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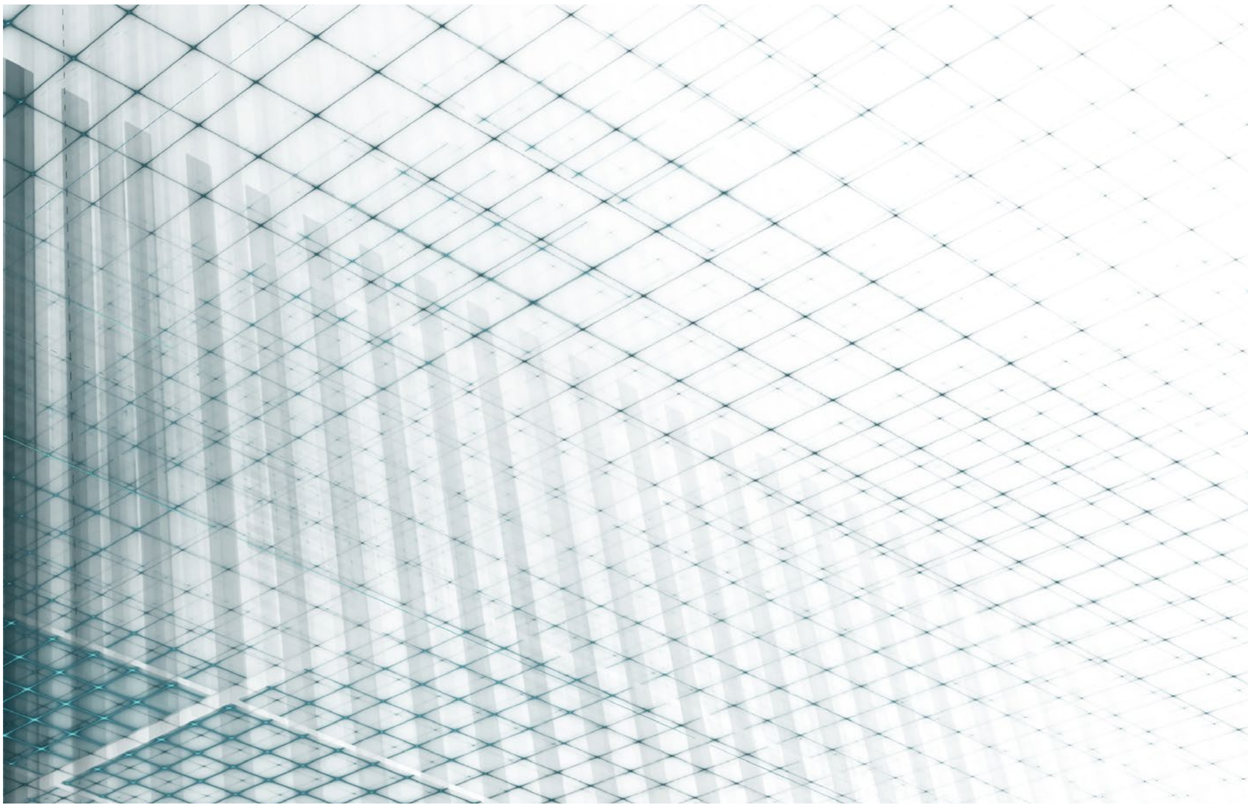

Model of the Australian tax and transfer system

A flexible open-source approach to tax-transfer modelling

M. Taylor

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Model of the Australian tax and transfer system: a flexible open-source approach to tax-transfer modelling

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Abstract

This paper introduces a new model of Australia's tax and transfer system: Model of the Australian Tax and Transfer System (MATTS). MATTS is a suite of Stata commands that provide researchers with the ability to model individual tax and transfer policies.

The MATTS suite can be applied to a range of tax-transfer modelling problems and methodologies, and is freely available to anyone with an interest in tax-transfer research.

This paper presents a specific application in which MATTS is used to illustrate how Australia's tax-transfer system augments the disposable incomes and effective marginal tax rates of single income support recipients. These simple examples illuminate some of the trade-offs involved in the design of means-tested tax-transfer systems.

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Acronyms

ABS	Australian Bureau of Statistics
AETR	average effective tax rate
ANU	Australian National University
BTO	Beneficiary Tax Offset
CRA	Commonwealth Rent Assistance
CURF	Confidential Unit Record File
DSP	Disability Support Pension
EMTR	effective marginal tax rate
LITO	Low Income Tax Offset
MATTS	Model of the Australian Tax and Transfer System
SAPTO	Senior Australians and Pensioners Tax Offset

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Tables and figures

Executive summary

This paper introduces a new model of Australia's tax and transfer system: Model of the Australian Tax and Transfer System (MATTS). MATTS is a suite of Stata commands that provide researchers with the ability to model individual tax and transfer policies.

In contrast to traditional tax-transfer models, MATTS is not a fully formed model built on a specific household survey dataset. Rather, MATTS is a suite of commands that can be applied across a range of tax-transfer modelling contexts, including cameo modelling, distributional modelling and structural economic modelling. MATTS facilitates the development of bespoke tax-transfer modelling that can be built on any dataset that contains sufficient information for modelling tax and transfer policies.

The commands are freely available to anyone with an interest in tax-transfer research. In light of the proliferation of tax-transfer models in Australian public policy research, it is hoped that the open-source nature of MATTS will reduce duplication in model development efforts among tax-transfer researchers and improve the replicability of tax-transfer research in Australia.

This paper presents a specific application of MATTS in which the commands are used to illustrate how Australia's tax-transfer system augments the disposable incomes and effective marginal tax rates of single income support recipients. These simple examples show how a tax-transfer model can be used to illuminate some of the trade-offs involved in the design of means-tested tax-transfer systems.

1 Introduction

Microsimulation models were first proposed by Orcutt (1957), who noted that '… current models of our socio-economic system only predict aggregates and fail to predict distributions of individuals, households, or firms in single or multi-variate classifications' (Orcutt 1957:116). Orcutt's vision was of models built on microdatasets, rather than the time-series data that formed the basis for the models of the time. Orcutt hoped that these new models would '… improve prediction about socio-economic aggregates by providing a method of bringing to bear knowledge about the elemental decision-making units that make up a socio-economic system' (Orcutt 1957:122).

Although microsimulation models refer to any model of a socioeconomic system built on microdata, the most common application of this approach in Australia is the modelling of the personal income tax and social security system. A typical tax-transfer model describes the mathematics of how taxation and social security policies transfer the incomes of individuals. At a minimum, this modelling requires data on the amount of income an individual receives that attracts personal income tax and any form of income used in the assessment of eligibility for social security payments. It is not uncommon for some tax policies to affect individuals differently according to their demographic characteristics, and many social security payments are reserved for those in particular household settings. For this reason, additional data on the demography of an individual, and others in their household, are also required. Most contemporary tax-transfer models are built on household income surveys, most commonly the Australian Bureau of Statistics (ABS) Survey of Income and Housing.

The primary purpose of tax-transfer models is to assess policy counterfactuals. Although household surveys can inform us of the evolution and distribution of individual and household incomes, they can only tell us about the outcomes of tax and transfer policies as they existed at the time of data collection. Tax-transfer models are mathematical abstractions of these policies that enable us to assess how incomes might have been distributed had the parameters and eligibility criteria of the policies been different from what they were. They can answer questions such as: How much additional tax revenue would the government receive if the top marginal tax rate were increased by 5 cents in the dollar? By how much would individual incomes decline if the maximum rate of a pension were cut by 10% for those currently eligible? Which households would benefit if eligibility for a pension were broadened?

Although the microsimulation approach to modelling tax and transfer policy was first proposed in the late 1950s, it took advances in computing power and the availability of microdata for Orcutt's vision to become reality. The first microsimulation model, SUSSEX, was completed in 1961, built on microdata from the 1950 United States Census of Population and run on an IBM 704 (Orcutt et al. 1961).[1] The development of Australian tax-transfer models had to wait until the early 1980s, with the first release of household income survey data by the ABS in the form of a Confidential Unit Record File (CURF)[2] (ABS 2015).

