The Effects of Flattening the Effective Marginal Rate Structure in Australia: Policy Simulations Using the Melbourne Institute Tax and Transfer Simulator *

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Abstract

This paper uses the Melbourne Institute Tax and Transfer Simulator (MITTS) to examine the effects of a reduction in the means-tested benefit taper, or withdrawal, rates in Australia to 30 per cent. That is, all taper rates of 50 per cent and 70 per cent in the 1998 system are reduced to 30 per cent, while leaving all basic benefit levels unchanged. This change is therefore expected to 'flatten' the tax structure by reducing the high marginal tax rates applying to those with relatively low incomes and increasing the marginal tax rates of medium incomes. Simulations in which all individuals are assumed to have an unchanged labour supply (using MITTS-A) are compared with behavioural simulations in which the majority of individuals are free to adjust the number of hours worked (using MITTS-B). The results reflect only the supply side of the labour market. The database used is the 1997 Income Distribution Survey (IDS), so that weekly incomes are based on the financial year 1997-98.

1 Introduction

This paper presents simulation results concerning the effect of a reduction in the Australian means-tested benefit taper (or withdrawal) rates to 30 per cent. Thus, all taper rates of 50 per cent and 70 per cent in the 1998 system are reduced to 30 per cent, while leaving all basic benefit levels unchanged. This change is expected to 'flatten' the tax structure to some extent by reducing the high marginal tax rates applying to those with relatively low incomes. Other individuals experience an increase in their effective marginal tax rate. The policy simulation was carried out using the Melbourne Institute Tax and Transfer Simulator (MITTS). Simulations in which all individuals have fixed labour supply (using MITTS-A) are compared with behavioural simulations in which the majority of individuals are free to adjust the number of hours worked (using MITTS-B). The results reflect only the supply side of the labour market, and a discrete hours framework is used in which individuals can move between specified discrete hours levels, rather than being able to vary hours continuously.

The cross-sectional database used is the 1997 Income Distribution Survey (IDS), so that weekly incomes are based on the financial year 1997-98. This is the most recent year for which IDS data are available. Furthermore, the econometric estimates of preferences underlying the behavioural responses were estimated for this period. Examples are provided of the implications for aggregate tax revenue and expenditure, and the effects on individuals and households, of hypothetical changes to the tax and transfer system operating in March 1998.[1] Revenues and expenditures are expressed in 1998 dollars.

The MITTS model consists of two parts, referred to as MITTS-A and MITTS-B.[2] MITTS-A provides the component in which the 'impact' effects of policy changes are calculated by implementing the necessary changes to the tax and benefit system. The income components for each individual are then calculated using the system before and after the policy change, assuming that each individual's labour supply does not change as a result of the policy change.

[1] Pre-reform benefits and taxes are based on the MITTS calculation of entitlements, not the actual receipt. Hence it is assumed that the take-up rates are 100 per cent. Furthermore, MITTS only applies income tests, as there is at present no asset imputation in the model.
[2] For a detailed description of MITTS, see Creedy and Duncan (2000).

The IDS distinguishes three types of unit: household, income unit and individual. MITTS can carry out a range of analyses using each of these as the unit of analysis. For example, in Section 2.3 on the distribution of income, information on the equivalised household income is used at the individual level. This means that sharing of income within a household is assumed, but when counting the proportion in poverty, for example, each individual is counted rather than each household. Depending on the average size of households in and out of poverty these approaches may result in different outcomes.

Section 2 discusses the results of the policy change, assuming no changes in labour supply. The potential changes in labour supply behaviour are taken into account in Section 3. Section 4 concludes.

2 The Non-behavioural Simulation Results

The policy change is one in which the free area of income remains as in March 1998, but the withdrawal rates for the different levels of income in excess of the free area (which are either 70 per cent or 50 per cent) are reduced to 30 per cent. The only exception is the withdrawal rate on parental income for people receiving Youth Allowance and AUSTUDY, which remains at 25 per cent.

Subsection 2.1 studies the effect at the individual level, for several types of household. Subsection 2.2 reports marginal effective tax rates by age. Subsection 2.3 compares the effects on different groups and on the distribution of income over the population. The aggregate effects on government income and expenditure are examined in Subsection 2.4.

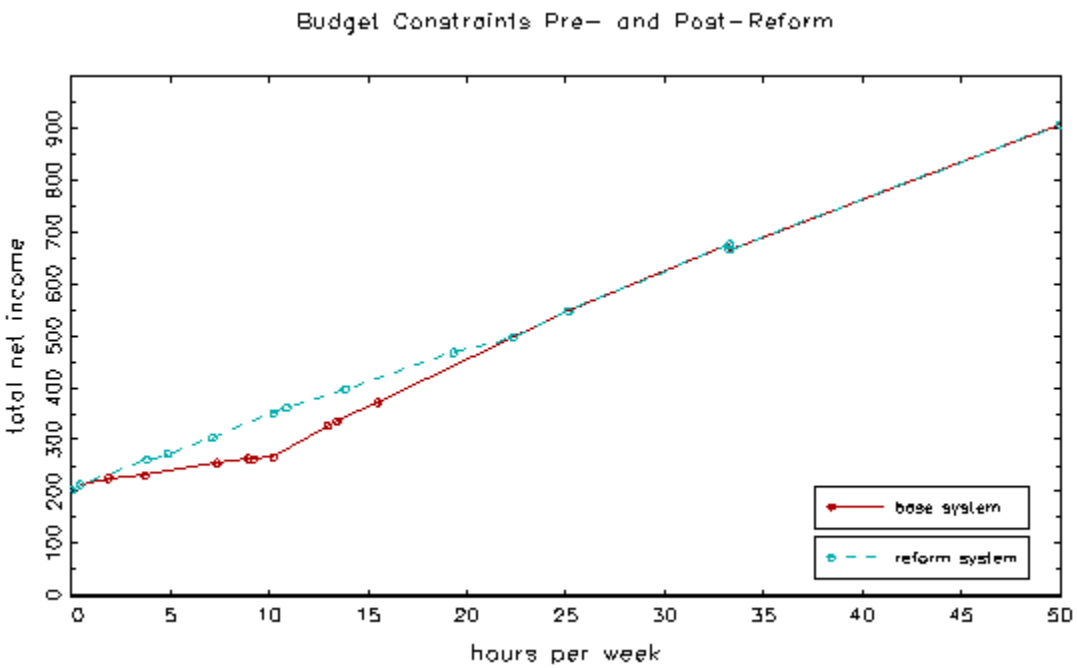
2.1 Effects on individual budget constraints

This decrease in the withdrawal rate has a large effect on the cut-off point below which people are eligible for benefit payments. For example, the cut-off weekly income for age pensioners before the change is $410 for singles and $685 for couples. With the decrease in the taper rate these increase to $650 and $1083. The change in cut-off points is even larger for people on unemployment benefits like NewStart Allowance, who face taper rates of 70

per cent for incomes over $70 per week before the change (instead of the 50 per cent withdrawal rate pensioners face). The result of the increased cut-off points is that people on higher incomes also become eligible for benefits. Under the assumption of full take-up, the number of welfare participants increases.

It is useful to consider the effects on individual budget constraints. First, consider a non-working single person, paying $70 in rent and having an imputed wage of $28.39 per hour. The net income of this person is graphed in Figure 1 for all hours of labour supply between 0 and 50 hours per week. This shows that the decrease in the taper rate substantially increases the net income in the part-time hours range. The reform results in higher net income when the individual works between about 1 and 23 hours per week. For people on lower wage rates this hours range is wider.

Figure 1 Single person



Comparing the marginal effective tax rates in the two systems, it is clear that from about 1 to 11 hours of labour supply the marginal effective tax rates are lower than in the March 1998 system, possibly providing positive work incentives (depending on the increase in the level of the budget constraint at that point). However, the marginal effective tax rates are higher from about 11 to 23 hours of employment (resulting from the extended

eligibility for benefits with the associated withdrawal rate), making work less attractive in this hours range. Thus low part-time working hours is expected to become more appealing and the higher levels of part-time working hours may become relatively less attractive.

