Extension of the behavioural component of MITTS with predicted confidence intervals and household level output

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1. Introduction

The work described in this report extends the main features of the Melbourne Institute of Tax and Transfer Simulator (MITTS) in two ways. Both extensions relate to MITTS-B, the behavioural component of MITTS. The aim of this project is twofold: (1) to provide a measure of reliability for the results predicted using the behavioural component of MITTS by constructing confidence intervals; (2) to allow separate analyses for each individual household of the effects of a reform on the predicted hours of work.

The first extension allows users to calculate the level of uncertainty associated with predictions by MITTS-B that result from estimated underlying parameters. MITTS-B allows individuals to choose an optimal level of hours worked in response to policy changes. These behavioural responses are based on estimated utility functions for labour supply and income. The predictions of behavioural responses are then used to calculate the aggregate changes in revenue and expenditure, participation probability and expected hours of work after a policy change for the whole sample. These results are displayed in output from the MITTS-B component. Up to this moment, MITTS-B only reported the point estimates of the predicted values after the reform, but it did not convey any information about the uncertainty associated with the predictions. Given the complexity of the behavioural model, it is not easy to derive the precision of the behavioural results predicted by MITTS-B analytically. In this project confidence intervals, indicating the extent of uncertainty of predicted values, are calculated by using a simulation technique.

The second extension allows users of MITTS to examine behavioural responses at the individual household level. Currently, MITTS can only provide details at the household level for the non-behavioural effects of changing the tax system on the benefit level and net income. These households can be selected either directly from the SIHC sample or they can be created from the hypothetical households. This allows policy makers to view and gain information about the characteristics of households who are affected, or not affected, by a policy change. This feature of MITTS is useful to get a better understanding of why a policy change has a particular effect and may help to explain unexpected results.

The plan of this report is as follows. The next section describes the methodology used for constructing the confidence intervals for MITTS-B. Section 3 discusses the confidence intervals generated from MITTS-B for the Australian New Tax System policy change. Section 4 analyses the individual transition probabilities for the same policy change. Section 5 concludes the report.

2. Methodology for constructing confidence intervals

Behavioural responses generated by MITTS-B are based on estimated labour supply models. Currently, MITTS-B only uses the point estimates of the labour supply parameters when computing the expected expenditure of the different social security payments. It does not, however, account for the uncertainty associated with the estimates. This can be overcome by deriving analytical confidence intervals, which provide an interval or range for the predictions of behavioural responses, of the labour supply model, but doing so would be extremely complex and cumbersome. Thus a different, more straightforward approach is to use simulation techniques to create empirical confidence intervals.

These empirical confidence intervals are created using both the point estimates of the parameters in the labour supply models and the variance/covariance of the parameters estimates. Suppose we want to calculate the confidence intervals for the changes in expenditure and revenue resulting from a particular policy reform. These can be constructed through the use of the following simulation method (see Van Soest, 1995). A vector of labour supply parameters is drawn randomly from a multivariate normal distribution with the mean and covariance matrix given by respectively the point estimates of the labour supply parameters and the variance/covariance matrix for the parameters. This randomly drawn vector is then used to compute the preference function and the usual (conditional) Logit probabilities at each of the discrete hours points after the reform. Given the probabilities for each of the discrete points, we can calculate the expected changes in expenditure and revenue after the reform. This is repeated a number of times (for example, 100, 500, or 1000 times).[1] After each draw, we store the corresponding estimate for the expected change in expenditure and revenue in a vector. This vector is then ranked in ascending order. From the ordered vector a 90 percent confidence interval can be constructed by taking the 5^{th} percentile and the 95^{th} percentile as the lower and upper bound of the interval. The resulting range of values indicates the variation in outcomes. In a similar fashion, confidence intervals can be constructed for other measures of interest, such as the probability of participation or changes in expenditure.

The code and procedures for calculating the confidence intervals have been included in MITTS. These calculations are very computationally intensive, and it could take weeks or even months – depending on the number of households, the number of draws from the error distribution, the number of tries allowed for each draw and the number of replications on which the intervals are based – before confidence intervals for outcomes from the behavioural component for a particular policy change could be provided. For example, on a Pentium-4 machine with 512 Mb of RAM and 1.90 GHz, it takes 200 minutes to run one behavioural simulation for 7170 households in the 1997/98 Income Distribution Survey (IDS) dataset if, for each household, the total number of draws is set to 100 and the maximum number of tries allowed to calibrate the observed hours for each draw is set to 1000.[2] The simulation needs to be repeated at least 1000 times and therefore it would take 200,000 minutes (around 4.5 months) in total to calculate the confidence intervals for this sample.[3] It is clear that this is impractical to carry out. In order to reduce the computation time, we can decrease the number of draws as well as the maximum number of tries to some extent.

Table 1 provides an idea of how sensitive the results are to the different number of draws and tries. The first column of Table 1 reports the time needed to do a simulation for the whole dataset; the second column lists the number of draws; the third column lists the

[1] More replications mean a more accurate calculation of the confidence intervals.
[2] These values are the default values in MITTS for running a behavioural simulation.
[3] We have fixed the number of repetitions of the simulation to a 1000 in MITTS, when the option of calculating confidence intervals is chosen.

maximum number of tries for each draw; and columns four to eight report the change in average number of hours worked for the five demographic groups. As an example, the change in average number of hours worked are calculated for the policy reform of reducing all taper rates in the March 1998 tax system (using the 1997/98 IDS data set) from 50 and 70 per cent to 30 per cent.

The first row of Table 1, where the number of draws and tries is quite large, is used as a benchmark. The results remain almost identical when the number of draws is increased to 150; that is the results become stable as we increase the number of draws and/or tries above a certain number. Choosing a smaller number of draws means less time is needed to run one simulation. However on the downside, as the number of draws is decreased, the results will become less accurate and more variable across simulations (depending more on the particular random draws that are taken from the error distribution), that is, the average number of hours for the different subgroups may be further from the stable benchmark results. The last row, which only has 10 draws and 100 tries, clearly shows that the average number of hours worked for all the demographic groups is quite different from the benchmark figures.

Table 1:
Predicted change in average number of hours worked by number of draws and tries

			Change in average hours worked				
Time (minutes)	Draws	Tries	Married men	Married women	Single men	Single women	Sole parents
200	100	1000	0.55	-0.49	0.36	0.12	2.88
280	*150*	*1000*	*0.55*	*-0.49*	*0.36*	*0.13*	*2.86*
151	100	500	0.35	-0.52	0.32	0.08	2.87
80	100	100	0.11	-0.51	0.16	-0.02	2.84
115	50	1000	0.54	-0.52	0.33	0.1	2.99
94	40	1000	0.56	-0.53	0.32	0.09	3.08
80	30	1000	0.54	-0.55	0.33	0.09	3.11
60	20	1000	0.52	-0.56	0.32	0.1	3.07
40	10	1000	0.53	-0.65	0.37	0.13	3.02
38	10	700	0.43	-0.66	0.34	0.06	3.02
35	10	500	0.33	-0.68	0.31	0.05	3.02
30	10	100	0.06	-0.64	0.17	-0.03	2.95

Note: Calculations are done on a Pentium-4 PC with 512 Mb of RAM and 1.90 GHz.