Tax-transfer models that are currently in use in Australia include the Australian Treasury's CAPITA model, PolicyMod at the Australian National University's Centre for Social Research and Methods, the Melbourne Institute Tax and Transfer Simulator (MITTS) at the Melbourne Institute of Applied Economic and Social Research, the Evaluation Model for Incomes and Taxes in Australia (EVITA) at Curtin University, and the Static Incomes Model+ (StInMod+) at the National Centre for Social and Economic Research. All of these tax-transfer models make use of the Survey of Income and Housing.

Tax-transfer models have a number of uses in research on taxation and social policy. They can provide estimates of the fiscal impact of a change in policy. An example is Hayes and Redmond (2012), who used a tax-transfer model to assess the fiscal impact of a generous nontaxable universal family benefit and more progressive personal income taxation. Their analysis indicates that their particular formulation would have increased spending on family payments in 2012–13 by $11.6 billion and tax revenue by $4.5 billion, leaving a shortfall of $7.1 billion.

Another important contribution that tax-transfer models make to public policy research is in aiding our understanding of how the incomes of different types of households and individuals will be affected by a policy change. Phillips and Taylor (2015) used a tax-transfer model and data from the ABS Household Expenditure Survey to model the distributional implications of personal income tax cuts financed by an expansion in the base of consumption taxes. They found that a 3% cut in each personal income tax rate in 2015–16 would reduce personal income tax by the same amount that would be raised by an expansion in the base of the goods and services tax (GST) to cover food and nonalcoholic beverages, water and sewerage, health and community services, and education services ($18.6 billion). Their modelling suggests that this change in the tax mix would reduce the progressivity of Australia's tax system. On average, the disposable incomes of households (net of GST) in the top quintile of equivalised household disposable income would increase by 1.4% compared with a reduction of 4.4% for those in the bottom quintile.

Given the complexity of individual tax-transfer policies and the way that they interact with one another in forming disposable income, tax-transfer models can also play a role in aiding our understanding of how a set of policies shape economic decision making by presenting graphs that relate disposable income to private income for hypothetical individuals. When tax-transfer models are used in this way, it is referred to as cameo modelling.

Apps and Rees (2010) used a simple tax-transfer model to argue that, although the structure of Australia's personal income tax system is applicable to individual taxable income, once the Family Tax Benefit and the Medicare levy are taken into account, couples are effectively taxed on their combined incomes. The authors present cameos that show how these policies, when taken together, impose high effective marginal tax rates (EMTRs) on secondary earners on low and middle incomes once children are present. They also illustrate how the average effective tax rates (AETRs) imposed on dual-earner households are more than twice those imposed on a single-earner household with the same level of taxable income.

The purpose of tax-transfer policy is often more than the mere redistribution of income. The behavioural response of individuals to the tax-transfer system, or 'second-round effects', can have significant implications for tax revenue and expenditure on government payments that are not captured by static microsimulation models.

Although not common practice, a number of Australian studies attempt to estimate second-round effects. One example is Gong and Breunig (2015) who decomposed the impact of childcare subsidies and tax rebates on total tax revenue, net of taxpayer-funded support for child care. Their analysis takes into account the contribution that each of these policies makes to total tax revenue via their impact on demand for child care, labour-force participation and hours worked net of their outlays. They conclude that a dollar spent on child care rebates yields a 13 cent higher return in net tax revenue than childcare subsidies, but that subsidies are better able to increase the welfare of low-income households.

While these authors model the impact of these policies on labour supply, taking into account the flow-on consequences for social security payments and personal income tax, their welfare comparisons make a number of assumptions. They do not account for the administrative costs of administering tax and transfer programs, assume that any additional demand for child care is met without any increase in childcare prices, and do not consider how an increase in the tax burden would be felt by different households. Although work of this nature makes an important contribution to understanding the likely consequences of potential policy reforms compared with the 'morning after' modelling that is typical of the tax-transfer literature in Australia, it will never be enough to silence all critics.

This paper introduces a new model of Australia's taxation and social security system: Model of the Australian Tax and Transfer System (MATTS). MATTS takes a somewhat different approach to tax-transfer modelling than the models listed above, in that it is a suite of commands written in the Stata programming language. Each of these commands models a specific tax or transfer policy. They can be used to construct cameos that show how the amount of a tax liability, or entitlement to a government payment, varies with private income and hours worked for a given wage rate. MATTS commands are publicly available and can be downloaded like any other user-written Stata command.

In addition to constructing cameos, MATTS commands can be run over survey data to simulate counterfactual policy settings and conduct distributional analysis. Where MATTS differs from other tax-transfer models is that it does not come packaged with a survey dataset required for such modelling efforts. It is up to the user to construct their own survey dataset for their purposes; once this is completed, the commands can be used for bespoke tax-transfer modelling. Although the MATTS commands could be put to a range of uses, the focus of this paper is to demonstrate how MATTS can be used to produce cameos that explain how the tax system affects single individuals with different levels of private income.

Clearly, MATTS is not for users who want to 'point and click'. The audience for this paper – and for the model more generally – is those who have an introductory level of ability in Stata programming and an interest in tax-transfer modelling. More sophisticated users with expertise in structural labour supply modelling may also find MATTS of value, because this sort of research requires estimating counterfactual amounts of disposable income for different levels of labour supply for a given wage rate. It is hoped that MATTS will allow researchers who do this modelling in Stata to spend more time on their econometric methodology, and less time coding up tax and transfer policies.

2 A crash course in Australian tax-transfer policy

Writing just after the turn of the century, Krever (2003) noted 'For several decades the [Tax] Act doubled in size every seven years but the pace of change has increased significantly in the past three decades, as has the complexity of the law' (Krever 2003:469). The same could be said of social security law. Of the two volumes of *A compendium of legislative changes in social security*, the first, covering 1908–1982, is a mere 137 pages. The second, covering the 17 years to 2000, is just under 1000 pages (DSS 1983; Daprè 2006a,b). Although there have been moves to simplify taxation legislation in recent times, there has been little in the way of reform in the past decade to reverse this trend for social security (Joint Committee of Public Accounts and Audit 2008).

This section provides an overview of Australia's tax and transfer system as it pertains to single individuals, with a focus on social security pensions and allowances, and personal income taxation. The purpose of this section is to introduce those aspects of the tax-transfer system that will facilitate the reader's understanding of the modelling methodology that follows. It is not intended as a thorough and exhaustive description of the system or of its constituent policies (which would require a weighty tome in their own right).

2.1 Income transfers

Australia's social security system began in 1908 with the enactment of legislation that established the age pension. This Commonwealth legislation replaced similar schemes that had been set up in New South Wales and Victoria, and made its first payment in 1909. In contrast to the social security systems that had been established in parts of Europe in the previous century, Australia's system was noncontributory. The age pension was – and remains – funded from general revenue rather than employer and employee contributions. Although subject to means testing, the maximum entitlement was, and remains, a flat rate unrelated to previous earnings. A universal Maternity Allowance followed in 1912, and unemployment benefits in 1945 (Herscovitch & Stanton 2008).

Today, social security and welfare expenditure accounts for $153 billion of Australian Government expenditure (Morrison & Cormann 2016). The age pension makes up the lion's share at $43.1 billion and dwarfs unemployment benefits, now termed Newstart Allowance, which make up $9.9 billion (Morrison & Cormann 2016). Despite this, there remains a popular perception among Australians that unemployment benefits are the largest social security payment made by the Australian Government (Sheppard et al. 2016).

Australia's social security system comprises two types of payments: pensions and allowances. According to the Harmer Review of pensions, their objective is 'providing an adequate level of income to those unable or not required to support themselves' (Harmer 2009:128). Allowances are paid to people of working age, and are intended to provide short-term financial assistance to those seeking paid employment and those who are employed on low incomes. In contrast to pensioners, allowees are usually required to meet job search requirements as a condition of eligibility for their payment (Australian Government 2017b). A detailed description of the various types of pensions and allowances, and their payment rates and eligibility criteria can be found in Centrelink's *A guide to Australian Government payments* (Centrelink 2017).