For a couple with four children, where the head works 15 hours at a gross wage of $11, while the partner does not work and has an imputed wage of $14.26, the constraints are shown in Figures 2 and 3. In these cases, with low wage rates, the change in the constraint is dominated by reductions in marginal effective tax rates. For both members of the couple net income is higher after the reform for labour supply over 5 hours per week for the head (given that the spouse is not working) and for the full labour supply range of the spouse (given that the head works 15 hours). Basically, they are better off after the reform if either of them works at least 5 hours. METRs are lower over nearly the full labour supply range, providing a work incentive for both partners.

Figure 2 Couple with 4 dependent children (head)

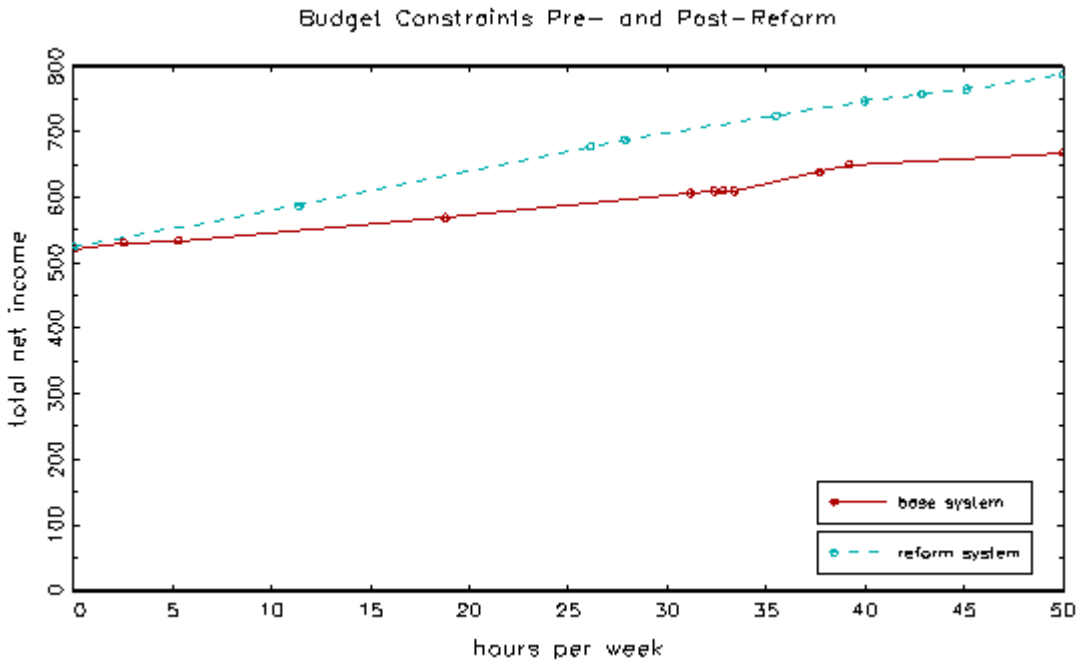
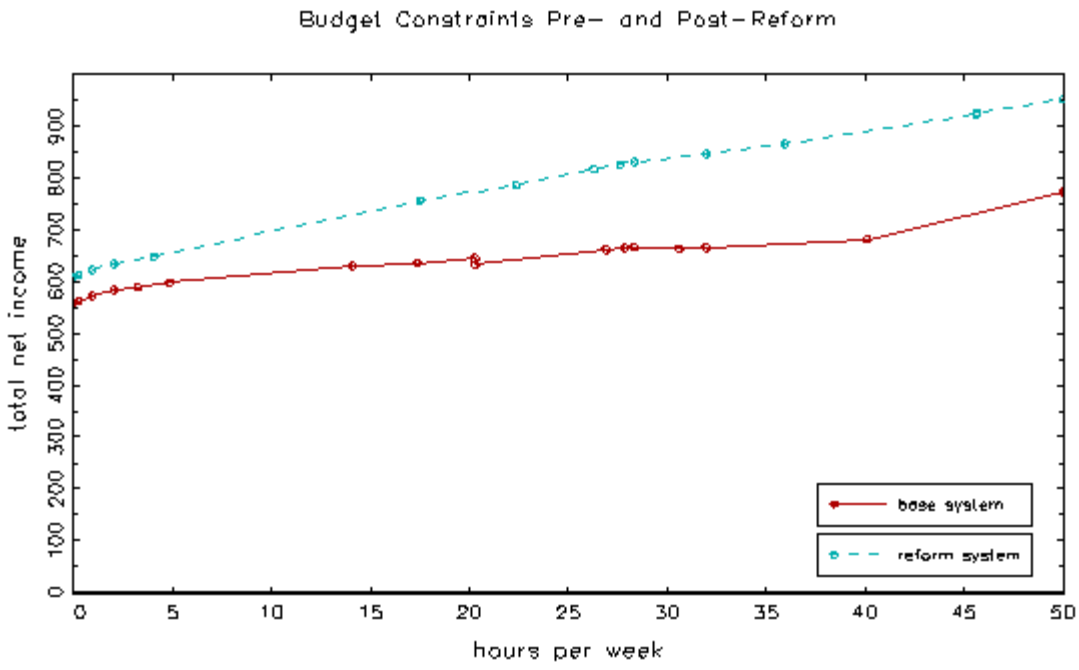


Figure 3 Couple with 4 dependent children (spouse)



2.2 Distribution of effective marginal tax rates

The extent of changes in effective marginal rates in the complete IDS survey, computed at observed hours of work, are shown by the two sets of distributions displayed in Tables 1 and 2. These tables show the weighted distribution of marginal effective rates for income unit heads for a range of age groups.

Table 1 Distribution of METRs under March 1998 system, by age (row percentages)[a]

Age	<0	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Average	Count
15 to 19	69	0	8	7	7	0	0	1	4	0	2	-	12.87	1244
20 to 24	26	-	4	9	40	6	0	2	4	4	3	1	33.81	1139
25 to 29	20	-	1	4	43	23	0	2	2	2	2	0	35.07	1034
30 to 34	19	-	2	4	28	33	-	2	3	5	2	2	40.24	894
35 to 39	17	0	1	4	27	36	0	2	4	5	2	1	39.94	909
40 to 44	15	-	2	3	27	38	0	3	5	4	2	2	42.14	824
45 to 49	14	-	2	5	27	39	0	4	3	3	2	0	39.66	774
50 to 54	20	-	2	5	27	37	0	1	4	2	1	0	36.67	695
55 to 59	28	-	3	6	24	28	1	2	5	3	2	-	33.07	546
60 to 64	41	0	3	5	14	14	2	5	8	4	4	0	31.66	474
65 plus	66	0	1	1	5	7	1	14	5	1	0	-	19.94	1598
All	34.19	0.03	2.59	4.67	23.45	21.10	0.52	3.95	4.13	2.84	1.92	0.62	31.48	-
Count	3464	3	262	473	2375	2138	52	400	418	287	194	62	-	10131

Note a: - denotes empty cells, whereas 0 denotes cells with less than 0.5 per cent of the observations for the relevant category.