The optimal number of draws and tries may be different for different subgroups and different policy simulations. Choosing 100 draws and 1000 tries is a safe choice, but it can most likely be reduced. From Table 1, it appears that married men, single men, and single women are less sensitive to the number of draws, but more sensitive to the number of tries. Married women, on the other hand, are less sensitive to the number of tries, but the number of draws plays an important role in achieving a stable result. Before starting the repeated calculations for confidence intervals, the researcher should experiment with the number of draws and tries in a simulation, using only the point estimates of the labour supply model, to find a combination that takes as little time to run as possible while providing stable results. Investing some time at this stage can greatly reduce the time needed to compute the confidence intervals.

MITTS allows users to run simulations on demographic subgroups. This could be used to make the calculation of confidence intervals even more efficient. It is recommended that the confidence intervals are calculated for one demographic group at a time rather than for all households together, since one demographic group may require more draws to obtain a stable result than another demographic group. By calculating the intervals separately for each subgroup the minimum number of draws sufficient for that subgroup can be chosen. Another advantage of this approach is that more than one computer can be used to calculate the intervals, which will reduce the total amount of run-through time needed for the calculations.

From Table 1 it can be seen that it is impractical to set a large number of draws and tries when calculating confidence intervals, because the simulation needs to be repeated so many times that the additional time needed becomes problematic from a computational point of view. If, however, we only provide point estimates for the behavioural component without the confidence intervals, then it is recommended to set a large number of draws and tries so that we can be certain that the results are stable. The additional time needed is not so relevant for one replication.

A large number of draws and tries may be unnecessary in many cases because the predicted values become stable for much lower numbers of draws and tries. In addition, a slight variation between draws only means the width of the confidence intervals could be overestimated to the extent of the remaining variation. When the variation is much less than the width of the confidence interval, this overestimation will not affect the results, and it will result in a conservative estimate of the uncertainty associated with the simulation results: that is overstating the uncertainty.

3. Calculation of confidence intervals in the simulation of ANTS

In this section, we use the new facility of calculating confidence intervals in MITTS to examine the effects of the New Tax System introduced in Australia in July 2000. Kalb, Kew and Scutella (2002) have studied the complete set of changes in detail. Here we will only present the aggregate results of the behavioural simulation for each demographic group, but in addition to the point estimates, confidence intervals are provided.

Based on Table 1, we choose 40 as the number of draws and 1000 as the number of tries for single men, single women, and sole parents. In the *Simulation Selection* option under *Run MITTS-B* we change *Confidence Intervals?* to “yes” from “no” by selecting the option. Tables 2 and 3 present the 90 per cent confidence intervals for the predicted change in revenue, expenditure and simulated responses of labour supply for all four demographic groups, with the couples subdivided in those with and without children. On a Pentium-4 PC with 512 Mb of RAM and 1.90 GHz, it takes around 4 days to calculate confidence intervals for sole parents, around 5 days for singles and around 20 days for couples with and without children each. The much longer time needed for couples is caused by the larger number of households and by the longer time needed per household to calculate probabilities at all combinations of labour supply for the head and the spouse. For couples there are 66 possible labour supply points compared to only 11 points for singles and sole parents.

For example, the 90 per cent confidence interval for the predicted decrease in income tax – See Table 2 – for single men after the reform ranges from \$1849.5 to \$1951.9 million.[4] The effects on Medicare are fairly minor, so that the overall revenue decreases by an

Table 2: Behavioural Responses: Change in Tax and Transfer Costs

	Pre-Reform	Post-Reform				
		Fixed	LS	Confidence intervals for the LS column		
	Abs. (\$m)	Abs.(\$m)	Abs.(\$m)	5%	medium	95%
Couples with children						
Government Revenue						
Income Tax	32539.6	-3849.3	-3490.6	-3565.2	-3491.2	-3416.3
Medicare	1950.1	-30.0	3.2	-2.7	3.1	9.0
Total Revenue	34489.7	-3879.4	-3487.4	-3567.2	-3488.1	-3407.0
Government Expenditure						
Tax Rebates	1241.8	-1004.5	-1017.3	-1020.2	-1017.4	-1014.1
Fam Payment	4361.7	-4361.7	-4361.7	-4361.7	-4361.7	-4361.7
FTP/FTB	417.4	6719.7	6612.2	6588.5	6611.6	6637.0
Allowances	4445	-754.8	-1131.6	-1203.4	-1133.8	-1055.0
Pensions	793.8	35.9	27.5	21.0	23.6	35.2
Pharm Allow	9.3	0.0	-0.3	-0.4	-0.3	-0.1
Rent Allow	369.2	106.1	101.6	96.2	101.6	106.2
Total Expenditure	11638.2	740.8	230.3	138.4	227.6	329.5
Net Expenditure		4620.1	3717.8	3564.1	3714.8	3882.1
Couples without children						
Government Revenue						
Income Tax	23659.5	-3337.7	-3076.3	-3145.3	-3079.6	-2993.2
Medicare	1493.9	-9.2	12.0	6.1	11.7	18.9
Total Revenue	25153.5	-3346.9	-3064.3	-3138.7	-3067.6	-2974.3
Government Expenditure						
Tax Rebates	1448	-174.6	-181.5	-185.1	-181.6	-178.0
Allowances	2911.0	63.9	-52.9	-100.4	-51.4	-11.2
Pensions	10641.6	501.9	495.0	491.9	494.7	498.5
Pharm Allow	110.6	4.1	4.0	3.9	4.0	4.1
Rent Allow	176.7	7.4	4.9	1.6	5.3	7.0
Total Expenditure	15287.9	402.7	269.5	218.6	270.8	314.3
Net Expenditure		3749.6	3333.8	3213.1	3338.8	3437.8

[4] The point estimates in Table 2 are slightly different from the point estimates in Kalb, Kew and Scutella (2002), because we can now keep more observations from the sample in the simulation (as a result of refining the definition of household type in MITTS) and we have increased the number of tries to locate a household at the observed hours before giving up.

Table 2 (continued)

	Pre-Reform	Post-Reform				
		Fixed	LS	Confidence intervals for the LS column		
	Abs. ($m)	Abs.($m)	Abs.($m)	5%	medium	95%
Single men						
Government Revenue						
Income Tax	14182.9	-2014.8	-1903.7	-1951.9	-1904.3	-1849.5
Medicare	966.9	-19.0	-9.3	-13.5	-9.4	-4.8
Total Revenue	15149.8	-2033.8	-1913.0	-1965.4	-1913.7	-1854.4
Government Expenditure						
Tax Rebates	447.3	-81.4	-87.2	-90.6	-87.1	-84.2
Allowances	3347.0	35.4	-82.8	-144.1	-80.1	-28.3
Pensions	3596.4	108.2	103.4	98.6	103.8	106.5
Pharm Allow	60.1	0.8	0.6	0.2	0.7	0.8
Rent Allow	396.9	12.5	6.1	0.1	6.4	11.1
Total Expenditure	7847.7	75.4	-59.9	-128.6	-56.8	2.5
Net Expenditure		2109.3	1853.1	1728.9	1854.9	1967.3
Single women						
Government Revenue						
Income Tax	8090.9	-1098.1	-1040.0	-1071.5	-1039.9	-1007.5
Medicare	533.3	3.5	9.3	6.6	9.2	12.0
Total Revenue	8624.2	-1094.6	-1030.8	-1064.9	-1030.7	-995.4
Government Expenditure						
Tax Rebates	761.1	-131.9	-135.1	-137.3	-135.0	-133.0
Allowances	2180.9	14.2	-65.1	-106.3	-64.2	-27.3
Pensions	7866.5	175.6	153.5	147.2	153.8	158.5
Pharm Allow	119.0	1.5	1.4	1.3	1.4	1.5
Rent Allow	321.7	7.3	3.6	-0.5	3.8	7.0
Total Expenditure	11249.2	66.6	-41.8	-88.8	-40.7	2.0
Net Expenditure		1161.2	989.0	911.6	989.5	1063.9
Sole parents						
Government Revenue						
Income Tax	2136.7	-266.0	-248.9	-274.6	-249.7	-221.2
Medicare	94.9	0.1	1.9	0.4	1.9	3.6
Total Revenue	2231.6	-265.9	-246.9	-274.2	-247.9	-217.6
Government Expenditure						
Tax Rebates	602.1	-320.2	-322.4	-323.8	-322.4	-321.1
Fam Payment	2322.2	-2322.2	-2322.2	-2322.2	-2322.2	-2322.2
FTP/FTB	239.7	2900.6	2890.6	2886.8	2890.6	2894.5
Allowances	3248.0	138.4	129.5	110.0	129.8	148.5
Pensions	167.3	2.3	2.0	1.7	2.0	2.2
Pharm Allow	51.8	2.2	1.6	1.4	1.6	1.8
Rent Allow	423.5	21.6	20.8	19.5	20.8	22.0
Total Expenditure	7054.7	422.7	399.9	374.3	400.0	424.7
Net Expenditure		688.6	646.9	595.0	646.7	693.9