Both pensions and allowances are means tested, which means that recipients' entitlement to a specific level of payment is reduced as their assessable social security income and/or assessable assets increase. Means testing of payments ensures that Australia's social security system is one of the most 'targeted' in the developed world – meaning that those on low incomes derive a far greater benefit from the system than those on high incomes (Whiteford 2010). Where pensions and allowances differ is that the maximum entitlement a recipient receives is higher for pensioners than it is for allowees – a gap that has grown considerably over time as a result of differences in indexation (ACTU 2012, McVicar and Wilkins 2013).

Figure 1a presents the annual level of allowance receipt for a single allowee by assessable social security income – in addition to the allowance's constituent components – as of 2016–17. Figure 1b presents the same information for pensions.

2.2 Income tax

Social security income transfers are financed via taxation, of which personal income tax contributes the greatest share (Morrison & Cormann 2016). The first federal government income tax was levied in 1915 to fund Australia's war effort in the First World War. It operated alongside state income taxes until 1942, when income tax was consolidated by the Commonwealth to provide revenue to fund Australia's involvement in the Second World War (Reinhardt & Steel 2006).

Australia's income tax system has always been progressive, such that taxpayers with taxable incomes above higher thresholds pay a higher marginal rate of tax than those with taxable incomes above lower thresholds. Table 1 presents the income tax thresholds and marginal rates for the 2017–18 financial year.

Table 1 **Formal tax scales for the 2017–18 financial year**

Taxable income ($)	Tax on this income
0–18 200	Nil
18 201–37 000	19 cents for each $1 over $18 200
37 001–87 000	$3572 plus 32.5 cents for each $1 over $37 000
87 001–180 000	$19 822 plus 37 cents for each $1 over $87 000
180 001 and over	$54 232 plus 45 cents for each $1 over $180 000

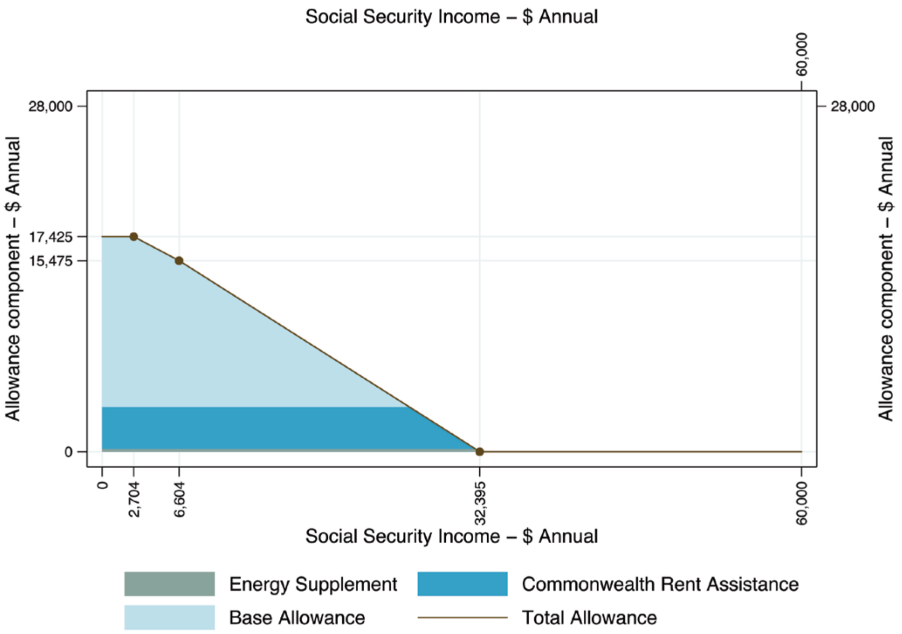
Source: Australian Taxation Office

Australia's personal income tax system is considerably more complicated than the formal tax scale illustrated in Table 1 would imply. The personal income tax system is complicated by various tax offsets and levies. The levy that affects most taxpayers is the Medicare levy, which partially funds the Medicare scheme. However, the $15 billion the Medicare levy raised in 2015–16 is considerably less than the $22.2 billion spent on Medicare benefits and is dwarfed by the $69 billion the Australian Government spent on health in that financial year (Australian Government 2016, 2017a).

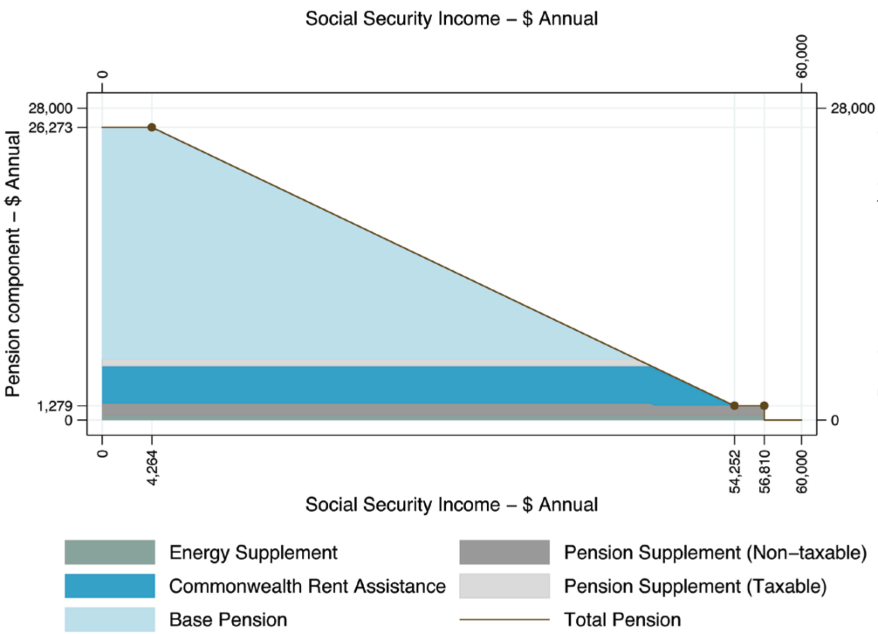
In contrast to some European nations, Australia's tax system is an individual tax system, in which members of a couple face the same tax rates (shown in Table 1). In some countries, couples are, or have the option of being, assessed according to their combined income (Bettio & Verashchagina 2009). Although this is not the case in Australia, there are elements of joint taxation over certain ranges of taxable income in the Medicare levy, and, when family payments are considered, the system as a whole is most certainly one that treats couples jointly (Apps & Rees 2010).

Figure 1 Components of means-tested social security payments, 2016–17

(a) Allowances



(b) Pensions



Notes: The entitlements in both panels assume no assessable assets.
Source: Model of the Australian Tax and Transfer System

2.3 Some useful tax-transfer concepts

Private income generally refers to income that is earned by an individual via the provision of labour or the rental of capital. The former usually takes the form of wages and salary, and the latter may include dividends from incorporated or unincorporated businesses and interest. Not all private income is subject to personal income tax. For instance, wages transferred into superannuation accounts are, subject to the annual contributions cap, exempt from personal income tax.

Taxable income comprises those forms of private income that form part of the personal income tax base less tax deductions. Tax deductions include, among other things, work-related expenses and personal superannuation contributions. The amount of personal income tax that arises from the application of the marginal tax rates in Table 1 is termed gross tax. Net tax refers to the amount of tax payable once tax offsets and dividend franking credits have been deducted from gross tax.

An individual's economic welfare is usually measured in terms of disposable income. This is total private income plus social security payments less net tax and levies payable. It is the income that is left over once the individual's obligations to the state have been paid.

EMTRs can be thought of as a generalisation of the tax rates in Table 1. The table indicates that those with taxable income in excess of $37 000 lose 32.5 cents for every dollar earned above this amount – a marginal tax rate of 0.325 per dollar of taxable income above the threshold. Since personal income tax reduces the amount of income an individual receives from investing or increasing their hours worked to earn an additional dollar, it makes sense that this presents a disincentive – even if only a small one – to work an additional hour or invest an additional dollar.