Table 2 Distribution of METRs after reform, by age (row percentages)[a]

	<0	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Average	Count
15 to 19	69	0	7	4	4	10	5	0	-	-	-	-	11.68	1244
20 to 24	26	-	4	4	11	15	35	5	0	-	-	-	35.53	1139
25 to 29	20	-	0	2	16	26	27	8	1	-	-	-	38.89	1034
30 to 34	19	-	1	3	11	35	22	8	1	0	-	0	41.43	894
35 to 39	18	0	1	2	10	37	22	8	2	0	-	0	41.42	909
40 to 44	16	-	1	4	11	41	20	6	1	0	-	0	41.33	824
45 to 49	14	-	0	3	10	45	20	6	1	-	-	-	41.15	774
50 to 54	20	-	1	2	9	41	19	6	1	-	-	-	39.02	695
55 to 59	28	-	2	4	7	35	18	6	0	-	-	-	35.03	546
60 to 64	41	0	2	6	4	21	18	8	0	0	-	-	28.61	474
65 plus	66	0	1	3	2	4	20	5	0	-	-	-	17.57	1598
All	34.27	0.04	1.99	3.29	8.37	25.07	20.49	5.74	0.67	0.04	-	0.02	31.95	-
Count	3472	4	201	333	848	2540	2076	581	67	4	-	3	-	10131

Note a: - denotes empty cells, whereas 0 denotes cells with less than 0.5 per cent of the observations for the relevant category.

Comparing the pre- and post-reform tax rates, the table shows that the average METR increases slightly as a result of the change, largely arising from the increase in the number of individuals facing rates in between 40 and 60 per cent. The change in average METR differs by age. The youngest and the older age groups have lower METRs, reflecting the lower labour force participation and perhaps also the lower average wage rates in these categories. In both systems, people aged 30 to 49 have the highest METR, reflecting the higher average earnings in this age group.

The distribution of marginal effective tax rates for various other characteristics are shown in Table 3 for the March 1998 system. The distributions for the reform system are not shown because, like for those by age, the differences in average METRs are small. The effects are as expected, for example, employed people have higher METRs than unemployed individuals or non-participants, whereas dependent children have low METRs compared to other groups.

These tables of marginal effective tax rates demonstrate that some individuals are observed to be working a number of hours such that they are facing very high effective marginal rates. One explanation for this is that in practice people may not be claiming all the benefits to which they are entitled, especially if the benefits are small, so that their actual METR is not so large as it seems from the calculations. An alternative explanation is that people are in practice restricted in their labour supply choice. This observation may

support the discrete hours approach used by MITTS-B. If people are actually at those hours levels, which give them marginal rates of 100 per cent or more, this could not be explained in a continuous hours labour supply framework. Such points could not be the optimal points in the model, since the indifference curves cannot be flat. However, in a discrete hours approach such labour supply points can be the optimal points, because if people are not free to vary their hours continuously they have to pick the best discrete choice available.

Table 3 Distribution of METRs under March 1998 system by number of children, employment status and income unit type (row percentages)[a]

	<0	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Average	Count
Number of children														
None	32	0	2	5	27	18	1	5	4	2	3	0	32.26	6532
One	37	-	4	4	19	26	0	3	3	2	0	1	28.60	1308
Two	35	0	4	3	17	29	0	2	4	4	0	1	32.36	1403
Three	42	-	3	3	14	25	1	1	4	6	1	1	29.83	648
Four	45	-	2	2	15	19	-	2	7	5	1	-	28.33	160
Five	72	-	1	-	6	5	-	4	7	4	1	-	17.31	50
Six	68	3	-	-	6	-	-	-	4	19	-	-	20.92	31
Employment status														
employed	8	0	3	7	37	32	1	2	5	4	1	1	42.29	6237
non-participation	74	0	1	2	3	4	1	7	3	1	4	0	16.25	3236
unemployed	91	-	2	3	0	1	-	2	0	1	-	-	3.83	658
Income unit type														
Couple	27	0	2	4	23	27	2	6	5	2	2	0	35.16	2216
couple&dep.child	12	0	1	4	26	41	0	2	6	5	1	2	43.83	2068
Dep. kid	83	0	10	3	2	1	1	0	0	-	-	-	4.34	1015
Single	34	0	2	6	30	14	0	4	4	2	3	0	30.77	4315
Sole parent	56	-	0	0	7	17	0	9	2	4	1	2	25.43	517

Note a: - denotes empty cells, whereas 0 denotes cells with less than 0.5 per cent of the observations for the relevant category.

2.3 Income effects for different groups

It is expected that a change in the benefit withdrawal rate has the largest effect on people who are working and earning a low-to-medium income. Weighted distributions of net income changes are shown in Table 4 for various groups. People of prime working age have the largest average change and people aged 15-19 and over 65 have on average the smallest income changes. The results indicate that there is either no change (in the majority of cases) or there is a greater than $10 increase in weekly equivalised net household income

of individuals. The income gain is highest for those who are employed and for couples with dependent children.

Table 4 Income Gainers/Losers by number of children, age, employment status and income unit type (row percentages)[a]

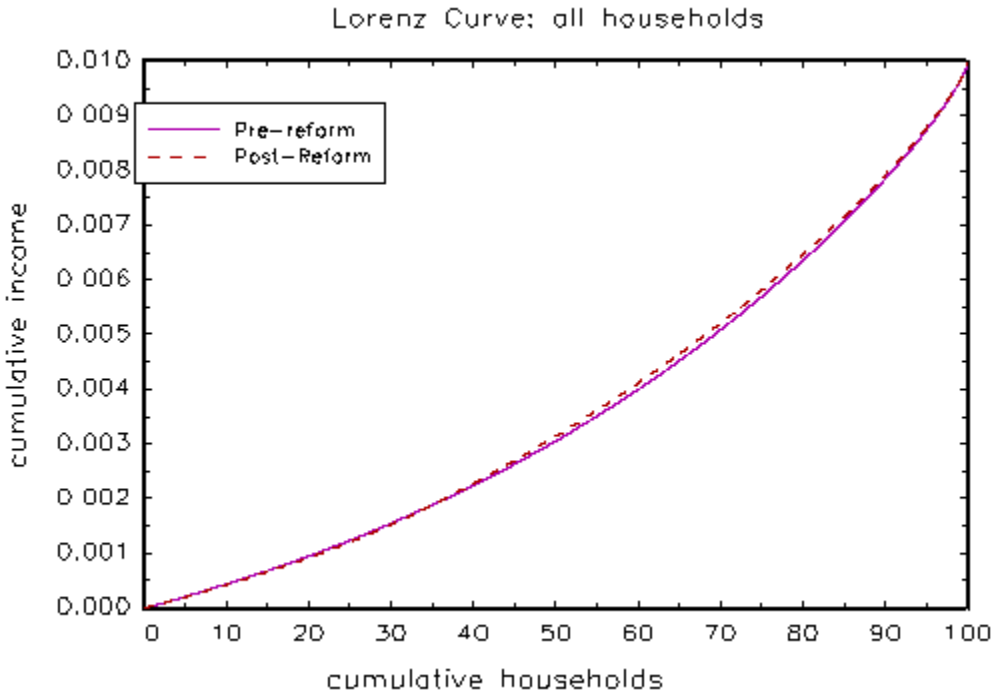
Individual level per capita equivalised household income									
	Decrease in $				Increase in $				
	<10	5-10	1-5	none	1-5	5-10	>10	Average	Count
Number of children									
None	-	-	-	59.4	3.0	3.3	34.3	17.40	8748.02
One	-	-	-	63.2	1.2	0.6	35.0	27.82	2016.06
Two	-	-	-	62.8	1.1	1.8	34.3	33.51	2257.11
Three	-	-	-	60.7	1.4	1.5	36.4	40.65	1021.91
Four	-	-	-	65.4	2.5	0.6	31.5	32.25	254.76
Five	-	-	-	67.8	-	3.0	29.2	36.38	72.62
Six	-	-	-	59.8	-	-	40.2	38.97	44.57
Age									
15 to 19	-	-	-	84.5	1.0	1.0	13.5	5.76	1259.98
20 to 24	-	-	-	49.6	2.5	3.5	44.4	20.61	1325.85
25 to 29	-	-	-	55.9	2.6	2.6	39.0	25.74	1434.36
30 to 34	-	-	-	58.5	1.8	1.8	38.0	32.75	1400.63
35 to 39	-	-	-	57.2	1.9	2.3	38.6	36.19	1473.86
40 to 44	-	-	-	59.3	2.0	1.8	37.0	32.37	1384.54
45 to 49	-	-	-	56.4	2.4	3.2	38.1	28.01	1293.85
50 to 54	-	-	-	58.9	1.9	2.0	37.3	24.79	1129.86
55 to 59	-	-	-	56.2	2.2	2.2	39.4	25.68	860.52
60 to 64	-	-	-	55.0	3.9	3.5	37.6	22.96	730.22
65 plus	-	-	-	68.8	3.3	3.5	24.4	9.15	2121.37
Employment status									
Employed	-	-	-	52.8	2.5	2.8	41.9	28.71	8510.15
non-participation	-	-	-	70.7	2.1	2.3	24.9	16.12	5139.61
Unemployed	-	-	-	81.9	1.5	0.1	16.5	14.23	765.30
Income unit type									
Couple	-	-	-	57.4	2.9	2.8	36.9	22.48	4432.85
Couple&dep.child	-	-	-	52.9	1.5	1.4	44.3	43.57	4135.44
Dependent child	-	-	-	99.0	0.3	0.3	0.5	0.13	1014.61
Single	-	-	-	61.4	3.1	3.8	31.7	12.17	4315.17
Sole parent	-	-	-	70.6	1.2	2.5	25.8	10.77	516.98
Total	-	-	-	60.69	2.32	2.49	34.5	23.45	-
Count	-	-	-	8748.53	334.29	358.91	4973.32	-	14415.05

