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The effects on excess burden of firm-size tax thresholds: the case of New South Wales payroll taxes

by

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Abstract: This paper considers the implications for excess burden from a tax in the presence of firm-size thresholds. Such thresholds can cause persistent distortions in firms' long-run input choices, which is not captured in standard CGE tax modelling. We address this problem for the case of payroll taxes in New South Wales where firms pay a tax on all wage bills above $0.75 million. This generates inter-industry distortions due to effective rates differing across industries and intra-industry distortions by inducing a downward bias in firm size. We estimate marginal and average excess burdens of the tax with a multiregional dynamic CGE model of the Australian economy, VURMTAX, which incorporates institutional features of a wide range of taxes levied by state/local and federal governments. Of particular importance here is that we explicitly model firm-size distributions for each Australian state and territory. The interaction between threshold-induced firm-size distortions and rate-induced payroll tax deadweight losses leads to simulation results that contradict some standard ideas. First, the marginal excess burden of an increase in the payroll tax rate is smaller than the corresponding average excess burden. Second, the marginal excess burden of a reduction in the payroll tax threshold (holding the tax rate fixed) is lower than that of an equivalent increase in the payroll tax rate at the existing threshold. Third, eliminating the threshold entirely recovers the deadweight losses associated with firm-size distortions, yielding an improvement in national welfare and implying a negative national average excess burden associated with the NSW payroll tax threshold. Central to these results is the observation that marginal changes in the threshold have little effect on effective tax rates and associated intra-industry, firm-size distortions, whereas complete removal of the threshold eliminates the associated intra-industry distortion altogether.

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1 Introduction

A common way to compare the efficiency of taxes is via their marginal excess burdens. A complicating issue in assessing the excess-burden effects of certain business taxes is the presence of firm-size tax thresholds. These thresholds are often accommodated by analysing effective tax rates that adjust for threshold effects. This approach is sufficient where the threshold does not generate persistent distortions in firms' long-run input choices. In this paper, we examine the implications of this condition failing to hold, and the resulting consequences for measuring the excess burden of taxation.

In this paper, we focus on Australian payroll taxes, which are levied and collected by state and territory governments. Our analysis centres on payroll tax in New South Wales (NSW). While payroll taxes may be a relatively minor revenue source in many countries, they are significant in Australia, accounting for around one-fifth of own-source revenue for most states.[1] Moreover, the insights arising from our analysis of firm-size thresholds in payroll taxation are relevant to other taxes—including capital taxes—that incorporate similar threshold structures.

In our database year, no payroll tax was payable in NSW until a firm's annual wage bill exceeded $0.75 million, after which a tax rate of 5.45 per cent applied to all wages above the threshold. This structure gives rise to two distinct distortions in Australia's payroll tax system (Murphy, 1999; Dixon *et al.*, 2004). First, the NSW threshold generates variation in effective payroll tax rates across firms, depending on their industry-specific firm size distribution and wage bill, distorting the allocation of resources across industries. Second, the threshold induces a downward bias in firm size in NSW; average costs rise in turn, leading to inefficient resource use within industries.

The inter-industry distortion associated with differential effective tax rates is routinely captured in conventional excess-burden analyses. This is the key distortion to allocative efficiency captured by CGE analyses. However, the intra-industry distortion arising from biased firm-size distributions is not ordinarily captured by CGE models. In this paper, we quantify both distortions and evaluate their combined effects on excess burden using VURMTAX, a dynamic multiregional CGE model of the Australian economy. VURMTAX incorporates the institutional features of a wide range of taxes levied by state/local and federal governments in Australia, allowing the excess-burden effects of individual taxes to be assessed within the context of the broader tax system. A brief description of relevant features of VURMTAX is provided in Section 2.

