Essays in Public Finance

Peter Varela

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Except where otherwise indicated, this thesis is my own original work.

Peter Varela
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Abstract

This thesis presents three papers in the field of empirical public finance. The first two papers are related, and are based on the concept of the Inequality Deflator, while the third paper is an applied empirical paper looking at gender differences in tax filing behaviour.

The first paper estimates the inequality deflator for the Australian economy using a novel approach based on dynamic microsimulation. An Inequality Deflator is a measure of the cost of redistributing income through the existing tax and transfer system, and can also be interpreted as the revealed preference of society for income redistribution. Moreover, using the inequality deflator as distributional weights in a cost benefit framework is equivalent to modifying the standard Kaldor-Hicks welfare criterion to account for a distortionary tax system. Therefore, the Inequality Deflator represents a promising option to incorporate issues of equity into a cost benefit framework. This paper also applies the Inequality Deflator to the Australian economy to determine how much growth could have been achieved in the period 1993-2013 if the tax system were used to ensure that growth was spread evenly across the population.

The second paper extends the concept of the Inequality Deflator to an applied cost benefit situation in which benefits accrue to consumers or business owners. As business owners typically earn higher than average income, money transferred to a business will increase observed income inequality. Therefore, to the extent that a society values both equity and efficiency, a transfer to a business owner will be less valuable than if that transfer were received by an average individual. The Inequality Deflator is used to determine the value of a windfall gain to a business by asking how much would be received by each member of society if that gain were redistributed evenly across the population using the tax and transfer system. This paper also includes a discussion of how the different welfare weights for consumers and businesses estimated in this paper can be incorporated into sufficient statistics style public economics research.

The final paper uses Australian tax return data and techniques from the gender pay gap literature, including the Oaxaca-Blinder decomposition and the DiNardo-Fortin-Lemieux decomposition, to show that men claim more deductions on their tax return than women in similar economic circumstances. After controlling for observable characteristics such as income and occupation, men are found to claim around 12 per cent more deductions than women, which when taken at face value, increases the gender pay gap in Australia by around $75 per year. The paper also finds an unexplained gender difference in 7 of 11 categories of deductions and amongst workers in 6 of 9 occupation classifications. Men and women earning different proportions of capital income and family tax planning are considered as potential explanations of the observed deduction gap. While both factors are found to influence the level of deductions claimed, they can only explain a small proportion of the observed difference in deductions between men and women.

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Chapter 1

Introduction

This thesis presents three papers in the field of empirical public finance. They combine theoretical and empirical research, and all of the papers have an applied policy focus.

The first two papers are based on the concept of the Inequality Deflator. This work quantifies the cost of redistributing income through the personal income tax and transfer system, and in doing so provides a framework for evaluating the distributional consequences of public policy without the need to specify a social welfare function. The third paper explores whether men and women behave differently when filing their taxes, and whether this difference in behaviour increases the gender pay gap.

Paper 1: An Inequality Deflator for Australia

The main focus of this paper is to estimate an Inequality Deflator for the Australian economy. An Inequality Deflator is a measure of the excess burden of redistributing income between different income groups using the existing personal income tax and transfer system. The Inequality Deflator can also be interpreted as the government's revealed preference for redistribution between different groups of people. Following these interpretations, the Inequality Deflator can be used to make normative judgments about policies with different distributional impacts without the need to specify a social welfare function. While there are a number of caveats to this approach, which are discussed at length in the paper, the Inequality Deflator presented in this paper represents a valuable tool for incorporating concerns about distributional equity into the cost benefit analysis framework.

This work follows the intellectual framework developed by Hendren (2014), who estimates an Inequality Deflator for the US economy. However, data

limitations meant that it was not possible to directly apply the Hendren methodology to Australian data. Therefore, this paper develops a methodology based on behavioural microsimulation. Specifically, it adjusts the tax function in the Melbourne Institute Tax and Transfer Simulator (MITTS) and bases the estimate of the Inequality Deflator on the observed behavioural response.

This paper also includes an application of the Inequality Deflator, in which the Deflator is used to evaluate the period of economic growth in Australia over the period 1993-2013. During this time, the Australian economy experienced significant economic growth, as well as significant increases in income inequality. In this paper, the Inequality Deflator is used to estimate how much economic growth could have been achieved if the tax system was used to spread the gains of economic growth evenly across the population. It finds this would have reduced the observed level of economic growth by around 18 per cent (from $11,300 to $9,300 per person). Another way to interpret these results is that the increase in inequality that has occurred over this time has cost the Australian economy $50 billion.

The paper also includes a number of methodological advances over previous work. For instance, the microsimulation based approach to estimation allows for a natural estimation of the Inequality Deflator at the household (as opposed to individual) level. As income inequality and consumption levels are often studied at the household level, a Household Deflator is a more natural concept in a number of settings.

The approach in this paper is also ideally suited to examining the cost of redistributing income using criteria other than just income levels. For instance, the Australian tax system provides different tax rates to families with children than to families without children. The Inequality Deflator estimated in this paper is able to identify the cost of such transfers.

Another useful aspect of the microsimulation approach is that it can estimate the cost of redistribution in a non-marginal setting. The Inequality Deflator defined by Hendren (2014) is a purely marginal construct. As such, it is unclear how large a policy counterfactual can be before the marginal assumption is no longer valid. As the methodology in this paper is based on a structural labour supply model, the paper is able to provide estimates of non-marginal transfers, and in doing so gives a sense of how large a transfer can be under the Inequality Deflator framework.

Paper 2: Relative welfare weights for individuals, consumers and producers. Evidence from the United States and Australia.

The second paper focuses on one important application of the Inequality Deflator. Namely, that when performing policy evaluation, it is common to observe welfare effects that fall to typical individuals, consumers, or capital owners. As these groups have different incomes (a typical capital owner has a higher income than a typical individual), these policies will have distributional effects that are of interest to policymakers. However, it is often unclear as to how to aggregate the welfare effects of these groups to determine an optimal policy.

The Inequality Deflator allows these welfare effects falling to different groups to be evaluated in a consistent framework. As in the Inequality Deflator exercises from the first paper, this is done by asking how much surplus a project would create if the income tax and transfer system was used to spread the surplus/cost of the project equally across the population.

This paper then implements this idea empirically using both Australian and US data. For Australia, the estimates of the Inequality Deflator were taken from the first paper of this thesis, while the joint distribution of income, consumption and capital ownership were taken from the Survey of Income and Housing. Using these values, the paper finds that $1 falling to a typical capital owner is equivalent to around 89 cents to a typical individual.

For the US results, the estimates of the Inequality Deflator are taken from Hendren (2014), while the joint distribution of income, consumption and capital ownership are taken from the Panel Study of Income Dynamics. Using these data sources, the paper finds that $1 falling to a typical capital owner is equivalent to around 88 cents to a typical individual.

In both the Australian and the US calculations, a number of different assumptions were used regarding the type of Inequality Deflator and the type of income and consumption. These various assumptions resulted in a relative welfare weight for capital owners that varied between 0.82-0.96.

The paper can also be used to improve welfare calculations in the sufficient statistics welfare literature. This literature (summarised by Chetty (2009)), generally assumes that a dollar transferred between consumers and businesses has no net welfare effect. However, if this assumption is not used, then an additional term is required to evaluate a welfare change. This paper demonstrates this process by modifying the well-known Harberger triangle formula.

Paper 3: A gender deduction gap: Do men and women in similar economic circumstances claim different amounts of deductions on their tax returns?

The final paper of this compilation uses Australian tax return data and techniques from the gender pay gap literature to show that men in similar economic circumstances to women claim around 12 per cent more deductions on their tax return. That is, if a man and a woman work in the same occupation and earn the same income, the man will typically claim 12 per cent more deductions on their tax return. A 'gender deduction gap' is observed in 7 of 11 categories of deductions and amongst workers in 6 of 9 occupation classifications.

The first section of this paper uses graphical techniques including histograms and binscatter plots to illustrate which type of deductions differ between men and women, whether the difference occurs at high income levels or low income levels, and whether the difference occurs due to extensive differences (more men claiming some form of a given deduction) or intensive differences (those who do claim a deduction claim more of that deduction).

In the next section, the paper uses the Oaxaca-Blinder methodology to control for observable characteristics, including income, occupation, partners status, age and tax lodgement method. The paper then draws on the considerable literature related to the Oaxaca-Blinder decomposition to interpret the regression output.

The paper then decomposes the observed difference in deductions using the DiNardo-Fortin-Lemieux (DFL) decomposition. While the Oaxaca-Blinder decomposition estimates the differences in the mean level of a deduction, the DFL methodology estimates a full counterfactual distribution of female deductions that would occur if they had the same observable characteristics as men. This decomposition shows that the difference between men and women is driven primarily by a small number of men who claim a large number of deductions.

The final section considers two issues that may affect the interpretation of the results. Namely, that men and women might organise their taxes together, or that men and women earn different types of income, and that some types of income are associated with greater levels of deductions. Both issues were found to explain a small proportion of the observed difference between men and women, but a large unexplained difference still remained.

Chapter 2

An Inequality Deflator For Australia

Abstract

This paper estimates an Inequality Deflator for the Australian economy, which represents the distributional trade-offs that exist within the current tax and transfer system. These trade-offs can be used to evaluate policy alternatives where equity is an important consideration, as well as provide a normative evaluation of the trend towards increased inequality in Australia. This normative evaluation can be justified in two ways. First, in can be argued that the government has revealed a preference for distributional trade-offs through the tax system, which should be followed in other policy analysis. Second, this approach is equivalent to altering the standard Kaldor-Hicks welfare criterion such that compensating payments are made through the existing tax system (rather than as lump sum payments). As such, implementing policy in this way, along with adjustments to the tax and transfer system, can be thought of as identifying realisable pareto improvements. In order to estimate an Inequality Deflator in the Australian setting, this paper develops an estimation method using The Melbourne Institute Tax and Transfer Simulator (MITTS). This methodology also allows for an Inequality Deflator to be estimated at the household level, and for different family types. Finally, the Inequality Deflator is applied to the Australian economy over the period 1994-2013 and finds that if the tax system was used to spread growth equally across the population, growth would be around 18 percent lower than recorded.

2.1 Introduction

The aggregation of welfare effects across individuals is a long-standing problem in economics. While many solutions have been proposed, there is far from a consensus as to the appropriate way to trade off welfare gains and losses of different individuals. That this type of question causes such debate amongst economists is particularly troubling, as a significant proportion of policy decisions require trade-offs of this kind.

Traditional responses to this issue include ignoring the distributional effects of policies and simply summing the relative welfare effects across individuals (Harberger 1971 and Parish 1976). This is equivalent to the standard Kaldor-Hicks criterion with lump sum transfers, and is often justified on the basis that distributional concerns are best handled through the tax and transfer system, thereby freeing other policymakers to focus solely on efficiency. While this may provide a useful rule of thumb in some circumstances, concerns regarding a fair distribution of income cannot be left to the tax and transfer system in a general sense,[1] as the tax and transfer system has costs associated with redistribution, and doing so might miss more efficient means of redistribution (Dreze and Stern 1987, Stiglitz 1988).

Others have argued for the use of distributional weights as part of the cost benefit process that replicate an underlying social welfare function. Distributional weights have a long tradition in academic debates,[2] were endorsed by the World Bank for a short period (Little and Mirrlees 1994), and are currently endorsed by the UK Treasury for government cost benefit analysis. Australian government guidelines for Cost-Benefit Analysis (Department of Finance and Administration 2006) discuss the option of using distributional weights, but provide little guidance as to how to practically estimate the appropriate weights.[3]

While distributional weights allow distributional concerns to directly enter the decision making process, the approach has been heavily criticized on the basis that the choice of weights is somewhat arbitrary, and that one

[1] Although, as discussed in Section 2.2, there are certain situations in which equal weighting is a well-justified approach.

[2] For example, Boadway and Bruce (1984); Brent (1984); Cowell and Gardiner (1999); Creedy (2006); Dasgupta and Pearce (1972); Dasgupta, Sen and Marglin (1972); Dreze (1998); Dreze and Stern (1987); Harberger (1978); Johansson-Stenman (2005); Liu, (2006); Little and Mirrlees (1974); Ray (1984); Squire and van der Tak (1975); Weisbrod (1968) and Yitzhaki (2003).

[3] The Productivity Commission (2011) include distributional weights in their analysis of the National Disability Insurance Scheme, although this approach was criticized in Harrison (2013).

person's preference for redistribution is no more 'correct' than another person's.[4] Moreover, even if each individual's preferences for redistribution could be easily observed, it is not obvious how to aggregate these preferences to create social preferences.[5]

Given the difficulty of determining the correct distributional weights, another approach is to simply report how the policy affects different groups, and allow politicians (or other decision makers) to make the relevant interpersonal trade-offs[6] (Boadway 1976). This approach is recommended by recent guidance provided by the Australian Government (OBPR 2014).

An appealing alternative, and the approach taken in this paper, is to use the distributional trade-off that exists in current policy to guide future policy. In other words, if we can estimate the trade-offs that are observed in the existing tax and transfer system, and that are available as policy options to the current government, then this can be used as a benchmark to assess any new policy proposal. This allows the policy analyst to provide guidance with regard to distributional trade-offs without the subjectivity inherent in the social welfare function approach. It also allows for the relative trade-offs between different groups to be equalised across policies, resulting in efficiency gains.[7]

One way to implement this idea is to attempt to identify the revealed preference of government based on observed policy decisions, and then replicate this trade-off when looking at new policies. Early approaches along these lines, such as Stern (1977), Piggott (1982) and Cowell and Gardiner (1999) rely on the strong assumption that the tax system places an equal absolute sacrifice on different taxpayers. More recent work has typically involved inverting formulas from the Mirrlees optimal income tax framework, such as proposed in Diamond (1998) and Saez (2001) and implemented by Bourguignon and Spadaro (2010), Bargain et al. (2014) and Lockwood and Weinzierl (2016).

An alternative approach is to implement policy proposals along with an adjustment to the existing tax and transfer system that removes any distributional incidence. This approach is equivalent to implementing the

[4] See Adler (2013) for a summary of these critiques.

[5] This is a direct consequence of Arrow's Impossibility Theorem (Arrow 1950).

[6] In practice, reporting the distributional impacts separately to the efficiency findings is very similar to just using the standard Kaldor-Hicks approach, as cost-benefit analysis is generally interpreted based on the headline figure.

[7] This is analogous to the cost-effectiveness approach commonly employed in cost-benefit analysis literature, where the goal is to achieve a given equity-based goal in the most cost-effective way.

standard Kaldor-Hicks criterion, making compensation payments through the tax system rather than lump sum transfers. As pointed out in Hendren (2014), this was an approach envisaged in the original work by Kaldor and Hicks, and developed in a theoretical setting by Bruce and Harris (1982), Diewert (1983), Kaplow (2004, 2008) and Coate (2000). Hendren (2014) developed an empirical framework to identify the costs of making transfers through the tax and transfer system, but significantly, did so in a way that once estimated, could be implemented as a set of shadow weights, allowing assessments to be made across multiple projects without having to re-estimate the cost of the distributional transfer. This paper was also the first to use the term 'Inequality Deflator'.

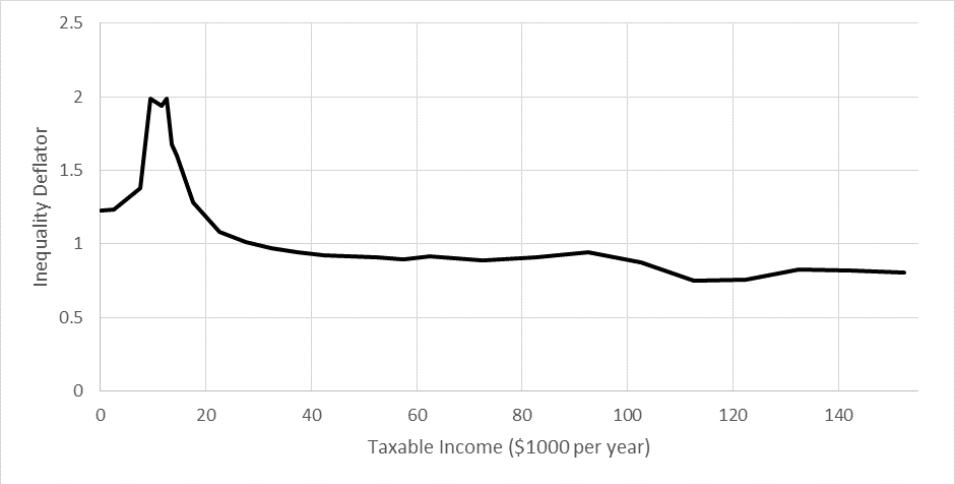
This paper follows the spirit and design of Hendren (2014), but estimate the Inequality Deflator using the Melbourne Institute Tax and Transfer Simulator (MITTS) – a behavioural microsimulation model (Creedy and Kalb 2004). This divergence in methodology is motivated partially by a lack of comparable elasticity estimates for the Australian economy. However, the microsimulation methodology does provide a number of advantages (and disadvantages) relative to Hendren's methodology. Notably, the microsimulation model provides for much more variation in behavioural response across the income distribution and by individual characteristics (such as family type) as the labour supply of each individual in the model is modelled separately. The MITTS framework also provides a natural way to look at distributional trade-offs at the household, rather than individual level. The richer picture that is obtained through the structural labour supply model comes at the cost of having to specify the labour supply model. Any results that are obtained are only as good as the labour supply response obtained through MITTS. The relative merits of the microsimulation approach will be discussed in detail in section 2.3.

Figure 2.1 presents the main estimates of the Inequality Deflator for the Australian economy. The y-axis of this chart should be interpreted as the cost, in terms of government revenue, of transferring one dollar to people at this income level through the tax and transfer system.[8] Therefore, in order to increase the welfare of people earning $120,000 by $1, it would only cost around 80 cents of government revenue. Alternatively, to increase the welfare of people receiving unemployment benefits by $1 costs around $2

[8]Note that this uses a slightly different definition of the Inequality Deflator to the Hendren paper, which defines the Deflator as the cost of transferring one dollar equally across the population. The definition used in this paper is more intuitive, but is not revenue neutral. For most applications, the two measures will be equivalent as applications are typically concerned with comparing the Deflator between different levels of income.

of government revenue. These figures vary as a direct result of the different labour supply responses to payments at different parts of the income distribution.

Figure 2.1: Australian estimates of the Inequality Deflator



Following the intuition above, this chart can also be interpreted as the revealed preference for redistribution that exists in the current Australian tax system. In other words, if we assume that the existing tax system is maximising Australian social welfare, then the marginal value of a dollar for someone earning $17,000 is 2.7 times as high[9] as the marginal valuation of a dollar for someone earning $120,000.

The remainder of this paper proceeds as follows. In Section 2.2, the Inequality Deflator is formally introduced, along with a motivating example and a discussion of the issues that arise when implementing the Deflator in a real world setting. Section 2.3 provides details on the empirical strategy, including details of the MITTS model, and a comparison with the empirical approach of Hendren (2014). Section 2.4 provides empirical results, along with a range of secondary output from the model to aid with interpreting the main results. This section also includes results by subgroup, as well as estimation of the household level Deflator. Section 2.5 uses the estimates of the Inequality Deflator for the Australian economy to evaluate the joint impact of increased growth and increased inequality in the Australia economy since 1994, finding that in the period 1994-2013, 18 per cent of Australian growth

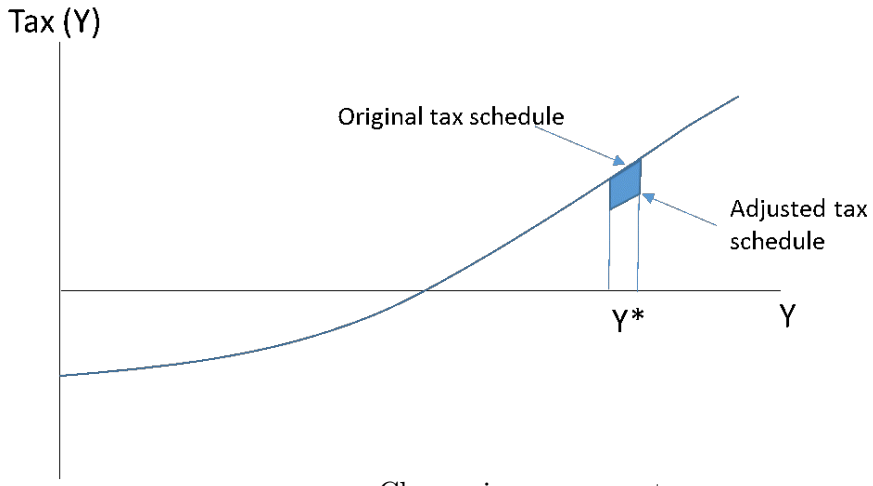
[9]Calculated as 2 (the Deflator evaluated at $17 000)/0.75 (the Deflator evaluated at $120 000).

would be lost if the Australian tax system was used to spread this growth equally across the income distribution. Section 2.6 concludes, and discusses a number of future potential applications of the Inequality Deflator.

2.2 The Inequality Deflator

The Inequality Deflator is found by altering the existing tax and transfer system to provide a small amount of money ($\$\varepsilon$) to people in the local region of income (Y*), as shown in Figure 2.2. The Deflator will be equal to the change in government revenue resulting from this adjustment, divided by the change in individual welfare (measured as the equivalent variation of the policy). It can be interpreted as the cost (in terms of government revenue) of transferring a dollar to people in a particular income interval.

Figure 2.2: Stylised depiction of an adjustment to the tax and transfer schedule



$$\text{Inequality Deflator} = \frac{\text{Change in government revenue}}{\text{Change in individual welfare (the sum of EVs)}}$$

In a static situation in which people did not respond to the tax change, the Inequality Deflator would be equal to one, as the n people who were originally earning Y* will now each be better off by $\$\varepsilon$, and the government will lose n x $\$\varepsilon$ in revenue.

However, changing the tax system will encourage people to change their income in order to receive the tax benefit. If people earn more as a result

of the tax change, it will offset some of the fiscal cost of the policy. As a result, the Inequality Deflator will be less than one. If people earn less as a result of the tax change (for instance, if people reduce their income to receive the targeted payment), it will increase the fiscal cost of the policy and the Deflator will be greater than one. Note also that for small changes in the tax system, the welfare effects for the group that is moving will be second order, which means that the change in the government revenue will determine the change in the Inequality Deflator.[10]

Another way to think about the Inequality Deflator is that most workers have a large marginal effective tax rate, even if they have a low or negative average tax rate (Ingles and Plunkett 2016). This means that, at the margin, the social benefit of an additional hour of work is typically more than the private benefit, and increasing the work hours of any individual by a small amount will result in a fiscal externality that will increase social welfare.

This provides the basic intuition for where the Inequality Deflator will be high and where it will be low. It will be low when an adjustment to the tax system (as in figure 2.2) leads to an increase in the hours that people work. Where a similar change to the tax system decreases the hours that people work, the Inequality Deflator will be high. Tracing the determinants one step further, changes in labour supply responses are high where there is a) high labour supply elasticity, and b) a large number of workers who are able to move to take advantage of the tax change. The importance of the second point can be seen by examining the lower end of the income distribution. By definition, a cash transfer to people with zero market income cannot result in people increasing their labour supply to receive the payment. We therefore expect to see high values of the Inequality Deflator for low income levels.

Following Hendren (2014), the Inequality Deflator as defined above can be used directly as a weight in cost-benefit analysis with three appealing rationales. First, the Inequality Deflator is equivalent to the social welfare weights that would rationalise existing government policy. In other words, if we assume that the government is acting rationally to optimise some general social welfare function, then the Inequality Deflator represents the social welfare weights of that function. This also has the appealing policy intuition that the high-level trade-off between equity and efficiency is set using the income tax and transfer system, and this trade-off is repeated in subsequent policy decisions.

[10]This result relies on the envelope condition. Effectively, if the cash transfer is small, there can be no first order welfare effects to individuals who change labour supply.

The second interpretation of the Inequality Deflator is that regardless of whether we think that existing government policy is optimal, implementing policies based on the Inequality Deflator, along with small changes to the existing tax system, will result in actual pareto improvements. The basis of this argument is to modify the existing Kaldor-Hicks criterion so that compensation payments are made through the tax system (rather than as lump sum payments). In this way, the distributional incidence of a new policy can be undone through changes to the existing tax and transfer system, with a policy being worthwhile if there is still leftover surplus once everyone has been compensated.

Finally, the Inequality Deflator can be interpreted as a way to test whether a policy is the most efficient way to achieve a stated equity-based goal, or whether that same outcome could be achieved through an adjustment to the tax system.

2.2.1 A simple example

To motivate the idea behind the Inequality Deflator, it is instructive to consider a simple example. Consider a world in which there are three people; Alan who works in a high paying job, Bill, who is unable to work (perhaps due to age or disability), and Colin who has two young children and works part-time in a low wage job.

The tax and transfer system affects each of these individuals differently. First, Alan pays an income tax, which reduces the incentive for him to work. We will assume that this tax has a constant excess burden of 20 per cent. In other words, in order to raise a dollar of government revenue, it must decrease the welfare (measured as the Equivalent Variation (EV)) of Alan by $1/0.8 = 1.25$.[11] Bill receives a transfer payment, but as he is unable to work, this can be considered a lump sum payment. Finally, Colin receives a welfare payment that varies with his final income. This transfer payment has an efficiency cost, as it provides him with a financial incentive to work fewer hours. For this exercise, we will assume that this cost is 40 per cent. In other words, in order to raise $1 of government revenue by reducing this payment, Colin's welfare would only need to be reduced by 60 cents.

In this example, the Inequality Deflator is the cost of transferring money from each individual to the government, measured as the EV loss to each individual.

[11] The literature uses different definitions to define the efficiency cost (or excess burden) of taxation. Through this example, measures of efficiency are defined as the efficiency cost without returning income lump sum to the person being taxed.

- For Alan, this is equal to 0.8.
- For Bill, this is equal to 1.
- For Colin, this is equal to $1/0.6 = 1.67$.

Now, consider a new project that is funded out of government revenue that costs \$100, has a benefit for Alan of \$10, a benefit for Bill of \$40, and a benefit for Colin of \$40. Using the Inequality Deflator approach, this project is valued at:

$$\begin{aligned}\text{Alan's Value} + \text{Bill's Value} + \text{Colin's Value} &= 0.8 * \$10 + 1 * \$40 + 1.67 * \$40 \\ &= \$114.67\end{aligned}$$

Following this methodology, this project has a surplus of \$14.67 and should go ahead.

We will now show that using the Inequality Deflator in this way is equivalent to implementing the Kaldor-Hicks criterion using changes to the existing tax and transfer system. Consider a policy in which each individual has the benefit of the project removed through changes to the tax system.

- For Alan, the income tax is increased to reduce his welfare (measured as an EV) by \$10, which results in \$8 of government revenue.
- For Bill, the lump sum payment he receives is reduced by \$40.
- For Colin, the transfer payment is reduced such that it reduces his welfare by \$40. However, given that this payment currently reduces his incentive to work, lowering the payment also removes some of the distortionary impact, and consequently increases government revenue by \$40 x 1.67 = \$66.67

Added together, this has raised \$114.67 of government revenue, of which \$100 is used to implement the program. Note that because everyone is just as well off as when they started, and the government has collected additional revenue, this policy (including the changes to the tax system to raise the revenue) represents a realisable pareto improvement.