Notes: LS refers to change in cost/revenue taking account of labour supply.
Fixed refers to change in cost/revenue with no labour supply response.

amount between \$1854.4 million and \$1965.4 million. The total expenditure on allowances and pensions is expected to decrease as well, but only by a small amount and the confidence interval indicates that we cannot be sure there is a decrease, given the uncertainty associated with the labour supply parameters it could be a small increase as well. The net effect of the decrease in direct income tax and the change in expenditure on benefits is an increase in the cost to government.[5] The results for single women are similar, although the change in expenditure is lower, because single women have a lower reduction in income tax. Sole parents display similar effects, but at a lower level again (partly because this group has fewer individuals in it and partly because they are on lower incomes, benefiting less from the reduction in income tax). In addition, the effect for this latter group when labour supply is fixed at the pre-reform level is not significantly different from the effect when labour supply is allowed to change. That is, 688.6 lies in between 595.0 and 693.9. For the other groups, the effects with and without labour supply changes are significantly different.

Examining the behavioural responses that are driving the results in Table 2, Table 3 shows for example that the 90 per cent confidence interval for single men moving from non-work to work runs from 0.48 percentage points to 1.11 percentage points. All effects are relatively small, but most of them seem statistically significant. From this table we conclude that ANTS did have the largest effect on couples with children. It is expected that the changes increase participation in the labour force of both married men and women more than for other groups and the average increase in hours worked is larger than for other groups as well, even though for married men similarly sized groups of workers increase and decrease their hours of work. We also conclude that ANTS did have a small positive effect on the labour supply of single men and women, and married men and women without children, increasing labour force participation for everyone and increasing hours worked for all men and the married women. Amongst the single women a similar number increased and decreased their labour supply. The effect for sole parents is smallest and not significant. Although a certain group seems to have increased their labour supply, another group is expected to decrease their labour supply or even

[5] Of course, this additional cost is compensated by the increase in indirect taxes, through the GST.

withdraw from the labour market altogether. The number of singles without children withdrawing from the labour market is negligible.

Table 3: Simulated Responses of Labour Supply

		Confidence Intervals		
Married Men (with children)		5%	Med	95%
Workers(% base)	72.57			
Workers(% reform)	74.02	73.73	74.02	74.29
Non-work --> work (%)	1.54	1.25	1.54	1.8
Work --> non-work (%)	0.08	0.05	0.08	0.12
Workers working more	0.75	0.65	0.74	0.86
Workers working less	0.6	0.5	0.59	0.72
Average hours change	0.62	0.49	0.62	0.74
Married Women (with children)				
Workers(% base)	51.12			
Workers(% reform)	53.03	52.75	53.03	53.3
Non-work --> work (%)	1.99	1.71	1.99	2.25
Work --> non-work (%)	0.08	0.03	0.07	0.17
Workers working more	0.55	0.43	0.54	0.68
Workers working less	0.18	0.11	0.18	0.26
Average hours change	0.5	0.41	0.5	0.59
Married Men (no children)				
Workers(% base)	45.24			
Workers(% reform)	45.85	45.66	45.85	46.05
Non-work --> work (%)	0.66	0.48	0.65	0.84
Work --> non-work (%)	0.04	0.00	0.02	0.12
Workers working more	0.38	0.26	0.37	0.51
Workers working less	0.13	0.07	0.12	0.20
Average hours change	0.28	0.20	0.28	0.37
Married Women (no children)				
Workers(% base)	39.79			
Workers(% reform)	40.38	40.21	40.37	40.56
Non-work → work (%)	0.62	0.47	0.61	0.80
Work → non-work (%)	0.03	0.00	0.02	0.09
Workers working more	0.50	0.35	0.49	0.67
Workers working less	0.07	0.03	0.06	0.15
Average hours change	0.28	0.22	0.28	0.36

Table 3 (Continued)

		Confidence Intervals		
Single Men		5%	median	95%
Workers(% base)	59.57			
Workers(% reform)	60.32	60.00	60.30	60.66
Non-work --> work (%)	0.77	0.48	0.76	1.11
Work --> non-work (%)	0.02	0.00	0.01	0.07
Workers working more	0.32	0.20	0.32	0.47
Workers working less	0.06	0.03	0.06	0.10
Average hours change	0.34	0.20	0.34	0.50
Single Women				
Workers(% base)	44.90			
Workers(% reform)	45.70	45.44	45.69	45.97
Non-work --> work (%)	0.82	0.57	0.81	1.09
Work --> non-work (%)	0.02	0.00	0.02	0.05
Workers working more	0.15	0.08	0.15	0.24
Workers working less	0.16	0.10	0.16	0.24
Average hours change	0.27	0.16	0.27	0.38
Sole Parents				
Workers(% base)	42.71			
Workers(% reform)	42.38	41.86	42.37	42.94
Non-work --> work (%)	0.36	0.18	0.33	0.64
Work --> non-work (%)	0.69	0.39	0.66	1.05
Workers working more	1.32	0.99	1.31	1.67
Workers working less	0.32	0.16	0.31	0.47
Average hours change	0.13	-0.07	0.13	0.35

The confidence intervals presented in Tables 2 and 3 are relatively narrow, signalling that the direction of the predicted behavioural responses based on our estimated model can be stated with a reasonable degree of confidence. In addition, the magnitude of the effect can be stated with a certain degree of precision as well. From Table 2 for example, it seems unlikely that the point estimate of the net expenditure is more than 10 per cent from any value that could reasonably be expected.

4. Individual labour supply responses

At the moment, MITTS does not provide the effects of changes to the tax and transfer system on the predicted level of labour supply responses at the household level. In contrast to the static microsimulation component where labour supply is fixed, which means there is only one possible outcome after the reform, the simulated value generated from the behavioural component of MITTS (MITTS-B) is calculated from a range of possible labour supply outcomes after the reform, each of which is assigned a probability. That is, MITTS-B follows a probabilistic approach and does not identify a particular level of hours worked for each individual, but generates a distribution of net incomes rather than just one value for net income. The point estimates in the tables generated in MITTS-B are based on the expected value of expenditure and transitions for all the individual households in the sample. Although we cannot follow exactly the same approach as in the "View Households" option in MITTS-A, it would be useful to have a similar tool included in MITTS-B. In the following subsection, we discuss the approach that we have chosen to summarize the information available from the behavioural simulations for individual households.