EMTRs take into account both the marginal rates of tax paid and the tapering of social security benefits described in Table 1. More specifically, an EMTR is the rate of disposable income that is lost over a range of private income and is therefore a function of all of the tax-transfer policies that affect disposable income, not just tax and tax offsets. Mathematically, the EMTR over the range of private income between x and $x + \Delta$ is equal to:

$$EMTR(x + \Delta) = -\left(\frac{y(x+\Delta)-y(x)}{x+\Delta-x} - 1\right)$$

where y is disposable income, itself a function of private income, and each of the tax and transfer policies that affect y over Δ. Although EMTRs are a function of private income, it is often informative to plot them with respect to the hours worked, at a given wage rate, required to earn different levels of private income.

Finally, an AETR is a generalisation of the tax burden. The tax burden, or average tax rate, refers to the percentage of an individual's private income that is lost in net tax. AETRs refer to disposable income as a percentage of private income. Those who are net beneficiaries of the tax-transfer system may face AETRs that are less than zero.

3 Setting up a simple tax-transfer cameo

Although Table 1 will be informative for most readers, some may find it easier to understand what progressive taxation involves if they can see how the amount of tax paid varies with taxable income. It is simple enough to use the MATTS command *tax* for this purpose; however, before presenting the command syntax, it is important to understand the policy parameters of personal income tax.

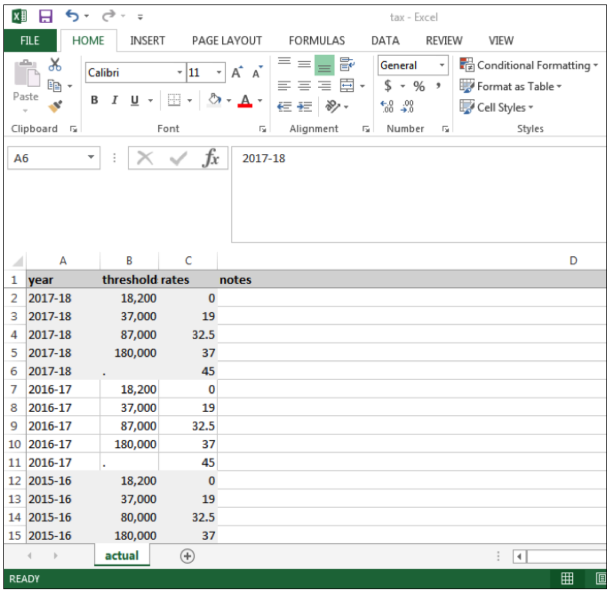
Figure 2 presents an excerpt of the parameter sheet for the *tax* command. The parameter sheet is merely a Microsoft Excel workbook that contains a worksheet labelled ‘actual’, which contains the tax parameters for various financial years. The sheet is labelled ‘actual’ because it contains the personal income tax parameters that actually existed in these financial years. If users want to model some counterfactual tax parameters, they need only insert a new worksheet into the workbook and are free to label this new worksheet however they wish. However, the new worksheet must have the same format as ‘actual’, with columns titled ‘year’, ‘threshold’ and ‘rate’. Each row within a financial year block must have a valid numerical value in it. The only exception is the final row in the block for the ‘threshold’ column, which does not require a value since the tax rate for this row will apply to all taxable income in excess of the value in the penultimate row of the ‘threshold’ column. For example, for financial year 2017–18, the marginal tax rate for annual taxable incomes in excess of $180 000 will be 0.45. The column ‘notes’ has nothing to do with the command – it is just there for users who want to annotate their parameters.

Before implementing the *tax* command, we need to set up a Stata dataset (a *.dta* file) that includes a variable that represents different levels of taxable income from which gross tax will be simulated. When implementing a cameo in MATTS, each MATTS command expects to find three variables in memory:

- a numerical variable, of storage type double, increasing at a constant increment called ‘xaxis’
- a string variable, of length 50, called ‘display’
- a numerical variable, of storage type double, called ‘hours’.

It is important that ‘xaxis’ and ‘hours’ be variables of storage type double for reasons that will become apparent shortly. The variable ‘xaxis’ is named thus because it will form the horizontal axis of the graph that we wish to draw. Our aim here is to show how a tax liability varies with taxable income, and so ‘xaxis’ will contain the levels of taxable income for which we would like to observe simulated amounts of gross tax. There is no need for ‘hours’ to contain any values; it is there just in case we want to plot gross tax by hours worked at a given wage rate. If this is our aim, ‘hours’ is merely ‘xaxis’ divided by the hourly wage rate, and further divided by 52 should we want to render hours worked per week. The role of the string variable ‘display’ will become clear in the following section.

Figure 2 Parameter sheet tax.xlsx



	A	B	C	D
1	year	threshold	rates	notes
2	2017-18	18,200	0	
3	2017-18	37,000	19	
4	2017-18	87,000	32.5	
5	2017-18	180,000	37	
6	2017-18	.	45	
7	2016-17	18,200	0	
8	2016-17	37,000	19	
9	2016-17	87,000	32.5	
10	2016-17	180,000	37	
11	2016-17	.	45	
12	2015-16	18,200	0	
13	2015-16	37,000	19	
14	2015-16	80,000	32.5	
15	2015-16	180,000	37	

Source: Model of the Australian Tax and Transfer System

The typical syntax to set up a cameo to observe gross tax over an interval of annual taxable income from $0 to $190 000 would look like:

```
local increment = 1
local max       = 190000
local wagerate  = 15.85
local obs       = (`max' / `increment') + 1

set obs `obs'
generate double xaxis   = ( _n - 1)*`increment'
generate double hours   = (xaxis / `wagerate') / 52
generate str50  display = ""

tax xaxis, fyear(2017-18) parameters(actual)
```

The code above enables a simulation of gross tax at every dollar of taxable income between $0 and $190 000, but there is nothing stopping the user from specifying a larger increment, such as $10, $100 or even $1000. The only cost of a smaller increment is that more rows must be added to the *.dta* file, and additional time is required for the command to run over more rows. Users are also free to choose an income range that begins at whatever value they wish; there is no need to begin at $0 as in the code above.[3]