2.2.2 Four important issues when applying the Inequality Deflator

Extending the Inequality Deflator to a population faces a number of practical and conceptual challenges. Understanding the nature of these challenges is essential for interpreting how the Deflator can be implemented in

a real world setting. Along with the empirical issues associated with estimation (discussed in Section 2.3), this section will examine four main issues – namely, how to deal with the fact that different people face different tax systems, how well the Inequality Deflator approach applies to non-marginal changes, how to interpret policies that have a different impact for people with the same income and whether the Deflator can be used when a publicly provided good affects labour supply incentives.

First, while it is convenient to think of transferring money to or from an individual earning a particular income, in a realistic tax setting individuals do not face a common tax and transfer system. Rather, the tax rates and transfer payments that each individual faces will depend on a wide range of personal characteristics, such as whether or not they have a partner, the income of that partner and the age and number of children that they have. This provides some flexibility to the Inequality Deflator, as compensation payments made through the tax system can now be made just to a particular group of people (e.g. the cost of transferring a dollar to a single parent with three children) rather than to the entire population.

However, this flexibility also adds to the empirical complexity. In principle, the Inequality Deflator could be defined for each possible tax schedule. However, it is implausible to estimate labour supply responses for each of these groups,[12] and within the MITTS framework dividing the cohort up into such small groups would leave too few observations to conduct a reliable modelling exercise. Nevertheless, it is important to separate the Inequality Deflator into different categories in order to capture the main variation within the tax and transfer system. In this paper, individuals were separated into four groups; singles with children, couples with children, singles without children and couples without children. This subgroup analysis is presented in Section 2.4.

The second implementation issue comes from the marginal nature of the Inequality Deflator. The results are based on small (infinitesimal) changes to the existing tax systems, so care should be taken when extending the results to interpret large policy changes. However, in order to practically implement the Deflator in a cost-benefit setting, it is useful to understand what counts as a 'small' policy change. One advantage of the MITTS modelling technique used in this paper is that it allows transfers of different sizes to be modelled, which can provide some insight regarding how much money can be efficiently

[12] As an example, the Family Tax Benefit Part A supplement has 30 different income test thresholds that vary according to the combination of children of different ages, (Centrelink 2009) meaning that a Deflator could in principle be defined for each of these combinations of child ages.

transferred through the tax system. The MITTS model showed that the larger the transfer was, the higher the efficiency cost of the transfer, but that the results were relatively smooth for values less than $1000 per annum. Further discussion of this topic is contained in Appendix 2.A.

The third implementation issue is determining what to do when surplus generated by a project is not equal for people at the same income level. For instance, if two people have the same income, and a policy benefits one person by $1 and hurts the other by $1, it is impossible to make changes to the income tax that result in compensating payments to both parties. Intuitively, the tax system is not flexible enough to reverse the policy impact. To some extent, more tailored policies can be implemented based on changes to different tax/transfer payments. For instance, thresholds for family income in the family tax benefit system could be changed to target families with children, while thresholds for individual income could be changed to target individuals with children. However, this process can only go so far, and there will still be variation of welfare amongst similar people.

In this case, implementing a cost-benefit process using the Inequality Deflator will not return a potential pareto improvement using the Kaldor-Hicks interpretation. Rather, it will ensure that the expected compensation for people at a given income level is greater than or equal to zero (while some people will be worse off and some people will be better off). As a result, this process no longer yields a pareto improvement.[13]

This style of analysis may still be justified on the basis of the revealed preference interpretation. This interpretation would say that for small policy impacts, the welfare gained by a person of a particular income level is offset by another person's loss at the same income level. However, this requires an additional assumption that the government is indifferent between people who are indistinguishable through the tax system. In other words, if two people share the same income, and the same characteristics used to define tax and transfer liabilities (such as relationship status and number of children), then the government would be indifferent between one gaining a dollar and the other losing a dollar.

The validity of this assumption is unclear, but it is more reasonable for small policies,[14] and for policies that affect people somewhat randomly. On the other hand, the assumption is less likely to be valid for large policies, or where the policy affects a group systematically based on a criterion that

[13] Instead it yields what Ng (1984) calls a quasi-pareto Improvement.

[14] Larger impacts would violate both the small policy assumption used in this paper, as well as notions of horizontal equity in the tax system.

is not part of the tax system, such as a policy that favoured all men, or all people of a particular age.

In order to maintain the Kaldor-Hicks interpretation of using the tax system to implement a pareto improvement, it is necessary to make an adjustment to the process. In this case, $\underline{S}(y)$ is defined (following Hendren's notation) to be the lowest level of surplus for any individual at a given income level. Implementing the Inequality Deflator with $\underline{S}(y)$ will guarantee a pareto improvement, but is a more difficult benchmark. Essentially, it results in overcompensating all individuals with $S(y) \geq \underline{S}(y)$, which will make it difficult to find welfare improving policy proposals, and will result in a strong status quo bias.

A final implementation issue is that this type of analysis is the concern that policies with distributional effects may create an incentive or disincentive to work in exactly the same way as an income tax. For instance, if a publicly provided good is available only to those who earn less than a certain wage threshold, there is a disincentive to earn more than that wage threshold. In this case, the incentives to earn must be incorporated into the final calculation. In fact, as shown in Kaplow (2004), if the policy being considered affects work decisions in exactly the same way as a tax, then under general assumptions,[15] equal welfare weighting should be used for all individuals in the policy analysis.

The key distinction in determining whether to evaluate a policy using weights based on the Inequality Deflator or equal weights is whether the benefit provided by the good occurs because they are poor, or whether enjoyment of the good is just higher amongst low-income people, who would continue to benefit from the good even if they had higher incomes.

To see the difference between the two cases, consider the following examples. In the first case, a means tested subsidy for health care that is only available to people with low incomes. In this case, a low-income individual who receives the subsidy will be concerned that they will lose this subsidy as they earn more money. Following the logic of Kaplow (2004), this policy should be evaluated using equal weights, rather than the Inequality Deflator. In the second case, a one-off policy that affects a small number of people, such as the decision to build a local park, or disaster relief to a small town, are unlikely to affect long-term incentives to earn money. In this case, the policy should be evaluated using the Inequality Deflator.

In practice, many types of policies and public goods will be a combination

[15]The main assumption is weak separability of leisure and consumption in the utility function.

of the two examples above. For instance, the provision of a public good may have no effect on work incentives in the short-term, but viewed in the long-term, such policies may slightly increase the desirability of a low-income lifestyle. Alternatively, a policy may increase a marginal effective tax rate, but because it is less salient than the income tax, it is less likely to affect work incentives. In this situation, a more general analysis is required in which the benefits of the policy are estimated using the Inequality Deflator, and the costs of the policy include any fiscal externalities resulting from people earning more or less as a result of the policy. Where these two effects are equal, the case reverts to an equal weighting result as in Kaplow (2004).

In summary, in order to evaluate policy using the Inequality Deflator, it is important to consider the following issues:

- Which group is being affected, and is it appropriate to use a population level Deflator, or a Deflator defined for a population sub-group?
- Is the policy being examined small? The Inequality Deflator is a marginal concept, so care must be taken in evaluating large changes.
- Does the policy affect people differently conditional on income, and if so, is there a reason to think that this group should be treated differently by the tax system?
- Does the policy being considered have a large effect on people's incentive to work and earn money? If so, there is an additional term to consider in welfare calculations. In the specific case where the policy being considered acts like part of the tax system, and utility is weakly separable, then equal weights should be used to evaluate the policy.

2.3 Estimation using MITTS

Estimation of the Inequality Deflator is performed in this paper using the Melbourne Institute Tax and Transfer Simulator (MITTS), which is a behavioural labour microsimulation model developed over a period of time by researchers at the Melbourne Institute of Applied Economic and Social Research. MITTS has been used in a large number of research projects to examine the impacts of changes to Australia's tax and transfer system

in both a positive and normative manner.[16,17] The MITTS project that is most closely related to this work is Creedy and Herault (2011), which looks at whether small tax changes to the existing tax system can be found that increase social welfare. However, it bases this analysis on the assumption of various social welfare functions, which is an approach that the current paper is designed to avoid.

The MITTS model is composed of two distinct parts, MITTS-A and MITTS-B. MITTS-A is a static microsimulation model and can calculate net incomes for each household in a cross sectional household survey (for this paper the 2009/10 Survey of Income and Housing is used as the base data). This calculator includes a significant amount of detail regarding the existing tax and transfer system and is used to calculate post tax/transfer income for different levels of labour supply. Tax liability at the household level is then scaled up to the population level using the sample weights from the underlying survey. This process also requires knowledge of each individual's wage, which are either observed in the data, or imputed using the process described in Kalb and Scutella (2002).

MITTS-B is based on a structural labour supply model as estimated in Kalb (2002). The model is neoclassical, with each household maximising a quadratic utility function over income and leisure. Households have a joint utility function and couples make joint labour force decisions. Household utility functions are estimated for four distinct groups; couples without children, couples with children, single individuals without children, and sole parents. Labour supply is not modelled for children, people over the age of 65, the self-employed, students, or people eligible for a disability pension.

Simulated household level utility functions are derived through a calibration process, by which an error term is added to the estimated utility function that returns the individual to the observed hours of labour supply. As there are a number of error terms that would be consistent with the observed labour supply point, the model takes one hundred draws of the error term that would be consistent with the observed level of labour supply. Labour supply is computed for each of the one hundred utility functions, which means that labour supply predictions are probabilistic.[18]

[16]The Melbourne Institute has a full list of projects completed using MITTS on their website: https://www.melbourneinstitute.com/labour/research-topics/microsimulation/mitts.html.

[17]More broadly, behavioural microsimulation is being increasingly used to look at issues of optimal tax changes and redistribution. See for instance, Bessho and Hayashi (2013) and Spadaro (2007).

[18]For instance, an individual in the model may be observed to enter the labour force

Once the household specific utility function is estimated, and the net income is known at each possible labour supply point, MITTS-B can directly calculate utility at each possible labour supply point. The observed response is simply the labour supply point that maximises utility. Equivalent (and compensated) variations are generated following the methodology of Creedy et al. (2010) by finding the cash payment required to generate an equivalent utility gain/reduction for each utility function generated.

Estimates of the Inequality Deflator are generated using MITTS by manually changing the existing tax system in a way analogous to Figure 2.2 above. This is done by altering the tax calculator component of MITTS to increase net income by $10 per week if their observed taxable income is within a given $5000 range. A similar calculation is performed where the tax system is used to transfer $10 away from people in a $5000 income range with the preferred estimate the average value generated by these two figures. The rationale behind the choice of these values is given in appendix 2.A.

The Inequality Deflator is calculated as the ratio of government revenue to personal welfare that is generated by such a tax change. One important implication of this approach is that transfer payments are not perfectly targeted. When the policy change is infinitesimal (as in Hendren (2014)), people may change labour supply in order to receive the payment, but in the limit, they will have an equivalent variation of zero. In contrast, in the modelled response, the equivalent variations will be greater than zero for this group. This can be interpreted as an approximation of a true Inequality Deflator, or it can be seen as a practical limitation as to how accurately a payment can be targeted through the tax system.

Labour supply responses generated by the MITTS framework are the key to the identification exercise in this paper. A comparison of elasticities generated by MITTS with other elasticity estimates for the Australian economy is found in Creedy and Kalb (2004). They conclude that the elasticities implicit in the MITTS model are consistent with the international literature.

2.3.1 A comparison with the Hendren methodology

The modelling exercise in this paper is based largely on the work of Hendren (2014). While the difference in approach is motivated primarily by the lack of a developed body of estimates of the elasticity of taxable in-

with a 5 per cent probability in response to a change in the tax rate.

come for the Australian economy,[19,20] the microsimulation approach does have some noticeable advantages and disadvantages relative to the Hendren (2014) approach.

Hendren (2014) is an example of the sufficient statistics approach to empirical public finance.[21] The paper identifies the desired value (the Inequality Deflator) and writes this as a function of empirically estimated elasticities. Specifically, the Inequality Deflator is defined as 1+FE (Fiscal Effect),[22] where FE is defined as:

$$FE(y) = -\epsilon^P(y)\frac{T(y)-T(0)}{y-T(y)} - \zeta(y)\frac{T(y)}{1-\frac{T(y)}{y}} - \epsilon^C(y)\frac{\tau(y)}{1-\tau(y)}\alpha(y) \qquad (2.1)$$

$$= \text{extensive margin effect} + \text{income effect} + \text{intensive margin effect}$$

Where:

- T(y) is the total tax function
- $\tau(y)$ is the marginal tax rate
- ϵ^P is the extensive margin elasticity of taxable income with respect to the net of tax rate
- ϵ^C is the intensive margin elasticity of taxable income with respect to the net of tax rate
- $\zeta(y)$ is the income elasticity of earnings
- $\alpha(y)$ is the elasticity of the income distribution, which is a measure of the shape of the underlying income distribution

To implement this formula, it is possible to use tax records to find the total and marginal tax rates as well as $\alpha(y)$, which defines the shape of the

[19] An exception is Johnson and Breunig (2016).

[20] Note that it is not possible to use international estimates to assist with an Australian estimate as the elasticity estimates are population/economy specific, and rely heavily on the existing tax system, rather than structural parameters.

[21] Chetty (2009a) provides a summary of the sufficient statistics approach in public finance, in which welfare consequences of various policies are written as functions of reduced-form elasticities rather than requiring full model specification.

[22] As discussed in footnote 7, this paper uses a slightly different definition of the Inequality Deflator. This formula corresponds to the definition used in this paper, whereas the definition in Hendren (2014) divides through by the average value of this term for the population. That is, the Inequality Deflator = (1 + FE)/E(1+FE).

income distribution. Hendren then uses elasticity estimates from a variety of sources to provide elasticities for three groups: those eligible for the Earned Income Tax Credit, those paying the top income tax rate, and all others.

This approach used in Hendren (2014) is subject to two potential critiques. First, there is an extensive literature that has come up with a wide range of estimates for the Elasticity of Taxable Income (ETI), with point estimates for the ETI ranging from zero to more than 1 (Chetty 2012).[23] The sufficient statistics framework is only valuable if those statistics can be accurately identified.

Second, it is unclear why the ETI would only vary by income for 3 distinct income groups. This assumption is necessary as it is difficult to obtain an elasticity estimate that varies by income. In contrast, the MITTS framework allows the elasticities to vary fully across the income distribution as a result of observed characteristics such as family, size and age.

Another useful advantage of the MITTS model is that it is able to provide Inequality Deflator estimates at the household, rather than individual level. This is a useful tool for looking at inequality as household income is a better measure of wellbeing than individual income. The Household Level Deflator is also useful for looking at elements of the Austalian welfare system which is generally based on household income. Estimates of the Inequality Deflator at the household level are provided in Section 2.4.5.

A further advantage of the structural modelling approach is that it allows for some idea of how well the marginal policy assumption holds. As discussed in Chetty (2009a), sufficient statistics are a function of the existing policy parameters, and as a result they provide local efficiency results. It is therefore unclear how well this approximation holds if we wished to transfer more than an infinitesimal amount of money to individuals. Appendix 2.A contains a series of estimates on an Inequality Deflator based on transfer of different sizes.

A final advantage of this approach is that the Inequality Deflator is still a relatively new concept, and it is unclear how accurately it can be estimated. As the microsimulation methodology here is quite different to that of Hendren, it can be used as a form of triangulation to increase confidence in the Hendren results.

The advantages of the structural modelling approach come at a cost. Most importantly, it is always difficult to fully test the reliability of the modelled response on which all of the results are built. Another significant

[23] Although Chetty (2012) paper provides one potential explanation for why this variation exists, there is still far from a consensus on the appropriate measure for the ETI.

drawback is that the model excludes a significant proportion of the population. It only estimates a labour supply response for working age population (over 18 years and under 65 years) and excludes those who are self-employed, eligible for the Disability Support Pension or who are students. As a result, the model can provide no insight with respect to these groups.

Another possible concern is that the MITTS framework is built upon survey data, which has significantly fewer observations than tax record data. As a result, it will perform less well than the ETI approach in parts of the income distribution with fewer observations (such as the top of the income distribution, or when looking at single parents).[24] The upside of using survey data is that it provides information on individuals with very low income who may not file a tax return.

Finally, the MITTS model only looks at one specific aspect of labour supply response, the change in hours of work to a change in the tax rate. It is unable to look at how people might change the way that they report their income to avoid taxation, which is incorporated in the Hendren approach.[25] This is particularly important for high-income individuals for whom this type of response is more likely.

2.4 Results

The main results of the model combines all types of individuals together and estimates the Inequality Deflator based on changes to taxable income.[26] The results are based on the tax and transfer system in place in 2009, and the results are shown in Figure 2.3. In this chart, the blue series represents the results from the policy experiment where \$10 per week is given through the tax system, and the red dots represent the experiment where \$10 per week is taken away through the tax system. The points are marked at the centre of the \$5000 income range (so the $20,000-25,000$ range is shown at \$22,500).

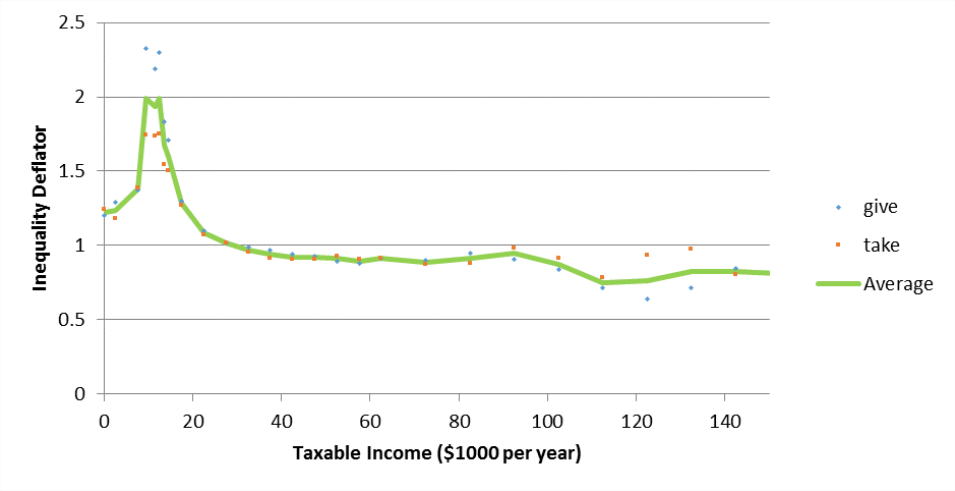
Following the different interpretations of the Inequality Deflator above, there are two ways to read the Deflator on the vertical axis of this chart. The first is that the value is equal to the marginal utility of income of

[24] This is a common problem in studies looking at trends in income distributions, and is one of the primary advantages of using administrative tax records when looking at income trends for high income earners (Wilkins 2015).

[25] This follows the argument of Feldstein (1999) that a rational agent would equalize the costs of reducing taxes across different channels (such as working fewer hours, and tax avoidance, and increasing deductible activities). However, as discussed in Saez et al. (2012) and Chetty (2009b), there are limitations to how far this argument can be applied.

[26] Taxable income is equal to market income plus taxable payments and pensions.

Figure 2.3: Australian estimates of the Inequality Deflator



individuals that would rationalise existing government policy. The second is that the vertical axis measures the cost (in terms of government revenue) of transferring a dollar to people in a particular income range.

There are several important features to this figure. First, there is a spike at $15,000 where the Inequality Deflator reaches around two. This corresponds with the level of income that is received by people on unemployment benefits and represents zero market income (people with income less than $15,000 are typically secondary income earners). The rest of this figure is split into two distinct groupings. First, there is a relatively consistent weight given to any individual earning between $40,000 and $100,000. Next, there is a slightly lower value for people earning between $100,000 and $150,000.

Note also that the results are that implied social weights are decreasing with income (for income more than $15,000), and are everywhere positive (a negative value would imply that we are on the wrong side of the Laffer curve).

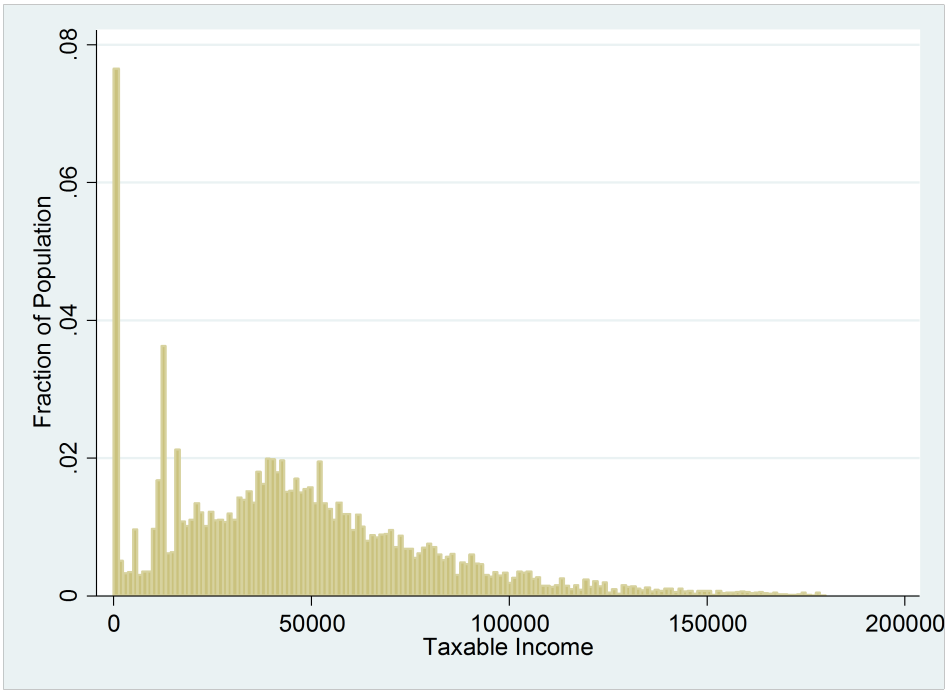
2.4.1 Understanding the results

In order to better understand the mechanisms working inside the MITTS model, the following section breaks down the above results into its various components. In doing so, it is useful to refer to equation 2.1, which shows that the Inequality Deflator can be written as the sum of the intensive margin effect, the extensive margin effect, and the income effect. These values, in

turn can be written in terms of the shape of the income distribution, the marginal and effective tax rates, and various labour supply elasticities.

A useful place to start is the underlying income distribution (Figure 2.4), remembering this only includes individuals modelled in the MITTS framework (excluding those aged under 18, aged over 65, those receiving a disability pension, students and the self-employed).[27] This figure shows that there are significant masses of individuals at $0 income, but also significant masses between $10,000 and $15,000 that correspond to the base payment rates for various Australian government payments.[28]

Figure 2.4: The Australian distribution of income



The chart also shows that there are relatively few people represented in

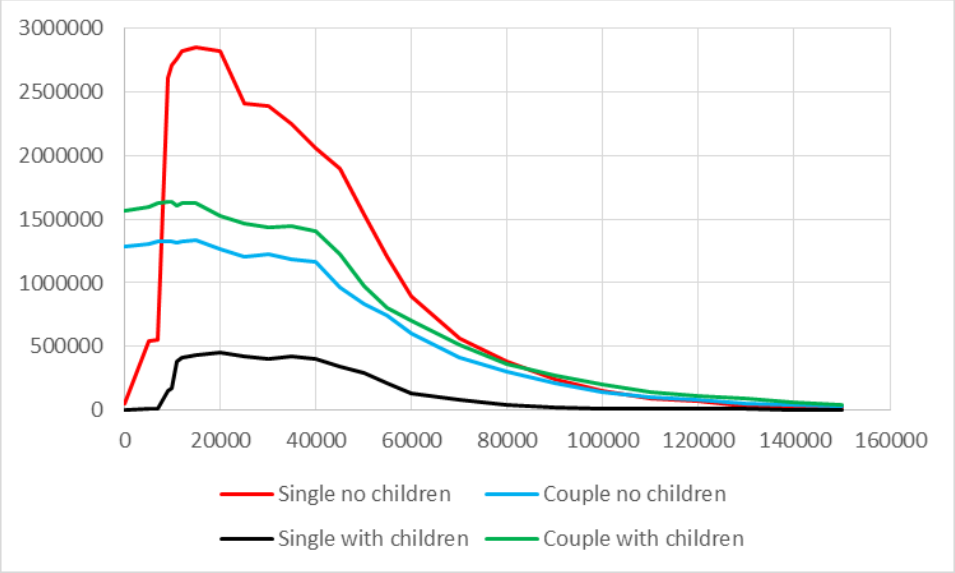
[27] This population underrepresents low income earners as younger people, older people and students are all likely to be amongst lower income earners. How to account for this population when implementing the Deflator is discussed in Section 2.5.

[28] The payment rates for government payments vary with a person's individual characteristics, such as whether or not they have children, and whether they have a partner, which explains why there are a number of point masses in this range. For instance, in 2009 the base rate of Newstart for singles with no children was $11,856 per year, the rate for singles with children was $12,826 and for couples was $10,699.

the model above $100,000. This means that figures estimated for this group should be viewed with caution.

As well as the baseline income distribution, shown above, it is useful to look at the distribution of potential incomes within the MITTS framework. Within the MITTS model, individuals can only choose from eleven discrete labour supply points (six for married men) at a given wage. Within this framework, individuals are unable to achieve income levels outside of these eleven points (even if very large incentives are placed on earning this income). Figure 2.5 shows the number of people who could possibly receive incentive payments, and is based on the $5000 ranges used in the modelling process.

Figure 2.5: Labour supply possibilities

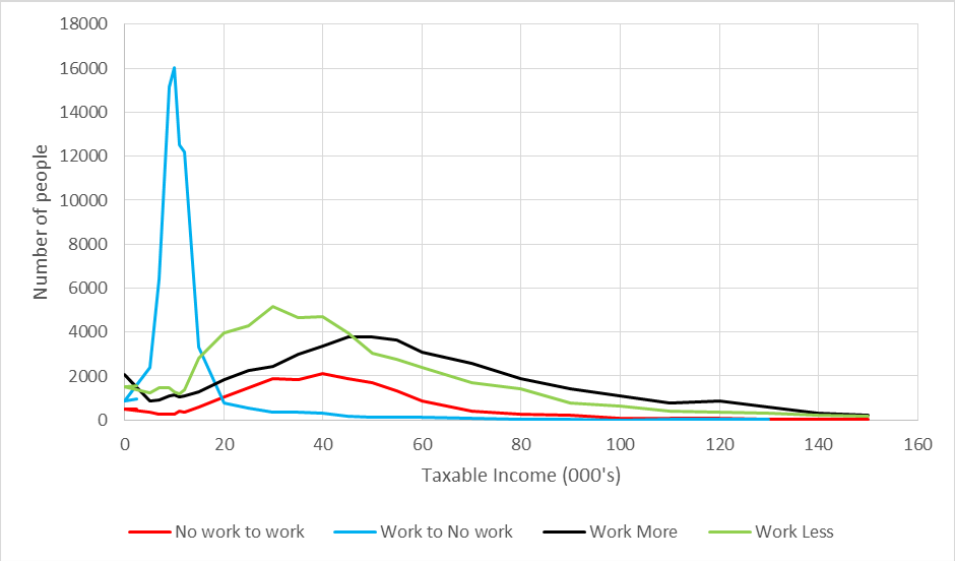


This shows that in the MITTS model, singles (with and without children) are generally unable to earn below the income support levels, meaning that they are unaffected by incentive payments in this low-income range. We also see that there are still relatively few observations at high-income levels. This means that even if people worked the maximum number of hours (which is top coded at 50 hours), the majority of people are unable to earn more than $100,000.