4.1 Approaches to analysing individual households

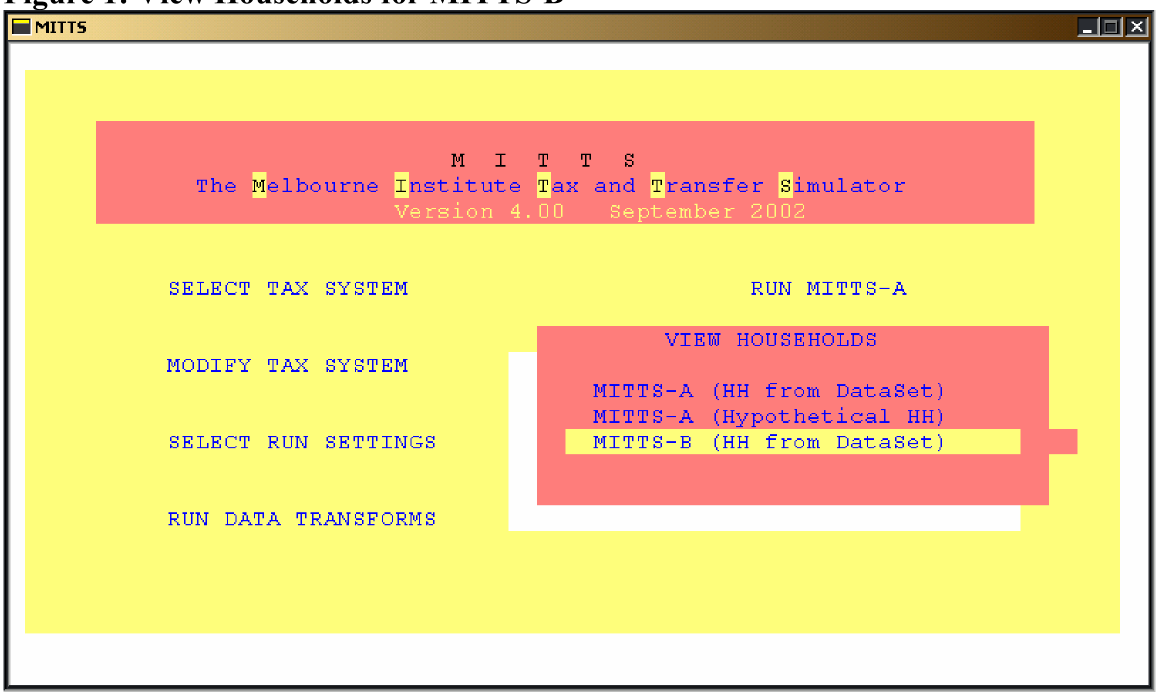
There are different approaches to analysing the breakdown of incomes for individual households in MITTS-B. The approach chosen here is to evaluate the benefit levels and net incomes for every individual at the expected hours (which are computed by multiplying each discrete hours point with its probability). These post-reform benefit levels and net incomes can then be compared to the benefit levels and net incomes at the observed hours before the reform in a similar way as the *View Households* option already does in MITTS-A.

In explaining and interpreting the simulation results it would be helpful to know the individual transition probabilities. To achieve this, we add a choice to the *View Households – MITTS-B* menu where an output table is computed at the individual level, which provides the distribution over the discrete hours of labour supply after the reform, conditional on fixing the hours before the reform to the observed hours. If we were to repeat this approach for all individuals and aggregate the weighted individual tables by demographic group, we would replicate the aggregate labour supply transition tables, which are already produced in MITTS-B, for the four demographic groups.

Information at the individual level can be helpful in examining specific cells of a labour supply transition table. For example, it may be of interest to know the characteristics of some of the sole parents who move from say 5 to 10 hours after the reform. It can also be helpful in understanding how particular characteristics would influence labour supply changes and determine whether the effects of a reform differ for particular subgroups.

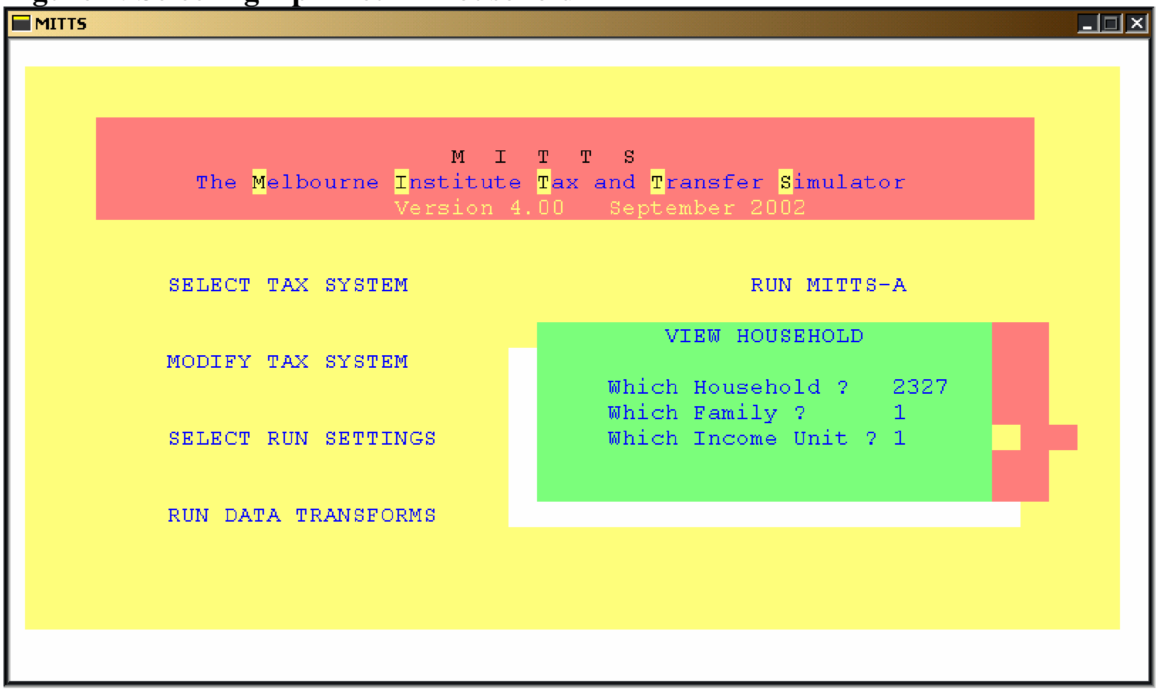
The pre- and post-reform output at the individual level can be viewed through the *View Households* button from the main menu. Figure 1 shows the additional choice in the *View Households* option. It shows that users can choose to view the details of any individual households from the dataset using either the static simulation (MITTS-A) or the behavioural simulation (MITTS-B).

Figure 1: View Households for MITTS-B



After selecting the option to view households from the sample using MITTS-B, users have to specify the household number, family number, and income unit number; this menu is shown in Figure 2.

Figure 2: Selecting a particular household



In Figure 3, the net incomes and benefit levels before the reform for the selected household – recorded here as household number 2327, family number 1, and income unit number 1 – are calculated based on the actual observed hours (similar to MITTS-A), but after the reform the net incomes and benefit levels are calculated using the expected hours. That is, it takes into account labour supply responses when calculating the net incomes for this particular individual after the reform. The displayed output is similar to what is presented when choosing *View Tax Details* in MITTS-A. For this household, which is a couple with dependent children, we have two separate screens for the head and the spouse. We move between the two screens with the page-up and page-down buttons (the same as in MITTS-A). The information at the top of the screen has changed slightly. Expected hours of work are added and gross earnings are deleted (which is just wage times hours).