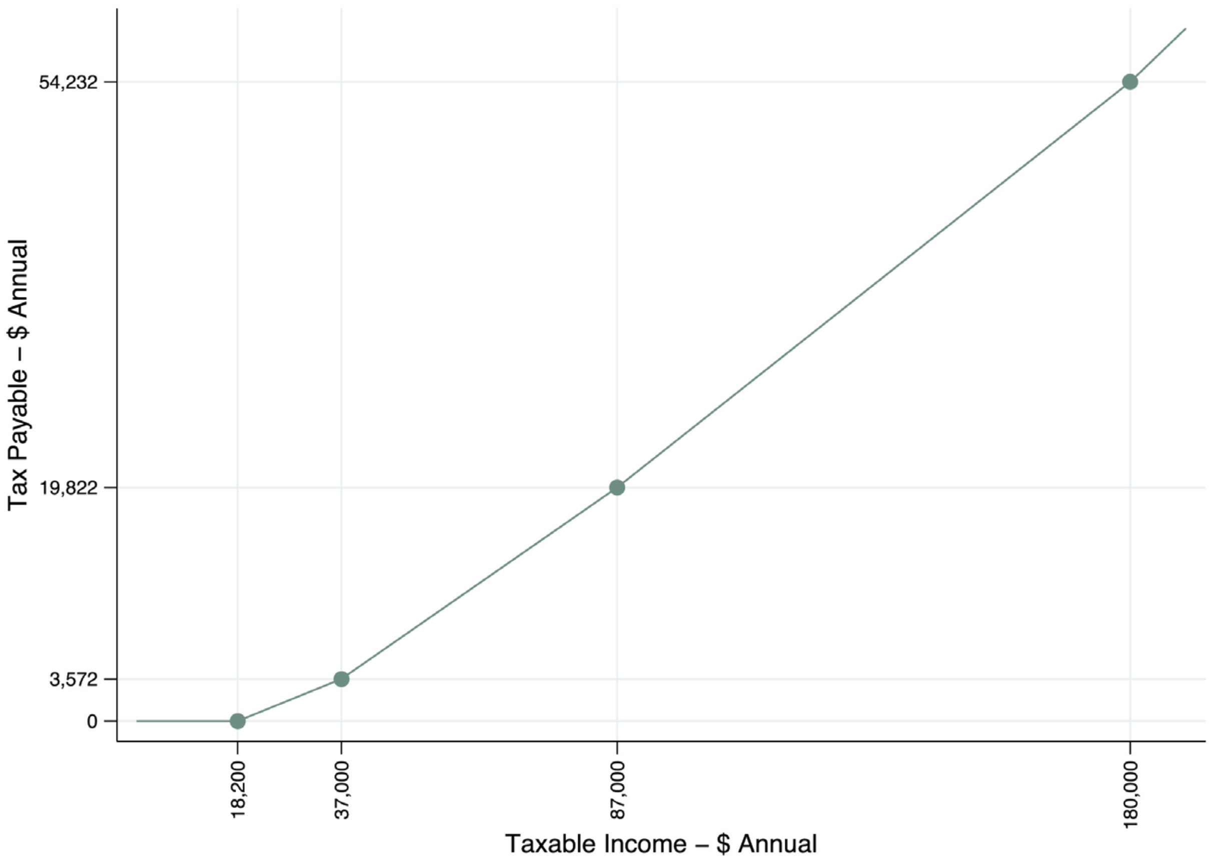
With these variables in memory, it is now possible to run the *tax* command as indicated above. The options specified after the comma include *fyear* and *parameters*, and both are required for the command to run successfully. The options tell *tax* where it will find the tax parameters we wish to simulate. Specifying '2017-18' in *fyear* and 'actual' in *parameters* ensures that *tax* takes its parameters from B2 to C6 in *tax.xlsx* shown in Figure 2. Parameters for the 2015–16 financial year (B12 to C15) could be obtained by specifying '2015-16' in *fyear* and 'actual' in *parameters*.

Once the command has finished running, it adds two variables to the *.dta* in memory: 'tax' and 'marginalrate'. The first of these contains the simulated amounts of tax payable; the second is a string variable that records which tax bracket the level of taxable income resides within. The command also saves the values of the tax thresholds and the amount of tax paid at the tax thresholds in the r-class macros *r(tax_xlabel)* and *r(tax_ylabel)*. The final r-class macro is *r(tax_xscatteri)*, which contains the coordinates of tax paid and taxable income at the tax thresholds.

After running the code shown above, we have everything we need to render our graph. Figure 3 is a line graph of the simulated estimates contained in 'tax' by 'xaxis'. The r-class macro *r(tax_xlabel)* contains the value labels for the horizontal axis, and the r-class macro *r(tax_ylabel)* contains the same for the vertical axis. The macro *r(tax_xscatteri)* can then be used with Stata graph type *scatteri* to plot the coordinates of tax payable at the taxable income amounts displayed in *r(tax_xlabel)*.

The above may seem daunting on first reading, but think about what has been accomplished. In a mere nine lines of code, all the information required to render a graph of Australia's personal income tax schedule has been gathered.[4] Furthermore, all that would be required to render the policy settings of an alternative financial year is a simple change of the *fyear* option. It is also possible to model an entirely hypothetical tax system in nine lines of code by inserting a new worksheet into *tax.xlsx*, adding whatever parameters are desired and changing the *parameters* option.

Figure 3 Annual tax payable, by annual taxable income, 2017–18 financial year



Source: Model of the Australian Tax and Transfer System

4 Using cameos to understand how the personal income tax system works

The MATTS *tax* and *taxoffsets* commands can be used to illustrate how a combination of tax policies changes the amount of tax that must be paid at different levels of private income and to compare how these policies affect different types of people. For instance, the MATTS commands can be used to compare the amount of disposable income that allowees and pensioners receive at different levels of private income. This can provide an insight into how tax-transfer policies are used to augment the labour supply incentives of allowees relative to pensioners. To these ends, the code below uses MATTS to model the disposable incomes of:

- an individual who would be eligible for Newstart Allowance at low levels of private income that would attract Beneficiary Tax Offset (BTO)
- an individual who would be eligible for the Disability Support Pension (DSP) at low levels of private income.

For simplicity, it will be assumed that these hypothetical individuals do not pay rent, such that neither is eligible for Commonwealth Rent Assistance (CRA), and that the entirety of these individuals' private incomes would be assessable for the purposes of calculating their allowance and pension entitlements.

4.1 Simulating disposable income

An important point of distinction between the simple cameo of the previous section and the code that follows is that here the variable 'xaxis' is intended to represent private income, not taxable income. Since the base amount of Newstart Allowance attracts personal income tax, our hypothetical allowee will have some taxable income, even when their private income is zero (see Figure 1).

The code excerpt below shows how to construct a cameo for the Newstart allowee. It is often a good idea to begin by specifying a local macro for the financial year and then referencing this in the code. This ensures that the correct financial year parameters are used in all of the commands. The local macro *year* below contains the string '2016-17' to ensure that all commands refer to the parameters for the 2016–17 financial year.

Before implementing the *tax* command, an estimate of taxable income must be simulated. The MATTS command *newstart* produces a new variable 'nsa' that contains the sum of the allowee's base Newstart payment, Energy Supplement and, where relevant, Pharmaceutical Allowance and CRA. In contrast to *tax*, the default for this command is to simulate fortnightly amounts; the specification of the option *annual* ensures that the command produces an annual amount for the 2016–17 financial year.

```
local year "2016-17"

newstart xaxis, period(Mar-17) parameters(actual) type(single) annual

local xlabel = r(nsa_xlabel)

tempvar   nsa
clonevar `nsa' = nsa
drop nsa
generate double nsa = .
replace         nsa = `nsa' - es if (`nsa' - es)> 0
replace         nsa = 0          if (`nsa' - es)<=0
generate double taxableincome = .
```

```
replace         taxableincome = xaxis + nsa

tax taxableincome, fyear(`year') parameters(actual)

local xlabel = "`xlabel' " + r(tax _ xlabel)

medicarelevy taxableincome, fyear(`year') parameters(actual)
                            type(individual)

local xlabel = "`xlabel' " + r(ml _ xlabel)

taxoffsets taxableincome, fyear(`year') parameters(actual) taxoffset(lito)

local xlabel = "`xlabel' " + r(lito _ xlabel)

bto nsa, fyear(`year') parameters(actual)

local xlabel = "`xlabel' " + r(bto _ xlabel)

generate nettax = .
replace  nettax = tax + medicarelevy - lito - bto if (tax + medicarelevy -
                                                      lito - bto)> 0
replace  nettax = 0                               if (tax + medicarelevy -
                                                      lito - bto)<=0

generate disposableincome  = .
replace  disposableincome  = xaxis + nsa + es - nettax
replace  disposableincome  = disposableincome[ _ n-1] if disposableincome==.

keep xaxis display disposableincome
rename display          display _ nsa
rename disposableincome disposableincome _ nsa

findvalues xaxis disposableincome, numlist(`xlabel')
local ylabel = r(ylabel)
```

The command also outputs the Energy Supplement component of 'nsa' as a separate variable, 'es'.[5] This is important because, in contrast to the base Newstart payment, Energy Supplement does not attract personal income tax. In this cameo, our interest is not in the amount of Newstart the allowee receives – this is merely a means to the end of constructing an estimate of their taxable income. Subtracting 'es' from 'nsa' provides a new variable that captures only that portion of total Newstart that is taxable. This new version of 'nsa' is then added to 'xaxis' to form 'taxableincome'. This is the variable that is subsequently submitted to the MATTS commands *tax*, *medicarelevy* and *taxoffsets*.

The command *medicarelevy* simulates the annual amount of Medicare levy payable and places this in a new variable 'medicarelevy'. The command *taxoffsets*, when used with the option *taxoffset(*lito*)*, simulates the Low Income Tax Offset (LITO) entitlement and places it in a new variable, 'lito'.[6]

As one looks down the code excerpt, a pattern should emerge. First, a MATTS command that simulates a policy is run; second, this information is placed in a local macro called *xlabel*.