A final method for understanding what is driving the main results for the Inequality Deflator is to identify the size of the intensive and extensive

margin effect at different points of the income distribution, which are shown in Figure 2.6. The y-axis shows the expected number of people who change labour supply. The figure excludes those who receive the payment and have no response, and those who don't receive the payment and have no response, as both categories are significantly larger than the values below.

Figure 2.6: Responses to giving $10



The most striking aspect of this chart is the large intensive margin effect at around $15,000 that corresponds with the largest value of the Inequality Deflator. This shows that the result is being driven by a large extensive labour supply response – i.e when unemployment benefits are increased by $10 per week, 16000 people drop out of the labour force. This is equivalent to an elasticity of labour force participation with respect to the unemployment benefit rate of approximately 1.5. This is towards the top end of a range of comparable international estimates, although significant variation exists amongst estimates from this literature.[29]

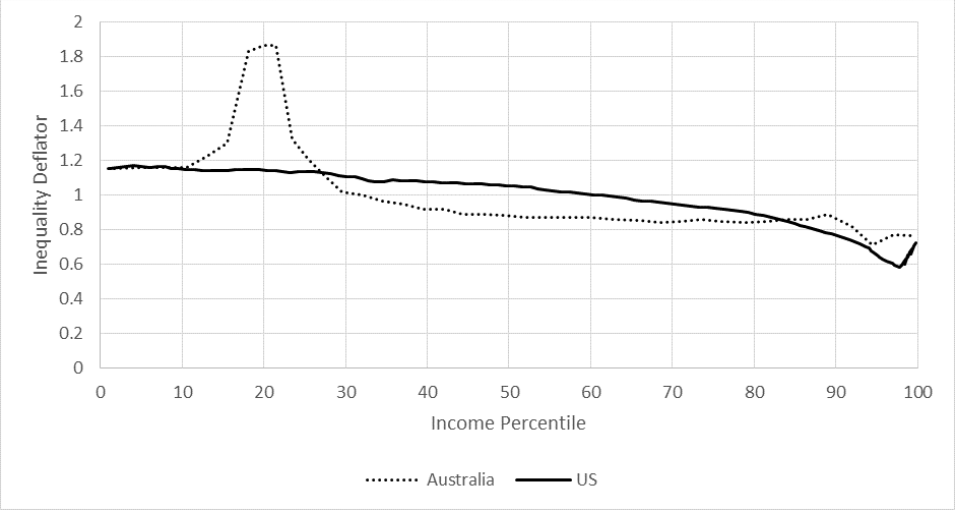
[29]For instance, Nickel (1998) performs a cross-country regression on OECD countries and finds a semi-elasticity with respect to the replacement rate of 1.3, which when evaluated at the Australian replacement rate gives an elasticity of 0.5. Fredriksson and Söderström (2008) use Swedish wage variation across regions to identify a semi-elasticity, which evaluated at the Australian replacement rate gives an elasticity of 1.9. Krueger and Meyer (2002) provide a detailed survey focusing largely on American estimates, and suggest an elasticity of around 1.

Another notable aspect of the chart is that the extensive margin responses ('Work More' and 'Work Less') have similar shape, but the 'Work More' response is shifted to the right of the 'Work Less' response. This result is driven by the underlying shape of the income distribution, which has a peak that lies between the 'Work More' and 'Work Less' peaks. Intuitively, the size of the labour supply response depends heavily on the underlying income distribution.

2.4.2 Comparison with Hendren's results

Given that this work is based on the intellectual concepts developed in Hendren (2014), it is natural to compare the empirical results obtained here with those from this paper. In order to make this comparison, the estimates presented above are converted using the adjustment noted in footnote 8. The results, shown in Figure 2.7, are also presented based on income percentiles, rather than on income level.

Figure 2.7: Comparison of results with Hendren (2004)



Several differences between the estimates are evident. The large spike in the Australian estimates due to income support payments is non-existent in the American Deflator. Further, the convex shape noted by Hendren, and interpreted as suggesting that 'it is more costly to redistribute from high-earners to median earners than from median earners to the low-earners' is also not evident in the Australian results. Finally, the American results show a much lower value for high-income earners.

The most important point to note in comparing these two sets of results is that the US results are based on percentiles of income amongst those who filed a tax return, whereas the Australian results are based on the percentile of income across the population. A significant proportion of those who don't file do so because they don't earn enough income to be required to file a tax return, and so care must be taken when making a comparison. In particular, the large 'spike' in the Australian data occurs at the base payment for Australian welfare payments, and many from this group would not file a tax return.

There are a number of other factors that could explain the differences between the two estimates. The Inequality Deflator is a product of the tax and transfer system that exists in each country, as well as the shape of the income distribution and the ability of workers to respond to changes in tax rates. All of these factors are likely to differ between Australia and the US. Australia has a more generous social safety net, a less skewed distribution of income, and less flexible workplace institutions than the US. Therefore, it would be expected that Australia and the US would have different estimates of the Deflator. However, there will also be variation that exists solely due to the difference in estimation methodology. While it is not possible to separate how much of the variation is due to a real difference between the Inequality Deflator in Australia and the US, and how much is due to different estimation approaches, it is important to consider the likely source of deviation by examining the main differences in turn.

The most striking deviation is the large value of the Inequality Deflator estimated for Australia for low-income earners, with no comparable feature on the American Deflator. It would be expected that this feature would be larger for Australia, given that Australia has a more generous social safety net. However, the apparent reason that this feature is completely missing from the American Deflator is that Hendren (2014) uses the IRS definition of 'Ordinary Income' as the main definition of income in the paper, which excludes most types of income support payments.

A second notable difference is the higher level of the Deflator estimated in Australia at high-income levels. While this is not as visible on the chart, it will have a large impact on many applications of the Deflator as the top few percentiles of income earners earn a significant proportion of national income. One of the weaknesses of the approach used in this paper is that MITTS is based on a cross sectional income survey, which have known limitations when looking at the top end of the income distribution. Therefore, any results from the MITTS application for very high income earners should be interpreted with caution.

2.4.3 Subclass analysis

In the previous sections, the Inequality Deflator was defined solely on income. However, the concept can be naturally extended to take account of different characteristics, such as whether or not the person is single, and whether or not they have children. However, in order for the underlying properties of the Inequality Deflator to hold, it is important to classify groups based on the existing structure of the tax system. For instance, it is possible to make a small adjustment to the existing tax/transfer system that only affects single parents by changing the payment rate or income test for the Parenting Payment. However, it is less sensible to think about a payment based on gender, as the existing tax and transfer system does not base payments on gender.

It is possible to imagine a separate Inequality Deflator for each group that faces a different tax schedule. For instance, it is possible to have a Deflator defined for families with two adults and three children, with the youngest child less than six years old. However, as the Australian tax system varies based on partner status, partner income, number of children and age of children (among others), and each different combination of these characteristics implies a different effective tax rate, there are not enough people in the MITTS setup to estimate a Deflator for each possible group. Instead, it is important to identify groups based on the most important characteristics used in the tax and transfer system. For this paper, four subgroups were chosen. These are singles without children, singles with children, couples without children and couples with children. These groups were chosen on the basis that partner and parental status are the main factors in determining tax liability and transfer eligibility.[30]

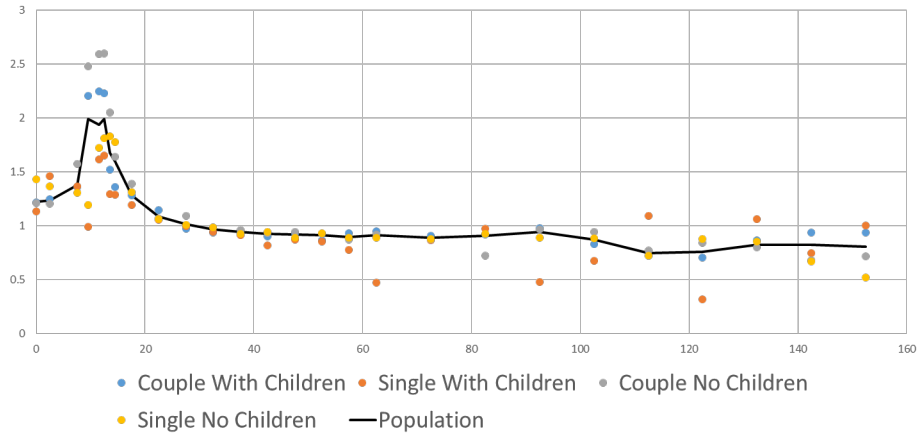
Figure 2.8 shows the results of the Inequality Deflator looking just at each individual group. For instance, it considers a $10 payment made to single parents with taxable income in a $5000 income range. The rest of the modelling follows the same process as described above.[31]

There are several important features to this chart. First, it should be noted that given the lower sample sizes, each individual result will be more variable. This is particularly evident when looking at single parents in high income ranges, where there are very few people in the model.

[30] These groups are also roughly aligned with the modelling approach used by MITTS, where separate labour supply preference parameters are estimated for couples, single men, single women and sole parents.

[31] As there is no attempt to model general equilibrium effects from the payment, the results from a payment to everyone can simply be split up into the different subdivisions for this analysis.

Figure 2.8: Estimates of sub-group Deflators



The next feature is that the general shape of the Deflator is quite similar across the four subgroups, with a spike around $15,000 and a slow decline after that point to a value slightly less than one. The major difference between the groups is that couples have more extreme values than do individuals. This is driven by the ability of families to adjust their labour supply to achieve a tax benefit.

2.4.4 Which Deflator to use?

We have now defined an Inequality Deflator at the population level, as well as one at a subgroup level. It is important to think carefully about which Deflator should be used to analyse policy proposals. In a general sense, the correct Deflator is the one that is at the level of transfer payment being considered. For instance, if we are thinking about implementing a policy, and then compensating people through the income tax system, then the correct Deflator is the population level Deflator as the income tax is only defined on taxable income (and doesn't vary with other personal characteristics). However, if we were going to compensate people through the transfer system, then it would be more suitable to use the subgroup Inequality Deflators.

From a practical perspective, estimated Deflators are very similar through the middle of the income distribution. Moreover, variation at the top end of the income distribution appears to be more due to smaller sample sizes and estimation issues, than to an underlying difference in behaviour between these groups. Given the relatively close estimates of the subclass Defla-

tors, it is unclear whether their use will give significantly different results in applied work compared to the population Deflator.

2.4.5 An Inequality Deflator based on household income

All of the previous sections have looked at the cost of redistributing income between 'individuals' with different levels of income. However, one of the advantages of the MITTS framework is that we can look at the cost of redistribution at the household level.[32] This is a sensible approach as household income is generally considered to be a better measure of welfare than individual income. Moreover, when performing policy evaluation, it is common to have the distributional impact of a policy measured at the household level, rather than at the individual level,[33] which implies that the Deflator should ideally also be measured at a household level.

The estimation of the household Deflator follows the same framework as previous sections, altering the amount of tax paid by $10 per week if the sum of taxable income amongst adult household members falls within a $5000 range. The results (for couples with and without children) are shown in Figure 2.9.

One noticeable difference between the household level results and those reported at an individual level is that there are no results reported for low-income levels. This occurs because there are very few households that have income below this level. Beyond this, the general shape of the Deflator is quite similar, with a high level at low incomes, a slow decline through most of the income distribution, and a drop off at high-income levels.

In order to see how the household Deflator compares to the earlier results, it is useful to compare the household level Deflator with the average value of the individual Deflator average for the couple. If these values are the same, then the household Deflator has no additional value. However, as can be seen in Figure 2.10, a significant divergence can be seen between the two values.[34]

The primary reason that these series diverge in Figure 2.10 is that the

[32] Throughout this section, the term household is used to refer to members of the same income unit, rather than to denote people living together. This means that couples/defactos are part of the same 'household' but a house with three adult friends would not be part of the same 'household'.

[33] Most measures of consumption for instance, are measured at a household rather than an individual level, therefore if we wanted to use the Inequality Deflator to analyse the incidence of a consumption tax, it is more meaningful to use a household level Deflator.

[34] This figure is generated using the Binscatter function discussed earlier, which removes variation amongst the average Deflator measure, as well as smoothing out both functions.

Figure 2.9: Estimates of the Household Deflator for couples with and without children

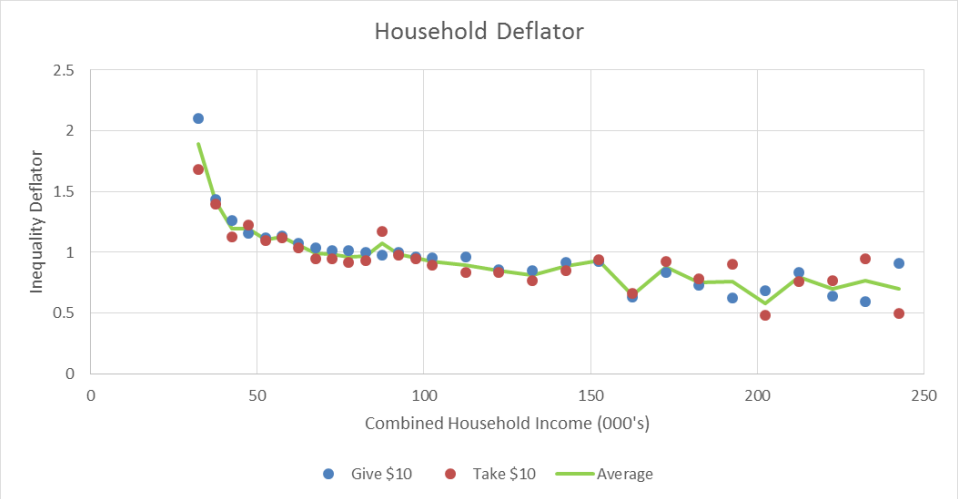
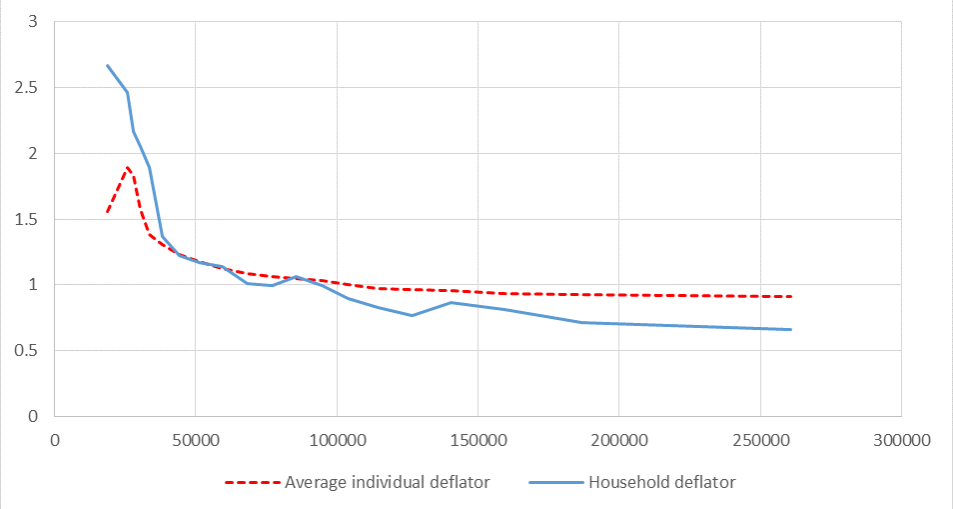


Figure 2.10: Comparison of the Household Deflator and the Individual Deflator



labour supply elasticity of an individual depends on their partner's income. For instance, a person with a low personal income will behave very differently if their partner is unemployed, compared to if their partner has a high income. As such, only looking at individual income misses a signifi-

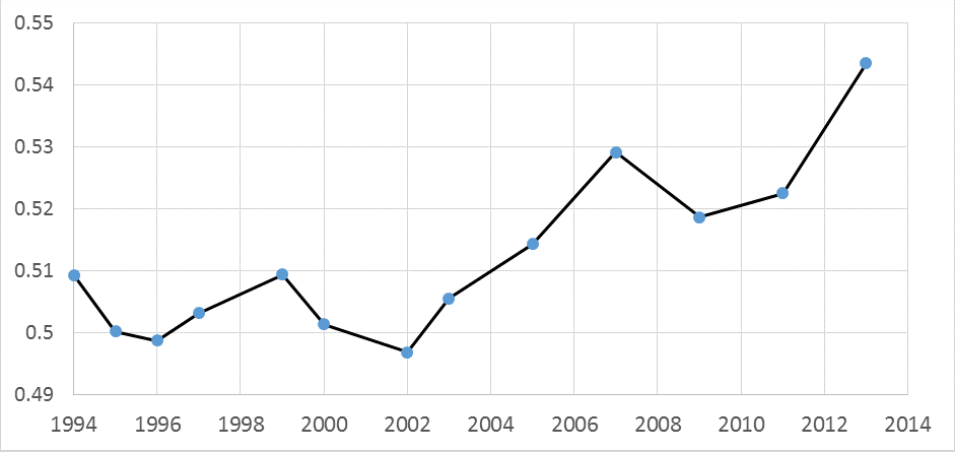
cant amount of information about the likely labour supply response of that individual.

The results presented here suggest that the household Deflator would generate qualitatively different results to the individual Deflator. This provides a further argument in favour of the structural labour supply approach used in this paper, as to implement a household Deflator using the reduced form approach used in Hendren (2014) would require the estimation of labour supply elasticities conditional on partner's income.

2.5 An application: Growth and growing inequality in Australia

In recent years, Australia has experienced a strong period of growth that has coincided with an increase in income inequality (Figures 2.11 and 2.12).[35] While this trend of rising inequality has not been as pronounced as in other countries (OECD 2015), it nonetheless poses a dilemma for making statements about improving living standards. Has the growth been a true expansion of the economic opportunities available in Australia, or simply a result of pursuing policies that favour efficiency over equity?

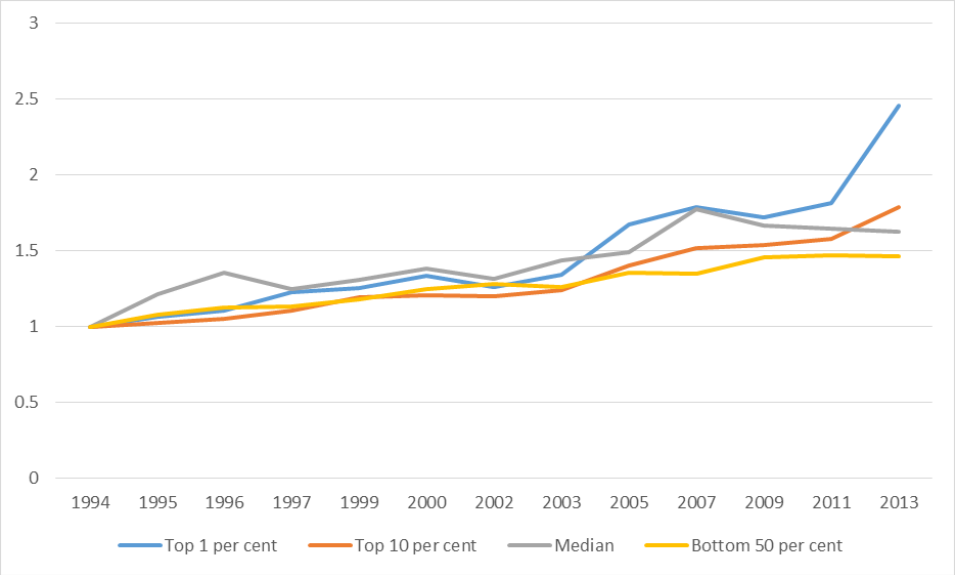
Figure 2.11: Trends in the gini index in Australia



Source: Survey of Income and Housing (various years).

[35] See also, Atkinson and Leigh (2006), Fletcher and Guttmann (2013) and Greenville et al. (2013).

Figure 2.12: Indexed income growth, by group



Source: Survey of Income and Housing (various years).

The Inequality Deflator provides one mechanism to answer this question. Using the Inequality Deflator, it is possible to create a policy experiment in which the modern income distribution is adjusted to reflect the income distribution in previous years. This generates the rate of growth that would be achieved if the tax system is used to ensure that this growth rate is equal across the income distribution. This methodology allows for the rate of growth to be examined while effectively holding the income distribution constant.

This technique is proposed in Hendren (2014) and implemented using US income tax data from 1979-2009. The paper found that roughly 15-20 percent of the growth in this period is lost if the US income distribution is held constant. Hendren (2014) also contains a discussion of the theoretical underpinnings of the approach. The key insight is that when comparing the income distributions of two different time periods, there are many ways to define the surplus gained or lost for any individual in that distribution. For instance, it is possible for people who are in the middle of the income distribution at one point in time to be at the top of the distribution at another point in time. However, for the purpose of this exercise, it is assumed that

the relative income rankings are stable. In comparing changes in the income distribution, the top percentile from one distribution will be compared to the top percentile of another distribution, the second percentile compared to the second percentile and so on.

Two other technical properties of this approach are worth noting. First, the Inequality Deflator is both conceptually defined and empirically estimated as a marginal concept, while this application is non-marginal. Therefore, the results are best thought of as first-order approximation of the costs of increased inequality. Second, as we are comparing income distributions, the difference in surplus must be equal for people with the same income level (by construction). This removes the conceptual issues discussed in Section 2.2 that occur when surplus varies amongst people with the same income level.

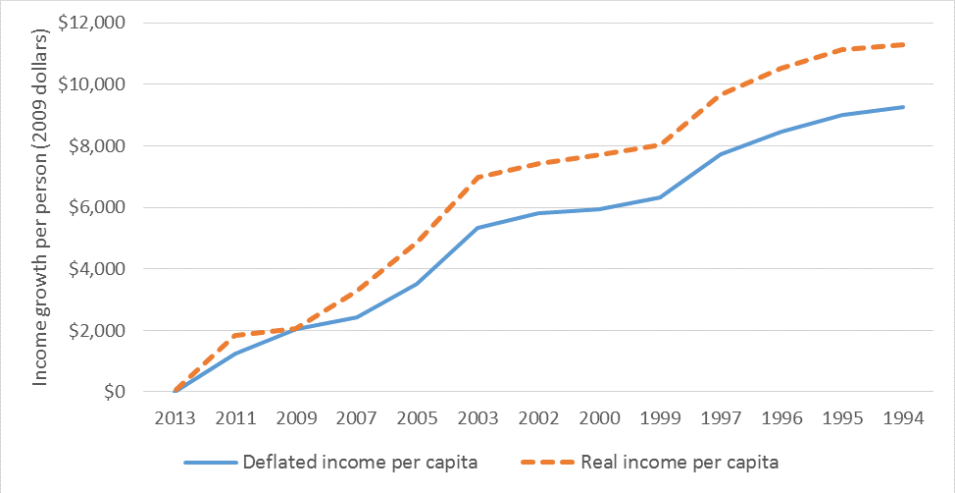
2.5.1 Estimation and results for Australia

Data on the income distribution in Australia are taken from the Household Income Distribution Surveys[36] conducted by the Australian Bureau of Statistics from 1994 to 2013, and use the total income from all sources in the previous financial year as the measure of income. Individual level data is used along with the individual level Deflator estimated in Section 2.4. The main result is presented in in Figure 2.13.

This figure is interpreted as the total level of growth since a given year, with the solid line showing the standard measure of income growth per capita, while the dashed line represents the amount of growth that would have occurred if the tax system had been used to spread the growth evenly throughout the income distribution. For instance, since the first survey in 1994, Australian incomes have grown around $11,300 per capita on average. However, if the tax system was used to spread this growth evenly across the income distribution (by adjusting the 2013 income distribution to be equal to the 1994 income distribution), then growth per person would be around $9,300. This implies that around 18 per cent of growth since 1994 is lost

[36] As discussed in Wilkins (2015), there are a variety of data sources that are suitable to the study of income inequality in Australia, including the surveys used in this exercise, ABS expenditure surveys, the Census, the HILDA survey and tax record data, with each data source possessing a number of strengths and weaknesses. This main issue raised in relation to the income survey used in this study is that, over time, the ABS have improved several features of the survey, as well as made changes to make the survey more internationally comparable (Siminski et al. (2003) and Wilkins (2014)). While these methodological changes do effect the comparability of the results across time, the issues will not qualitatively effect the results in this section.

Figure 2.13: Growth in Australia adjusted with the Inequality Deflator



once we account for this increase in inequality.

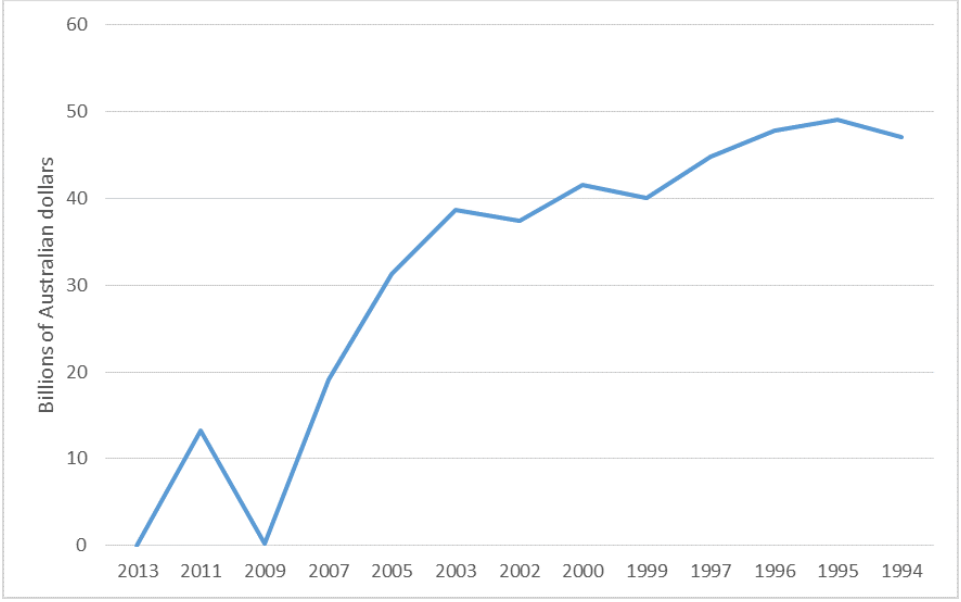
Another way to interpret these results is to look at the total cost of increased inequality in Australia (Figure 2.14). This is calculated as the difference between the two lines in Figure 2.13, and scaled up based on the Australian population. The results, displayed in Figure 2.14, suggest that the cost of increased inequality in Australia between 1994 and 2013 is around $50 billion.[37]

2.6 Conclusion

The Inequality Deflator provides a promising practical process for making policy decisions where equity and efficiency considerations are in conflict. It also provides a way to evaluate the economic progress of a country that has experienced both growth and increased income inequality. This paper develops a new method for estimating the Deflator for the Australian economy. This approach is used to estimate sub-group Deflators for four household types, as well as a household level Deflator for the Australian economy. The structural microsimulation model also allows for an examination of how well the marginal approximation of the Inequality Deflator performs for non-marginal projects. Finally, the new approach provided in this paper can act as a complement to the sufficient statistics approach used in Hendren (2014)

[37] 2009 dollars.