Figure 4 shows the individual's and household's characteristics. This screen contains the same information in MITTS-B as in MITTS-A and is only added for the convenience of the user.

Figure 3: Tax and Benefit Calculations under behavioural simulation

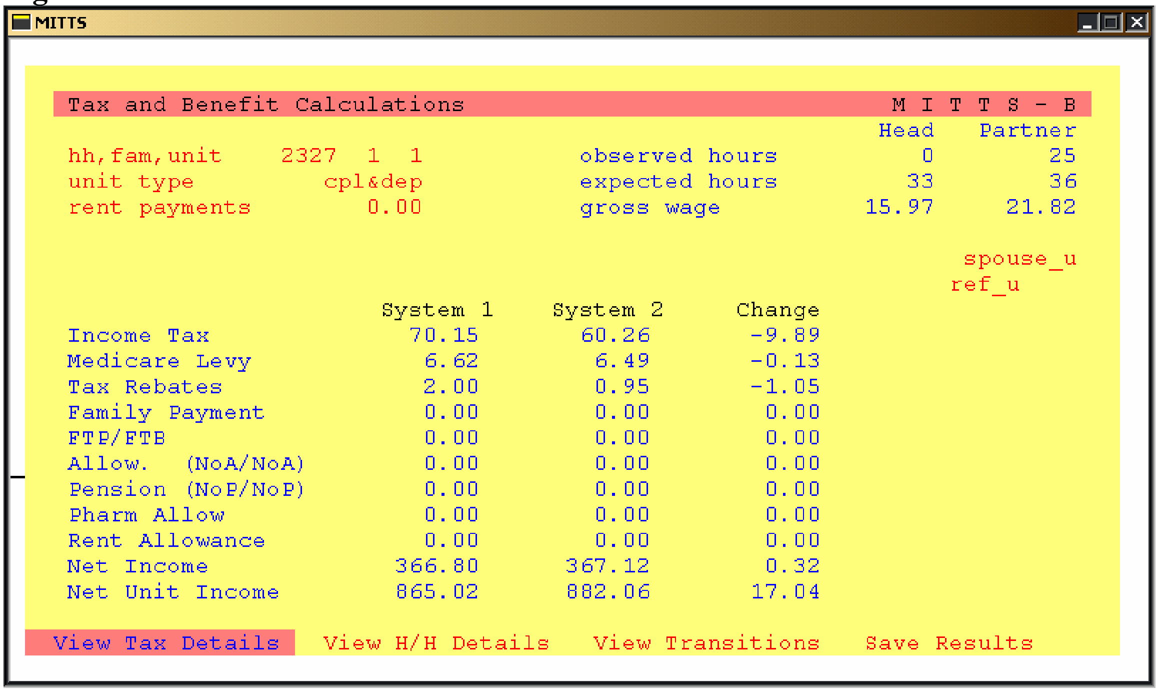
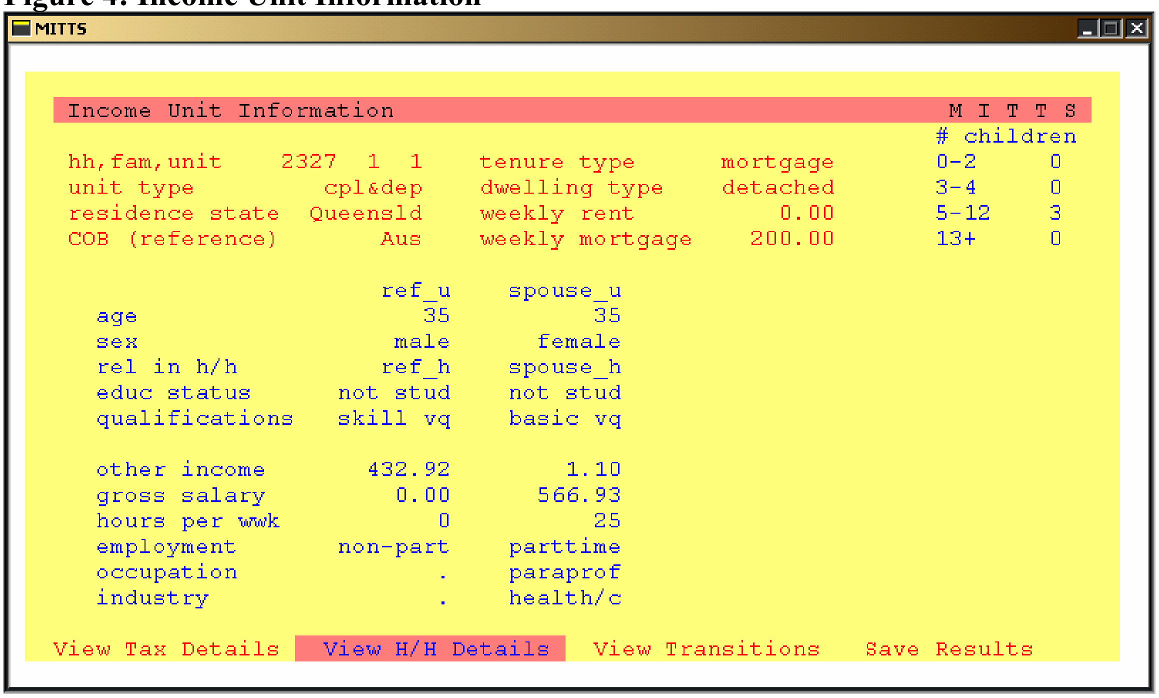
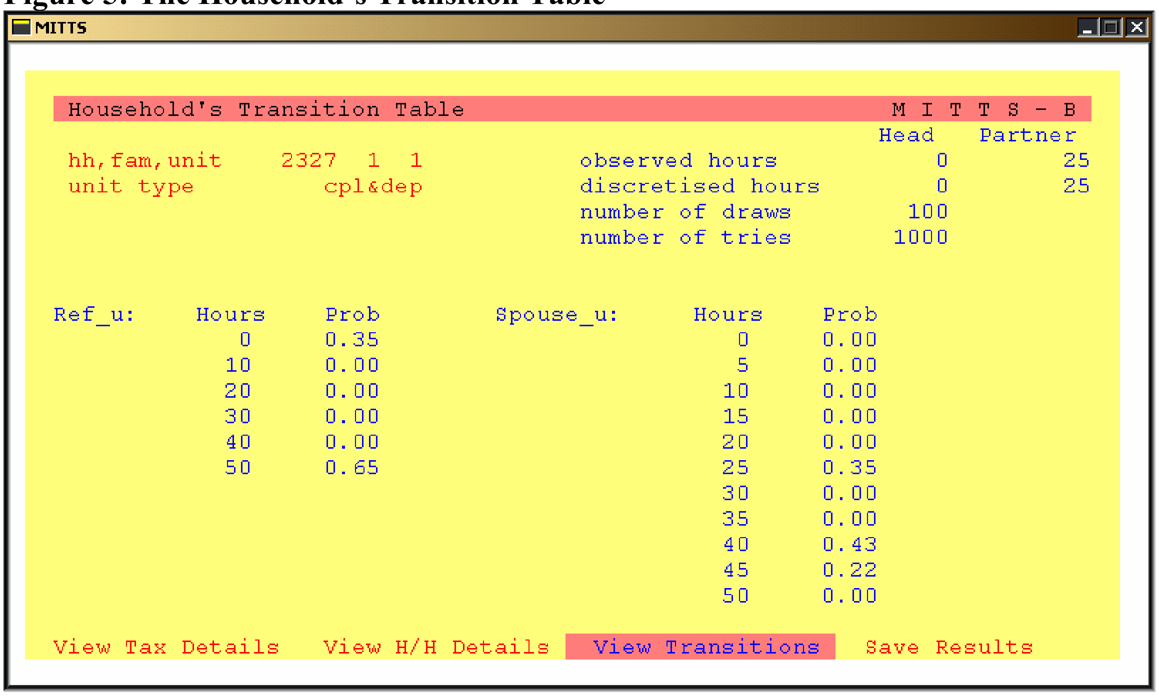