Note a: - denotes empty cells, whereas 0 denotes cells with less than 0.5 per cent of the observations for the relevant category.

The Lorenz curves of net income (unweighted) before and after the reform are shown in Figure 4. These indicate that the reform generates a slight increase in equality for the relatively higher incomes, shifting the curve somewhat closer to the 45-degree line. For the

lower income groups, there is a slight increase in inequality. The fact that the Lorenz curves intersect means that an overall judgement requires an explicit measure of inequality.

Figure 4



The Gini coefficients (based on the unweighted sample) are shown in Table 5, indicating that, within each age group, incomes are slightly more equal, except for people over 65 years of age. For these groups, where only a few people are working, inequality increases when those who work become better off, while those who are not working remain at the same income. However, if most people are working in an age category, improving the incomes of those on lower income levels decreases inequality.

A useful indication of the various aspects of poverty is provided by TIP curves, where the acronym refers to the 'three 'I's of Poverty', the 'I's being incidence, intensity and inequality. Suppose that the poverty line, below which individuals are judged to be in poverty, is y_p. Define the poverty gaps as $g(y_i|y_p) = y_p - y_i$ for $y_i < y_p$, and $g(y_i|y_p) = 0$ for $y_i > y_p$, and rank all N individuals in ascending order in terms of their net incomes, y. The TIP curve is obtained by plotting the poverty gap per person against the corresponding

proportion of people, when moving from poorest to richest. That is, plot $\frac{1}{N}\sum_{i=1}^{k} g\left(y_i \middle| y_p\right)$ against k/N for k=1,…,N. In view of the ranking from lowest to highest net incomes, the curve becomes flatter as k is increased. Clearly the curve becomes horizontal as soon as the value of k is reached for which all the remaining poverty gaps are zero. The corresponding proportion of people represents the headcount measure of poverty. The value of the corresponding total poverty gap per person, divided by the proportion of people in poverty, is the average poverty gap among the poor. The slope of the TIP curve at any point measures the poverty gap at that point.[3]

Table 5 Gini coefficients by age

	Before	After	Change
Age			
15 to 19	0.2134	0.2037	-0.0097
20 to 24	0.2312	0.2193	-0.0119
25 to 29	0.2444	0.2304	-0.0141
30 to 34	0.2682	0.2510	-0.0172
35 to 39	0.2571	0.2395	-0.0176
40 to 44	0.2674	0.2492	-0.0182
45 to 49	0.2593	0.2437	-0.0156
50 to 54	0.2681	0.2529	-0.0152
55 to 59	0.2806	0.2672	-0.0134
60 to 64	0.2828	0.2802	-0.0026
65 plus	0.2352	0.2439	0.0087
All	0.2752	0.2655	-0.0097

The question arises of how to set the poverty line in the simulations. One approach is to consider benefit levels. The Age Pension (for individuals) might be said to reflect the government's view about a poverty line. A single person's basic Age Pension rate was $180 per week in March 1998 and after adding the maximum rent assistance of about $75 to this amount, the total weekly income for a non-worker without other income is $255. By comparison, the Henderson poverty line for a working single person in March 1998 was about $242 (MIAESR, 2001).

[3] For a detailed treatment of TIP curves, see Jenkins and Lambert (1997).

Two sets of TIP curves for the March 1998 system (pre-reform) and policy 1 (post-reform) are shown in Figures 5 and 6, based on household equivalent incomes for each individual in the household. The unweighted sample is used in the calculations. The first curve uses a poverty line of $250, while the second uses a line of $200. Figure 5 shows a slight decrease in the headcount measure of poverty caused by the policy change, and a small reduction in the poverty gap per capita. However, for the lower poverty line there is a much smaller effect on poverty measures.

Figure 5 Poverty line: $250

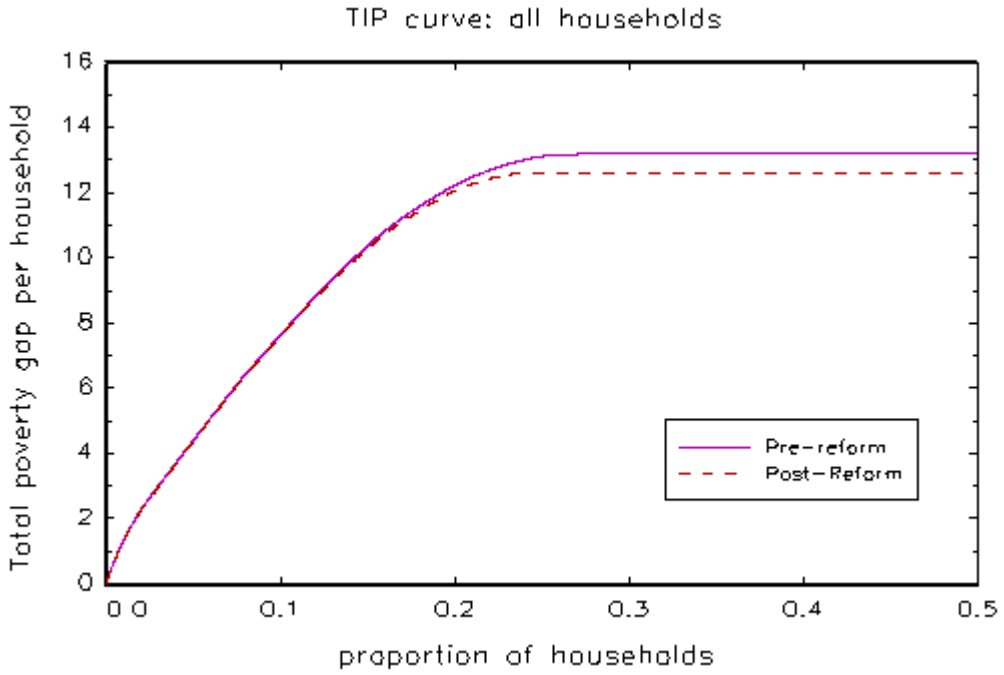
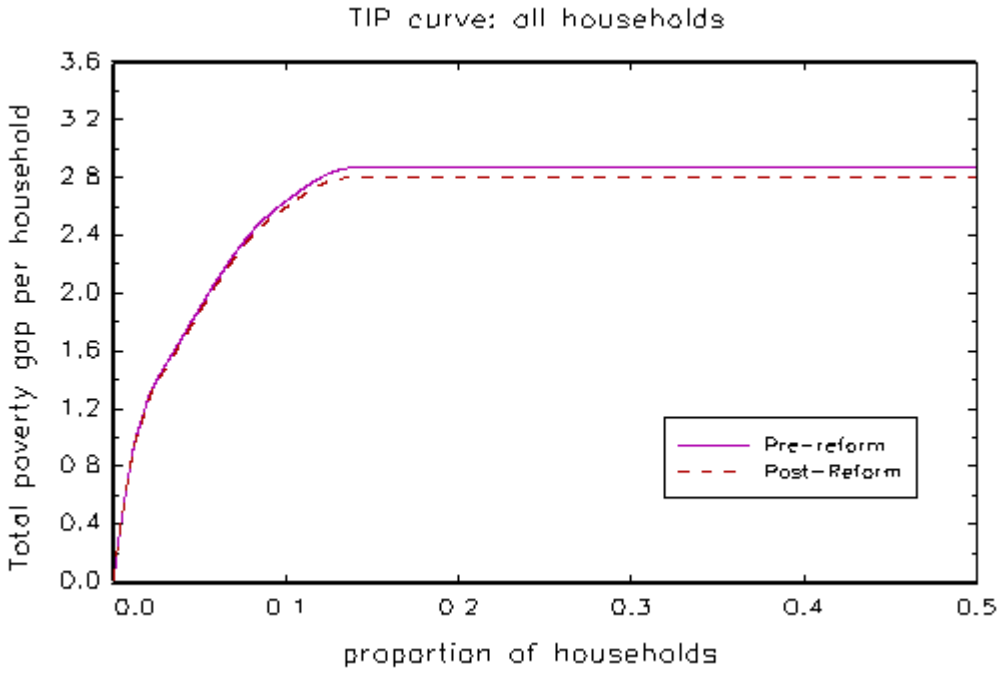