Figure 2.14: Total cost of increased inequality



that provides useful insights into a new field.

In addition to the applications discussed through the paper, the Inequality Deflator provides a number of promising areas for future research. The Inequality Deflator represents the redistributive trade-off that is currently made through the Australian tax system. An obvious application is to compare this with estimates of society's preference for redistribution, in order to estimate whether Australia currently has too much or too little redistributive taxation. Another potential avenue for future research is to use the Inequality Deflator to calculate an inequality adjusted marginal excess burden. Typically, the efficiency cost of a tax is generated using a calculation that returns tax revenue in a lump sum manner. If instead, this revenue was returned through the income tax (ie using the Inequality Deflator), then the value of the measured excess burden would be distribution neutral. This would be particularly useful for comparing the excess burden of two taxes, as it holds equity consideration constant while allowing efficiency to be directly compared.

2.A Discussion of the modelling approach

This paper utilises the MITTS modelling framework to estimate the Inequality Deflator for the Australian economy in 2009. For the most part, this modelling was done using parameters and assumptions that were common to previous MITTS projects. This includes the utility function, the choice of which households' behaviour was modelled and adjustment of weights to align with national aggregates. However, the nature of the exercise necessarily required judgment calls to be made regarding the specification of the shock used in the model. Further, given the time required to run the MITTS model, it is not possible to perform sensitivity analysis across all possible variables of interest.

This appendix aims to provide the rationale behind four key decisions; the size of the financial incentive provided through the tax system, the width of income for which people are eligible for the financial incentive, the range of income for which the modelling exercise is performed, and the use of the average of 'give' and 'take' runs.

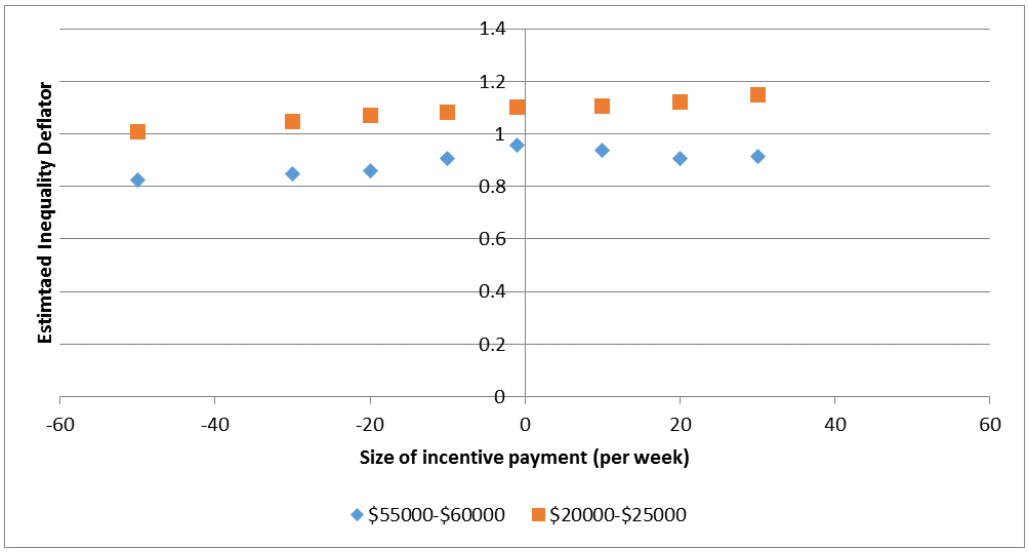
The size of the financial incentive

The Inequality Deflator is estimated by providing a small financial incentive to adjust labour supply. In the main calculations, this small amount was chosen to be $10 per week. However, in order to determine the appropriate size of the shock, a number of alternative sized shocks were estimated for two points in the income distribution. The results of these runs can be seen in Figure 2.15.

This exercise provides several important pieces of information. First, for the modelled income ranges ($20,000-$25,000 and $55,000-$60,000), there is a relatively constant ratio between the Deflators. This suggests that the size of transfer would not affect the application of the Inequality Deflator to welfare trade-offs between these groups.

Next, there is an increasing trend for both series, suggesting that the cost of transferring money through the tax system faces increasing costs. However, for values around $0, these differences are relatively small. This can be seen as the estimation error that occurs as we move away from a marginal change and towards a larger policy impact. However, it also provides some guidance as to how large a transfer can be considered using this framework before the assumption of a marginal policy change breaks down.

Figure 2.15: Effect of the size of the modelled shock on the estimated Deflator



There is also a modelling concern around having transfers that are too small. Effectively, there is a concern that if a financial transfer is too small, there will be very little behavioural response in the model, and the results will be driven by one or two individuals, who may have atypical labour supply characteristics.[38]

The final decision of $10 per week was a compromise between the concern that for large values, the Inequality Deflator values will diverge, and for small values, the results may be unreliable.

The width of the transfers

In this exercise the tax incentive was provided to people in $5000 ranges (for instance, a $10 per week incentive is given to people with income between $20,000 and $25,000).

The main concern regarding this decision is that MITTS is a discrete model, meaning that individuals choose from eleven discrete labour supply

[38]The probabilistic nature of the model can alleviate this concern to some extent, however, even with one hundred observations of each individual, a small policy change may result in a one percent probability of one or two people responding in the model. The difference between the implied elasticity in this case is 100 per cent.

points (six for married men). If the income range is too small, it is more likely that individuals in the model will not have a labour supply point within the set. This would result in a downward bias in the level of behavioural response.

On the other hand, wider ranges provides less specific information about particular ranges of the income distribution. For instance, it is possible that there is more variation in the Inequality Deflator for low incomes that is averaged out by applying wide income ranges.

The ranges for which the estimates are accurate

This paper estimates the Inequality Deflator for levels of annual taxable income between $0 and $150,000. It is natural to ask whether the Deflator can be extended further up the income distribution, as well as whether the existing high-income estimates are sound.

The main issue that occurs at high incomes is that the policy will influence fewer people as the income range increases. This will increase the variance of the estimates of the Inequality Deflator as the budgetary impact and welfare impact of a policy is determined by a small number of individuals. Having a small number of individuals is problematic, both because those individuals might have unusual labour supply characteristics, but also because with a small number of records, the observed income distribution becomes less smooth. As discussed in Section 2.2, an important driver of the size of the Deflator is the number of people in the income distribution above and below the targeted payment, as this represents the number of people who can increase/decrease their labour supply in response to a compensation payment. If the sample size becomes too small to accurately represent the shape of the income distribution, then the Deflator estimates will become unreliable.

There is a further issue that occurs as incomes rise due to the top-coding of labour supply in the MITTS framework. At the high end of the income distribution, a reasonable proportion of individuals work 50 hours a week. By the assumptions of the model they are unable to work more than this amount. As a result, any tax increase that occurs at their existing hours of work can only be avoided by decreasing work (while for other individuals on the income distribution, this tax can potentially be avoided by increasing or decreasing labour supply.

It is unclear whether this is a reasonable assumption. It is possible that these top coded individuals are actually working as hard they can, and it

is not possible for them to increase their income. However, to the extent that this is just a result of the structure of the model, this will increase the measured efficiency cost (decrease the Inequality Deflator).

Finally, it should also be noted that for high-income individuals, it is not clear that labour supply responses are the main mechanism that people use to respond to higher/lower taxes. Very high-income individuals may be more likely to respond to tax changes by rearranging their tax affairs, which is outside the scope of this model.

More generally, it is unclear that if society wished to increase taxes on the very wealthy, the best way to do it would be through the income tax. In this case, it may be more reasonable to measure the distributional trade-offs that exists in the corporate tax system or estate planning laws. As a result, very high income individuals are best seen as beyond the scope of this project.

The preferred estimate as the average of the 'give' and 'take' runs

The model was run to provide a small benefit through the tax system, and was also run to provide a small cost through the tax system. Under the Hendren approach, the Deflator estimated in these cases will be equal. However, under the MITTS approach used in this paper, the estimates differed in some situations. In these cases, the average of the 'give' and 'take' runs was used as the preferred values.

Referring to Figure 2.3, it is notable that the give and take estimates are very close through the middle of the income distribution, while they diverge at the extremes of the income distribution. The likely driver of this result is masses of people earning a particular amount of income and being unable to earn more/less because they are at the top/bottom of the allowable labour supply, while others around this income level are not subject to the same constraints. Effectively, the give and take scenarios are targeting different groups of people.

For instance, there are a large number of people earning around $10,000-$15,000 that have zero labour income, with the income provided through income support payments. An adjustment to the tax system to get people to move away from this income level will impact on this mass of people, who are all unable to earn less than this amount. In contrast, an incentive payment to move to this income amount will influence both people above and below this initial income amount.

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Chapter 3

Relative welfare weights for individuals, consumers and producers

Abstract

This paper applies the concept of an Inequality Deflator to evaluate the relative value of capital versus individual income. As the shareholders of businesses are typically higher income earners than the average person (and the typical consumer), money transferred to business owners or shareholders will, on average, increase the level of inequality in an economy. To the extent that society values both equity and efficiency goals, benefits accruing to businesses should be less valuable than benefits accruing to a typical individual (or a typical consumer). The Inequality Deflator, when applied to capital earnings, can be interpreted as the amount of money that would be received by everyone if the income tax and transfer system were used to redistribute a dollar earned by a business evenly across the population. This paper estimates the relative welfare weights based on the Inequality Deflator for the United States and for Australia and finds that once distributional differences are adjusted for, a benefit of $1 to a business is equivalent to around 97 cents to a typical consumer (weighted by consumption) and around 88 cents to a typical individual. The paper can also be used to improve welfare calculations in the sufficient statistics welfare literature, which typically assumes that a dollar transferred between a consumer and a producer has no net welfare effects and can therefore be ignored. However, once distributional effects are considered, the incidence of the tax (whether it falls on producers or consumers) has welfare effects.

3.1 Introduction

Modern societies display a preference for both efficiency and equity. As a result, if two policy options differ in terms of both efficiency and equity, it is difficult to make a firm policy recommendation. An appealing solution to this problem is to imagine small changes made to the existing income tax and welfare system that can be implemented along with a policy, which gives the two policy options an equivalent distributional outcome. This allows the two options to be directly compared. As redistribution through the tax system is costly, this process effectively puts a value on the equity outcomes of a policy or project. This approach was proposed in a series of papers by Kaplow (2004 and 2008), was developed into a workable empirical framework in Hendren (2014), and has two appealing rationales. First, it can be seen as identifying the revealed preference between equity and efficiency present in the existing income tax and welfare system, with this trade-off applied to new policy proposals. Second, the changes to the existing tax and transfer system can be seen as realisable compensation payments in a Kaldor-Hicks framework.[1]

In this paper, this intellectual framework is applied to the question of how to treat a welfare gain to a typical individual, in comparison with a typical producer and a typical consumer.[2] As the distribution of capital earnings and the distribution of consumption are not equal across the population, any policy that impacts either producers or consumers will change the effective distribution of income. The Inequality Deflator can be used to remove this distributional impact and allow a distribution-free comparison of policies.

The motivation for this research is twofold. First, practitioners of economic policy and program evaluation must continually make decisions that trade-off benefits and costs to individuals, consumers and businesses. At present, there are widely varied approaches to this problem. In some settings, a total surplus rule is used, which equates the value of producer and consumer surplus. However, this is often seen as a necessary simplification, and is described as a limitation of the cost benefit process in the Australian Government Handbook of Cost Benefit Analysis (Department of Finance and Administration 2006).[3] In other cases, a Consumer Surplus test is used.

[1] As opposed to lump sum transfers that are used in the standard Kaldor-Hicks framework.

[2] A typical consumer is taken to be a weighted average of individuals using observed consumption levels as weights. Similarly, a typical producer uses ownership of equity as weights. Finally, a typical individual uses equal weights for everyone.

[3] This policy dilemma is also discussed in Productivity Commission (2013), and

For instance, in questions of competition law, a Consumer Surplus test is used in Australia (Fallon 2005) and is increasingly used in a global setting (International Competition Network 2011).[4] This provides zero weighting to producers and will typically provide very different policy advice to a total surplus test. A final approach is to say that distributional concerns are beyond the scope of cost benefit analysis, and to report which parties gain and lose, but leave a normative judgement to an external party, such as an elected official.[5] The methodology proposed in this paper provides a simple means to account for the distributional impact of a policy and allows the economic analyst to compare proposals in a pragmatic and consistent manner.

The second motivation is that the relative welfare weights estimated in this paper can be used to extend the sufficient statistics literature, which typically relies on the assumption that benefits to producers and consumers are equivalent (see for instance Harberger (1964) and Chetty (2009)). This assumption allows transfers between parties to be ignored, and in some cases dramatically simplifies the welfare calculation. While it has long been noted that these weights need not be equalised (Harberger 1978), the assumption has been used by default given the absence of a reasonable alternative weighting system. This paper can be seen as a validation test of this assumption. If the relative welfare weights for consumers and producers estimated using the method in this paper are close to one, then the assumption that producer and consumer benefits are equivalent is reasonable, while if the estimated weights differ considerably from one, then a transfer between producers and consumers will have welfare effects that need to be incorporated into the calculations.

Calculation of the relative welfare weights for individuals, producers and consumers requires an estimate of the Inequality Deflator, and the joint distribution of income, equity ownership of businesses, and consumption. This paper performs this calculation for the US and Australian economies. For the US calculation, the estimates of the Inequality Deflator are taken from Hendren (2014), while the joint distribution of income, consumption and wealth are taken from the 2013 wave of the Panel Study of Income Dynamics. For the Australian calculation, the estimates of the Inequality

Sims (2012).

[4]It should also be noted that, as described in Orbach (2010), the Consumer Welfare standard is not well defined in a legal setting, and has been used in different ways in different legal rulings in the United States.

[5]This was proposed by Boadway (1976), and is currently the official policy of the Australian Government (OBPR 2014).

Deflator are taken from Chapter 2, with the joint distribution of income, consumption and wealth taken from the 2009 survey of Income and Housing Costs. A range of alternative specifications are considered, including varying the assumptions used to estimate the Inequality Deflator, and varying the definition of capital and consumption. The results are reasonably robust to such variation, with $1 of benefits to a capital owner being roughly equivalent to a 94-99 cent benefit to a typical consumer, and around 80-96 cents to a typical individual.[6]

3.2 The Inequality Deflator

The Inequality Deflator takes its name from a working paper by Hendren (2014). The conceptual basis of the Deflator is to imagine a small change to the existing tax and transfer system that returns a small amount of money to people earning a given income (Figure 3.1).[7] If there was no behavioural response to this tax change, the cost in terms of government revenue would be equal to the benefit received by individuals. However, the change to the tax system will change the incentives for people to earn income. If people respond to the tax change by earning more income (and therefore paying more tax), the impact on government revenue will be less than the welfare cost. If people respond by earning less income (and therefore paying less tax), the impact on government revenue will be more than the welfare cost.[8]

The Inequality Deflator is defined as the ratio of the budgetary cost and the benefit to individuals (measured as the sum of equivalent variations) resulting from such an adjustment to the tax system. It can be thought of as the cost, in terms of government revenue, of transferring money to people at different points in the income distribution. It can also be interpreted as a measure of the marginal cost of funds for people at a particular point in the income distribution. Importantly, as shown in Hendren (2014), it can be used directly as weights in cost benefit analysis to account for the distributional impact of a policy or project.

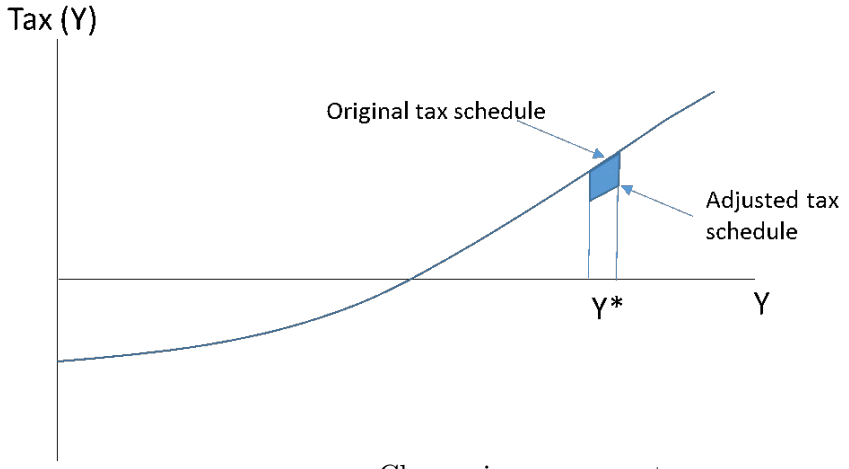
Using the Deflator in cost-benefit analysis has two intuitive interpretations. The first is that through the income tax and transfer system, the

[6]There is a larger distributional difference between a typical individual and a typical owner of capital than there is between a typical consumer and a typical owner of capital. This is because the distribution of consumption is also highly correlated with income.

[7]This section contains a brief overview of the Inequality Deflator. However, a much more thorough treatment is provided in Hendren (2014) and Chapter 2 of this thesis.

[8]The benefit to those who move to receive the payment is second order, and for a small payment will be equal to zero by the envelope theorem.

Figure 3.1: A stylised depiction of an adjustment to the existing tax and transfer system



$$\text{Inequality Deflator} = \frac{\text{Change in government revenue}}{\text{Change in individual welfare (the sum of EVs)}}$$

government reveals a preference regarding the relative welfare of different income groups in society.[9] Using the Inequality Deflator to evaluate future policy decisions is equivalent to following the revealed preference of the government. This can also be expressed in terms of social welfare functions, where the Inequality Deflator is defined as the social welfare function that rationalises observed government policy. Policy options are then evaluated based on this social welfare function.

The second interpretation is that a policy proposal could be implemented alongside a small adjustment to the existing tax and transfer system in order to make the proposal distribution neutral. This is equivalent to implementing the traditional Kaldor-Hicks welfare criteria so that transfer payments have to be made through the tax and transfer system (rather than through

[9]To see why this is the case, the government could actually implement the shock described in Figure 3.1, and take away or give a small amount of money to someone earning a particular income. The amount of government revenue this costs is equal to the Inequality Deflator. The fact the government has chosen not to do this suggests that social valuation of income in this group must be equal to the social valuation of the government revenue that could be transferred. If the social value to the income group was greater than the Deflator, then transferring money to this group would be welfare improving. Similarly, If the social value to the income group was less than the Deflator, then transferring money away from this group would be welfare improving.

lump sum transfers). This interpretation has the desirable property that if a policy influences people equally conditional on income, then using the Deflator is equivalent to searching for potential pareto improvements, and so doesn't depend on the assumption that existing government policy is rational. However, the example covered in this paper has a large amount of variation conditional on income, and so the interpretation of the Deflator must be modified.[10] Instead, it is possible to implement compensating payments through the tax and transfer system so that, on average, people at a given income level are fully compensated (meaning that some will be better off and some worse off after the compensation payment).[11]

As discussed in Section 2.2.2, a key concern when evaluating a project or policy using the Deflator is whether there are additional fiscal effects from implementing the project or policy. For instance, a policy may be highly valued by low income individuals, but if this increases the attractiveness of earning a low income relative to a high income, it is equivalent to an increase in the marginal tax rate.[12] As such, the methods used in this paper are best applied to situations in which there is no change in behaviour, such as transfers of economic rent between business and individuals.

The empirical estimates of the Inequality Deflator used in this paper come from Hendren (2014) for the US economy, and from Section 2.4 for the Australian economy. The main estimates of the Deflator are presented in Figure 3.2, while a number of alternate specifications are included in the results. The vertical axis represents the total amount of surplus that would be received by everyone if money was taken from a particular individual and spread throughout the economy. For instance, a dollar of surplus to someone in the 10th income percentile could be turned into \$1.20/n for every person (where n is the number of people in the economy).

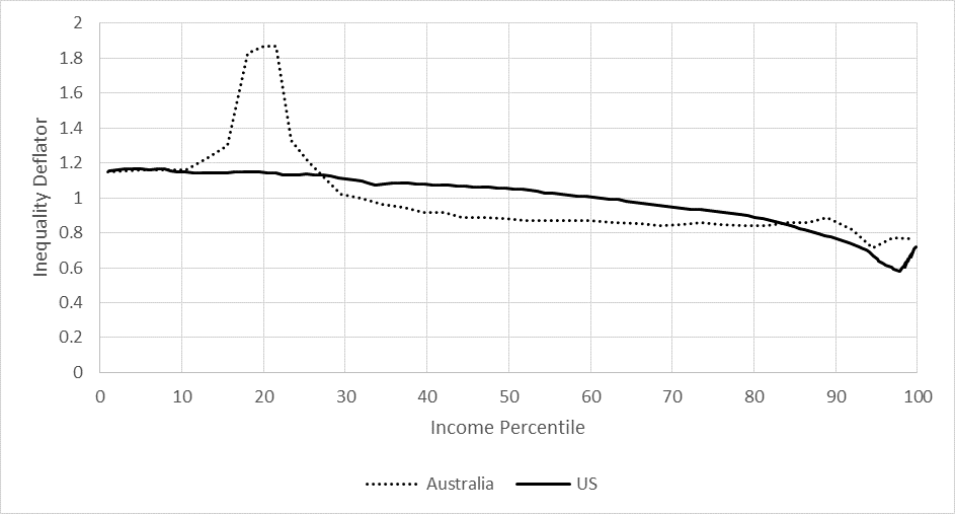
As discussed in Section 2.4.2, care should be taken in making direct comparisons between the sets of results in Figure 3.2 as the definition of income percentile varies between the two studies. For the US results, income percentile refers to percentile of those who file a tax return, while the Australian results refer to percentiles of the Australian population. In particular, the 'spike' that is observed in the Australian results occurs at the base payment

[10] Both Hendren (2014) and Section 2.2.2 include discussions of the interpretation of the Inequality Deflator when the benefits to individuals vary conditional on income.

[11] This type of Quasi-Pareto Improvement was proposed by Ng (1974).

[12] In the case in which a distributional payment acts exactly like part of the tax system (such as a means tested subsidy for health or education), then a redistributive payment through the tax system will have the exact opposite effect as the subsidy, and so it is appropriate to use equal weights to evaluate policy in this case (Kaplow 2004).

Figure 3.2: Inequality Deflator estimates for Australia and the US



rate for Australian government income support payments. Many people at this point of the income distribution do not file a tax return and therefore would not be identified using the US methodology.

Beyond this issue, there are two sources of difference between the US and Australian results. First, the Inequality Deflator is a product of the tax and welfare system utilized by each country, and will also be affected by other country specific factors such as the elasticity of taxable income and the design of the tax and transfer system in each country. For instance, Australia's relatively larger social safety net is a primary driver of the large 'spike' around the 20th income percentile.[13] The second source of divergence is that Hendren (2014) and this thesis use different estimation techniques, which will inevitably introduce variation in results. It is noteworthy that while there are a range of factors that create divergence between the Australian and US estimates of the Inequality Deflator, these differences do not result in large differences in the relative welfare weights of individuals, consumers and producers estimated in this paper.

[13]The 'spike' in the Australian Deflator represents the income of individuals on unemployment benefits and other welfare programs, with little or no other income. Those with lower levels of income are ineligible for these benefits, generally as a result of a spouse's income.

3.3 Applying the Inequality Deflator to individuals, producers and consumers

The starting point for the discussion is the well-established finding that capital tends to be more unequally distributed than income, which is less equally distributed than consumption. This has been shown in the American context by Saez and Zucman (2015), in the Australian context by Finlay (2010) and Headey et al. (2008), and found to be a common feature of OECD countries in Förster et al (2014). It was also established to be a consistent feature of economies in different countries and at different points in time in Thomas Piketty's Capital in the Twenty First Century (Piketty 2014).[14] Piketty also established that capital earnings increased the level of total inequality in an economy. This implies that if $1 is taken from every individual, and then returned in proportion to a person's capital ownership or consumption level, it would result in an increased level of inequality in a society.

This paper uses the framework of the Inequality Deflator to provide relative welfare weights for a typical owner of capital, a typical consumer (weighted by the level of consumption), and a typical individual. In practice, this means calculating the average value of the Inequality Deflator for people in each of these groups. As discussed in Hendren (2014), taking the average Deflator amongst a group of individuals in this manner can be interpreted as implementing the same preferences as exists in the current tax and transfer system, provided the government is acting to maximize a social welfare function based on individual income. However, as discussed in Section 2.2.2, this can be problematic if the relevant social welfare function also includes other factors, such as age, and gender, that are not able to be influenced through the income tax system.[15]

An alternative interpretation of the Inequality Deflator applied to these aggregate groups, is to imagine a dollar gained by a typical owner of capital, and then distributed through the population using the tax and transfer system. The amount of surplus that can be gained when spread equally is

[14] Piketty (2014) is based on a broad range of research conducted with the World Wealth and Income Database.

[15] While this paper is primarily concerned with issues of vertical equity, and the trade-offs made between people of different income levels, the actual preferences of a society are likely to be more nuanced, and may include issues such as gender, age, race and geographic location, which aren't directly captured by the tax and transfer system. This suggests that where such an issue is a primary driver of policy, the Inequality Deflator is not the correct tool to perform analysis.

the Inequality Deflator for capital owners.[16]

An important clarification to be made with regard to this framework is that it is designed to examine transfers where the incidence of the transfer is known, and the transfer does not change the incentives of anyone to earn income. For instance, it is designed to look at small one-off transfers between groups. However, if that transfer was expected, it would change the incentives to earn and save (and the question then becomes one of optimal capital taxation). The Inequality Deflator is also limited in the sense that a decision to transfer money between two groups may be 'unfair' in a manner removed from the concept of vertical equity examined in this paper. For instance, a regulatory decision that makes a business' property freely available may improve equity, but may still be considered unfair if it is violating an existing property right.

Some examples of policy debates in which benefits between different groups could be compared using this framework include:

- Transfers to businesses as a result of monopoly pricing.
- A reduction in the corporate tax rate that creates a 'windfall gain' for existing owners of capital.
- The decision to use government purchasing power to lower the price of pharmaceuticals.
- Increasing the prices allowed to be charged by regulated monopolies, such as electricity networks.
- Efficient regulation of banking fees and consumer credit.

In many of these cases, the transfer between groups is only part of the impact of the policy, and policy analysis must include all the relevant components. Moreover, some of these cases may include offsetting incentives that must be considered in any policy analysis.