As the user runs subsequent commands, the new information is placed in the same local macro such that it accumulates values, bringing us to the question: What is being accumulated in the *xlabel* local macro?

In answering this question, it is important to consider the difference between the allowance modelled by *newstart* and the commands that model personal income tax, tax offsets and the Medicare levy. Recall that in this cameo the variable 'xaxis' represents private income. It is clear from the code above that the only command to which 'xaxis' is submitted is *newstart*. The other commands, with the exception of *bto*, receive the 'taxableincome' variable that was constructed in the code. This is as it should be, since gross tax and the Medicare levy are functions of an individual's taxable income, whereas a person's entitlement to an allowance is determined by their private income.

It is clear from Table 1 that personal income tax is not payable until one has at least $18 200 in taxable income. Clearly, however, someone eligible for Newstart would begin paying (gross) personal income tax at a private income well below this amount as a result of their receipt of a taxable allowance. The objective of a cameo is to understand how tax-transfer policies affect disposable income as private income increases. Although it is not obvious in the code above, each time a MATTS command is run, it accesses the 'xaxis' variable – not just *newstart* but *tax*, *taxoffsets*, *medicarelevy* and even *bto*. The commands do this to make an approximation of the level of private income at the thresholds that are native to the policy that they model. For example, the *tax* command makes an approximation of the level of private income at the point at which the variable 'taxableincome' – to which it was submitted – is equal to $18 200, just as it does for the higher tax thresholds. Once the *tax* command has made this approximation,[7] it saves this information in the r-class macro *r(tax_xlabel)*.

It should now be clear what the local macro *xlabel* is doing and why the variable 'xaxis' has to exist in Stata's memory for the cameo to work. The local macro *xlabel* is accumulating the private income thresholds at which the tax-transfer policies affect disposable income. This local macro can then be used to label the horizontal axis of a graph that plots the simulated estimates of disposable income with respect to private income.

There is now one final step before the graph can be constructed.

The objective of this section is to plot disposable income by private income. Not until all the MATTS commands have been run is it possible to obtain the amounts of disposable income associated with the private income amounts accumulated in *xlabel*. Obtaining these is straightforward using the command *findvalues*. In contrast to the other MATTS commands, *findvalues* does not simulate a tax-transfer policy. This command merely returns the values in the second variable that coincide with the row of the first variable where the values in the option *numlist()* are to be found.

In the code above, if the local macro *xlabel* contains the number 26 679, *findvalues* searches each row of the variable 'xaxis' until it finds this value and places the value it finds in the variable 'disposableincome' at that row in the r-class macro *r(ylabel)*. Once it has done this for all the values in *xlabel*, all that is required to plot the cameo for the Newstart allowee has been obtained.

Details of the code for the pensioner's cameo are in Appendix A. The code follows a similar pattern to that above except that disposable income is constructed using the simulated estimates of DSP obtained from the MATTS command *dsp*. After appending the datasets that contain the cameos for the allowee and the pensioner, the graph in Figure 4 can be rendered.

Although simple, Figure 4 is informative. What stands out most is the large gap between the level of disposable income that an allowee and a pensioner receive, for a given level of private income. At $0 of private income, the DSP recipient has disposable income that is $8849 higher than the Newstart allowee. It is not until both have $49 998 in private income that their disposable incomes coincide at $41 094.

Figure 4 also illustrates the use of the 'display' variable. Just as each MATTS command accesses 'xaxis' to approximate the private income threshold associated with a policy parameter, the commands access 'display' and insert the name of the policy parameter.

As well as telling the user where the policy parameters affect the relationship between private and disposable income, the MATTS commands can also tell the user what the specific policy parameter is. The variable ‘display’ can be used in the *mlabel()* option for the graph type *scatter* to label the private income thresholds as shown below.

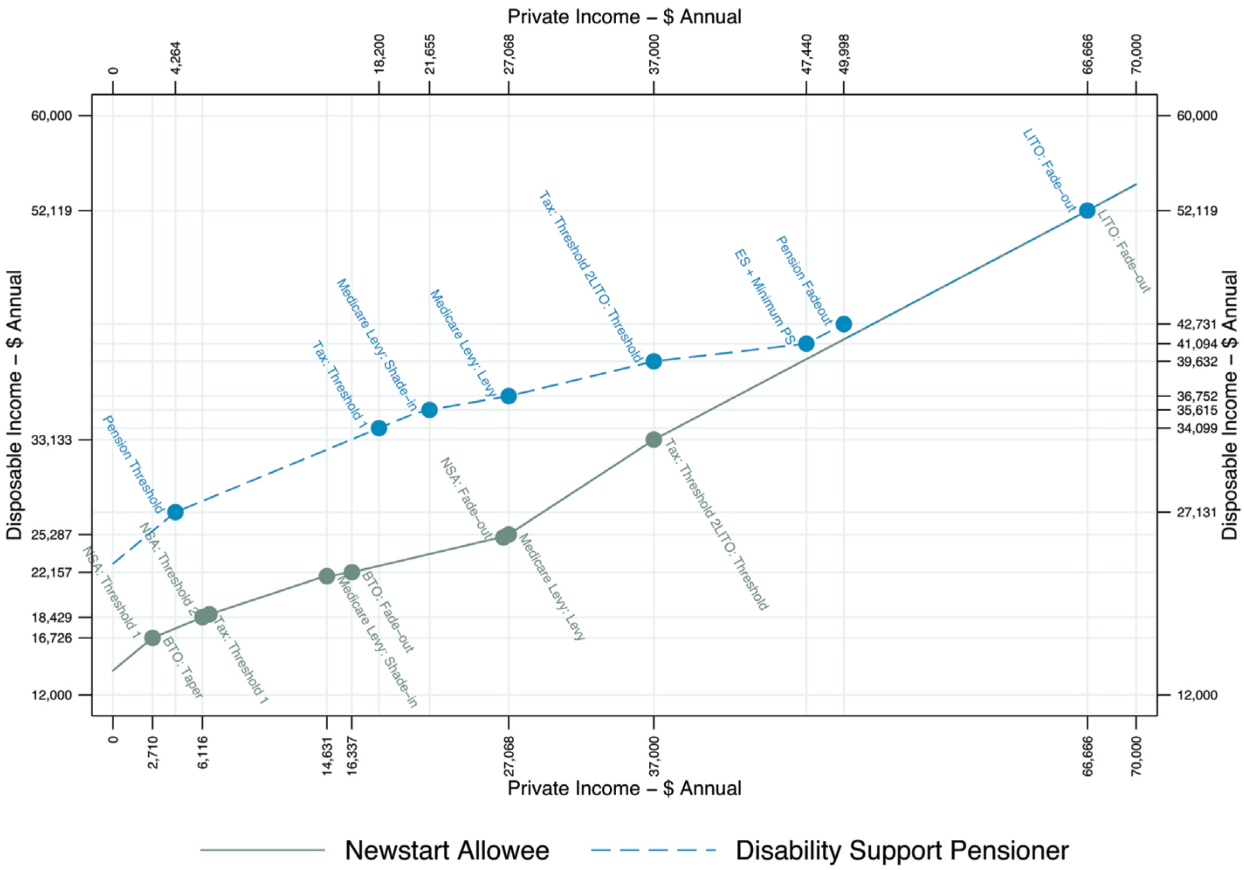
Figure 4 also provides an insight into how it is that the disposable incomes of the allowee and the pensioner come to coincide at $49 998 of private income. At $37 000 of private income, the allowee no longer receives Newstart; they are paying the full Medicare levy and are in the second tax bracket, although they are still receiving modest tax relief in the form of LITO. The same is true for the pensioner, and it is only at this level of private income that they lose their pension entitlement, including the supplements.

4.2 Simulating effective marginal tax rates

Cameo modelling is also useful for understanding how a combination of tax-transfer policies affects the labour supply incentives of those who are subject to them. This is typically done via the estimation of the EMTRs described earlier. Although EMTRs are a function of private income, it is often informative to plot them with respect to the hours worked, at a given wage rate, required to earn a given level of private income.