To capture the intra-industry inefficiency generated by the NSW payroll tax threshold, we explicitly model firm-size distributions for each Australian state and territory following Dixon *et al.* (2004). The analysis begins with a zero-threshold counterfactual, characterised by a smooth distribution of firm sizes within each industry. We then simulate the effects of alternative threshold settings on firm-size distributions and the resulting shifts in industry cost curves. A key insight from Murphy (1999) and Dixon *et al.* (2004) is that thresholds affect not

[1] For instance, payroll taxes are responsible for only 0.052 per cent of total tax revenue in the United States, but for Australia the corresponding percentage is 6.222 (PwC, 2021). Other countries which raise significant payroll taxes are Austria (around 9 per cent) and France and Israel (about 5 per cent each). Sweden is an outlier with payroll taxes accounting for about 16.7 per cent of its total tax revenue (PwC, 2021, Figure 1.2).

only firms close to the cut-off but also firms with wage bills up to around one and a half times the threshold, through their impact on industry cost structures.

The firm-size module is run in conjunction with VURMTAX using GEMPACK. Excess burden is measured as the ratio of the change in real welfare - defined as leisure-adjusted gross national income at the national level - to the change in real government lump-sum transfers to households, which are endogenously determined to maintain government budget balance. See Section 2.2 for details.

This framework leads us to revise several established conclusions regarding the excess burden of payroll taxation. In particular, we identify three key results arising from the interaction between threshold-induced firm-size distortions and rate-induced payroll tax deadweight losses. First, contrary to standard findings, the marginal excess burden of an increase in the payroll tax rate is smaller than the corresponding average excess burden. Second, the marginal excess burden of a reduction in the payroll tax threshold (holding the tax rate fixed) is lower than that of an equivalent increase in the payroll tax rate at the existing threshold. Third, eliminating the threshold entirely recovers the deadweight losses associated with firm-size distortions, yielding an improvement in national welfare and implying a negative national average excess burden associated with the NSW payroll tax threshold.

Central to these results is the observation that marginal changes in the threshold have little effect on effective tax rates and associated intra-industry, firm-size distortions, whereas complete removal of the threshold eliminates the associated intra-industry distortion altogether. We conclude that accurate modelling of threshold-induced intra-industry effects is crucial for excess-burden assessment, particularly in settings characterised by monopolistic competition and steep firm-level cost curves.

2 Model and methodology

2.1 Multiregional fiscal modelling

The CGE model we employ here is bottom-up multi-regional dynamic model of Australia's states and territories, called VURMTAX. The general framework underlying VURMTAX is similar to the Monash multi-regional forecasting (MMRF) model and its successor VURM; see Adams *et al.* (2015). A state/local government agent therefore operates within each region, with an overarching federal government agent operating across all state and territories.

VURMTAX differs from MMRF/VURM in several ways to capture the institutional features of Australia's tax system for three levels of government. Examples of the modifications are: the inclusion of new theory to model the interaction between Australia's corporate and personal tax system via full dividend imputation; and a modification the standard Klein-Rubin utility function that governs the consumption choices facing region-specific representative households to take account of important distortions in consumer choice caused by Australia's tax system. Details of these and the various other modifications we make to treat the Australian tax system can be found in Nassios *et al.* (2019a).

For this paper we employ a two-region (NSW and Rest of Australia) 76-industry version of VURMTAX. Most industries produce a single commodity, but 6 industries produce multiple commodities to facilitate modelling certain taxes (e.g. both the Low-density dwellings and

High-density dwellings industries produce Owner-occupied and Rental variants of their dwellings services output to facilitate the modelling of various property/conveyancing taxes). See Section 3 of Nassios *et al*. (2019a) for details of the commodity structure.

In this section, we provide a brief description of the overall structure of VURMTAX. Investment in each regional industry is assumed to be positively related to expected rates of return on capital in each regional industry. VURMTAX recognises two investor classes: local investors (i.e. domestic households and government) and foreign investors. Effective tax rates on each investor class differ, with foreign investors not liable to pay Australian personal income tax on their capital income, while they are also unable to claim back Australian franking credits. Capital creators assemble, in a cost-minimizing manner, units of industry-specific capital for each regional industry. Each region has a single representative household and a state government. The federal government operates in each region. The foreign sector is described by export demand curves for the products of each region, and by supply curves for international imports to each region. Supply and demand for each regionally produced commodity is the outcome of optimising behaviour. Regional industries are assumed to use intermediate inputs, labour, capital and land in a cost-minimising way, while operating in competitive markets. Region-specific representative households purchase utility-maximising bundles of goods, subject to given prices and disposable income. Regions are linked via interregional trade, interregional migration and capital movements, and governments operate within a fiscal federal framework.