[16]However, given that people with the same income level have different amounts of consumption and capital income, it is not possible to characterize this as a potential pareto improvement. In fact, in the empirical exercise conducted in this paper using a rule in which all people must be compensated (such as is described in Section 3.5 of Hendren (2014)) is prohibitively difficult to implement.

3.4 Results

3.4.1 Results for the US economy

This section reports the average value of the Inequality Deflator amongst different groups, relative to the average Deflator of a typical individual. These groups include typical capital owners (weighted by the level of capital ownership), and typical consumer (weighted by the level of consumption), as well as a number of subcategories of capital and consumption. In order to test the robustness of the results, a variety of different definitions are used for the Inequality Deflator. This section reports the results for the US economy, while the following section reports the results for the Australian economy.

The measure of capital ownership is intended to represent the beneficiary of a dollar gained by a business. The main measure of capital ownership is the value of shares plus the value of businesses and farms owned by the household reported in the Panel Study of Income Dynamics (PSID). Alternate measures of capital ownership include the total value of all assets (both with and without housing equity), and total cash in annuities and chequing accounts.

The main measure of consumption used in the exercise is the sum of all expenditure reported in the PSID. A small literature exists that compares this measure of consumption with results from the Consumer Expenditure Survey (CES),[17] which is typically considered to be the best source of consumption data, but is not suitable for use in this paper as it has no information on individual wealth levels. This research finds that the PSID matches the levels of aggregate expenditure from the CES quite well, and is therefore suitable for use in this exercise.

The empirical estimates of the Inequality Deflator are taken from Hendren (2014). However, a number of different specifications of the Deflator are presented in this work. Therefore, in this section four different values of the Deflator are used. The first is the baseline estimate of the Deflator, which is calculated using a compensated elasticity of taxable income of 0.3.[18] The second and third Deflator values are based on the high elasticity (ETI = 0.5) and low elasticity (ETI=0.1) estimates from Hendren (2014). The final Deflator is the household estimate calculated in Section 4.5 of the Hendren

[17] For instance, Andreski et al. (2014) and Charles et al. (2006).

[18] A different ETI is used for people in the phase-in region (0.31) and phase-out region (0.14) of the Earned Income Tax Credit. There is also an extensive margin elasticity of 0.09 applied to those eligible for the Earned Income Tax Credit.

paper. For the first three cases, the Deflator is estimated at an individual level. In order to align this with consumption and wealth information, which is recorded at the household level, the average value of the Deflator amongst adult members is used.

The main results are presented in Table 3.1. These results should be interpreted as the relative weight between a type of capital owner and a consumer. For instance, the value of 0.88 in the first cell of the table means that a typical capital owner has a weighting that is 0.88 times the weight of a typical individual in the baseline scenario.

Table 3.1: Relative welfare weights in the US

	Baseline	High Elasticity	Low Elasticity	Household
Capital Owners	0.88	0.80	0.96	0.84
Consumers	0.97	0.94	0.99	0.95

Table 3.2 reports results of the average relative weights calculated using different definitions of consumption and wealth.[19] In each case, the result is reported as the relative welfare weight compared to a typical individual (as in Table 3.1).

Table 3.2: Welfare weights for different US asset classes

	Baseline	High Elasticity	Low Elasticity	Household
Total wealth including property	0.92	0.87	0.97	0.88
Total wealth excluding property	0.91	0.84	0.96	0.87
Stocks	0.90	0.83	0.96	0.86
Net value of Businesses and Farms	0.86	0.75	0.94	0.82
Annuities and IRA accounts	0.97	0.94	0.99	0.95
Own home	0.96	0.93	0.99	0.93
Other real estate	0.89	0.82	0.96	0.86
Chequing and Saving	0.94	0.89	0.98	0.91

Finally, Table 3.3 shows the results disaggregated by different consumption types. Vacations and Other Recreation are associated with highest income earners and therefore having the lowest welfare weighting, while food was associated with lower incomes and has a higher relative welfare weight.

[19] With the definition of these categories the same as those used in the PSID.

Table 3.3: Welfare weights for different US consumption items

	Baseline	High Elasticity	Low Elasticity	Household
Total Utilities	0.98	0.95	0.98	0.97
Total Food	1.01	1.03	1.00	0.98
Transport costs (ex. cars)	0.99	0.97	0.99	0.98
Clothing	0.93	0.88	0.97	0.91
School fees and related costs	0.95	0.90	0.98	0.93
Home repairs	0.93	0.88	0.97	0.91
Home furnishings	0.94	0.90	0.98	0.92
Vacations	0.92	0.86	0.97	0.90
Other recreation	0.93	0.87	0.97	0.91
Health	0.99	0.97	0.99	0.96

3.4.2 Results for the Australian economy

The results for the Australian economy follow a similar structure to the US results presented above. The relative welfare weights of typical capital owners, typical consumers and typical individuals are presented. Then, the definitions of capital owner and consumption are varied to show that the results are relatively robust to different specifications of these variables.

The main measure of capital ownership is the total measure of capital holdings included in the 2009 Survey of Income and Housing Costs, and includes government and non-government superannuation, shares, partnerships, trusts, incorporated and unincorporated businesses, loans, bonds and financial accounts. Alternative measures of capital include total ownership of businesses (incorporated and unincorporated), total value of superannuation (government and non-government), and total holding of shares. A breakdown of the Deflator by all capital classes included in the Survey of Income and Housing Costs is included in Appendix 3.A.

The measure of consumption is total consumption at the household level reported in the Household Expenditure Survey.[20] Consumption measures by category of expenditure are included in Appendix 3.A, although there is little variation across expenditure classes.

The empirical estimates of the Inequality Deflator are taken from Section 2.4, which defines Inequality Deflators in a number of different ways. Therefore, in this section, results will be presented using five different De-

[20]The Survey of Income and Housing and the Household Expenditure Survey are collected together, and are linked at the unit record level.

flators.

- **Deflator 1**: This is the baseline estimate provided in Section 2.4. It is based on a change to the personal income tax and transfer system, and the average Deflator is evaluated across all records in the Survey of Income and Housing Costs. For households with multiple adults, the average value of the Deflator is used.

- **Deflator 2**: The same as Deflator 1, but the estimate is only evaluated on records included in the sample used to estimate the Deflator. This means that those under eighteen years old, over sixty-five years old, those who are self-employed, eligible for the Disability Support Pension or who are full time students are excluded from the exercise.

- **Deflator 3**: The same as Deflator 1, but using a lower estimate for high income earners. As discussed in Section 2.2.2, the approach used to estimate the Deflator in Australia is less suitable at high incomes than that used in Hendren (2014).[21] While Hendren also stressed caution regarding the exact estimation of the Deflator at high incomes, and caution should be applied in using estimates from different countries, the Deflator for those earning above $150,000 is changed from 0.81 to 0.6 (the value for high income earners in Hendren (2014)) as a form of sensitivity test.

- **Deflator 4**: The Subclass Level Deflator. This uses the values estimated in Section 2.4.3, and it allows the Deflator to vary, both by income level, and by household type (couples with children, couples without children, singles with children and singles without children).

- **Deflator 5**: The Household Level Deflator. This is estimated by providing an incentive to earn a particular level of household income, rather than individual income. For single adult households, this is set equal to Deflator 1.

The primary results are shown in Table 3.3. As with the preceding section, the results in this table are presented as the average welfare weight relative to a typical individual.

[21] The Australian methodology was based on underlying survey data, which has well known limitations for examining the top of the income distribution, compared to an approach that uses all tax records. Moreover, the approach in Chapter 2 only looks at the labour supply response, rather than looking at all responses to an income tax (such as tax planning). This approximation is likely to be more problematic for high income earners.

Table 3.4: Relative welfare weights in Australia

	Def. 1	Def. 2	Def. 3	Def. 4	Def. 5
Total equity	0.89	0.92	0.86	0.82	0.89
Expenditure	0.94	0.97	0.93	0.89	0.95

Table 3.5: Welfare weights for different Australian asset classes

	Def. 1	Def. 2	Def. 3	Def. 4	Def. 5
Businesses	0.88	0.89	0.82	0.86	0.88
Trusts (private)	0.83	0.85	0.77	0.69	0.84
Shares	0.90	0.92	0.87	0.79	0.89
Superannuation	0.91	0.94	0.89	0.82	0.91

The results show that regardless of the definition of Deflator used, a typical capital owner should be given a welfare weight of between 82-92 percent of a typical individual. Where a policy affects a typical consumer (such as an indirect tax), a typical capital owner should be given a weight of between 89-97 per cent of a typical consumer.

In Table 3.4 the results are shown by type of equity ownership. It shows that the Deflator is higher (and hence the implied welfare weight is higher) for superannuation and businesses, while the Deflator is lower (and the implied welfare weight is lower) for private trusts. However, the qualitative result that a dollar falling to a capital owner is less valuable than a dollar falling to a typical individual is consistent regardless of the definition of capital used.

Appendix 3.A contains estimates of the average Deflator by all classes of capital, as well as by type of expenditure. There is a significant amount of variation amongst the type of capital holding. This reflects the fact that different capital classes are utilized differently by people with different levels of income. The values in table 3.5 are preferred to those in the Appendix, because the table is more indicative of a typical business owner. However, regardless of the definition used, the same qualitative result holds, that income to businesses should be treated less favorably than income to individuals, and a 'transfer' between these groups will have welfare consequences.

3.4.3 Summary of results and discussion

The method described above is performed using different estimates of the Inequality Deflator, as well as using different assumptions about what constitutes capital and consumption. Given these variations, the weights for equity holding varied between 0.8 to 0.96 in the US, and from 0.82 to 0.92 in Australia, while the weights for typical consumers varied between 0.94 to 0.99 in the US and from 0.89 to 0.97 in Australia. Breaking down the results further into type of capital ownership and expenditure showed additional variation, with business ownership, shares and private trusts being associated with a lower welfare weight (as they are associated with higher income earners), while annuities, IRAs and standard bank accounts were all associated with weights close to one.

While some caution must be exercised when comparing the results across the two countries, as the methodology of estimating the Inequality Deflator varies for the two countries, there is enough stability in the results to suggest that the relative welfare weights for capital owners is, both economically and statistically,[22] different from one.

There are two further factors that suggest that the relative welfare weights should be further removed from one. The first of these issues is foreign ownership of capital. Throughout the calculations, foreign ownership (and indeed foreign consumption) is ignored. However, in the United States around 15 per cent of business equity is owned by foreign investors (US Federal Reserve 2016) while in Australia, the figure is around 7 per cent (Australian Government Treasury 2016). The extent to which this changes the results depends on what value a policymaker puts on non-residents. For instance, if a weighting of zero is given to outside parties, then the relative welfare weights for US equity presented above need to be scaled down to 0.88*0.85 = 0.75. However, if non residents are considered in a similar manner to residents, then the original results remain.

The second issue is that this methodology uses a single cross section of data, and in doing so pools together people at different ages, and at different stages of the employment cycle. For instance, it will show recently unemployed people, university students and recently retired people as low income, whereas over their lifecycle these individuals might actually be high income.

[22] For the Australian estimates, the MITTS model is not well suited to calculating standard errors. However, the US high and low estimates can be viewed as bounds on a confidence interval, and justify the claim that the relative weights are statistically different from parity.

This raises an interesting restriction of the current Inequality Deflator approach. As specified, the Inequality Deflator assumes that governments have a revealed preference over the income distribution in any year. Alternatively, following the other interpretation of the Deflator, it assumes that governments can target payments or taxes to individuals earning a particular income level, but that it cannot tax target payments based on existing asset levels (which may better target lifetime income). In reality, governments do exhibit some preference for redistribution across lifetime income, such as taxes on capital income and asset tests associated with the Australian Age Pension. Nevertheless, the majority of redistributive taxation is defined based on annual income, and so the existing Inequality Deflator framework is likely to be a good approximation.

Extending the empirical framework of the Inequality Deflator to include government preferences for redistribution over the lifetime is a daunting empirical exercise (and one beyond the scope of this research). Nevertheless, we can get an idea as to how such an adjustment would change the final result. Lifecycle patterns are observed in both wealth levels and yearly income. Variation in wealth occurs as people accumulate savings to retire, and then (partially) run down these savings after retirement. This variation will increase the observed correlation between income and wealth, and mean that the relative welfare weights reported above are too low. On the other hand, yearly income levels fluctuate due to periods of study, short term unemployment and retirement, which will all show an individual to be very low income even though they might have a high lifetime income. This effect will push the observed results in the opposite direction, meaning that the relative welfare weights reported above will be too high. The combined effect of these two factors will depend on which factor has a larger influence. In a general sense, it will depend on whether annual income or current wealth is more highly correlated with lifetime income. However, without a long-term panel of wealth and income, or an agreed upon measure of lifetime income that the government would use for distributional purposes, it is difficult to say in which direction this effect would ultimately bias the results.

3.5 The importance of this approach for sufficient statistics papers

Evaluating welfare effects through the sufficient statistics technique is increasingly common in modern public finance. This process, well summarised by Chetty (2009), involves specifying a utility maximization problem in ab-

stract terms, and using first order conditions to write the welfare effect of interest in terms of empirically estimated variables. In doing so, it allows normative results to be found without the need to fully specify the relevant utility and production functions.[23]

One common assumption used in this literature is that a small change in prices will have no welfare effect. Effectively, a price change will just transfer welfare from producers to consumers with no net effect. However, the relative value of producer and consumer benefit is a subjective choice. In this section we will explore how relaxing this assumption can increase the complexity of the welfare calculations using the example of Harberger triangles. As discussed in Chetty (2009), Harberger triangles can be understood as the intellectual forerunner to much of the modern sufficient statistics literature, which suggests that an equivalent effect will occur if this principle is applied to a range of modern papers.[24]

In the standard Harberger problem, a single indirect tax is placed on a good (x_1), while a representative consumer is assumed to maximize a utility function:[25]

$$U = \max_{x,y} u\big(x_1, ..., x_j\big) + y \quad s.t.\ p.x + tx_1 + y = z \tag{3.1}$$

While a representative firm takes prices as given and maximizes:

$$\pi = \max_{x} p.x - c(x) \tag{3.2}$$

This also provides the two first order conditions for individual and firm maximisation:

$$U'(x) = p \tag{3.3}$$
$$C'(x) = p \tag{3.4}$$

[23] A full description of the sufficient statistics framework, as well as a number of examples of the framework being applied are found in Chetty (2009).

[24] A similar argument can be made regarding pecuniary externalities. In a standard welfare framework, pecuniary externalities have no welfare effect as a change in price will harm consumers and benefit producers in equal measure. However, if these groups were not given equal standing, then pecuniary externalities would have net welfare implications.

[25] As is common in the literature, an iso-elastic utility function is used here to simplify the algebra by removing income effects.

In the standard Harberger welfare problem, social welfare is written as the sum of consumer welfare, producer welfare and tax revenue (with equal relative weightings):

$$W = \max_x \big[u(x) + Z - tx_1 - p(t)x\big] + \max_x \big[p(t)x - c(x)\big] + tx_1 \tag{3.5}$$

This allows the p(t)x terms to cancel out from the producer and consumer side:

$$W = \max_x \big[u(x) + Z - tx_1\big] + tx_1 \tag{3.6}$$

Taking derivatives:

$$\frac{dW}{dt} = u'(x)\frac{dx}{dt} - x_1 - c'(x)\frac{dx}{dt} + x_1 + t\frac{dx_1}{dt} \tag{3.7}$$

Using the first order conditions in (3.3) and (3.4), this can be simplified to the familiar result:

$$\frac{dW}{dt} = t\frac{dx_1}{dt} \tag{3.8}$$

This result suggest that the welfare effect of a tax can be determined with a relatively small amount of information, and the simplicity of this result has resulted in a large empirical literature (Hines (1998), and Dahlby (2008)). In order to show the potential importance of distributional outcomes, we now return to the Harberger example, and assume that producers and consumers have a different welfare weight. We continue to assume that tax revenue is returned lump sum to households and give this the same weight as consumers (although this is not necessary). Finally, we normalize the weight of consumers to one, with a welfare weight of δ given to producers. In this case, equation 3.5 becomes:

$$W = \max_x \big[u(x) + Z - tx_1 - p(t)x\big] + \delta\big[\max_x(p(t)x - c(x))\big] + tx_1 \tag{3.9}$$

$$= \max_x \big[u(x) + Z - tx_1 - \delta c(x)\big] + (\delta - 1)p(t)x + tx_1 \tag{3.10}$$

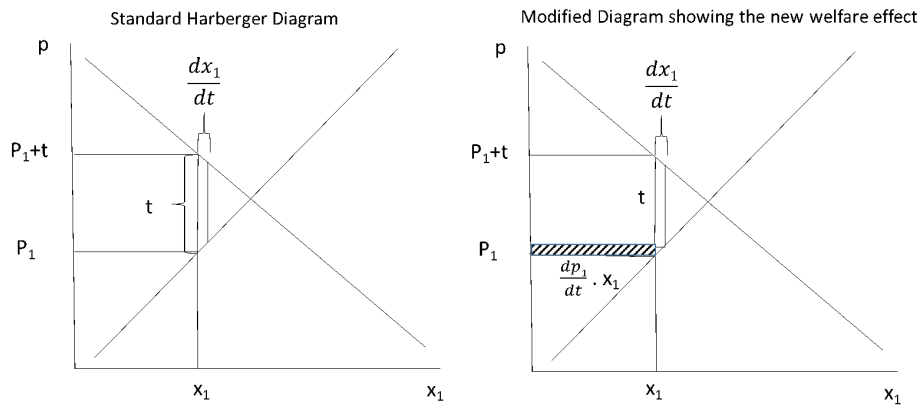
$$\frac{dW}{dt} = u'(x)\frac{dx}{dt} - x_1 - \delta c'(x)\frac{dx}{dt} + (\delta - 1)\left[p(t)\frac{dx}{dt} + x_1\frac{dp}{dt}\right] + x_1 + t\frac{dx_1}{dt} \tag{3.11}$$

$$= p\frac{dx}{dt} - \delta.p.\frac{dx}{dt} + (\delta - 1)\left[p(t)\frac{dx}{dt} + x_1\frac{dp}{dt}\right] + t\frac{dx_1}{dt} \tag{3.12}$$

$$= (\delta - 1)\Big(x\frac{dp}{dt}\Big) + t\frac{dx_1}{dt} \tag{3.13}$$

There is now an additional term in the welfare expression that represents any transfer between producers and consumers as a result of the price change. This transfer could occur in the market in which the tax is placed (x_1), but could also occur in any other market where prices change as a result of the tax. The result is apparent in the standard Harberger welfare diagrams in Figure 3.3:

Figure 3.3: Harberger diagram with distributional effects



The first thing to note about this result is that in order to evaluate this expression, two additional pieces of information are now required. Namely, it is now necessary to know both the relative welfare weights and the incidence of taxation on consumer prices across multiple markets. This means that even if the relative welfare weights are known (or assumed), the welfare calculations are still more difficult than if the welfare weights are assumed to be equal.

It should also be noted that the Harberger framework is a partial equilibrium framework, and so excludes the possibility of offsetting welfare effects in other markets. For instance, if the indirect tax being considered lowers the return to investment, which reduces the level of investment and savings, then this would have an offsetting welfare effect that would push the relative weight back towards unity. However, such effects are generally very difficult to predict, and are typically ignored in this type of analysis.

Finally, it should be noted that the equation reverts back to the original form (as in equation (3.8)) if $\frac{dp}{dt} = 0$. In other words, if the tax is fully borne by consumers, and there are no price changes in secondary markets,[26] the

[26]For instance, if there is perfect competition in all markets.

original formula is still valid regardless of the assumptions around relative welfare weights.

3.6 Conclusion

This paper highlights a practical problem from the project evaluation field. Namely, how to apply relative weights to individuals, consumers and owners of businesses when performing welfare analysis. It proposes a simple and practical solution to this problem that builds on the modern public finance literature. Importantly, as with the Inequality Deflator more generally, the results can be implemented as a simple weighting scheme, with the same weights being used regardless of the project or policy being examined.

The procedure here is subject to three potential critiques. The first is whether the Inequality Deflator can be estimated reliably enough to be used in applied policy discussions. A significant amount of variation still exists in empirical estimates of the Elasticity of Taxable Income, which is a significant determinant of the Inequality Deflator. Both Hendren (2014) and Section 2.2.2 acknowledge the difficulties in estimating the Inequality Deflator, and care should be taken to not overstate the accuracy of the final results. Still, varying the definition of capital and consumption as well as varying the specification of the Inequality Deflator provides some sense of the robustness of the results in this paper.

The second critique is that policies that trade-off benefits between individuals and businesses may affect the incentives for individuals to save and invest. If this is the case, it is incorrect to evaluate such policies in a partial equilibrium framework that holds savings and investment fixed as there will be offsetting welfare effects that occur in these markets. However, this approach would still be valid when looking at the transfer of economic rent.

The final critique is whether averaging the value of the Inequality Deflator amongst a group is a sensible measure for policy evaluation. As discussed above, this results in a policy with the same distributional trade-off as that observed in the income tax system. However, as there is variance in the ownership of capital and consumption conditional on income, the Inequality Deflator is no longer equivalent to searching for pareto improvements. To some extent the value of this approach is a subjective decision. However, the merits of the approach must be judged against the alternatives in this area, which ignore distributional concerns (giving everyone equal weighting), or approach them in a relatively arbitrary way (an assumed social welfare function). Viewed in this way, the technique developed in this paper represents

a pragmatic approach to an important policy dilemma.

3.A Appendix

In this appendix, additional calculations are reported for the Australian economy, with further disaggregation by type of capital and consumption. For instance, a typical business owner is wealthier than the typical owner of a bank account, and so implementing this technique will imply a lower welfare weight for a business owner than for the holder of a bank account. However, care should be taken with these results as they are based off survey results, and some categories within this survey have a relatively small number of large positive responses.

The tables show that the average Deflator varies significantly across different types of capital. The top row of Table 3.6 shows the average across all asset classes, so all other rows should be read relative to that row. For instance, incorporated and unincorporated businesses, private trusts and silent partnerships all had a lower Deflator than the one calculated using the total capital measure. This means that a policy evaluation on one of these asset classes would use a lower welfare weight. On the other hand, accounts held with financial institutions, bonds and loans made to others were all associated with a higher Deflator level, implying that a higher welfare weight should be used.

Table 3.6: Average Australian welfare weights, by type of capital holding

	Defl. 1	Defl. 2	Defl. 3	Defl. 4	Defl. 5
Total wealth	0.93	0.94	0.91	0.88	0.94
Balance of accounts with government superannuation funds	0.90	0.94	0.89	0.80	0.90
Balance of accounts with non-government superannuation funds	0.91	0.94	0.89	0.83	0.92
Value of accounts held with financial institutions	0.96	0.95	0.95	0.93	0.96
Value of debentures and bonds	0.95	0.91	0.95	1.17	0.92
Value of own incorporated business (net of liabilities)	0.83	0.86	0.76	0.70	0.84
Value of own unincorporated business (net of liabilities)	1.02	1.10	1.02	1.26	1.00
Value of public unit trusts	0.95	0.96	0.94	0.85	0.98
Value of silent partnerships	0.84	0.86	0.80	0.75	0.79

A similar exercise is performed for different types of consumption in Table 3.4. There is less variation amongst expenditure types than amongst

capital types, although tobacco products, food and beverages, medical care and fuel and power all have a higher Deflator than the overall consumption Deflator.

Table 3.7: Average Australian welfare weights, by expenditure class

	Defl. 1	Defl.2	Defl. 3	Defl. 4	Defl. 5
Total Consumption	0.94	0.97	0.93	0.89	0.95
Housing	0.95	0.98	0.95	0.91	0.94
Fuel and Power	0.97	0.99	0.97	0.95	0.98
Food and Non-Alcoholic Beverages	0.96	0.97	0.95	0.92	0.97
Alcoholic Beverages	0.93	0.96	0.92	0.88	0.94
Tobacco Products	0.99	1.01	0.99	0.98	1.01
Clothing and Footwear	0.93	0.95	0.91	0.86	0.94
Household Furnishings	0.93	0.95	0.92	0.89	0.93
Household Services and Operations	0.95	0.97	0.95	0.91	0.96
Medical Care	0.95	0.96	0.95	0.91	0.96
Transport	0.93	0.96	0.92	0.87	0.94
Recreation	0.93	0.96	0.93	0.89	0.94
Personal Care	0.94	0.96	0.93	0.89	0.95
Miscellaneous	0.92	0.94	0.91	0.84	0.93

3.B References

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Chapter 4

A gender deduction gap

Abstract

This paper uses Australian tax return data and techniques from the gender pay gap literature, including the Oaxaca-Blinder decomposition and the DiNardo-Fortin-Lemieux decomposition, to explore whether men in similar economic circumstances to women claim more deductions on their tax return. After controlling for observable characteristics such as income and occupation, men are found to claim around 12 per cent more deductions than women, which when taken at face value, increases the gender pay gap in Australia by around $75 per year. The paper also finds an unexplained gender difference in 7 of 11 categories of deductions and amongst workers in 6 of 9 occupation classifications. Men and women earning different proportions of capital income and family tax planning are considered as potential explanations of the observed deduction gap. While both factors are found to influence the level of deductions claimed, they can only explain a small proportion of the observed difference in deductions between men and women.

4.1 Introduction

The Australian tax system relies on individual taxpayers to keep records of the deductions that they are entitled to claim and submit these records along with their annual tax return. This means that if a taxpayer is more aware of the deductions that are allowed through the tax system, or more organised in keeping receipts throughout the year, they will end up paying less income tax than another person who earns the same amount.

This paper tests one implication of this voluntary deduction process. Namely, for men and women in similar economic circumstances, whether

men will claim more deductions than women, and therefore pay less income tax. In other words, if there is a man and a woman who both earn the same amount of income, work in the same occupation and are the same age, the man will generally claim more deductions than the woman.

The paper finds evidence that this gap exists, and is reasonably large (around 12 per cent). Moreover, this gap is observed in the majority of industries, and for the majority of types of deductions. When evaluated at the mean level of female income and deductions, this equates to approximately $240 of deductions, which at a marginal tax rate of 32.5 per cent changes take home income by around $75 per year.

In interpreting this observed gap, it is useful to identify three potential drivers that can cause men and women to claim different levels of deductions. The first cause is that when faced with an identical situation, men will be more likely to claim a deduction that women. This may occur because men are more familiar with the deductions that they are able to claim, because they are more willing to maintain the appropriate records throughout the year, or because they are more willing to claim a deduction when they are not sure if it is allowed.

The second difference is an institutional bias that may exist within the tax system by which expenses incurred by men are easier to claim as tax deductible.[1] For instance, if men work in more traditional employment rolls, then expenses that occur may be more likely to be allowed by the tax code.

Finally, it is also possible that men incur more costs in earning income in a way that is not related to other observed factors. This explanation, also known as 'selection on unobservables', may also occur if an important explanatory factor is not available in the tax data.[2,3] While some attempt is made to distinguish between these causes, ultimately, the task of fully disentangling these effects is left to future research.