Figure 4: Income Unit Information



As can be seen in Figures 3 and 4 in the bottom menu bar, an alternative menu item has been added. The menu now allows the user to choose the *View Transitions* option. Figure 5 shows the screen for our household when *View Transitions* is chosen. The information for the head and spouse is presented in one screen. The screen also presents information on the simulation, that is the number of draws for the error distribution (100 are used in this example) and the maximum number of tries allowed for each draw (1000 are used in this example) to calibrate the pre-reform discrete hours points to the observed labour supply. More draws increase the precision of the probability distribution, particularly when small probabilities are involved. The observed hours present the actual hours of work before the reform and the discretised hours present the actual pre-reform hours rounded to the relevant discrete hours point. When a household is selected that is fixed at the observed hours (for example, when an individual is over 65 or disabled) this will be indicated on the screen.

Figure 5: The Household's Transition Table



In this example, the reference person does not work whilst the spouse is observed to work a total of 25 hours a week. In the discrete hours modelling framework, the reference person and the spouse are recorded at 0 hours and 25 hours, respectively. As can be seen in the figure, there are 6 and 11 discrete hours points for the head and spouse, respectively. It shows that, as a result of the policy change, the probability of the reference person moving from 0 to 50 hours is 0.65, while for the spouse, the probability of moving from 25 hours to 40 hours is 0.43 and the probability of moving to 45 hours is 0.22. The household in Figure 5 has a reasonably high transition probability, which is not typical and other households may show much more modest changes.

4.2 Results for individual households

The Australian New Tax System (ANTS) implemented on 1 July 2001 is used to generate the transition probabilities at the individual level for the four demographic groups. In this section we focus on the individual labour supply responses and compare the response with the associated pre- and post-reform budget constraints. We select one household from each of the demographic groups and report their labour supply response.[6] Table 4 presents the characteristics of each of these households and their labour supply responses.

Table 4: Characteristics of individual households

	Sole Parent	Single Man	Single Woman	Couple with Children		Couple without Children	
				Man	Woman	Man	Woman
Wage Rate	$22.42	$13.63	$16.30	$15.97	$21.82	$11.31	$27.88
Number of children	2	-	-	3	3	-	-
Age of youngest child	5	-	-	5	5	-	-
Observed hours	15	0	0	0	25	40	15
Labour supply responses after reform							
0	0.03	0.49	0.50	0.35	0.00	0.00	0.00
5	0.00	0.00	0.00	-	0.00	-	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.49	0.00	0.00	-	0.00	-	0.57
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	-	0.35	-	0.00
30	0.04	0.00	0.34	0.00	0.00	0.18	0.00
35	0.02	0.00	0.15	-	0.00	-	0.00
40	0.15	0.00	0.01	0.00	0.43	0.57	0.00
45	0.11	0.02	0.00	-	0.22	-	0.00
50	0.16	0.49	0.00	0.65	0.00	0.25	0.43

[6] The sole parent is taken from household number 472, family number 1, and income unit number 1. The single man is taken from household number 3339, family number 1, and income unit number 2. The single woman is taken from household number 2393, family number 1, and income unit number 1. The couple with children is taken from household number 2327, family number 1, and income unit number 1. The couple without children is taken from household number 27, family number 1, and income unit number 1.

To help interpret the results in Table 4, Figures A.1 to A.7 in the Appendix show the budget constraints associated with the individual households presented in Table 4. Comparing the budget constraints for the different households, it is clear that the changes were more straightforward for households without dependent children. Net income has increased quite evenly across the labour supply range, with the increase being smaller at low hours (low income) and larger at a higher level of labour supply. This change is mostly driven by the income tax changes. The figures for households with dependent children look more complicated because of the interaction of the income tax changes and the family benefit changes. This results in the increase in net income going up, then going down, before going up again across the hours of labour supply range.

The result for the sole parent household in Table 4, where the sole parent has a relatively high wage rate, shows there is a very small probability of the household withdrawing from the labour market and a nearly 50 per cent probability of an increase in labour supply. Examining the budget constraint in A.1, it can be seen that net income has increased at all levels of labour supply but most at the higher income levels. In addition to this the slope of the budget constraint has become somewhat steeper over most hours ranges. Both effects can provide an incentive to work more hours.

The effect for the single man seems much more dichotomous. He either stays out of the labour market or he decides to work 50 hours. When looking at his budget constraint, this can be explained by the relatively low effect of the policy change, particularly for the lower hours of labour supply. This can be explained by his relatively low wage rate. The increase in net income is highest at the highest levels of labour supply. At the lower hours of work the improvement of net income after the reform is very modest, not providing much of an additional reason to enter the labour market compared to the pre-reform situation.

The effect for the single woman is expected to kick in at a lower level of labour supply, given that the budget constraint shows a more substantial increase in net income at lower levels of labour supply. This is reflected in the predicted response which is to work 30 or 35 hours per week if she decides to enter the labour market.

The couple with dependent children graphs illustrate the pre-reform "sudden-death" withdrawal of family benefits between 25 and 30 hours of labour supply for the head and around 45 hours of labour supply for the spouse.[7] There is only a large predicted probability of working 50 hours for the non-working head, although there are relatively high net income increases from just below 30 hours onwards. However, in the pre-reform system there was a drop in net income just below 30 hours (resulting from the "sudden-death" withdrawal of family benefits), which means the large increase is from a relatively disadvantaged position. The spouse, who already works 25 hours, has a high probability of increasing her labour supply to 40 or 45 hours, which shows a relatively high increase in net income. Although an even higher increase can be observed at 50 hours, this increase is from a relatively disadvantaged pre-reform position and the increase does not seem sufficient to make the highest labour supply level attractive enough.

Finally, an example for couples without dependent children, where the head works 40 hours and the spouse works 15 hours. The head has comparable probabilities of moving one hours level up or moving one hours level down. The highest probability is of having no change. His spouse is also most likely to remain where she is, but if she moves she is predicted to move to 50 hours, where the difference between pre- and post-reform net income is higher than at the lower levels of labour supply. This is driven by her relatively high wage rate.

5. Conclusion

This project has resulted in two useful extensions of the behavioural component in MITTS. First, the point estimates of changes in costs and revenue to the government and labour supply responses can now be complemented by confidence intervals for these

[7] In couple households the budget constraint for the head is drawn conditional on the observed labour supply for the spouse and vice versa. This results in the net income at zero hours being different for the head and the spouse.

effects, and second, the impact of policy changes on individual labour supply can now be viewed interactively in MITTS.

The report has given illustrations of these two new facilities. This shows that in the case of the ANTS policy simulation, the predicted point estimates of changes in expenditure and labour supply are quite accurate. Except for sole parents, labour supply effects are positive but small. Government expenditure has increased for all groups as a result of the reduced direct income tax, which is of course at least partly compensated by the increase in indirect taxation through the GST.