VURMTAX provides results for economic variables on a year-on-year basis. The results for a particular year are used to update the database for the commencement of the next year. More specifically, the model contains a series of equations that connect capital stocks to past-year capital stocks and net investment. Similarly, debt is linked to past and present borrowing/saving, and the regional population is related to natural growth and international and interstate migration. The model is solved with the GEMPACK economic modelling software (Harrison and Pearson, 1996).

Readers interested in the values of key elasticities incorporated in the version of VURMTAX used here, see Section 3.3 of Nassios *et al*. (2019a).

2.1.1 Modelling long-run region-specific labour

VURMTAX does not explicitly model a consumption/leisure trade-off. Instead, we allow regional participation rates to respond to movements in regional real consumer wages. Households therefore face a labour/leisure trade-off, which we account for when calculating the welfare impacts of changes in regional or national taxes. Workers in each region increase their labour supply in response to deviations (in per cent) of region-specific post-tax real consumer wage rates from their baseline forecast, $rwage\_ct_q$, where region $q \in$ REG spans the set of VURMTAX regions, i.e., NSW and RoA, as outlined by equation (1):

$$l\_s_q - wpop_q = \gamma \cdot rwage\_ct_q. \qquad (1)$$

In equation (1), l_s_q is the deviation (in per cent) of region-specific labour supply from its baseline forecast, while $wpop_q$ is deviation (in per cent) of the region-specific working age population from its baseline forecast. The left-hand-side of equation (1) is thus the deviation in the workforce participation rate (in per cent) from its baseline forecast. In VURMTAX, we set the labour supply elasticity γ = 0.15 in equation (1) for all regions. The motivation for this choice is discussed in Section 3.3.3 of Nassios *et al*. (2019a).

A lagged-interregional-migration module, developed and documented by Giesecke and Madden (2013), has also been incorporated in VURMTAX. Under the standard closure, workers across regions migrate depending on differences in cross-regional real (CPI-deflated) consumer wages.

VURMTAX thus provides two avenues for an expansion in the long-run region-specific labour supply:

(1) via increases in region-specific participation rates, i.e., the region-specific ratio of labour supply to the working age population increases relative to the baseline forecast, according to equation (1); and

(2) via inter-regional migration, which increases the region-specific working age population and thus labour supply at the expense of labour supply in other regions.

In the short-run, changes in tax rates may also cause changes in the unemployment rate, which impacts employment but not labour supply. In VURMTAX, households are assumed to derive no value for additional leisure hours caused by involuntary unemployment.

The labour supply theory described here introduces a labour/leisure trade-off in VURMTAX. In order to calculate the region-specific welfare impact of changes in region-specific tax policy, we must value any additional (foregone) leisure time. Herein, we value any additional labour supplied at the marginal (post-tax) value of labour in the baseline forecast, i.e., at the base-period real consumer wage. If the marginal value of leisure were higher than this, then workers would have supplied less labour under the baseline. Under this framework, the value of leisure in A\$m. consumed in region q in year t of our simulation is therefore equal to:

$$VLEIS_{q,t} = RWAGE_{q,t}^{c,B} \cdot WPOP_{q,t}. \left[1 - PRT_{q,t}\right], \qquad (2)$$

where superscript "B" denotes a variable that takes its baseline value in both the baseline and policy simulations, $RWAGE^{c,B}{}_{q,t}$ is the baseline value of the real consumer (superscript c) wage in region q at time t, $WPOP_{q,t}$ is region q's working population at time t, and $PRT_{q,t}$ is region q's participation rate at time t. When the participation rate in region q increases in a policy simulation, i.e., $PRT_{q,t} > 0$, this materialises via an expansion in region-specific labour supply relative to the region-specific working population. From equation (2), this reduces the value of leisure derived by households, because some leisure time has been forsaken to increase labour supply in response to the new (higher) counterfactual simulation real post-tax consumer wage. At the national level, we compute the value of changes in leisure time by summing equation (2) over all $q \in REG$.