Figure 6 Poverty line: $200



2.4 Effects on government revenue and expenditure

Table 6 presents the net increase in costs resulting from the policy change, by main payment type. These values are weighted to represent the values for the Australian population. Government revenue is expected to increase but not enough to compensate for the increased payments. A large proportion of the increased cost is due to allowances. This is partly because they are the largest group of payments and partly because allowance recipients are more likely to work than pension recipients, which means they are most likely to benefit from a reduction in the taper rate. In addition, people who are currently working without receiving benefits and who would become eligible for payments after the change as a result of the higher cut-out income, would most probably become eligible for an allowance rather than a pension.

Table 7 presents a further decomposition of the different payment types and finds that Newstart Allowance, Partner Allowance and Parenting Payments contribute most to the increase in expenditure. This is because these three groups are most likely to be in work and those benefit recipients (or their partners) who work are more likely to benefit from a reduction in the taper rate. Overall, the payments associated with unemployment seem to be relatively more affected by the change than the other payments. This is supported by the

fact that the relative increase in the costs of Mature Age Allowance and Youth Allowance is large. However, in absolute terms the latter two payments contribute a small amount because the number of recipients is low for both these payments.

Table 6 Main Revenues and Expenditures

Tax or Transfer	Cost ($m)		Numbers (×1000)	
	Before reform	Change	Before reform	Change
Government revenue				
Income Tax	71910.3	1872.4	13125	2
Medicare Levy	4505.8	208.7	8366	629
Total	76416.1	2081.1		
Government expenditure				
Tax Rebates	4372.8	-593.1	9762	-235
Family Payment	6218.3	1779.3	3214	0
FTP/FTB	631.2	180.4	1641	748
Allowances	17917.7	8828.7	4022	2843
Pensions	21625.5	1190.8	3046	168
Pharm Allow	342.4	23.1	3439	284
Rent Allowance	1699.4	975.5	1567	874
Total	52807.3	12384.7		
Net expenditure	-23608.7	10303.5		

Table 6 shows that pensions constitute a small part of the change in costs. Although Age Pensioners form the largest subgroup in the pension payments and the largest relative change is for Age Pensioners (see Table 7), labour force participation amongst people who are potentially eligible for the Age Pension is still quite low. As a result there is little change after the reform.

Finally, Table 6 shows an increase of $2081 million of government revenue from income taxes and medicare levy. Rebates have decreased after the reform. The difference in the amount of total rebate, presented in Tables 6 and 7, is caused by the fact that the amount in Table 7 is the potential amount of rebate that people are eligible for, without taking into account the amount of tax paid by each individual. As a rule, the amount of rebate received can never be more than the amount of tax paid. The actual amount of rebate received can only be calculated for the sum of rebates and cannot be decomposed into the separate components. Table 7 examines the components of the potential amount of decrease in tax rebates. This shows that, in particular the dependent spouse rebate decreases considerably after the reform.

Table 7 Detailed Costs and Revenues

Tax or Transfer	Cost ($m)		Numbers (×1000)	
	Before reform	Change	Before reform	Change
Allowance Costs				
Parenting Payment (sgl)	2685.9	244.6	336	42
Parenting Payment (cpl)	2525.8	2344.2	793	331
Sickness Allowance	363.6	10.6	46	3
Widow's Allowance	680.9	291.9	103	90
AUSTUDY/ABSTUDY	3618.4	98.3	561	19
NewStart Allowance	5371.2	4593.9	901	1814
Mature Age Allowance	166.8	200.8	38	54
Youth Allowance	251.8	50.6	37	8
Special Benefit	997.8	94.1	136	18
Partner Allowance	1255.5	899.8	199	162
Pension costs				
Age Pension	13605.4	985.8	1844	138
Disability Support Pension	3900.8	83.6	483	1
Wife's Pension	723.1	30.6	103	2
Widow B Pension	366.9	3.2	41	0
Carer's Payment	190.3	1.3	23	0
Veteran Pension	1387.6	86.3	195	5
Veterans Disability Pension	471.1	0.0	75	0
War Widows Pension	980.3	0.0	98	0
Rebate Costs				
Beneficiary Rebate	685.9	125.6	1604	512
Pension Rebate	2004.0	-54.9	2087	-21
Sole parent Rebate	642.6	0.0	517	0
SP Pension Rebate	251.8	-15.0	335	-22
Low Income Rebate	1309.7	-53.1	9160	-319
Dep Spouse Rebate	1469.5	-614.7	1375	-249
Total Rebate Cost	6363.5	-612.0		

3 Behavioural Simulations Using MITTS-B

This section presents the results of MITTS-B, which allows for labour supply responses to the policy change. The basic approach used is described in Subsection 3.1. The labour supply responses are presented in Subsection 3.2, and the implications for expenditures and revenues are given in Subsection 3.3.

3.1 The basic approach

MITTS-B takes into account behavioural changes resulting from policy changes to taxes and transfers. The behavioural responses generated by MITTS-B are based on the use

of quadratic preference functions whereby the parameters are allowed to vary with an individual's characteristics. These parameters have been estimated for five demographic groups, which include married or partnered men and women, single men and women, and sole parents[4]. The framework is one in which individuals are considered constrained to select from a discrete set of hours levels, rather than being able to vary labour supply continuously. Different sets of discrete hours points are used for each demographic group.[5]

For the couples in the labour supply estimation, two sets of discrete labour supply points are used. Given that the female hours distribution is much more spread over part-time and full-time hours than the male distribution, which is mostly divided between non-participation and full-time work, women's labour supply is divided into 11 discrete points, whereas men's labour supply is represented by just three points. The couple's joint labour supply is estimated simultaneously, contrary to the popular approach in which female labour supply is estimated with the spouse's labour supply taken as exogenous.

For those individuals in the data set who are not working, and who therefore do not report a wage rate, an imputed wage is obtained. This imputed wage is based on estimated wage functions, which allow for possible selectivity bias, by first estimating probit equations for labour market participation.[6] However, some individuals are excluded from the database if their imputed wage or their observed wage (obtained by dividing total earnings by the number of hours worked) is unrealistic.[7] In total, 121 observations are discarded from the behavioural simulations for this reason.