To investigate this issue, this paper uses the publically available two per cent sample of confidentialised[4] Australian tax return data for the year

[1] See, for example, the different tax treatment of briefcases and purses (Han 2016).

[2] This paper uses occupation data at the one-digit ANZSCO level, and it is likely that more detailed occupation data would better explain the level of deductions. To the extent that these factors vary between men and women, the more detailed level occupation data would be considered selection on unobservables, and show up as part of the unexplained component.

[3] This is an issue common to all work done with this type of wage decompositions, and has led to a significant debate about whether the unexplained wage differences should be interpreted as 'discrimination' or just the unexplained difference in wages. (Fortin et al. 2011)

[4] The data are confidentialised by the Tax Office by perturbing certain variables such

2013/14, which contains 257,639 unique records. This data set includes unit level information on eleven categories of deduction (shown in Table 4.1), detailed information on different income sources, partner status, age, one-unit data on occupation classification, and information about whether the individual used a tax agent.

This paper employs a number of empirical techniques that are commonly used to study wage discrimination in the labour market. In Section 4.2, the empirical distributions of deductions for men and women are plotted in histograms and binscatter plots. This is an effective informal way to illustrate which type of deductions differ between men and women, whether the difference occurs at high income levels or low income levels, and whether the difference occurs due to extensive differences (more men claiming some form of a given deduction) or intensive differences (those who do claim a deduction claim more of that deduction).

In Section 4.3, the difference in tax deductions claimed by men and women is formally decomposed using the Oaxaca-Blinder decomposition framework. This section shows that after controlling for observable characteristics such as income, occupation and age, men tend to claim about 12 per cent more deductions than women. Moreover, this difference is observed in 7 out of 11 deduction types and in 6 of 9 occupation groups.

In Section 4.4, the wage decomposition is extended using an approach proposed by DiNardo, Fortin and Lemieux (1996) (DFL). The DFL approach allows for a comparison of deductions between men and women that does not require the assumption of linearity used in the Oaxaca-Blinder decomposition. Using this methodology, men are found to claim 28 per cent more deductions than women (after controlling for observable characteristics). The DFL methodology can also be used to construct a full counterfactual distribution, which allows a more formal answer to the questions addressed visually in Section 4.2.

Section 4.5 tests two alternative theories that could explain the difference in deduction patterns between genders. First, it examines whether the observed results could be the result of tax planning at the household level. For instance, where it is possible to do so, there is an incentive for couples to claim deductions against the income of the higher income partner, and this could provide an explanation of the observed gap. This section then considers whether the deduction gap can be explained by the different com-

that the mean is preserved. Moreover, variables are top-coded whereby the top one per cent of each category are all given the average value amongst that top percentile. This process will have very little effect on the empirical methodologies used in this paper.

position of income types between men and women. There is evidence that both of these factors contribute to the observed deduction gap, even once these effects are considered, an unexplained gap in deductions remains of around 10 per cent.

Section 4.6 concludes the paper, looks at some of the policy implications of this result, and highlights some areas for future research.

4.1.1 The Australian personal income tax

The Australian income tax is paid on net taxable income, which is equal to the gross amount of income earned, less deductions. The tax is levied on personal, rather than family income, and there is no option to take a 'standard deduction'.

Tax deductions are allowed for a number of different items, and are included in the tax code for a variety of reasons. A significant proportion of tax deductions are designed to offset costs that are incurred in the process of earning income in order to only apply the income tax to net, rather than gross income. Deductions against taxable income are also allowed for selected items that the government wants to encourage (such as charitable giving) and to lower the effective tax rate on capital income. This paper classifies deductions into the 11 categories used by the Australian Tax Office Individual Sample File, which are described in Table 4.1.[5]

4.1.2 Related literature

While to my knowledge, this is the first paper to look at the deduction claiming behaviour of men and women in this manner, there is a substantial literature examining the interaction between gender and the tax system. While this literature covers a much broader range of topics than is covered in this paper, it suggests that the finding of a gender deduction gap is not surprising.

For instance, a gender gap has also been observed in randomised audit studies. In Kleven et al. (2011), after a random sample of Danish tax returns was audited, tax returns of men were more likely to be adjusted to pay more tax. A similar difference is observed in Paetzold and Winner (2014), in which women are found to be less likely to overstate commuting distance in order

[5] In addition to the 11 categories of deductions considered in the main results in this paper, the Individual Sample File also includes information on negative gearing of rental properties and fringe benefits taxes. Analysis of these variables are reported in Appendix 4.B.

Table 4.1: The eleven categories of tax deduction used in this paper

	Explanation
Work Related Expenses	
Car	Using a car for work-related travel, but does not include travel between home and work.
Travel	Meals, accommodation and incidentals while travelling overnight for work.
Uniform	Clothing that is required for work, and that allows the public to easily recognize your occupation.
Self-Education	The education must be related to current employment.
Other WRE	Including home office expenses, tools and mobile phones.
Other deductions	
Dividend Deduction	If money is borrowed to invest in shares or other related investments, the interest on this loan is deductible against personal income.
Interest Deduction	Account keeping fees where an account is held for investment purposes.
Charitable Gift	Must be to a registered Deductible Gift Recipient and greater than $2.
Superannuation Contribution	Contributions to superannuation above the level provided by an employer.
Cost of Tax Affairs	The cost of tax professionals and tax preparation software.
Other Deductions	Including union fees, election expenses and income protection insurance.

to receive an associated tax deduction. Such studies are clearly related to the different tax behaviours explored in this paper. However, there are also very important differences with this approach as audits will only pick up (a proportion of) fraudulent claims. On the other hand, the differences observed in this paper will result from a combination of fraudulent activity, a greater knowledge of the tax system, and a greater willingness to engage with the tax system. As a result, an audit based approach will be likely to underestimate the true difference in tax compliance between genders.

A gender gap has also been observed when a part of the tax system moves from being self-reported to being automated. Gillitzer and Skov (2013) examine a reform of the Danish tax system in which charitable donations are automatically reported to the tax office by the charity and pre-populated on individual tax returns. Following this reform, both men and women are found to have an increased level of claimable deduction, but this increase

is larger for women. This suggests that women were more likely to make charitable donations that they later don't claim as tax deductions.

A gender deduction gap is also supported by studies looking at how the perception of taxes differs between genders. McGee (2014) examines World Values Survey data for 82 countries and finds that women are significantly more opposed to evading taxes than men, and that this result was true in the majority of countries.[6] McGee also provides a review of a range of papers comparing ethical behaviour between gender citing 39 studies in which women are found to be more ethical than men, 29 studies in which there is no difference between men and women, and only 2 papers in which men are more ethical than women.

More broadly, the gender pay literature identifies a number of potential explanations of the gender pay gap that may also be important in driving the gender tax gap. For instance, in Blau and Kahn (2016), men are found to place a higher value on money, have higher self-esteem, be more competitive and be more self-confident. Moreover, men take weaker stances on ethical behaviour (Glover et al. 1997), are less risk averse (Croson and Gneezy (2009), Eckel and Grossman (2008)), and are more likely to commit any type of crime (Schwartz and Steffenmeier 2008). While these findings were made in the context of wage comparisons, it is likely that they also play a role in explaining the observed difference in reported tax deductions found in this paper.

4.2 Graphical representations of the key results

The aim of this section is to visually illustrate the key differences in tax deductions by gender. This includes showing which types of deductions vary by gender, and the relative size of this contribution. The visual presentations also provides a natural benchmark for the Oaxaca-Blinder (Section 4.3) and DFL analysis (Section 4.4) in the following sections.

Table 4.2 shows the raw differences in average deduction level for men and women. It shows that the largest differences (in absolute terms) occur in motor vehicle and 'other' work related expenses, and that based on raw data, men claim more of all types of deduction other than self-education expenses. The table also shows that two categories of deductions, car work related expenses and other work related expenses, comprise 48 per cent of

[6] In 63 per cent of countries in the study, women opposed tax evasion more than men when tested at the 10 per cent level, while in a further 29 per cent of countries women were more opposed to tax evasion, but at a statistically insignificant level.

male deductions, and more than half of the raw difference between men and women. This table also includes two aggregate categories, Total Work Related Expenses (which includes the 5 categories of work related expenses), and Total Deductions (which is the total of all 11 deduction categories), which will be used in much of the analysis that follows.

Table 4.2: Average levels of deductions claimed by men and women

	Mean (Men)	Mean (Women)	Difference	T statistic: Equal means	P Value (2 sided)
Work Related Expenses					
Car	$877	$433	$444	57.8	0.000
Travel	$242	$80	$162	33.5	0.000
Uniform	$149	$112	$38	45.8	0.000
Self-Education	$88	$88	$0	-0.1	0.912
Other WRE	$672	$444	$229	42.5	0.000
Total WRE	$2025	$1153	$872	67.1	0.000
Other Deductions					
Dividend Deduction	$118	$56	$62	5.7	0.000
Interest Deduction	$72	$41	$31	5.3	0.000
Charitable Gift	$252	$209	$43	2.8	0.003
Superannuation	$322	$240	$82	7.5	0.000
Cost of Tax Affairs	$212	$137	$75	11.0	0.000
Other Deductions	$224	$87	$137	15.4	0.000
Total Deductions	$3218	$1916	$1301	43.5	0.000

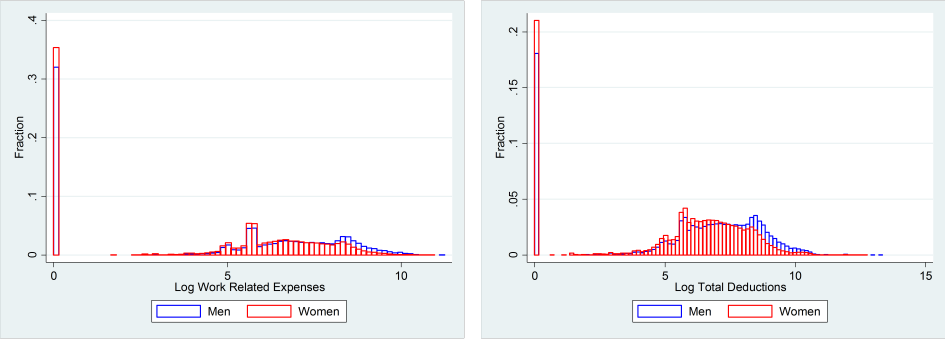
In Figure 4.1, the distributions of total work related expenses and total deductions are drawn as histograms on a log scale. Two important facts are observed in this figure. First, there is a significant proportion of people who claim zero deductions, and this proportion is higher among women than men.[7] Second, there is a significant mass of high deduction individuals in the male distribution that is not apparent in the female distribution.

The final illustrative figure, is a binned scatterplot showing the relationship between deductions and income for men and women.[8] These binned scatterplots separate the X variable (in this case Gross Taxable Income) into 50 equal sized bins, and calculate the average value of deductions amongst this group. This provides a simple way to control for differences in income

[7] In the analysis in this paper that involves logs, one is added to all variables so that the zeroes can still be used.

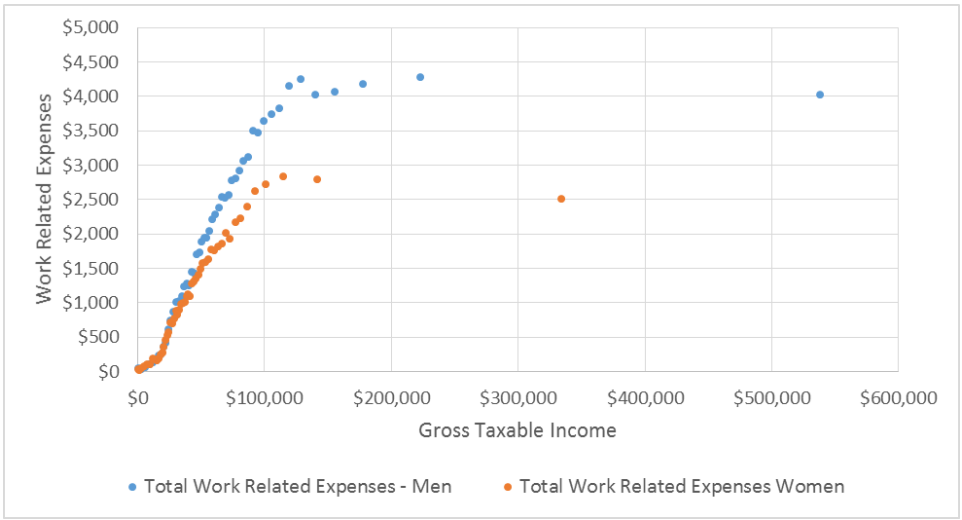
[8] An introduction to the binscatter technique is provided in Stepner (2014).

Figure 4.1: Histograms of Total Work Related Expenses and Total Deductions, by gender



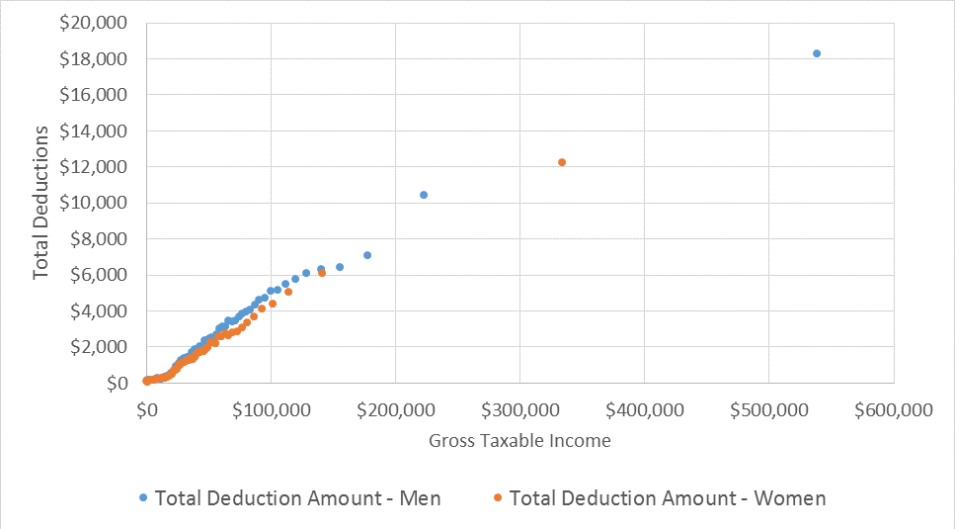
between men and women. The chart shows a significant difference in work related expenses between the genders, and a smaller difference in the level of total deductions. Figure 4.2 shows that there is a significant difference in the level of work related expenses claimed by men and women of the same income level. Figure 4.3 shows that the difference in total deduction is slightly smaller, but still substantial.

Figure 4.2: Binned Scatterplots of Total Work Related Expenses, by gender



Similar binscatter charts are constructed looking at each type of deduction, as well as comparing the trends within occupation. These charts, which

Figure 4.3: Binned Scatterplots of Total Deductions, by gender



are presented in Appendix 4.A.3, show that the gender gap is observed in the majority of deduction types, and the majority of industries, but that there is significant variation in these trends.

4.3 Analysing the gender gap using a Oaxaca-Blinder decomposition

The previous section compares the average amount of tax deductions claimed by men and women, but it is difficult to interpret the difference in outcome between genders. For instance, looking at the results in Section 4.2, it is possible that men might claim more deductions because of an inherent gender difference, or it might be the case that men have higher income on average, and work in industries associated with higher work related expenses. In order to more formally approach this question we want to know what level of deduction are claimed by men and women who have similar observable characteristics. In other words, if we take a population with similar incomes, similar occupations, similar ages and similar tax filing status do men still claim more deductions than women? In order to answer this question, this section uses the Oaxaco-Blinder technique. In the following section, this result is generalised using the a DFL decomposition.

The Oaxaca-Blinder technique is a counterfactual decomposition tech-

nique developed independently by Blinder (1973) and Oaxaca (1973). This technique is widely used, particularly in the labour market and discrimination literature, and the strengths and weaknesses of this approach are well understood. Reviews of the Oaxaca-Blinder decomposition can be found in Stanley and Jarrell (1998), Weichselbaumer and Winter-Ebmer (2005), and Fortin et al. (2011).

The Oaxaca-Blinder decomposition is conducted by separately estimating a regression equation that predicts the level of deductions claimed by men and women. Evaluated at the means, these two equations will give a raw difference between the expected level of deductions for men and women. Then, the regression equation for women is used to estimate the expected level of deductions if they had the same observable characteristics as men.[9] That is, the average wage of men, the occupational profile of men, the age profile of men etc. are substituted into the female wage equation, and used to predict a counterfactual level of deductions. The amount that is estimated in this equation is said to be the explained portion of the raw difference, while the remainder is considered 'unexplained'.

As discussed previously, some care must be exercised in interpreting the unexplained portion, as it will potentially include differences in the behaviour of men and women, as well as 'selection on unobservables'. This means that if an important determinant of filing behaviour is not included as an explanatory variable, and that determinant is correlated with gender, then this effect will be included as part of the unexplained portion.

The regression equation used in the Oaxaca-Blinder decomposition in this section is:

$$\begin{aligned} LnDed_i = &\beta_1 LnGrossTaxableIncome_i + \beta_2 Occupation_i + \beta_3 Age_i + \\ &\beta_4 PartnerStatus_i + \beta_5 lodgmentMethod_i + Constant \end{aligned}$$

where each individual is recorded as belonging to one of 10 industries and 12 discrete age ranges.[10] Partner status is defined as whether there is a partner recorded on the tax form, and lodgment method is either agent-prepared or self-prepared.

[9] This description characterizes the so called 'two part' Oaxaca-Blinder decomposition. A well-known issue with the Oaxaca-Blinder literature is that a decomposition performed in the manner described here will yield different results than if the procedure is reversed (estimating the male equation with female observed characteristics). A variety of potential solutions to this issue are discussed in the literature reviews described above, but are not considered further in this paper.

[10] These age ranges are 5 year bins, as well as an 'under 20' and 'over 70' category.

The results from the baseline Oaxaca-Blinder decomposition of total deductions and total work related expenses are shown in Table 4.3. In the case of work related expenses, the Oaxaca-Blinder framework identifies a raw difference of around 52 per cent between genders, of which 33.8 percentage points[11] are explained by differences in observable characteristics between men and women, and 18.2 percentage points were left unexplained. The biggest explanatory factors were difference in income, and difference in occupation, while lodgement method, partner status and age range are relatively unimportant in explaining the deduction difference.[12]

Table 4.3: Results of the Oaxaca-Blinder Decomposition

	Total WRE (log percentage points)	Total Deduction Amount (log percentage points)
Total difference	52.0	57.1
	(1.4)	(1.2)
Explained	33.8	45.5
	(1.2)	(1.0)
Unexplained	18.2	11.6
	(1.1)	(1.1)
Explained by:		
Ln (Total Income)	19.3	33.8
	(0.3)	(0.5)
Occupation	11.9	7.9
	(1.0)	(0.7)
Lodgment Method	2.3	3.3
	(0.1)	(0.1)
Age Range	0.2	0.0
	(0.1)	(0.1)
Partner Status	0.0	0.3
	(0.0)	(0.0)

The Oaxaca-Blinder decomposition for total deductions claimed has a

[11] Throughout these results, percentage point differences are based on a difference in logs, and therefore won't relate exactly to percentages in the underlying data.

[12] The standard errors reported throughout this paper are estimated using Stata's 'Oaxaca' command, and are calculated using the delta method. This allows for variation in the regressors (as well as variation in the outcome variable) to be incorporated into the estimates of standard errors (Jann 2008).

similar interpretation. There is a 57.1 percentage point difference between men and women, of which 45.4 percentage points can be explained by differences in observed characteristics, leaving 11.6 percentage points unexplained.

The Oaxaca-Blinder framework can also be applied at the level of each individual deduction, to determine whether there is a difference between genders at this disaggregated level. As is the case above, log of total income, occupation, lodgment method, age range and partner status are used as control variables. Table 4.4 shows the gross gender difference, the explained portion and the unexplained portion for each type of deduction.

Several elements of Table 4.4 are noteworthy. First the gender deduction gap is evident in seven of the eleven categories. Women claim significantly more than men in three categories of deductions, educational expenses, charitable gifts and non-employer superannuation. In the case of charitable giving, this gap is increased further once controlling for observable characteristics in the Oaxaca-Blinder framework.[13]

Finally, the Oaxaca-Blinder framework is applied at the occupation level. The results, shown in Tables 4.5 and 4.6, show that men claim more than women in six out of nine occupation classifications while women claim more than men in the community and personal service sector and professional sector.

4.4 Analysing the gender gap using the DFL methodology

In this section, the different levels of tax deductions claimed by men and women are examined using an approach first proposed in DiNardo, Fortin and Lemieux (1996). This approach reweights the observations of women in order to create a counterfactual distribution of women that have similar characteristics to men (similar income, similar proportions working in each occupation, similar age, etc.). The average level of deductions can then be compared between the male sample and the weighted female sample.[14] The DFL methodology can also be used to compare the distributions of male and female deductions, and can show effects that are not visible when only

[13]This aligns with other research that suggests women are more likely than men to make charitable donations (Mesch (2010) and Piper and Schnepf (2008)).

[14]When applied in this way, the DFL decomposition is very similar to the propensity score reweighting method used in the program evaluation literature (Fortin, Lemieux and Firpo 2011).

Table 4.4: Oaxaca-Blinder Results, by type of deduction

	Difference	Explained	Unexplained
Aggregates			
Total WRE	52.0	33.8	18.2
	(1.4)	(1.2)	(1.1)
Total Deduction Amount	57.1	45.5	11.6
	(1.2)	(1.0)	(1.1)
By Deduction			
Car WRE	43.9	27.0	16.9
	(1.2)	(0.9)	(1.4)
Travel WRE	22.3	10.0	12.3
	(0.7)	(0.5)	(0.8)
Uniform WRE	49.0	42.2	6.8
	(1.1)	(0.8)	(1.1)
Self-Education WRE	-3.0	-0.7	-2.3
	(0.6)	(0.4)	(0.7)
Other WRE	47.0	24.7	22.4
	(1.3)	(1.0)	(1.2)
Dividend Deduction	3.2	0.8	2.3
	(0.4)	(0.2)	(0.4)
Interest Deduction	0.7	0.6	0.1
	(0.4)	(0.2)	(0.4)
Charitable Gifts	-10.7	4.6	-15.3
	(1.0)	(0.7)	(1.1)
Non-Employer Superannuation	5.5	7.3	-1.8
	(0.5)	(0.3)	(0.5)
Cost of Tax Affairs	43.6	26.1	17.6
	(1.1)	(0.8)	(1.1)
Other Deductions	32.1	8.9	23.1
	(0.6)	(0.5)	(0.8)

looking at a comparison of means (such as the Oaxaca-Blinder analysis used in the proceeding section).

The reweighting factor used in the DFL approach is designed to create a sample of women that have a similar distribution of predictive variables. This means that where there are predictive variables (X) that are more

Table 4.5: Oaxaca-Blinder Results, WRE by Occupation

	Difference	Explained	Unexplained
Managers	27.0	17.9	9.1
	(3.8)	(9.1)	(3.7)
Professionals	-6.6	28.3	-34.9
	(2.6)	(1.4)	(2.6)
Technicians and Trades Workers	111.5	81.5	30.0
	(5.1)	(2.8)	(4.8)
Community and Personal Service	55.7	74.2	-18.5
Workers	(4.4)	(3.1)	(3.8)
Clerical and Administrative	55.3	33.8	21.5
Workers	(4.2)	(2.6)	(4.1)
Sales Workers	49.0	46.5	2.4
	(5.1)	(3.2)	(4.5)
Machinery Operators and Drivers	71.5	35.6	35.9
	(9.7)	(5.2)	(8.3)
Labourers	85.9	78.5	7.4
	(4.4)	(3.1)	(3.9)
Consultants, apprentices and	97.3	57.3	40.0
Not Specified	(4.7)	(3.0)	(4.2)

Table 4.6: Oaxaca-Blinder Results, Total deductions by Occupation

	Difference	Explained	Unexplained
Managers	42.6	36.5	6.1
	(3.2)	(1.5)	(3.0)
Professionals	11.6	35.7	-24.1
	(2.3)	(1.3)	(2.1)
Technicians and Trade Workers	104.2	81.9	22.4
	(4.6)	(2.6)	(4.2)
Community and Personal Service	55.6	69.3	-13.7
Workers	(4.2)	(3.1)	(3.5)
Clerical and Administrative	43.7	37.2	6.5
Workers	(3.8)	(2.6)	(3.4)
Sales workers	49.0	45.8	3.2
	(4.9)	(3.3)	(4.1)
Machinery Operators and Drivers	69.7	36.0	33.7
	(9.1)	(5.0)	(7.6)
Labourers	82.3	71.7	10.6
	(4.2)	(3.0)	(3.6)
Consultants, apprentices and	90.7	55.1	35.6
Not Specified	(4.4)	(3.0)	(3.8)

common among men than women (such as working as a machinery operator), they will be given a larger weight in the female sample. On the other hand, if there are predictive variables (X) that are more common amongst women than men (such as working in the community services sector), individuals with these characteristics will be given less weight in the DFL methodology. Specifically, the reweighting factor is of the form:

$$\psi(x) = \frac{Pr(X \backslash Gender = Men)}{Pr(X \backslash Gender = Women)} \tag{4.1}$$

In order to generate these probabilities, both the numerator and denominator are expanded using Bayes rule:

$$Pr(X \backslash Gender = Men) = \frac{Pr(Gender = Men \backslash X).Pr(X)}{Pr(Men)} \tag{4.2}$$

$$Pr(X \backslash Gender = Women) = \frac{Pr(Gender = Women \backslash X).Pr(X)}{Pr(Women)} \tag{4.3}$$

Substituting (2) and (3) into (1) leaves the expression:

$$\psi(x) = \frac{Pr(Gender = Men \backslash X)/Pr(Men)}{Pr(Gender = Women \backslash X)/(Pr(Women)} \tag{4.4}$$

The probabilities required to implement this model are generated using a logit model that predicts the gender of the tax return using the predictive variables (Log Gross Income, Occupation, Age, Partner Status, Lodgment Method, and a dummy for having zero income).

The intuition behind the DFL approach can be appreciated in Table 4.7, which presents the descriptive statistics of the male, female, and reweighted female tax returns. This shows that after using the DFL approach, the reweighted women's sample has a very similar distribution of occupations, and a more similar level of income than the unweighted sample.

These weights are then used to compare the level of each type of deduction made by men with those made by the reweighted female group. The results, presented in Table 4.8, show that the DFL technique can explain 46 per cent of the observed difference in total deductions, but only 8 per cent of work related expenses.

These weights can also be used to create a full counterfactual distribution of deductions that would occur if women had the same observable characteristics as men. Figure 4.4 shows the distribution of work related expenses amongst men and women, along with the rewrighted distribution of work related expenses using the DFL weights. Figure 4.5 shows the same comparison for total deductions.