We have also viewed a few individual households and it is interesting to see how the individual budget constraints relate to the effects shown in the labour supply transition tables.

References

Soest, A.V. (1995) "Structural Models of Family Labour Supply," Journal of Human Resources, 30, pp. 63-83.

Kalb, G., Kew, H., and Scutella, R. (2002) "Effect of the New Tax System: A policy simulation using the Melbourne Institute Tax and Transfer System". Final report prepared for the Department of Family and Community.

Appendix: Figures with pre- and post-reform budget constraints

Figure A.1: Budget Constraint for a sole parent

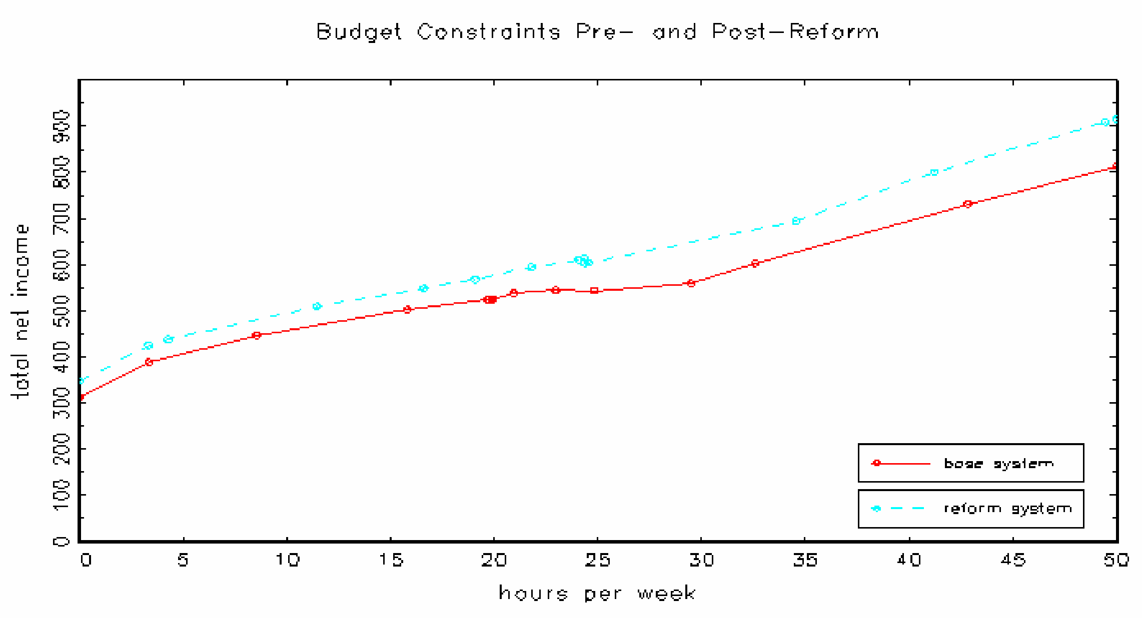


Figure A.2: Budget constraint for a single man

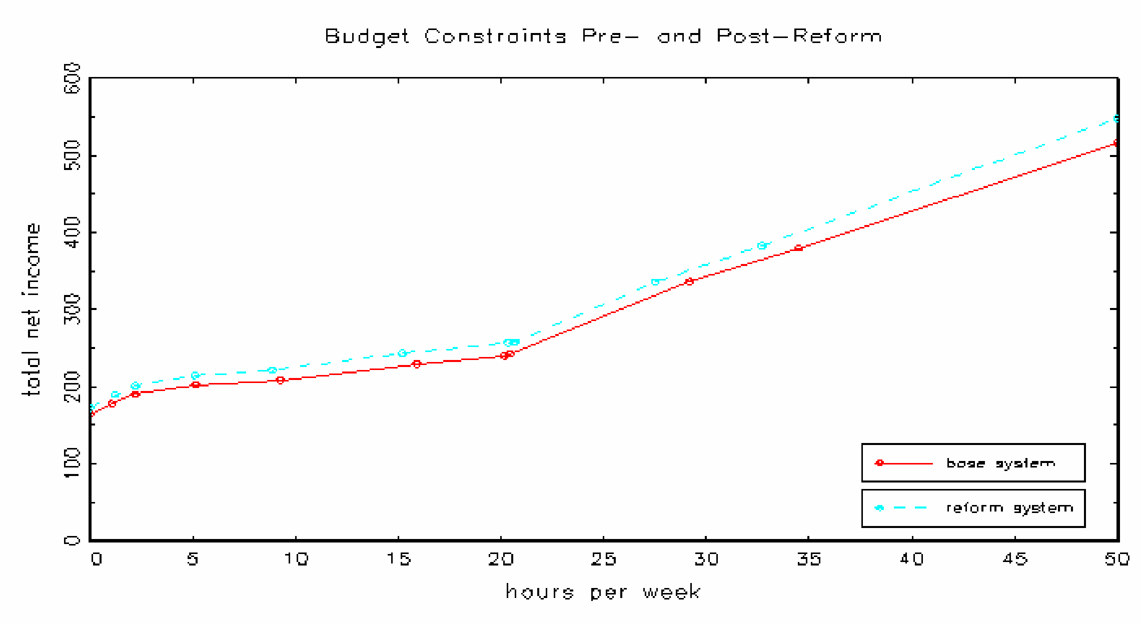


Figure A.3: Budget constraint for a single woman

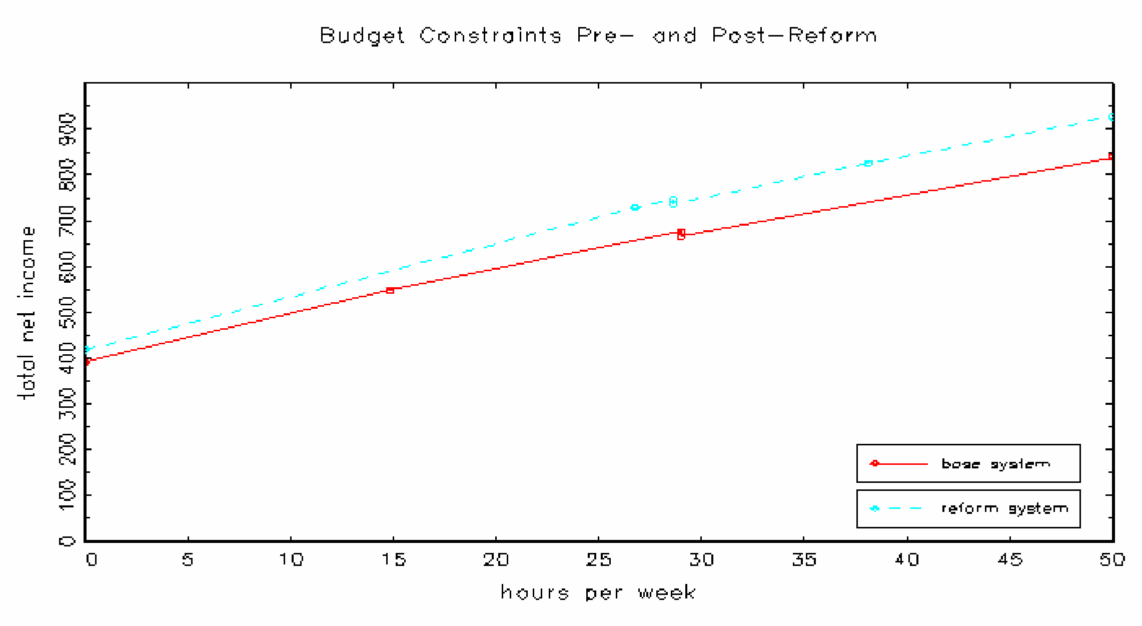


Figure A.4: Couple with children, the male's budget constraint

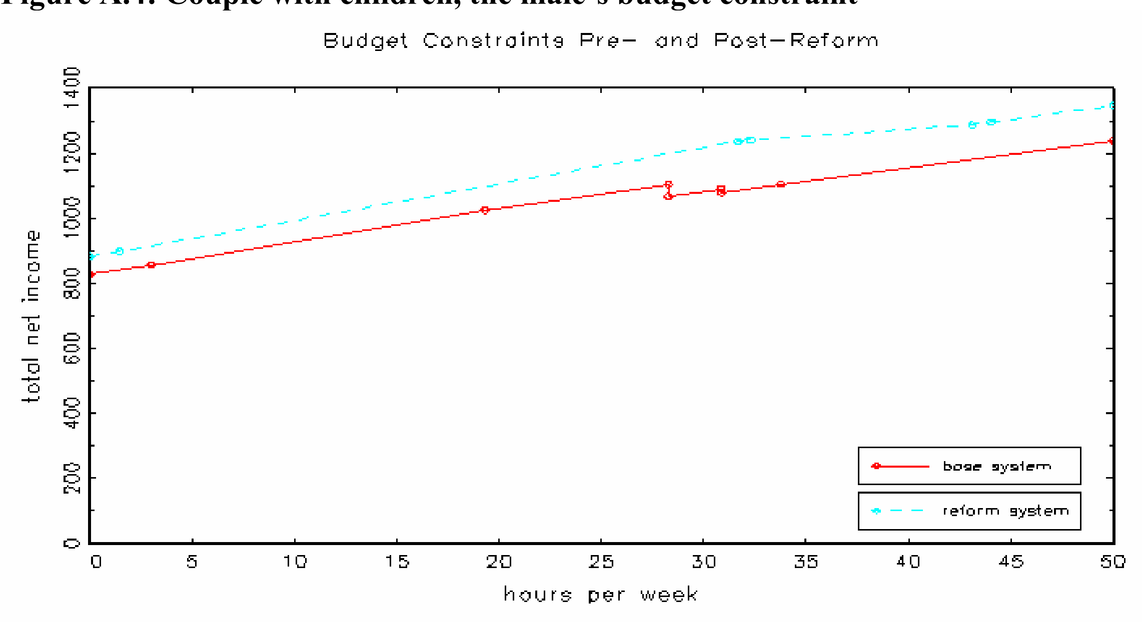


Figure A.5: Couple with children, the female's budget constraint

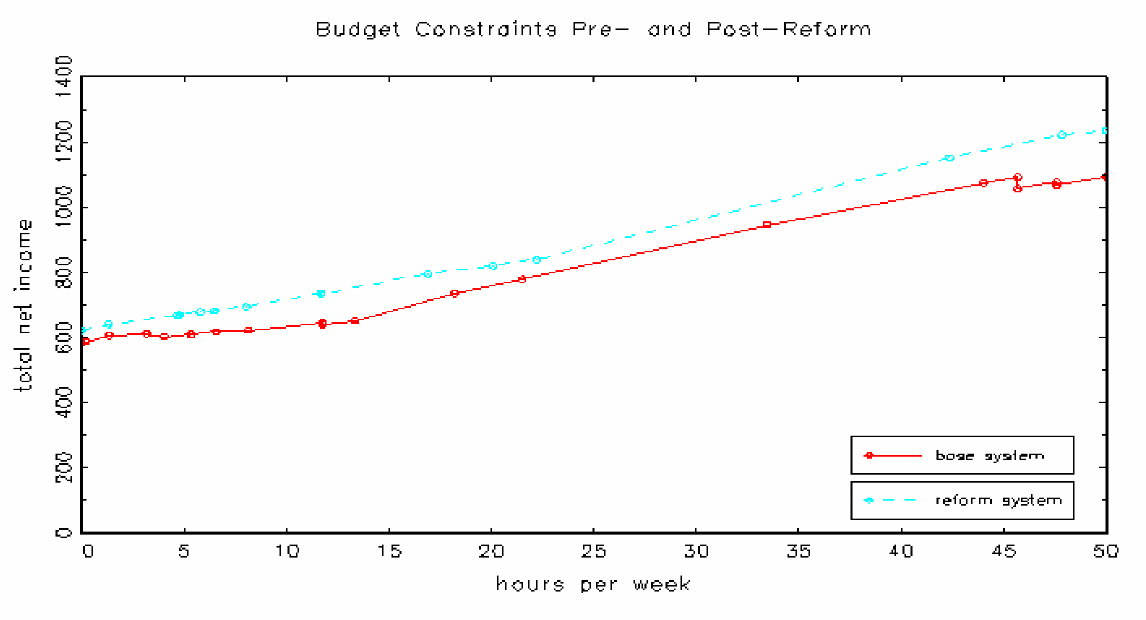


Figure A.6: Couple with no children, the male's budget constraint

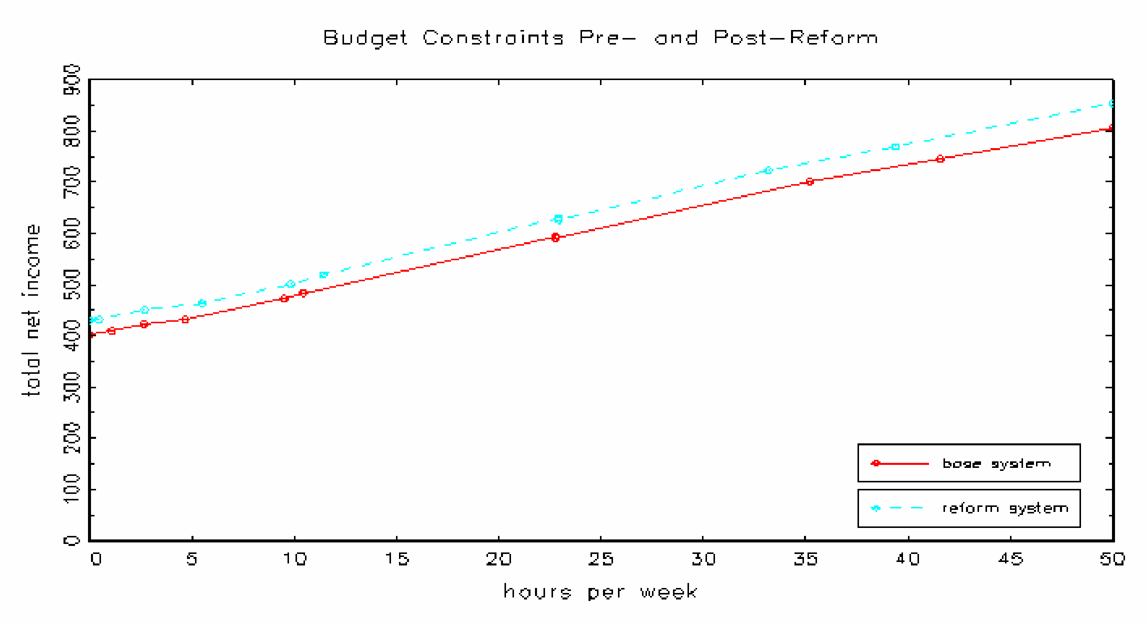


Figure A.7: Couple with no children, the female's budget constraint