The simulation is essentially probabilistic. That is, it does not identify a particular level of hours worked for each individual after the policy change, but generates a probability distribution over the discrete hours levels used[8]. For this reason the present version of MITTS-B does not produce distributional analyses of the effects of tax reforms

[4] Duncan and Harris (2001) give a description of the labour supply model used in MITTS for sole parents.
[5] For a survey of alternative approaches to behavioural microsimulation, see Creedy and Duncan (2001).
[6] See Creedy et al. (2001), which also describes the imputation process in which extraneous information about the industry and occupational characteristics of the unemployed is used.
[7] The rejection range is less than 4 and more than 100 dollars per hour.
[8] A multinomial logit model is used to estimate the probabilities of the discrete labour supply points.

on net incomes.[9] Some individuals, such as the self employed, the disabled, students and those over 65 have their labour supply fixed at their observed hours; the numbers of individuals in these categories are 885, 518, 640 and 1625 respectively.

The behavioural simulations begin by taking the discrete hours level for each individual that is closest to the observed hours level. Then, given the parameter estimates of the quadratic preference function (which vary according to a range of characteristics), a random draw is taken from the distribution of the 'error' term[10]. This draw is rejected if it results in an optimal hours level that differs from the discretised value observed. The accepted drawings are then used in the determination of the optimal hours level after the policy change. A total of 100 'successful draws' (that is, drawings which generate the observed hours as the optimal value under the base system for the individual) are produced.[11] This gives rise to a probability distribution over the set of discrete hours for each individual under the new tax and transfer structure. In computing the transition matrices showing probabilities of movement between hours levels, the labour supply of each individual before the policy change is fixed at the discretised value, and 100 transitions are produced for each individual.

When examining average hours in MITTS-B, the labour supply after the change for each individual is based on the average value over the 100 draws for which the error term leads to the correct predicted hours before the change. This is equivalent to calculating the expected hours of labour supply after the change, conditional on starting from the observed hours before the change. In computing the tax and revenue levels, an expected value is also obtained after the policy change. That is, the tax and revenue for each of the 100 accepted draws are computed for each individual, and the average of these is taken.

In some cases, 100 successful random draws producing observed hours as the optimal hours cannot be generated from the model within a reasonable number of total drawings. In the present simulations, if after 5000 draws from the error term distribution, the model fails

[9] It is planned to extend the analysis in future versions.
[10] This is an extreme value type I distribution, which is associated with the multinomial logit model.
[11] MITTS allows the user to vary the number of successful random draws that are retained.

to predict the observed labour supply 100 times, the individual is dropped from the simulation. This occurs 521 times, which in addition to the 121 rejected cases because of unrealistic wages represents 6.5 per cent of all individuals in the database. The use of such a probabilistic approach means that the run-time of MITTS-B is substantially longer than that of MITTS-A.

3.2 Labour supply responses

The potential effect on labour supply of the reduction in the taper rates is equivocal because it does not automatically mean a reduction in effective marginal tax rates for all individuals. This is because the budget constraint is convex – or the budget set is non-convex – under the March 1998 system. For example, the budget constraint for the single individual considered above has a range between about 10 and 23 hours, which involves an increase in the marginal rate. Indeed, comparing the distributions of METRs under the two systems, the average METR increases. This is an inevitable consequence of flattening the marginal rate structure while keeping basic benefit levels unchanged. This means that the new constraint starts from the same point at zero hours, but increases at a faster rate in the lower income range. However, at the point where, in the pre-reform system, eligibility for benefit would have ceased, the METR in the post-reform system is higher.

The average METR increases in some of the age groups, showing that a significant number of people are in the corresponding hours range where marginal rates increase, though this hours range differs between individuals. On the other hand, other age groups show a decreasing average METR as a result of the reform. This means that aggregate labour supply can go either way (see Tables 1 and 2).

The changes in the probability of working, over all individuals for a range of categories, are presented in Table 8.[12] The oldest and youngest age groups do not have large changes. This is because labour supply is fixed at the observed hours for people over 65 years of age and for students, who probably form a large proportion of the 15 to 19 year

[12] Since actual labour supply points are rounded to the nearest discrete labour supply point, the definition of non-participation depends on the number of discrete labour supply points that are used. For women it is working less than 3 hours and for men it is working less than 10 hours.

old group. However, about one third of people aged between 25 and 54 years old are expected to have a change in their work probability.

Table 8 Change in work probability by age, income unit type, number of children and employment status (row percentages)[a]

	Decrease in %-points				Increase in %-points				
Age	**>50**	**10-50**	**2-10**	**none**	**2-10**	**10-50**	**>50**	**Average**	**Count**
15 to 19	-	-	2	97	1	1	-	0.11	1181.51
20 to 24	-	1	12	79	3	6	-	0.65	1211.95
25 to 29	-	2	15	69	7	8	-	0.89	1333.89
30 to 34	-	4	13	65	11	7	-	0.67	1274.58
35 to 39	-	5	16	64	9	7	-	0.43	1334.77
40 to 44	-	5	20	61	8	7	0	0.26	1231.81
45 to 49	-	4	22	63	6	4	0	-0.37	1168.52
50 to 54	-	3	20	66	7	5	-	0.06	1036.52
55 to 59	-	2	12	75	8	4	0	0.54	808.18
60 to 64	-	0	7	77	7	8	0	1.81	685.92
65 plus	-	-	-	100	-	-	-	0.00	2114.99
Income unit type									
Couple	-	2	18	72	5	3	-	-0.37	4167.55
couple&dep.child	-	6	19	55	12	8	-	0.60	3645.73
Dependent child	-	-	-	100	-	-	-	0.00	979.32
Single	-	0	3	96	1	0	0	0.09	4088.08
Sole parent	-	0	0	46	12	41	-	8.27	501.96
Number of children									
None	-	1	11	84	3	1	0	-0.14	8255.63
One	-	4	17	59	9	12	-	1.46	1841.82
Two	-	4	14	64	10	8	-	0.85	2015.88
Three	-	4	10	67	10	8	-	1.05	917.58
Four	-	4	6	65	12	12	-	2.15	240.47
Five	-	-	3	64	8	25	-	5.48	67.97
Six	-	-	2	79	9	9	-	1.54	43.29
Employment status									
Employed	-	4	20	75	0	0	-	-1.47	7777.53
Non-participation	-	-	-	78	13	9	0	2.44	4998.38
Unemployed	-	-	-	59	13	28	-	7.28	606.72
All	-	2.25	11.9	75.58	5.47	4.74	0.07	0.39	-
Count	-	300.88	1592.02	10114.93	731.6	634.39	8.83	-	13382.64

Note a: - denotes empty cells, whereas 0 denotes cells with less than 0.5 per cent of the observations for the relevant category.

Most changes lie between 2 and 10 percentage points and reductions are more frequent than increases. However, on average there is an increase in the work probability. The largest number of reductions in probability is found for the age groups between 40 and 54 years. The largest positive effect is found for the 60 to 64 years old caused by the relatively large number of people who experience an increase.

Most notable amongst the other characteristics in Table 8 is the result that sole parents are predicted to have a large increase in the probability of working as a result of reduced taper rates. This sensitivity to work incentives is found in several other studies as well. Unemployed people and people from large families are also more likely to participate in the labour market after the reform.

Table 9 reports the effects of the reform on changes in preferred hours. The same groups who are more likely to have changes in the probability of working are also more likely to wish to change the number of hours they work. Most changes are small, between 1 and 5 hours difference, and reductions are most prevalent.

On average there is a reduction in hours for most age groups (and indeed for the total population) except for the youngest and oldest groups. The largest reductions are seen for people aged between 35 and 54 years. This excludes the younger age groups from 25 to 35 years old for which the increase in work probability is fairly large.