Table 4.7: Mean of predictive variables by gender using DFL weights

	Men	Women	Women (DFL weights)
Gross Taxable Income	$71,556	$48,275	$65,495
Proportion with Zero Income	0.46%	0.58%	0.48%
Proportion with Partner	56.29%	54.62%	54.04%
Managers	11.49%	7.70%	11.35%
Professionals	14.37%	19.61%	14.19%
Technicians and Trades Workers	15.21%	2.51%	14.10%
Community and Personal Service Workers	4.72%	11.53%	4.72%
Clerical and Administrative Workers	4.93%	18.56%	4.97%
Sales Workers	4.14%	8.17%	4.16%
Machinery Operators and Drivers	8.41%	0.54%	8.19%
Labourers	10.35%	5.24%	9.86%
Consultants, Apprentices and Not Specified	7.12%	7.66%	7.15%
Occupation not listed/specified	19.26%	18.48%	21.31%

Table 4.8: DFL estimates of the Deduction Gap Between Men and Women

	Men	Women	Women (DFL Weights)
Car WRE	$880	$435	$454
Travel WRE	$242	$80	$90
Uniform WRE	$149	$111	$128
Self Education - WRE	$88	$88	$85
Other WRE	$675	$446	$468
Total WRE	$2032	$1158	$1223
Dividend Deduction	$118	$56	$94
Interest Deduction	$72	$41	$61
Charitable Donation	$253	$209	$372
Non-Employer Superannuation	$323	$241	$476
Cost Tax Affairs	$212	$137	$186
Other Deduction	$224	$87	$113
Total Deductions	$3227	$1922	$2518

Figure 4.4: DFL Counterfactual Distribution of Work Related Expenses

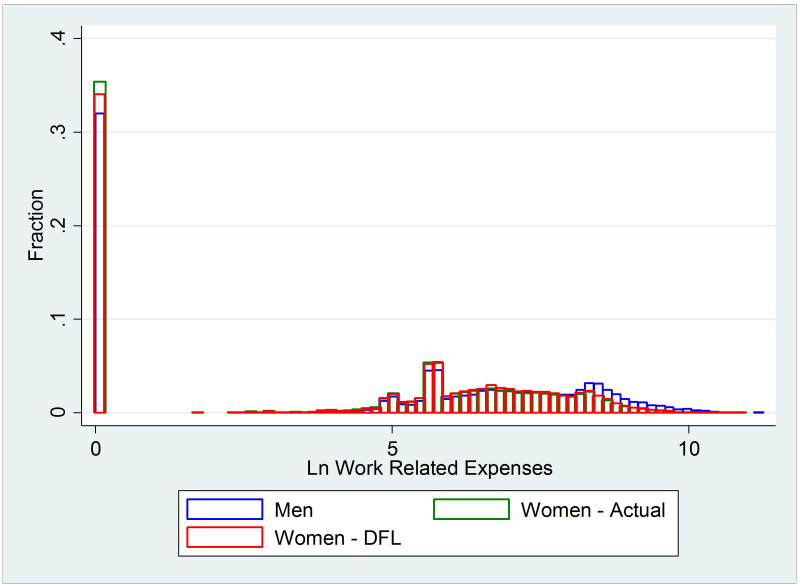
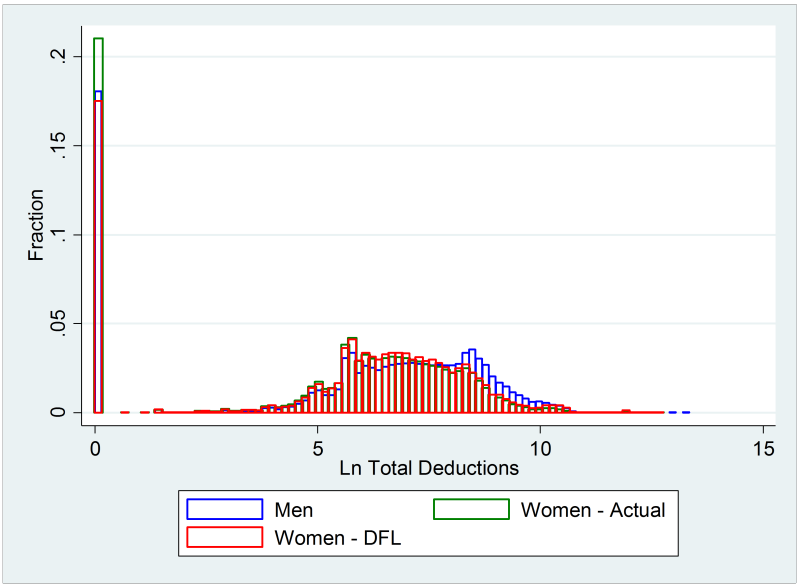


Figure 4.5: DFL Counterfactual Distribution of Total Deductions



There are two key observations to make from these figures. First, the DFL methodology can explain a significant proportion of the difference between men and women who claim zero deductions, which suggests there is not a systematic difference between men and women at the extensive margin. However, other than this difference at zero deductions, the DFL counterfactual looks very similar to the unweighted women's distribution. This is further evidence that there is a real difference between men and women in tax behaviour, and the difference cannot be explained by differences in observable characteristics. In particular, the large mass of deductions claimed by men at the top of the distribution cannot be explained using the DFL technique.

4.5 Family tax planning and different income sources

4.5.1 Family tax planning

One potential complication with this type of exercise is that couples may organise their tax affairs together, and if there is some discretion about which partner claims a particular deduction, the observed gender difference might actually result from tax planning decisions made by the couple. One issue of particular concern is that under a progressive tax system, there is an incentive to claim deductions against the income of a partner with the higher marginal tax rate. If, on average, men have a higher marginal tax rate than their partner, then there is an incentive to claim any discretionary deductions against the man's income.[15] This could cause the observed gender bias reported in this paper.

Working against this hypothesis is the fact that the largest observed gender differences occur for types of deductions that are hardest to shift between individuals. If this difference was being driven by family tax planning, we would expect to see a large difference on the types of deductions that are easier to shift between partners (such as charitable donations, superannuation and the cost of tax affairs) and no gap on work related expenses that are specifically tied to a person's earnt income. In the data, we tend to see the opposite. The gap is largest for work related expenses, and negative for charitable giving.

One way to investigate this issue is to restrict the analysis to single individuals.[16] The results of this analysis, shown in Table 4.16 in Appendix

[15] 74 per cent of men in the sample file have a higher income than their partner.

[16] Which excludes people who are married and in de facto relationships.

4.B, show that there is a significantly smaller unexplained gap between men and women when only looking at the singles in the population. However, it should also be noted that there are significant differences between singles and the total population. For instance, singles are on average much younger, have much lower incomes, and more likely to claim zero deductions. Therefore, it is not possible to say whether this smaller result is evidence that family tax planning is creating the result in the main sample, or just that single men and women are much more similar than men and women generally, which would be consistent with results from the gender pay gap literature.

Another way to test this hypothesis is to add an additional variable to the Oaxaca-Blinder framework used in Section 4.3. This variable was constructed based on information on partner's income included in the 2013/14 tax records, and indicates whether an individual is in a lower tax bracket, a higher tax bracket or the same tax bracket than their partner.

$$LnDed_i = \beta_1 LnGrossTaxableIncome_i + \beta_2 Occupation_i + \beta_3 Age_i + \beta_4 Partner_i + \beta_5 LodgmentMethod_i + \beta_6(Hightaxbracket) + \beta_7(lowtaxbracket) + Constant$$

The results of this new specification (shown in Table 4.9) show strong indications of tax planning at the household level.

For instance, the coefficients for charitable giving and cost of managing tax affairs are both large. In the case of charitable giving, the interpretation here is that on average, the partner in the higher tax bracket tends to claim the deduction for charitable giving, and once this is accounted for, the women give even more to charity than men. Non-Employer Superannuation also shows some signs of household tax planning, but in this case, the incentive is to accumulate more superannuation to the lower income partner.[17]

However, table 4.9 shows some results that are not consistent with the family tax planning hypothesis. In particular, a number of work related expenses are associated with being the higher income earner. While it is possible that some types of work related expenses are substitutable amongst different earners in a household, it is also possible that this is a spurious

[17]The incentive for family tax planning with relation to voluntary superannuation could work in either direction. If neither party has any contributions, there is an incentive to deduct the money from the higher income partner, as with other deductions. However, there is a limit to how much each individual can place in superannuation. If one partner is at this limit, then there is an incentive to make contributions into the lower income partner's account.

Table 4.9: Oaxaca-Blinder results including partner's tax rate

	Difference	Explained	Unexplained	Explained by different tax brackets
Total WRE	52.0	42.5	9.5	10.6
	(1.4)	(1.2)	(1.2)	(0.5)
Total Deductions	57.1	46.8	10.3	1.9
	(1.2)	(1.1)	(1.2)	(0.5)
By Deduction				
Car WRE	43.9	22.4	21.5	6.8
	(1.2)	(1.1)	(1.5)	(0.7)
Travel WRE	22.3	12.0	10.2	2.5
	(0.7)	(0.7)	(0.9)	(0.4)
Uniform WRE	49.0	48.7	0.3	7.5
	(1.1)	(0.9)	(1.1)	(0.5)
Self-Education WRE	-3.0	-2.0	-1.0	-1.5
	(0.6)	(0.4)	(0.7)	(0.3)
Other WRE	47.0	35.1	11.9	12.7
	(1.3)	(1.1)	(1.3)	(0.6)
Dividend Deduction	3.2	0.1	3.0	-0.8
	(0.4)	(0.3)	(0.5)	(0.2)
Interest Deduction	0.7	0.0	0.7	-0.8
	(0.4)	(0.3)	(0.5)	(0.2)
Charitable Gifts	-10.7	12.5	-23.2	9.5
	(1.0)	(0.8)	(1.2)	(0.5)
Superannuation	5.5	2.4	3.1	-5.7
	(0.5)	(0.4)	(0.6)	(0.3)
Cost of Tax Affairs	43.6	36.7	6.9	13.0
	(1.1)	(0.9)	(1.1)	(0.5)
Other Deductions	32.1	8.9	23.1	0.0
	(0.7)	(0.6)	(0.9)	(0.4)

relationship driven by the correlation between income and the variable for having a higher income than your partner.

In summary, the results in table 4.9 show evidence that tax planning at the family level occurs, and may contribute to the observed gender deduction gap. However, even accounting for this result, there is still a significant unexplained gap of around 10 per cent.

4.5.2 Different income sources among men and women

A second concern with the main specification used in Section 4.3 is that men and women earn different types of income (Table 4.14 in Appendix 4.B). Men tend to receive more business income and superannuation payments, while women tend to receive more fixed interest annuities and government pensions. Since different deductions are claimable against different types of income, these different income profiles may be causing the observed deduction gap in the aggregate data.

In this section, this hypothesis is examined in three ways. The first approach is to perform the Oaxaca-Blinder decomposition from Section 4.3 using wage and salary income rather than total income as an explanatory variable. Wage and salary income accounts for around seventy-one per cent of income for both men and women (Table 4.14), and should be a good proxy for income that work related expenses are deducted against. The results of this specification are shown in Table 4.10.

Using the log of wages and salary rather than the log of total income explains less of the difference, leaving a larger proportion as an unexplained gap.

The second approach is to exclude various individuals from the analysis that may have a strong influence on the results. The analysis is repeated while excluding:

- Individuals with business income greater than $10,000, where business income includes net business income, distributions from partnerships and farm income. This excludes around 10 per cent of individuals.
- Individuals who claim the highest cost of managing their tax affairs. 1 per cent of individuals are removed, which equates to those who claim more than $1832 on tax management costs.
- Individuals aged less than 25 or older than 60 years old.
- Individuals who receive more than half of their total income as unearned income (including interests, shares, pensions, superannuation and annuities).
- All of these groups together.

The results of this analysis are shown in Appendix 4.A in Table 4.17 (Work Related Expenses) and Table 4.18 (Total Deductions). The results show that in each specification, a significant difference in deductions between

Table 4.10: Oaxaca-Blinder results using wage and salary income.

	Total WRE	Total Deductions
Percentage point difference	52.0	57.1
	(1.4)	(1.2)
Explained	31.9	25.9
	(1.1)	(0.9)
Unexplained	20.1	31.2
	(1.1)	(1.2)
Explained by		
Log (Salary and Wages)	13.2	10.4
	(1.0)	(0.8)
Occupation	15.8	10.6
	(0.6)	(0.6)
Age	2.5	4.1
	(0.1)	(0.2)
Lodgment Method	0.3	0.1
	(0.1)	(0.1)
Partner Status	0.1	0.6
	(0.0)	(0.1)

men and women remains unexplained. While this does not prove that the gender difference exists in all groups, it does make it highly unlikely that the result is being driven by a small number of unusual tax returns.

A final approach used to investigate the impact that the different composition has on the results in this paper is to include the proportion of each income type as a predictor in the Oaxaca-Blinder decomposition results in Section 4.3.[18]

$$LnDed_i = \beta_1 LnGrossTaxableIncome_i + \beta_2 Occupation_i + \beta_3 Age_i + \beta_4 PartnerStatus_i + \beta_5 LodgmentMethod_i + \beta_6 Proportionincome_i j + Constant$$

This model is equivalent to assuming that each type of gross income typically generates a given proportion of deductions, and that this proportion

[18] In this case, the proportion of income obtained from income source is equal to the income derived from this source divided by total income for that individual. This amount is then bounded between zero and one to remove the influence of people who claim a very low taxable income (ie, people who report a taxable income of $1).

is different for different types of income. In this specification, the different composition of income explains a small proportion of the gender deduction gap (Table 4.11), which is further evidence that the main results are not being driven by a different composition of income.

Table 4.11: Oaxaca-Blinder results when including composition of income as an explanatory variable

	Total WRE	Total WRE	Total Deductions	Total Deductions
Includes income types	Yes	No	Yes	No
Percentage point difference	52.0	52.0	57.1	57.1
	(1.4)	(1.4)	(1.2)	(1.2)
Explained	36.0	33.8	47.8	45.5
	(1.2)	(1.2)	(1.0)	(1.0)
Unexplained	16.0	18.2	9.3	11.6
	(1.1)	(1.1)	(1.1)	(1.1)
Explained by				
Log Total income	18.7	19.3	34.5	33.8
	(0.3)	(0.3)	(0.5)	(0.5)
Occupation	12.6	11.9	8.5	7.9
	(0.7)	(1.0)	(0.6)	(0.7)
Age	0.3	2.3	0.1	3.3
	(0.1)	(0.1)	(0.1)	(0.1)
Lodgment Method	2.7	0.2	3.4	0.0
	(0.1)	(0.1)	(0.2)	(0.1)
Partner Status	0.0	0.0	0.3	0.3
	(0.0)	(0.0)	(0.0)	(0.0)
Income types	1.6		1.1	
	(0.1)		(0.3)	

4.6 Conclusion

This paper has explored the difference in deductions claimed by men and women, and found that in general, men are likely to claim more deductions than women. This result is found in 7 of 11 categories of deductions, and in 6 out of 9 industries. After controlling for differences in observable characteristics using the Oaxaca-Blinder framework, the paper finds that men

claim around 12 per cent more deductions than women, which equates to around $240 in deductions per year.

The paper has also explored a range of possible explanations of this observed gap, including family tax planning and different compositions of income between men and women, and found that while both factors are important in explaining tax behaviour, they can only explain a small proportion of the observed gap.

However, it should also be noted that beyond these factors, this paper is not able to distinguish between other possible explanations; such as men being more willing to risk audit, men having more information about the deductions available to them, men being more willing to maintain the documentation needed to claim deductions, and men being entitled to more deductions in a way that is not captured by observable characteristics. This creates a potential policy dilemma, as the correct policy response to this observed gap depends on what is driving the underlying result.

If there are parts of the tax system that allow deductions for things commonly used by men, but do not allow deductions for similar deductions used by women, then the gap could be reduced by identifying and removing this distinction (either by allowing deductions for women, or disallowing deductions for men). While this issue has been debated in Australia in the context of briefcases and purses(Han 2016), it is likely to have a much larger financial impact in other less obvious areas, such as when looking at the tax deductibility of driving a work vehicle (which is deductible), as opposed to commuting to and from work (which is not deductible).

If men are more willing to risk audit than women, either because they think that the tax office won't audit them, or because they are more willing to claim a deduction when they are unsure if it is allowable, then the Australian Tax Office should take gender into account when determining who to audit.

To the extent that women are less informed about the levels of deductions that are available, then a potential solution would be to provide more information to women about what can be claimed. However, given the strong financial incentives that already exist for people to discover this information, alongside incentives for tax preparers to supply this information, it is unclear that any program of information provided by the government would be effective.

Another solution that would potentially reduce this gap is to automate more parts of the tax return process. This could be done by encouraging more deductions to be claimed at the point of use through salary sacrificing, rather than claiming the deduction at the end of the year. It could also

be done by allowing a standard deduction for certain types of deductions, and automatically giving everyone that deduction. Automating more of the tax system in this manner would also potentially have significant welfare impacts. If there are deductions that some people are not collecting because the costs of keeping records is too great, it suggests that there is potentially significant welfare implication of having this deduction in the tax system, as it implies that others are collecting the deduction (which has an impact on tax revenues), but losing much of the value through the recording process.[19]

[19]This issue is explored in the US context in Benzarti (2016). This paper uses a bunching based methodology to look at the cost of itemising a tax return, and finds that this process has an average revealed cost of around $600. While this cost is for the process of itemising all deductions, it suggests that the welfare impact of having to keep records is potentially substantial.

4.A Negative gearing and fringe benefit taxation

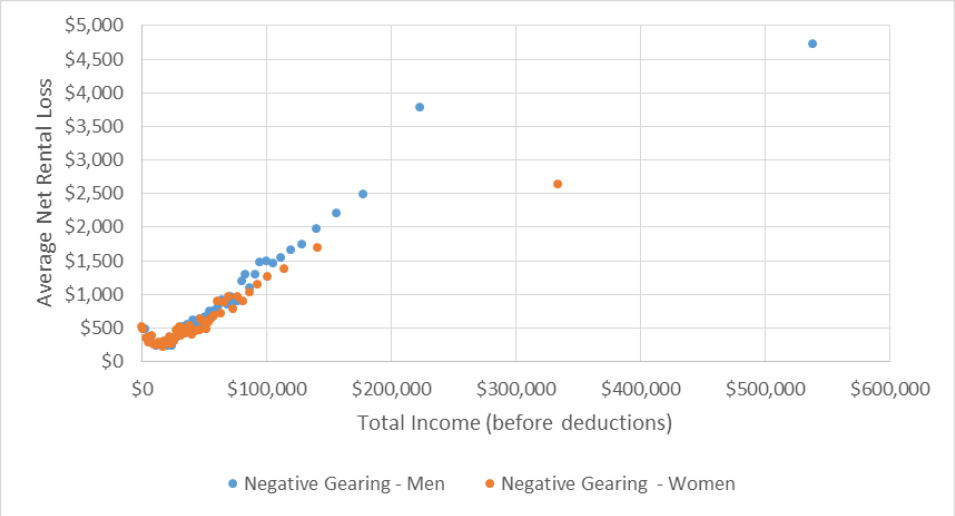
Negative gearing of rental properties is a feature of the Australian tax system where losses from investment properties (interest repayments and proprty expenses less rental income) can be used to offset income from other sources. It is often seen as an attractive investment strategy as the capital gains made on rental accommodation are taxed at a lower rate than other income. For the purposes of this exercise, the level of negative gearing is defined to be net rental losses (but equal to zero if there is a net rental gain).

4.A.1 Negative gearing

Negative gearing of rental properties is a feature of the Australian tax system where losses from rental properties can be used to offset income from other sources. It is often seen as an attractive investment strategy as the capital gains made on rental accommodation is taxed at a lower rate than other income. For the purposes of this exercise, the level of negative gearing is defined to be net rental losses (but equal to zero if there is a net rental gain).

The first result uses the binscatter method from Section 4.2. This shows that there is a difference in the filing behaviours of men and women conditional on income, and this difference is most pronounced at higher income levels.

Figure 4.6: Binned scatterplots of negative gearing, by gender



This difference is also apparent in the Oaxaca-Blinder framework. When

the baseline specification used in Section 4.3 is applied to negative gearing, we find that men claim 12.9 per cent more than women on average, and that this gap is only reduced a small amount (to 12.5 per cent) once other variables are controlled for in the Oaxaca-Blinder decomposition.[20]

Table 4.12: Oaxaca-Blinder decompostion of negative gearing

	Negative Gearing (log percentage points)
Total Difference	12.9
	(1.0)
Explained	0.4
	(0.7)
Unexplained	12.5
	(1.1)
Explained by:	
Ln (Total Income)	4.0
	(0.2)
Occupation	-6.2
	(0.6)
Lodgment Method	2.0
	(0.1)
Age Range	-0.1
	(0.1)
Partner Status	0.6
	(0.1)
Number of Observations	257,639

In the context of negative gearing, an observed gender difference most likely represents a more active approach to investment and tax management, rather than a difference in the way in which men and women file their taxes, although it potentially captures larger reported values for property management and depreciation amongst those with investment properties.

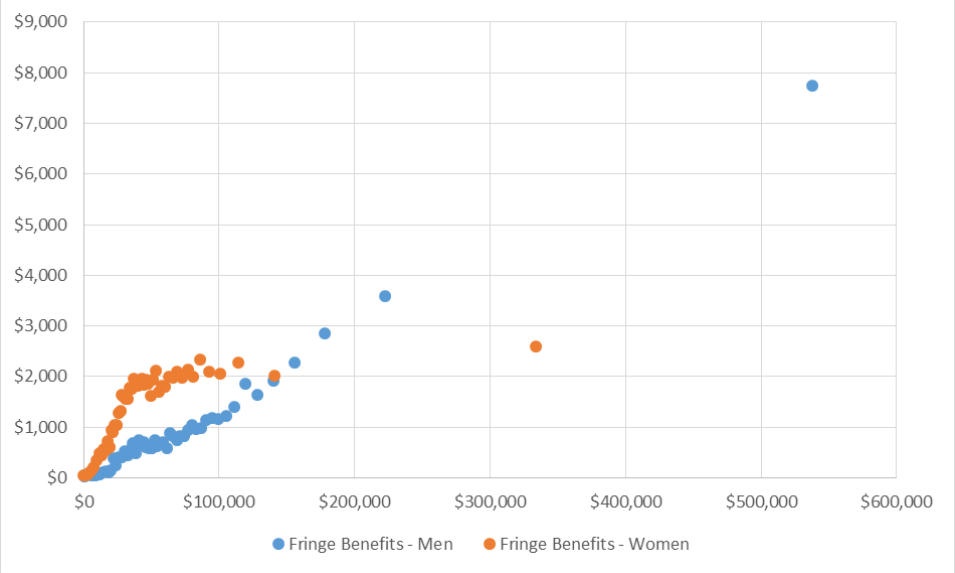
[20] As with the analysis in the main section, this result is robust to different empirical specifications, including adding dummies for being in a higher or lower tax bracket than your partner, and excluding different groups of individuals as in Table 4.17.

4.A.2 Fringe benefit taxation

Under the Australian personal income tax system, benefits provided to an employee in place of salary or wages are taxable at the highest marginal tax rate. However, a range of exemptions exist that allow fringe benefits to be paid to employees without paying fringe benefits tax. These include a number of exemptions in the community services and health sectors and religious institions, as well as a lower tax rate on company cars. In such cases, it is often advantageous to arrange employment contracts to maximise benefits paid in this way.

For the purpose of this paper, the trends of fringe benefits paid to different employees is interesting for two reasons. First, from the perspective of equity, women tend to receive more of their income in this way (Figure 4.7), and to the extent that this represents favourable tax treatment, it may balance out the difference in deductions examined in the main part of this paper. Second, in some cases, Fringe Benefit Tax (FBT) exemptions are substitutable for deductions. For instance, an individual that receives a FBT exempt work vehicle will not be able to claim that vehicle as a deduction against their income tax.

Figure 4.7: Binned scatterplots of reported fringe benefits, by gender



The data for fringe benefit tax included in the ATO data used in this paper includes taxable fringe benefits and so called quasi-fringe benefits (ATO

2017). These are benefits provided to workers in a public benevolent institution, a health promotion charity, a hospital, a public ambulance service and workers in a live-in residential care setting. However, they do not include other FBT exempt items which are not required to be reported to the tax office. Furthermore, the ATO data does not distinguish between individuals that receive taxable fringe benefits and those that receive quasi-fringe benefits. However, by comparing the sample file with data on total tax revenue from fringe benefit taxation (ABS 2016), around 45 per cent of FBT reported in the tax data are tax exempt.

In interpreting the results in this section, it is important to remember that the quasi fringe benefits described above are provided in industries that employ a high proportion of women and it is therefore likely that the observed trend is a result of this sectoral difference, rather than an underlying behavioural difference.

When analysed in the Oaxaca Blinder Framework (Table 4.13), women are found to receive around 13 per cent more fringe benefits than men in similar situations. When evaluated at the mean($960 for men), this is equivalent to a difference of $125 in fringe benefits received. If these are assumed to be tax exempt, these additional exemptions are worth about $40 per person.