A partial code extract for the construction of the EMTRs for the Newstart allowee and the DSP recipient is provided in Appendix B. It is similar in most respects to the code used to construct disposable income. However, one important difference is that the variable ‘hours’ cannot be left empty.

Figure 4 Annual disposable income by annual private income for a hypothetical Newstart allowee and Disability Support pensioner, 2016–17



Source: Model of the Australian Tax and Transfer System

If the intention is to show how EMTRs vary according to hours worked, it is necessary to assume a specific wage rate and decide what range of hours worked per week is of interest.

The code below can be used to initialise a cameo for an individual who receives the full-time minimum wage ($15.85 an hour), and can choose to work between 0 and 50 hours a week for 52 weeks of the year.

```
local increment = 1
local max       = 50
local wagerate  = 15.85
local obs       = int((`max' * 52 * `wagerate') / `increment') + 1

set obs `obs'
generate double xaxis   = ( _n - 1)*`increment'
generate double hours   = (xaxis / `wagerate') / 52
generate str50  display = ""
```

The code in Appendix B is much the same as that for the simulation of disposable income. However, an important difference is that, instead of accumulating the private income thresholds contained in the r-class macros, the r-class macros that pertain to hours worked are those that are to be accumulated.

These will form the labels for the horizontal axis in the graph that is generated.

The final step is constructing simulated estimates of the EMTRs from disposable income. This is done as follows:

```
gsort + hours + xaxis + disposableincome

generate double emtr = .
replace         emtr = (((disposableincome - disposableincome[ _n-1])
                       / (xaxis - xaxis[ _n-1])) - 1)*-1
replace         emtr = emtr[ _n-1] if emtr==. & display~=""
```

Figure 5 presents simulated estimates of the EMTRs faced by the Newstart allowee and DSP recipient, were they to choose between 0 and 50 hours of work a week, at $15.85 an hour. At low levels of labour supply, there are no EMTRs, because private income is not high enough to taper the social security payments. The Newstart allowee faces an EMTR of 0.5 at 3.2 hours worked because their private income is high enough for them to be subject to the 50 cent taper on their Newstart entitlement. This increases to 60 cents once they reach the second Newstart threshold at 8 hours of work. For the DSP recipient, the EMTR does not increase to 0.5 until 5.2 hours of work, since the pension taper threshold is higher than that for allowances (see Figure 1). The EMTRs for the DSP recipient remain at this level until 24.9 hours of work, at which point LITO is no longer enough to offset gross income tax and the pensioner begins paying net tax.

Figure 5 succinctly presents a considerable amount of information on how the tax-transfer system incentivises different types of income support recipients. Even at the full-time minimum wage, a single day of work per week is enough to ensure that both allowees and pensioners face EMTRs of 50 cents in the dollar. At two days of work per week, the EMTR of the allowee is even higher, at 60 cents in the dollar. Once the tax liability of the allowee is sufficient to exceed BTO and LITO, there is an abrupt increase in EMTRs to as high as 81 cents in the dollar, where they remain until BTO is exhausted. This occurs at 19.8 hours – just under three days – of work per week, when the EMTR remains as high as 71 cents in the dollar. The incentives presented by Newstart, for minimum wage recipients, are to accept at least 32.8 hours a week to face an EMTR of 21 cents in the dollar, thereby moving off Newstart altogether.

In summary, EMTRs are considerably higher for allowees than for pensioners between 8 and 24.8 hours of work, and the reverse is true once hours worked exceed the latter amount. The higher EMTRs faced by low-wage DSP recipients are arguably less of a concern insofar as the DSP is intended for those whom the community does not expect to work. This is not to say that the high

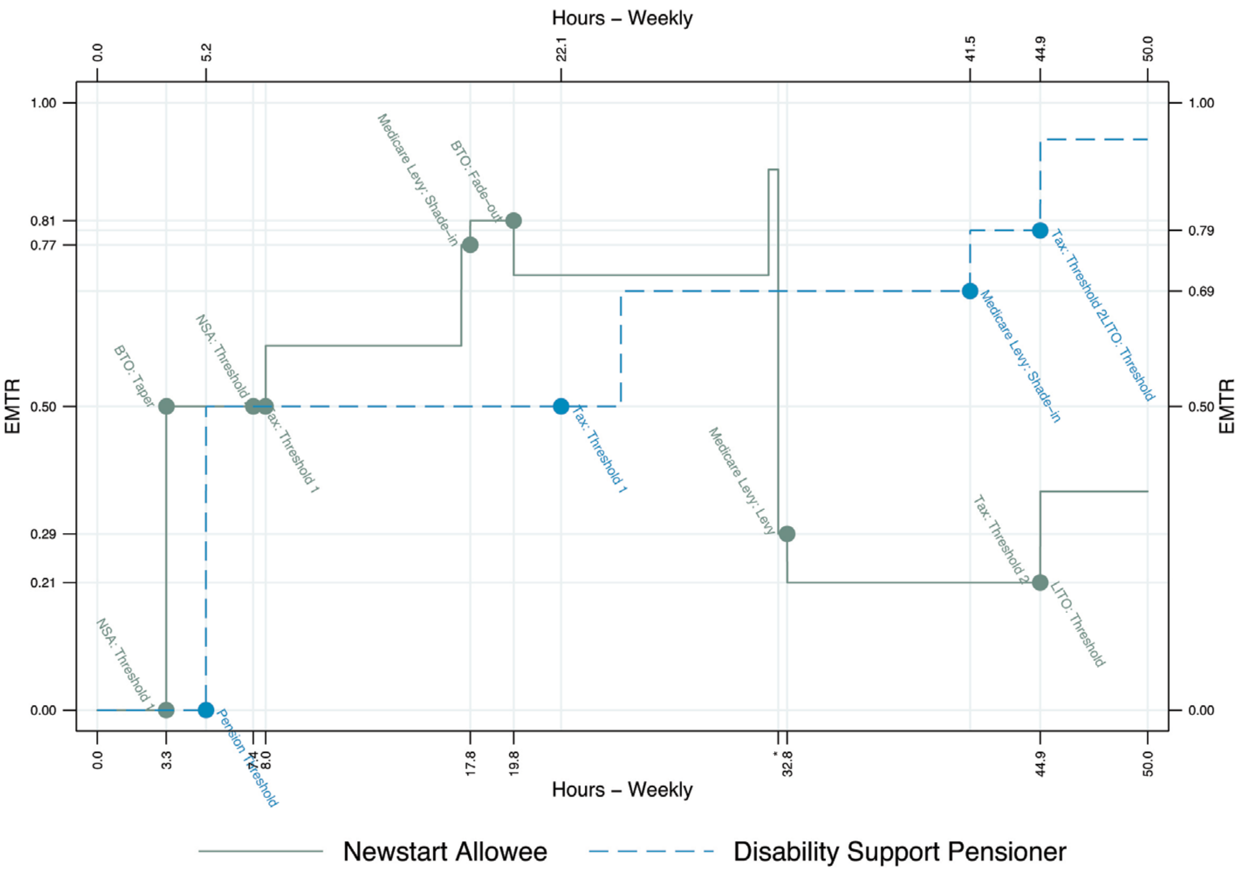
EMTRs faced by pensioners are of no concern more broadly, because the high EMTRs embedded in the design of the age pension may influence labour supply and investment decisions in the lead-up to retirement (Tran & Woodland 2014).

Whether the higher EMTRs faced by low-wage allowees are problematic is more complex. On the one hand, the structure of EMTRs encourages full-time rather than part-time work. On the other hand, if part-time work is a pathway to full-time work, these high EMTRs may act as a disincentive for allowees to take up part-time work (ACTU 2012). Of course, these disincentives are to some extent offset by the activity testing usually associated with allowance eligibility.