Transition matrices showing the probabilities of movement between discrete hours levels, for each of the five demographic groups, provide further information about changes in labour supply behaviour.[13] For both single and married males, only three hours levels are used, reflecting the observed distribution of hours of work by men. For the female groups and sole parents, 11 discrete hours levels are used. Separate transition matrices for married men and women, single men, single women and sole parents are presented in Tables 10 to 14.

[13] As explained above, 100 transitions are computed for each individual in the sample.

Table 9 Change in average predicted hours by age, income unit type, number of children and employment status (row percentages)[a]

	Decrease in hours				Increase in hours				
Age	**>10**	**5-10**	**1-5**	**none**	**1-5**	**5-10**	**>10**	**Average**	**Count**
15 to 19	-	-	2	96	2	1	0	0.09	1181.51
20 to 24	0	1	11	76	7	4	1	0.23	1211.95
25 to 29	0	2	19	66	9	4	1	0.03	1333.89
30 to 34	0	3	21	62	10	3	1	-0.12	1274.58
35 to 39	1	3	24	59	10	3	1	-0.36	1334.77
40 to 44	0	4	25	56	9	3	1	-0.40	1231.81
45 to 49	0	3	28	61	4	2	1	-0.54	1168.52
50 to 54	0	2	24	66	5	3	1	-0.31	1036.52
55 to 59	-	2	15	76	5	2	1	-0.03	808.18
60 to 64	-	0	7	80	8	5	1	0.49	685.92
65 plus	-	-	-	100	-	-	-	0.00	2114.99
Income unit type									
Couple	0	2	21	72	4	1	0	-0.44	4167.55
couple&dep.child	1	4	28	52	10	3	2	-0.42	3645.73
Dependent child	-	-	-	100	0	-	-	0.01	979.32
Single	-	0	2	94	2	1	0	0.13	4088.08
Sole parent	-	1	11	27	34	23	5	2.88	501.96
Number of children									
None	0	1	12	83	3	1	0	-0.15	8255.63
One	1	3	24	54	10	6	2	0.05	1841.82
Two	1	3	22	59	11	4	1	-0.16	2015.88
Three	1	3	18	64	11	2	2	-0.04	917.58
Four	1	2	13	66	11	4	3	0.29	240.47
Five	-	-	2	66	21	5	7	1.55	67.97
Six	-	-	7	79	13	-	-	0.17	43.29
Employment status									
Employed	0	3	26	68	1	1	0	-0.82	7777.53
Non-participation	-	-	-	84	12	4	1	0.73	4998.38
Unemployed	-	-	-	63	16	13	7	2.29	606.72
All groups	0.26	1.71	15.23	73.64	5.94	2.46	0.76	-0.10	-
Count	34.71	228.46	2038.73	9854.82	794.93	328.86	102.13	-	13382.64

Note a: - denotes empty cells, whereas 0 denotes cells with less than 0.5 per cent of the observations for the relevant category.

Table 10 shows that some married men are increasing their labour supply as a result of the reform, whereas others are decreasing their labour supply. The net effect is a decrease in the number of non-participants and full-time workers, who move into part-time work.

The reform seems to have the smallest effect on married women who work 10 hours or less; see Table 11. Most women in this group remain at the same labour supply. At each

labour supply level the largest off-diagonal proportions are for moves from work to zero hours. However looking at hours before and after the reform, there is little change in the distribution of hours worked. There is a slight shift from full-time to part-time work and non-participation.

Table 10 Married men's labour supply transitions (row percentages)

	From pre to post reform: rows to columns			
Hours	**0**	**20**	**40**	**Total**
0	97.0	1.1	1.9	43.07
20	1.3	95.1	3.6	2.24
40	1.3	4.8	94.0	54.70
Total	42.51	5.19	52.30	100.00

Note a: Weighted number of observations on which this table is based is 3,906,640.

Table 11 Married women's labour supply transitions (row percentages)

	From pre to post reform: rows to columns											
Hours	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**Total**
0	97.1	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.1	59.37
5	1.0	97.7	0.2	0.4	0.2	0.2	0.2	0.0	0.1	0.0	-	0.57
10	3.4	0.3	95.0	0.2	0.2	0.4	0.1	0.1	0.1	0.1	0.1	1.75
15	4.7	0.4	0.3	93.2	0.3	0.3	0.2	0.3	0.1	0.1	0.0	3.15
20	5.2	0.6	0.6	0.7	91.3	0.4	0.4	0.3	0.2	0.2	0.1	4.75
25	4.7	0.4	0.6	0.6	0.5	92.0	0.4	0.3	0.2	0.2	0.1	3.98
30	5.3	0.5	0.6	0.6	0.9	0.6	90.3	0.4	0.4	0.2	0.2	3.71
35	5.9	0.5	0.8	0.7	0.9	0.8	0.8	88.5	0.5	0.4	0.2	4.82
40	5.9	0.6	0.6	0.8	0.8	0.8	0.8	0.6	88.6	0.4	0.2	12.62
45	5.6	0.6	0.6	0.9	1.0	1.0	0.8	0.6	0.5	88.2	0.2	1.86
50	3.6	0.3	0.3	0.5	0.6	0.7	0.6	0.5	0.4	0.3	92.1	3.41
Total	59.76	0.93	2.09	3.41	4.81	4.13	3.79	4.59	11.38	1.84	3.27	100.00

Note a: Weighted number of observations on which this table is based is 3,906,640.

In the transition matrices for single men and women (see Tables 12 and 13), both increases and decreases in labour supply can be observed, although the majority of singles remain at their old labour supply. This indicates that singles are spread over the hours range where the budget constraint is affected by the reduction in the withdrawal rate resulting in both positive and negative effects on labour supply. Part-time workers are most likely to change and are more likely to increase than decrease their labour supply. Few of the non-participants are encouraged by the reform to enter the labour market. The overall effect is a slight increase in full-time work for men and in the two highest categories of full-time work for women.

Table 12 Single men's labour supply transitions (row percentages)

From pre to post reform: rows to columns				
Hours	**0**	**20**	**40**	**Total**
0	99.30	0.10	0.60	47.71
20	0.70	83.40	15.90	6.69
40	0.00	0.00	100.00	45.60
Total	47.45	5.60	46.95	100.00

Note a: Weighted number of observations on which this table is based is 2,515,222.

Table 13 Single women's labour supply transitions (row percentages)

From pre to post reform: rows to columns												
Hours	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**Total**
0	99.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.44
5	-	100	-	-	0.0	-	-	-	-	-	-	3.21
10	0.2	0.0	99.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.68
15	0.4	0.2	0.1	98.4	0.0	0.0	0.0	0.1	0.2	0.3	0.3	2.86
20	0.3	0.3	0.1	0.1	96.7	0.1	0.2	0.1	0.3	0.5	1.3	1.33
25	0.4	0.6	0.3	0.1	0.2	97.0	0.0	0.1	0.4	0.3	0.7	1.39
30	0.8	0.6	0.3	0.2	0.1	0.0	95.4	0.3	0.4	0.3	1.5	2.16
35	0.7	0.6	0.3	0.3	0.1	0.1	0.1	96.5	0.2	0.4	0.8	5.51
40	0.6	0.6	0.3	0.3	0.2	0.1	0.0	0.0	96.7	0.3	0.9	15.99
45	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0.0	-	98.4	0.4	3.09
50	0.1	0.1	0.1	0.0	0.1	0.1	-	0.0	0.0	-	99.4	4.34
Total	56.56	3.39	3.76	2.89	1.34	1.39	2.08	5.34	15.50	3.14	4.59	100.00

Note a: Weighted number of observations on which this table is based is 2,552,175.

Sole parents also experience both increases and decreases in labour supply; see Table 14. However, compared with singles they are more likely to change labour supply, particularly at the lower and upper end of the hours range. Sole parents working fewer than 25 hours seem most likely to increase their hours whereas sole parent working 35 hours or more are more likely to reduce their hours. After the reform, more women prefer to participate in the labour market since very few women move from work to non-participation.

