.8	3.5	6.8
Changes in the wage distribution	12.1	−14.8	−16.4	5.6	0.6	−9.1	19.5	10.8	13.1	11.3
Change in the capital income distribution	−17.8	−20.5	−32.0	19.7	3.8	−17.3	44.9	6.2	−26.6	−2.1

Notes: [a]Contrary to the results presented in Table 2, the contributions do not sum to 100 percent, as they are each derived from a different decomposition in which the contributions of T and TLS remain unchanged and equal to the values reported in Table 2. Each row of the lower panel of Table 3 is a new version of row E in Table 2 derived from a new decomposition.

[b]RE is the Gini coefficient of market income minus the Gini coefficient of disposable income.

Source: Authors' calculations based on MITTS and SIHC data.

Table 3 also shows that changes in wage dispersion led to an increase in both market and disposable income inequality. This finding relates to an observed shift away from the bottom wage brackets to the middle wage brackets in addition to growth in the proportion of income units in the top wage bracket. This result is consistent with the increase in wage inequality documented by Coelli and Borland (2014). This trend also contributed to an increase in the average tax rate and a reduction in tax progressivity.

Changes in the distribution of capital income appear to have led to substantial changes in income distribution. These changes contributed to increasing both market and disposable income inequality. The most important change in the distribution of capital income between 1999/00 and 2007/08 is an increase in the share of tax units reporting positive capital income. However, this trend may be partially driven by an improved ability to capture capital incomes in the 2007/08 survey compared with the 1999/00 survey (Wilkins, 2014).

4. Conclusions

Tax-transfer policies are crucial in determining the distribution and redistribution of income. The primary difficulty in assessing the role of these policies lies in the endogeneity of the market income distribution with respect to the tax-transfer system. Furthermore, measures of progressivity and redistributive effects of the tax-transfer system themselves depend on the distribution of market income. The two existing approaches of Kasten *et al.* (1994) and Dardanoni and Lambert (2002) are useful for assessing the evolution of progressivity and redistributive measures over time or for making cross-country comparisons; however, these methods do not explicitly recognize the role of employment decisions or the influence of tax policies on these decisions and the implications for market income distribution.

The aim of this paper is to present a new approach that enables an additive decomposition of the observed changes in income distribution and redistribution measures while fully accounting for and measuring the effect of concomitant changes in employment and their consequences in terms of market income distribution. Furthermore, we introduce a distinction between employment changes driven directly by labor supply responses to tax-transfer reforms and other employment changes. This distinction relies on combining the method developed by Bargain (2012) with the use of counterfactual decomposition techniques proposed in DiNardo *et al.* (1996) and Bover (2010) to generate counterfactual distributions. Furthermore, the flexibility of the approach enables it to be used to explore not only the role of employment changes but also the role of changes in the distributions of a wide range of population characteristics. Like previous approaches, however, the new approach ignores behavioral responses (other than labor supply responses) to tax-transfer policy reforms, such as changes in tax evasion or tax avoidance behaviors.

The application of this decomposition approach to Australia over the 1999–2008 period represents the first attempt to describe and understand recent changes in the progressivity and redistributive effects of income taxes and cash transfers in this country. The decomposition indicates that employment changes played an

important role in reducing market income inequality. This period was also marked by a reduction in tax progressivity and in the redistributive effect of the tax-transfer system, which are reflected in the increased inequality in disposable income. The decomposition shows that tax-transfer reforms accounted for half of the observed increase in disposable income inequality, despite the finding that tax reforms actually helped to limit the reduction in tax progressivity. The reductions in tax progressivity and in the redistributive effect of the tax-transfer system were found to be largely explained by employment changes, some of which were attributable to labor supply responses to tax-transfer reforms. These results demonstrate the importance of considering employment changes in the analysis of the redistributive effects of tax and transfer systems.

We exploit the flexibility of the decomposition approach to investigate other potential contributing factors of the observed changes in income distribution and redistribution. We find that although ageing, increased educational attainment, and changes in income unit structures all played a role, their contributions were limited compared with the effects of tax-transfer reforms and labor supply changes. The results suggest that compared with other factors, the increased dispersion of wages and capital incomes played a more substantial role by increasing both market and disposable income inequality.

Finally, although the application presented in this paper draws from a behavioral microsimulation model, the approach can also be applied using a simple tax-benefit calculator. In this case, the approach cannot distinguish between the contributions of labor supply changes driven by tax-transfer policy reforms and other employment changes. However, the primary effect (i.e., in the absence of behavioral responses) of tax policy reforms can still be identified. Moreover, the role of various determinants, such as ageing or changes in household structure, can be assessed in the same manner that is illustrated in this paper.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix A: The Derivation of Counterfactual Distributions
Appendix B: The Melbourne Institute Tax and Transfer Simulator (MITTS)
Table B.1: Taxes and benefits in MITTS
Appendix C: Income Tax Schedules
Table C.1: Income tax schedules 1999/00 and 2007/08