Figures 4 and 5 are not merely of academic interest. Taken together, they illuminate a policy debate that has been in progress for some time. A number of inquiries into tax-transfer policy have sounded concerns about the magnitude of the gap in the maximum rate of allowances compared with pensions and in the adequacy of allowances more generally. However, these same inquiries all point to the importance of the tax-transfer system in providing incentives for those of working age to enter, and remain, in paid employment (Harmer 2009, Australian Government 2010, Senate Standing Committee on Education, Employment and Workplace Relations 2012, Reference Group on Welfare Reform 2015).

This underlines one of the most acute tensions in the design of tax-transfer policies for payments intended for those of working age: How best can payment adequacy be balanced with incentives for self-sufficiency?

Figure 5 Effective marginal tax rates by weekly hours worked for a hypothetical Newstart allowee and a hypothetical Disability Support pensioner who both earn the minimum wage, 2016–17



Notes: The EMTR for the Newstart allowee at $26 718 has been omitted because it is somewhat larger than the rest of those shown in the figure but only applies over a very small range of income.

Source: Model of the Australian Tax and Transfer System

5 Conclusion

This paper introduces a new model of Australia's tax and transfer system. The MATTS Stata commands model individual tax and transfer policies, providing a flexible modelling platform that can be adapted to a range of tax-transfer modelling objectives. This paper shows how these commands can be deployed to construct cameos that illustrate how the tax and transfer system augments the disposable incomes of single allowees and pensioners, and how these policies shape their EMTRs.

MATTS has a number of features that will be useful to researchers with a basic proficiency in Stata and an interest in tax-transfer policy. First, MATTS is freely available to anyone who wishes to use it. The MATTS suite of Stata user-written commands can be loaded into Stata like any other user-written command.

Second, the modular nature of MATTS affords users considerable flexibility in how the commands can be deployed in conducting tax-transfer research. MATTS can be used 'out of the box' to construct cameos as described above, but the commands can also be run over survey datasets in bespoke tax-transfer modelling projects. These may include behavioural modelling, dynamic microsimulation or distributional analysis. Of course, those interested in these applications will have to construct their own datasets upon which to run the commands. With respect to distributional analysis, constructing datasets that can reliably estimate static fiscal impacts requires a considerable investment. Household survey data do not typically include all that is required to model tax-transfer policies, and a range of imputations and usually some reweighting of the survey data are needed (Cai et al. 2006). Those looking for a general-purpose distributional tax-transfer model would probably find more traditional models, such as CAPITA and PolicyMod, of greater utility. The MATTS commands are best suited to more bespoke modelling efforts.

Finally, although the MATTS commands perform very different functions from other Stata commands, their syntax is of comparable usability. Since each MATTS command models an individual policy, the code that users produce presents a concise and transparent summary of how the tax-transfer system – or some counterfactual – is structured. The Stata code shown in this paper hides the complexity of individual tax-transfer policies, allowing users to see the overall architecture of the system. Of course, those interested in the mathematical minutiae can always look at the command code to gain an understanding of the specifics of the policies modelled. This is not hidden from the user, and users are encouraged to edit the code should they wish to simulate more substantive policy reforms.

At the time of writing, the MATTS commands available to the public include those that provide users with the ability to model Newstart Allowance and DSP for singles, LITO, BTO, personal income tax and the Medicare levy. These commands have undergone rigorous quality assurance, but those who wish to assess the quality of the commands for themselves are free to examine the command code. Subject to the same rigorous quality assurance, additional commands will follow during 2018. These may include family payments, income support payments for low-income parents and childcare subsidies. This is not an exhaustive list of the tax-transfer policies that MATTS will ultimately cover. Insofar as Australian tax-transfer policy will grow and evolve to meet the economic and social challenges of the time, MATTS will evolve to provide those interested in tax-transfer research with the ability to model these policies.

Appendix A Stata code for simulating disposable income for DSP recipient

```
drop _all

set obs `obs'
generate double xaxis   = (_n - 1)*`increment'
generate double hours   = (xaxis / `wagerate') / 52
generate str50  display = ""

dsp xaxis, type(singlehomeowner) assets(0) period(`period')
           parameters(actual) annual

local xlabel = r(dsp_xlabel)

generate double taxableincome = .
replace         taxableincome = xaxis

tax taxableincome, fyear(`year') parameters(actual)

local xlabel = "`xlabel' " + r(tax_xlabel)

medicarelevy taxableincome, fyear(`year') parameters(actual)
                            type(individualsapto)

local xlabel = "`xlabel' " + r(ml_xlabel)

taxoffsets taxableincome, fyear(`year') parameters(actual) taxoffset(lito)

local xlabel = "`xlabel' " + r(lito_xlabel)

generate nettax = .
replace  nettax = tax - lito if (tax - lito)> 0
replace  nettax = 0          if (tax - lito)<=0

generate disposableincome = .
replace  disposableincome = xaxis + dsp - nettax - medicarelevy
replace  disposableincome = disposableincome[_n-1] if disposableincome==.
```

Appendix B Stata code for simulating EMTRs by hours worked per week

```
newstart xaxis, period(`period') parameters(actual) type(single) annual

local hlabel = r(nsa _ hlabel)

tempvar   nsa
clonevar `nsa' = nsa
drop nsa
generate double nsa = .
replace         nsa = `nsa' - es if (`nsa' - es)> 0
replace         nsa = 0          if (`nsa' - es)<=0

generate double taxableincome = .
replace         taxableincome = xaxis + nsa

tax taxableincome, fyear(`year') parameters(actual)

local hlabel = "`hlabel' " + r(tax _ hlabel)

medicarelevy taxableincome, fyear(`year') parameters(actual)
                            type(individual)

local hlabel = "`hlabel' " + r(ml _ hlabel)

taxoffsets taxableincome, fyear(`year') parameters(actual) taxoffset(lito)

local hlabel = "`hlabel' " + r(lito _ hlabel)

bto nsa, fyear(`year') parameters(actual)

local hlabel = "`hlabel' " + r(bto _ hlabel)

generate double nettax = .
replace         nettax = tax - lito - bto if (tax - lito - bto)> 0
replace         nettax = 0                if (tax - lito - bto)<=0

generate double disposableincome  = .
replace         disposableincome  = xaxis + nsa + es - nettax –
                                    medicarelevy

gsort + hours + xaxis + disposableincome

generate double emtr = .
replace         emtr = (((disposableincome - disposableincome[ _ n-1]) /
                         (xaxis – xaxis[ _ n-1])) - 1)*-1
replace         emtr = emtr[ _ n-1] if emtr==. & display~=""
```

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Notes

1. Nelissen (1995) indicates that SUSSEX '… was primarily developed to prove that this kind of model was possible. It was also limited to population simulations. The model was a dynamic one, but modelling was too rough for real applications' (Nelissen 1995:321). The first tax-transfer model, TAX, was built to analyse the United States tax system (Pechman 1965).
2. The ABS Income Distribution Survey was first undertaken in 1968, but the ABS did not begin providing CURFs for researchers until 1983 (Gallagher 1990, Lambert 1996). Gallagher (1990) provides a survey of early Australian tax-transfer models.
3. There is also no need to specify a wage rate. This code merely shows an example of how the variable 'hours' could be constructed to provide the number of hours worked each week at the minimum wage, $15.90 an hour, to earn the level of taxable income contained in 'xaxis'.
4. The Stata code to produce the graph in Figure 3 and the other graphs in this paper is available from the author on request.
5. Were the intention to model an individual with a CRA entitlement, the annual amount of CRA would be submitted in the option *cra()*. If the allowee were eligible for Pharmaceutical Allowance the option *pha* would ensure that this was added to the stack.
6. Since the mathematical structure of LITO, Seniors and Pensioners Tax Offset (in the absence of transferability), and Dependent (Invalid and Carer) Tax Offset is the same, it makes little sense to have separate commands for each of these. The *taxoffset()* option for the taxoffsets command allows users to specify which of these they require and ensure that the command looks in the parameter sheet applicable to the tax offset specified.
7. Although only an approximation, it is important to emphasise that users have complete control over the size of the increment in 'xaxis'. The approximations performed by the MATTS commands are therefore as accurate as the user wants them to be.

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