Table 14 Sole parents' labour supply transitions (row percentages)[a]

From pre to post reform: rows to columns												
Hours	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**Total**
0	85.9	0.0	0.3	0.8	1.0	1.9	1.8	1.7	2.1	2.2	2.5	58.72
5	-	89.2	0.3	0.4	1.0	0.7	1.7	1.9	1.6	2.3	0.8	2.91
10	-	-	86.3	0.6	0.5	1.4	1.5	2.7	2.1	2.4	2.5	2.24
15	-	0.1	0.1	91.7	0.3	0.7	1.4	1.1	1.7	1.4	1.6	2.79
20	-	-	-	0.1	95.0	0.2	1.1	0.9	0.8	1.3	0.7	3.88
25	0.0	-	-	-	-	97.8	0.0	0.3	0.4	0.6	0.9	3.61
30	-	0.4	0.3	0.3	0.5	1.1	95.2	0.2	0.7	0.8	0.4	3.36
35	-	0.2	0.3	0.7	1.0	1.6	0.5	94.7	0.2	0.6	0.3	3.98
40	0.2	0.3	0.6	1.6	1.7	2.5	1.7	0.3	90.8	0.2	0.2	12.32
45	0.4	0.3	0.4	1.0	1.9	1.8	2.0	1.9	1.1	87.9	1.3	1.01
50	0.1	0.3	0.4	0.8	1.1	1.0	1.1	1.3	0.9	0.4	92.5	5.17
Total	50.46	2.69	2.22	3.33	4.64	5.21	4.71	5.07	12.67	2.48	6.51	100.0

Note a: Weighted number of observations on which this table is based is 502,963.

Table 15 summarises the labour supply effects for the different groups and shows clearly that a reduction in the taper rates has the largest effect on sole parents.

Table 15 Simulated responses of labour supply

Behavioural Response	**Couples:**		**Single**	**Single**	**Sole**
	Men	**Women**	**Men**	**Women**	**Parents**
Workers (%,base)	56.93	40.63	52.29	43.56	41.28
Workers (%,reform)	57.49	40.24	52.55	43.44	49.54
non-work-->work (%)	1.29	1.72	0.33	0.07	8.30
work-->non-work (%)	0.73	2.10	0.06	0.18	0.03
Workers working more	0.08	0.37	1.07	0.42	1.29
Workers working less	2.60	1.43	0.01	0.44	1.81
Average hours change	-0.37	-0.49	0.32	-0.10	2.88

3.3 Government revenue and expenditure

Summary information about the revenue and expenditure implications of the reform is given, for the weighted sample used in the simulations, in Table 16. The revenue changes for fixed labour supply do not correspond exactly to those under MITTS-A. This is because in the case of MITTS-B the costs and revenues are evaluated at the fixed discrete hours nearest to the actual hours, rather than the actual hours themselves. However, the results for MITTS-A and MITTS-B are quite close. The changes in MITTS-B allowing for labour supply effects are based on averages for each individual, over the distribution of discrete hours levels.

Table 16 Behavioural responses: change in tax and transfer costs

	Pre-Reform	Change after reform			
		LS		Fixed	
	Abs. value ($m)	**Abs. ($m)**	**%**	**Abs.($m)**	**%**
Couples					
Government Revenue					
Income Tax	40884.9	-206.0	-0.5	900.3	2.2
Medicare	2516.2	56.9	2.3	114.9	4.6
Government Expenditure					
Tax Rebates	2340.8	-555.2	-23.7	-567.6	-24.2
Fam Payment	3815.8	1923.6	50.4	1531.4	40.1
FTP/FTB	394.0	202.7	51.4	164.4	41.7
Allowances	6484.6	5852.4	90.3	5222.4	80.5
Pensions	11019.7	784.7	7.1	805.0	7.3
Pharm Allow	116.6	10.0	8.6	10.0	8.6
Rent Allow	525.8	264.5	50.3	208.6	39.7
single men					
Government Revenue					
Income Tax	10928.0	523.3	4.8	373.0	3.4
Medicare	754.0	48.0	6.4	40.0	5.3
Government Expenditure					
Tax Rebates	426.2	-16.8	-3.9	-12.2	-2.9
Fam Payment	0.0	0.0	0.0	0.0	0.0
FTP/FTB	0.0	0.0	0.0	0.0	0.0
Allowances	3317.7	1227.7	37.0	1357.1	40.9
Pensions	3204.2	145.7	4.5	145.7	4.5
Pharm Allow	54.4	2.4	4.4	2.4	4.4
Rent Allow	297.5	402.3	135.2	410.9	138.1
single women					
Government Revenue					
Income Tax	7398.7	321.0	4.3	334.9	4.5
Medicare	486.2	29.4	6.0	32.4	6.7
Government Expenditure					
Tax Rebates	793.8	-13.9	-1.8	-19.5	-2.5
Fam Payment	0.0	0.0	0.0	0.0	0.0
FTP/FTB	0.0	0.0	0.0	0.0	0.0
Allowances	3297.7	1119.1	33.9	1070.4	32.5
Pensions	7048.2	230.9	3.3	231.6	3.3
Pharm Allow	118.4	3.3	2.8	3.3	2.8
Rent Allow	334.1	309.5	92.6	313.1	93.7

Table 16 (continued)

	Pre-Reform	Change after reform			
		LS		Fixed	
	Abs. value ($)	**Abs. ($)**	**%**	**Abs.($)**	**%**
sole parents					
Government Revenue					
Income Tax	1643.3	174.5	10.6	74.5	4.5
Medicare	68.9	7.9	11.5	4.9	7.1
Government Expenditure					
Tax Rebates	533.0	13.7	2.6	-12.0	-2.2
Fam Payment	2086.2	116.6	5.6	89.0	4.3
FTP/FTB	224.0	0.0	0.0	0.0	0.0
Allowances	2938.1	77.7	2.6	260.8	8.9
Pensions	155.0	-4.3	-2.7	1.1	0.7
Pharm Allow	48.4	6.9	14.2	5.9	12.2
Rent Allow	398.8	11.8	3.0	5.4	1.3

Notes:
LS refers to changes taking account of labour supply.
Fixed refers to changes without accounting for labour supply responses.

An important general result arising from Table 16 is that when allowance is made for behavioural responses, there can in some cases be substantial effects on the expenditure simulations. Changes can move in opposite directions for different subgroups or payment types, depending on whether labour supply is allowed to vary or is fixed. The potential importance of including such labour supply effects for tax policy microsimulation is therefore clear.

4 Conclusions

This paper has reported a policy simulation, involving a partial flattening of the effective marginal tax rate structure in Australia, carried out using the Melbourne Institute Tax and Transfer Simulator (MITTS). Simulations in which all individuals have an unchanged labour supply (using MITTS-A) were compared with behavioural simulations in which the majority of individuals is free to adjust the number of hours worked (using MITTS-B). The results reflect only the supply side of the labour market, so that no general equilibrium effects on wage rates were considered. Furthermore, a discrete hours framework was used, in which individuals move between pre-specified discrete hours levels, rather than being able to vary hours continuously.

Examples were provided of the implications for aggregate tax revenue and expenditure, and the effects on individuals and households, of hypothetical changes to the tax and transfer system operating in March 1998. Revenues and expenditures were expressed in 1998 dollars.

The reform involved a reduction in the means-tested benefit taper rates to 30 per cent. Thus, all taper rates of 50 per cent and 70 per cent in the 1998 system were reduced to 30 per cent, while leaving all basic benefit levels unchanged. This change flattens the tax structure to some extent by reducing the high marginal tax rates applying to those with relatively low incomes, and this has the expected effect of raising the probability of working and of increasing hours worked. For others (those on medium incomes), there is a range of hours for which marginal rates increase, producing reductions in average hours worked.

These simulations must be treated with caution, in view of the provisional nature of some of the econometric estimates underlying the model. Nevertheless the paper demonstrates the potential importance of allowing for labour supply responses in tax policy analysis.

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