Table 4.13: Oaxaca-Blinder decomposition of reported fringe benefit taxes

	Reported Fringe Benefits (log percentage points)
Total difference	-22.5
	(0.9)
Explained	-9.2
	(0.6)
Unexplained	-13.3
	(1.0)
Explained by:	
Ln (Total Income)	4.5
	(0.2)
Occupation	-14.0
	(0.5)
Lodgment method	2.1
	(0.1)
Age Range	-0.2
	(0.2)
Partner Status	0.2
	(0.0)
Number of observations	257,639

4.A.3 Additional results and figures

Table 4.14: How income sources vary by gender

	Men	Women	Difference	p value (difference = 0)
Salary/wage	71.3%	71.0%	0.3%	0.063
Allowances	1.4%	0.8%	0.6%	0.000
Employment termination payments	0.3%	0.1%	0.2%	0.000
Gross interest	2.6%	4.5%	-1.9%	0.000
Government pensions or allowances	3.9%	5.4%	-1.6%	0.000
Unfranked dividends	0.2%	0.2%	0.0%	0.002
Franked dividends	2.4%	3.1%	-0.6%	0.000
Dividends franking credit	1.1%	1.4%	-0.3%	0.000
Net rental income	1.8%	2.4%	-0.5%	0.000
Net farm management deposits	0.0%	0.0%	0.0%	0.002
Net primary production business income	0.2%	0.1%	0.1%	0.000
Net non-primary production business income	5.7%	2.8%	2.9%	0.000
Net capital gains	0.7%	0.8%	-0.1%	0.000
Annuity or superannuation income - taxed	0.3%	0.3%	0.0%	0.899
Annuity or superannuation income - untaxed	1.2%	0.7%	0.5%	0.000
Other net foreign source income	0.1%	0.2%	0.0%	0.004
Other income not separately listed	2.8%	2.3%	0.5%	0.000
Net partnership and trusts - primary prod.	0.6%	0.5%	0.1%	0.001
Net partnership and trusts - non-primary prod.	5.0%	5.2%	-0.2%	0.002
Total income	100.0%	100.0%	0.0%	

Table 4.15: Extended results of Oaxaca-Blinder Decomposition by deduction type

	Difference (percentage)	Percentage points explained by:					Explained	Unexplained	P Value (Explained = 0)
		Ln (Income)	Occupation	Lodgment method	Age Range	Partner status			
Aggregates									
Total WRE	52.0	19.3	11.9	2.3	0.2	0.0	33.8	18.2	0.000
	(1.4)	(0.3)	(1.0)	(0.1)	(0.1)	(0.0)	(1.2)	(1.1)	
Total Deduction Amount	57.1	33.8	7.9	3.3	0.1	0.3	45.5	11.6	0.000
	(1.2)	(0.5)	(0.7)	(0.2)	(0.1)	(0.0)	(1.0)	(1.1)	
By Deduction									
Car WRE	43.9	12.0	2.6	1.8	0.5	0.0	16.9	27.0	0.000
	(1.2)	(0.3)	(0.8)	(0.1)	(0.2)	(0.0)	(0.9)	(1.4)	
Travel WRE	22.3	6.4	4.0	-0.5	0.2	-0.1	10.0	12.3	0.000
	(0.7)	(0.2)	(0.5)	(0.1)	(0.1)	(0.0)	(0.5)	(0.9)	
Uniform WRE	49.0	8.2	32.6	1.5	0.1	-0.1	42.2	6.8	0.000
	(1.1)	(0.2)	(0.7)	(0.1)	(0.1)	(0.0)	(0.8)	(1.1)	
Self-Education WRE	-3.0	2.0	-1.8	-1.0	0.1	0.0	-0.7	-2.3	0.000
	(0.6)	(0.1)	(0.3)	(0.1)	(0.1)	(0.0)	(0.4)	(0.7)	
Other WRE	47.0	17.4	3.5	3.6	0.2	0.1	24.7	22.4	0.000
	(1.3)	(0.3)	(0.2)	(0.2)	(0.1)	(0.0)	(1.0)	(1.2)	
Dividend Deduction	3.2	3.2	-2.3	-0.1	-0.1	0.0	0.8	2.3	0.000
	(0.4)	(0.1)	(0.2)	(0.0)	(0.0)	(0.0)	(0.3)	(0.4)	
Interest Deduction	0.7	2.0	-1.1	-0.2	0.0	0.0	0.6	0.1	0.865
	(0.4)	(0.1)	(0.2)	(0.0)	(0.0)	(0.0)	(0.2)	(0.4)	
Charitable Gifts	-10.7	15.0	-9.7	-0.9	-0.1	0.2	4.6	-15.3	0.000
	(1.0)	(0.3)	(0.6)	(0.1)	(0.2)	(0.0)	(0.7)	(1.1)	
Non-Employer Superannuation	5.5	7.0	0.2	0.1	-0.1	0.1	7.3	-1.8	0.001
	(0.5)	(0.1)	(0.3)	(0.0)	(0.1)	(0.0)	(0.3)	(0.5)	
Cost of Tax Affairs	43.6	12.6	3.3	10.1	0.1	0.0	26.1	17.6	0.000
	(1.1)	(0.3)	(0.6)	(0.5)	(0.2)	(0.0)	(0.8)	(1.1)	
Other Deductions	32.1	7.2	0.3	1.2	-0.3	0.5	8.9	23.1	0.000
	(0.7)	(0.2)	(0.5)	(0.1)	(0.1)	(0.1)	(0.5)	(0.8)	

Table 4.16: Oaxaca-Blinder decomposition for singles and the population

	Singles				All People			
	Difference (percentage)	Explained	Unexplained	Mean deduction (pooled average)	Difference (percentage)	Explained	Unexplained	Mean deduction (pooled average)
Aggregates								
Total WRE	37.3	34.2	3.1	$1583	52.0	33.8	18.2	$1608
	(2.0)	(1.7)	(1.8)		(1.4)	(1.2)	(1.1)	
Total Deduction	23.4	28.4	-5.0	$2180	57.1	45.5	11.6	$2595
	(1.9)	(1.5)	(1.7)		(1.2)	(1.0)	(1.1)	
By Deduction								
Car WRE	34.2	20.1	14.1	$630	43.9	16.9	16.9	$664
	(1.9)	(1.3)	(2.1)		(1.2)	(0.9)	(1.4)	
Travel WRE	12.4	6.6	5.7	$170	22.3	10.0	12.3	$164
	(1.1)	(0.8)	(1.3)		(0.7)	(0.5)	(0.8)	
Uniform WRE	50.2	48.0	2.2	$147	49.0	42.2	6.8	$131
	(1.6)	(1.2)	(1.6)		(1.1)	(0.8)	(1.1)	
Self-Education WRE	-3.2	1.3	-4.4	$107	-3.0	-0.7	-2.3	$87
	(0.9)	(0.6)	(1.1)		(0.6)	(0.4)	(0.7)	
Other WRE	29.9	22.7	7.4	$534	47.0	24.7	22.4	$563
	(1.9)	(1.5)	(1.8)		(1.3)	(1.0)	(1.2)	
Dividend Deduction	-0.5	-2.5	2.1	$55	3.2	0.8	2.3	$88
	(0.5)	(0.3)	(0.5)		(0.4)	(0.2)	(0.4)	
Interest Deduction	-1.6	-1.8	0.2	$31	0.7	0.6	0.1	$57
	(0.4)	(0.3)	(0.5)		(0.4)	(0.2)	(0.4)	
Charitable Gifts	-43.6	-8.8	-34.8	$190	-10.7	4.6	-15.3	$231
	(1.4)	(0.9)	(1.5)		(1.0)	(0.7)	(1.1)	
Non-Employer Superannuation	2.1	0.9	1.2	$100	5.5	7.3	-1.8	$283
	(0.4)	(0.3)	(0.5)		(0.5)	(0.3)	(0.5)	
Cost of Tax Affairs	6.5	16.1	-9.6	$140	43.6	26.1	17.6	$176
	(1.5)	(1.2)	(1.5)		(1.1)	(0.8)	(1.1)	
Other Deductions	9.6	2.9	6.7	$87	32.1	8.9	23.1	$158
	(0.8)	(0.5)	(1.0)		(0.6)	(0.5)	(0.8)	

Table 4.17: Oaxaca-Blinder decomposition for work related expenses while excluding subgroups

	Baseline model (from Section 4.3)	Excluding high cost of tax affairs	Excluding high business income	Excluding high other income	Just prime aged workers	Excluding high unearned incomes	Excluding all groups
n (men)	134961	132693	117962	126446	94618	121069	88230
n (women)	123812	122377	112056	118402	86834	106799	83872
Percentage point difference	52.0	51.9	74.5	52.0	56.1	41.5	72.2
	(1.4)	(1.4)	(1.4)	(1.4)	(1.5)	(1.4)	(1.4)
Explained	33.8	33.9	54.4	35.0	31.1	23.7	61.2
	(1.2)	(1.2)	(1.1)	(1.2)	(1.3)	(1.1)	(1.1)
Unexplained	18.2	17.9	20.0	16.9	25.0	17.7	11.0
	(1.1)	(1.1)	(1.2)	(1.2)	(1.4)	(1.2)	(1.4
Explained by:							
Ln(Total Income)	19.3	19.4	25.9	20.8	24.9	21.2	38.6
	(0.3)	(0.4)	(0.4)	(0.4)	(0.5)	(0.4)	(0.6)
Occupation	11.9	12.1	25.8	11.8	3.5	-0.1	19.3
	(1.0)	(1.0)	(0.9)	(1.0)	(1.2)	(1.0)	(0.8)
Age	2.3	2.2	0.1	0.2	0.5	0.0	0.7
	(0.1)	(0.1)	(0.2)	(0.1)	(0.1)	(0.2)	(0.1)
Lodgment Method	1.2	0.2	2.5	2.2	2.3	2.6	2.6
	(0.1)	(0.1)	(0.2)	(0.1)	(0.2)	(0.1)	(0.2)
Partner Status	0.0	0.0	0.1	0.0	-0.1	0.0	-0.1
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)

Table 4.18: Oxaca-Blinder results for total deductions while excluding subgroups

	Baseline model (from Section 4.3)	Excluding high cost of tax affairs	Excluding high business income	Excluding high other income	Just prime aged workers	Excluding high unearned incomes	Excluding all groups
n (men)	134961	132693	117962	126446	94618	121069	88230
n (women)	123812	122377	112056	118402	86834	106799	83872
Percentage point difference	57.1	55.3	68.4	55.2	64.4	50.3	65.2
	(1.2)	(1.2)	(1.2)	(1.2)	(1.3)	(1.2)	(1.3)
Explained	45.5	44.2	54.8	45.9	43.5	38.1	57.0
	(1.0)	(1.0)	(1.0)	(1.0)	(1.1)	(0.9)	(1.0)
Unexplained	11.6	11.1	13.6	9.3	20.9	12.2	8.2
	(1.1)	(1.2)	(1.1)	(1.2)	(1.3)	(1.2)	(1.3)
Explained by:							
Ln(Total Income)	33.8	32.7	37.3	34.6	38.5	31.8	40.9
	(0.5)	(0.5)	(0.6)	(0.5)	(0.6)	(0.5)	(0.7)
Occupation	7.9	8.1	13.9	8.1	2.3	2.7	13.3
	(0.7)	(0.7)	(0.6)	(0.7)	(0.8)	(0.7)	(0.7)
Age	0.1	0.0	-0.1	0.0	0.0	0.4	0.1
	(0.1)	(0.1)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)
Lodgment Method	3.3	3.1	3.3	3.1	3.0	3.2	2.8
	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)
Partner Status	0.3	0.3	0.3	0.2	0.2	0.1	-0.2
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)

Figure 4.8: Binned scatterplots of each deduction, by gender

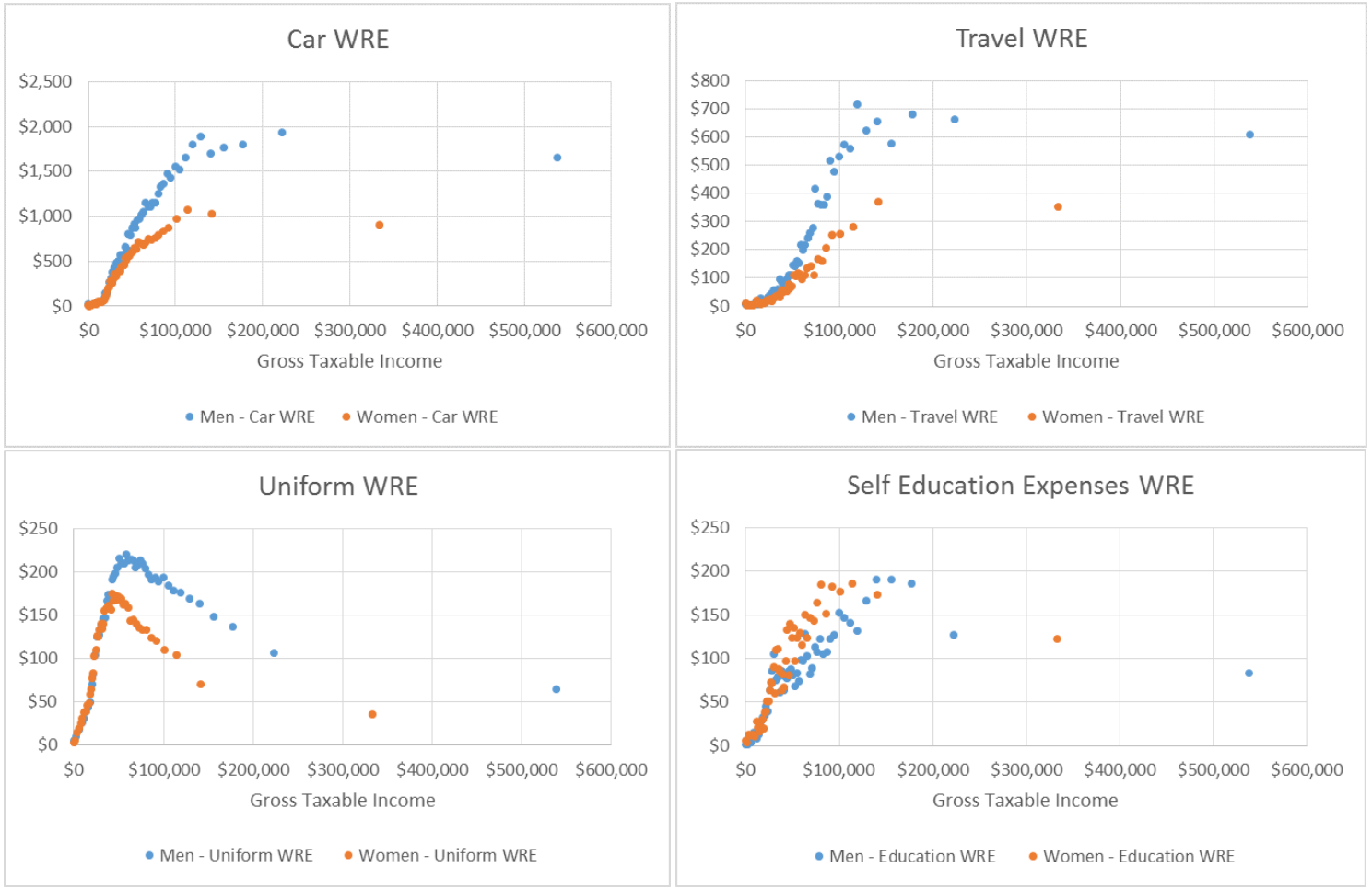


Figure 4.9: Binned scatterplots of each deduction, by gender (cont.)

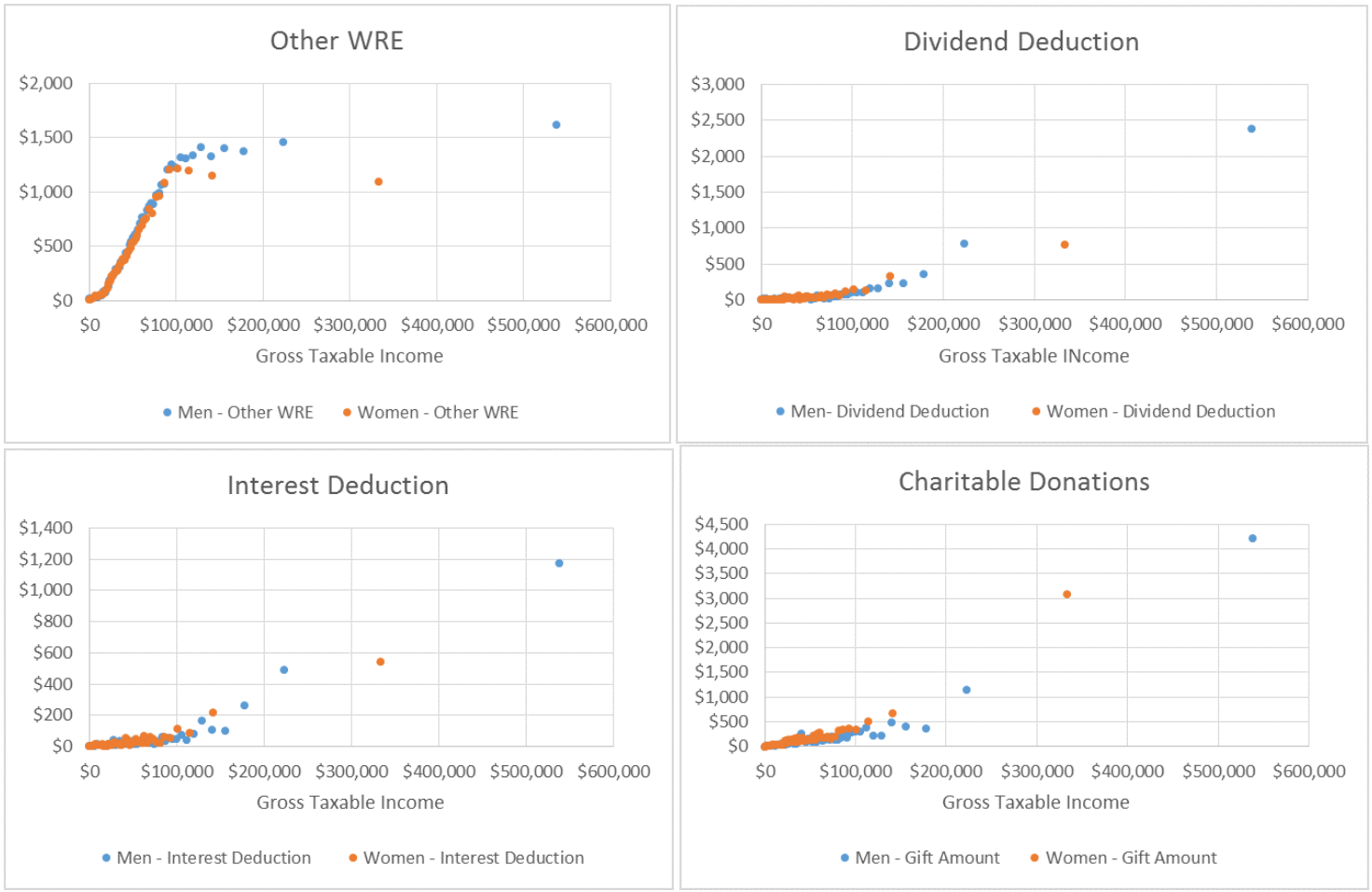


Figure 4.10: Binned scatterplots of each deduction, by gender (cont.)

Figure 4.11: Binned scatterplots of total deductions, by occupation

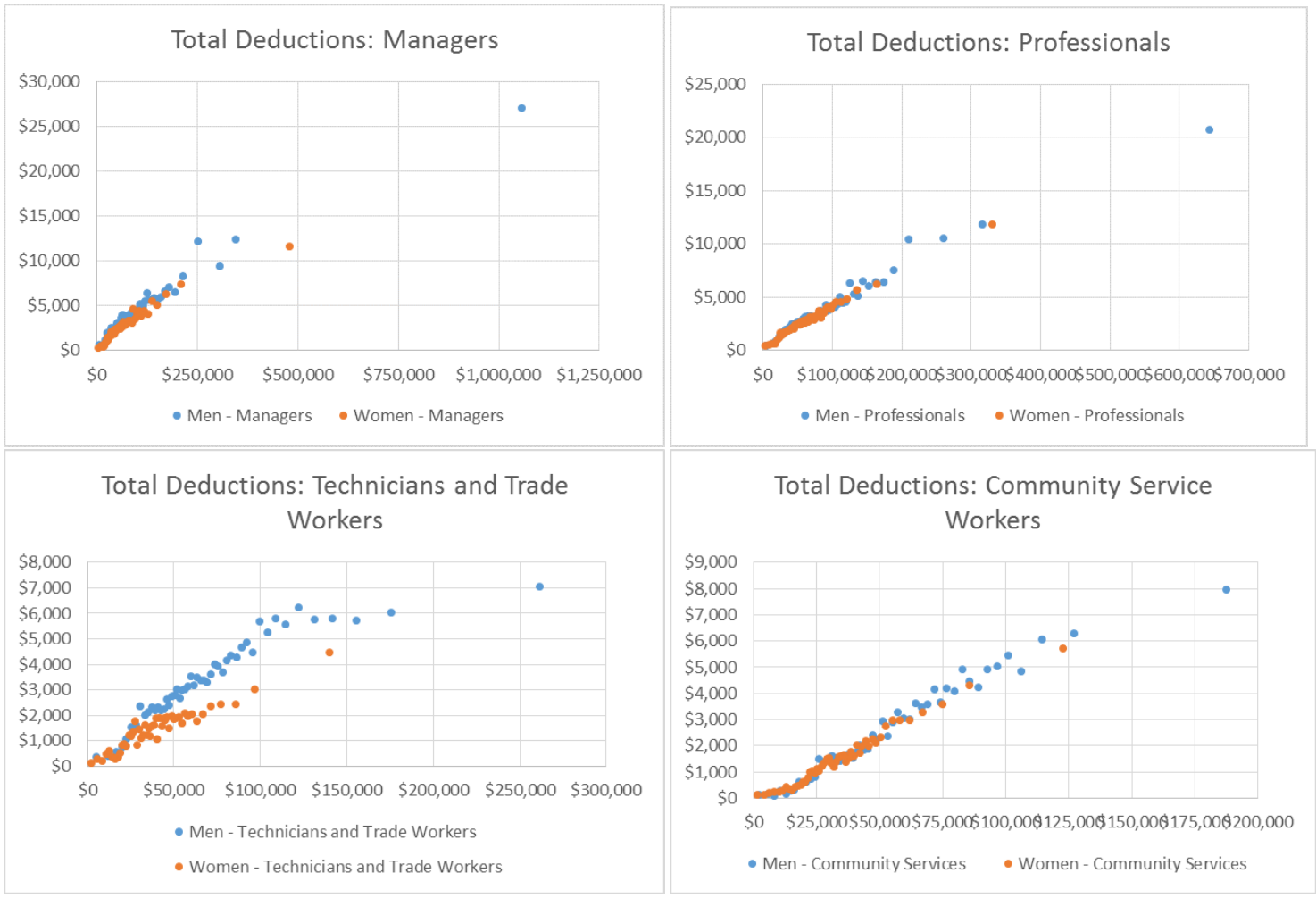


Figure 4.12: Binned scatterplots of total deductions, by occupation (cont.)

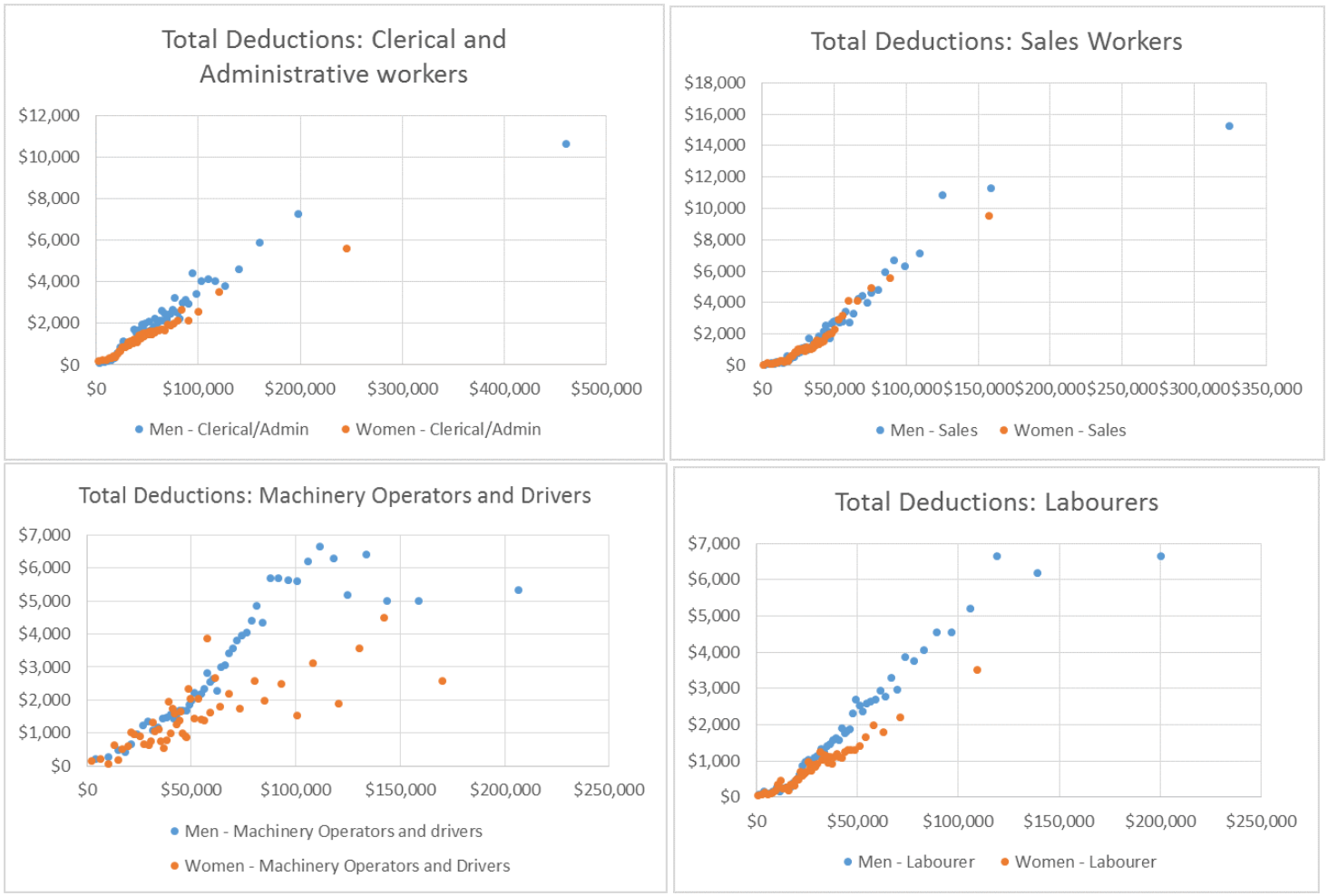
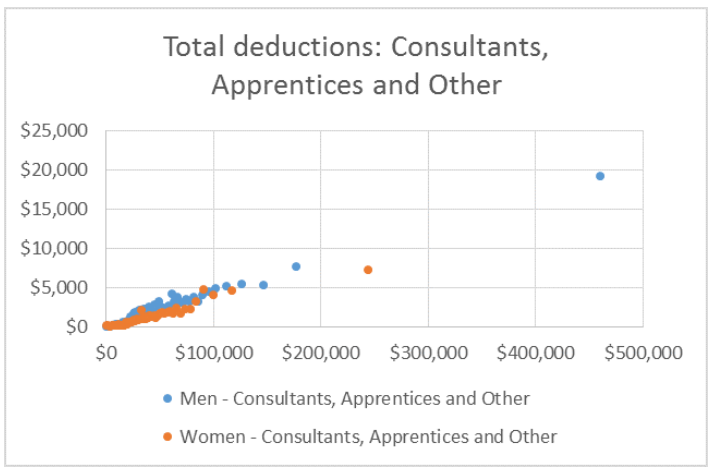
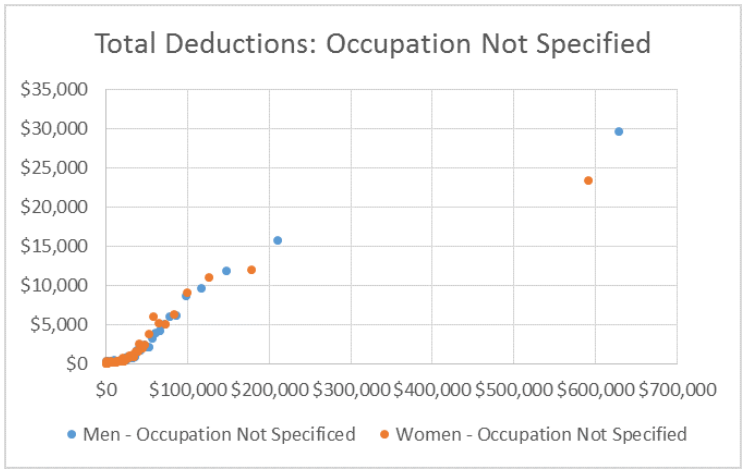


Figure 4.13: Binned scatterplots of total deductions, by occupation (cont.)





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