2.1.2 Endogenous determination of the national savings rate

Implicit within our framework is a sticky adjustment mechanism for the national savings rate. This mechanism is active throughout a counterfactual simulation and is calibrated to ensure stabilisation in the deviation of the net foreign debt to national income ratio from its baseline forecast level. In the case of the public sector, we assume that its propensity to contribute to national foreign liability accumulation is largely constrained by the assumption that state and federal public sector borrowing requirements do not deviate from baseline. Hence, in VURMTAX the private sector adjusts its consumption behaviour endogenously to ensure that the economy-wide ratio of foreign liabilities to GNI stabilises around 15 to 20 years after the shock-year.[2]

2.1.3 Closure

In solving VURMTAX, we undertake two parallel model runs: a baseline simulation and a policy simulation. The baseline simulation is a business-as-usual forecast for 2017-40. The policy simulation is identical to the baseline simulation in all respects, other than the addition of shocks describing the tax policy under investigation. We report results as percentage (and in some cases, A$m) deviations in the values of variables in each year of the policy simulation, away from their baseline values.[3] The simulations are undertaken under the following model closure:

(1) Regional labour markets characterised by short-run real wage stickiness with endogenous regional unemployment rates, transitioning to a long-run environment of regional wage flexibility with exogenous regional unemployment rates;
(2) Rates of inter-regional migration are sticky in the short-run, but adjust gradually in response to movements in inter-regional relativities in real post-tax per-capita income to ensure that such income relativities are gradually returned to baseline values;
(3) Regional participation rates adjust to deviations in region-specific real consumer wages, as previously discussed in section 2.1.1.;
(4) National private consumption spending is the sum across regions of regional private consumption. Within each region, private consumption spending is a given proportion of regional disposable income. Regional average propensities to consume are endogenously adjusted by a uniform percentage across all regions, to ensure that the ratio of net foreign liabilities to GDP stabilizes over a seven-to-ten-year time period following any given policy shock;
(5) For public consumption spending undertaken by state and local government, we assume a constant ratio of real regional government public consumption spending to real regional private consumption spending. For federal consumption spending within each region, we assume a constant ratio of region-specific federal public consumption spending to national private consumption; and
(6) Net operating balances of regional governments and the federal government are held at baseline values via endogenous adjustment of lump sum payments to households.

2.2 Calculating excess burden

The term "excess burden" was coined by Harberger (1962) to describe the impact (in totality) of US corporate tax on US national income. Because VURMTAX is dynamic, it is capable of calculating year-on-year excess burden measures using a similar principle. Here, we use the approach adopted by Nassios *et al.* (2019b) in their study land tax in Australia. More

[2] Note, this mechanism does not alter the economy's capacity to reach the new optimal capital stock following a tax policy shock. Instead, our sticky savings rate mechanism alters the degree to which the investment required to achieve this optimal capital stock is financed by domestic or foreign savings.

[3] See Dixon and Rimmer (2002) for a thorough review of the construction of baseline and policy simulations with a detailed CGE model.

specifically, the efficiency loss caused by a tax policy package in time-period t at the national (Australia-wide) level, $\mathrm{EB}^{t}_{\mathrm{Nat}}$, is evaluated according to:

$$EB^{t}_{Nat} = -100\left[\frac{\Delta GNI^{t} + \sum_{q}\Delta VLEIS^{t}_{q}}{\sum_{g}\Delta LST^{t}_{g}}\right], \tag{3}$$

where ΔGNI^{t} is the deviation in real gross national income (GNI) in year t expressed as the difference between the policy simulation and baseline simulation values for GNI in year t; $\Delta VLEIS^{t}_{q}$ is the deviation in the value of leisure in region q at time t calculated using equation (2); and ΔLST^{t}_{g} is the deviation in revenue-neutral lump sum transfer by government g in year t. Equation (3) is a measure of the change in real national income, adjusted for changes in the value of leisure, caused by a change to state or federal tax policy that results in a change in the government's capacity to make a budget-neutral transfer to Australian households of $\sum_{g}\Delta LST^{t}_{g}$.

By using the value of aggregate lump sum payments to households in the denominator (rather than, say, revenue raised from the tax in question), we take account of general equilibrium effects, including induced changes in: revenue raised from other tax basis, the price of government spending, and government benefit payments.

3 Modelling payroll tax

Payroll tax in Australia is levied and collected by the states and territories. Previous studies by Murphy (1999) and Dixon *et al.* (2004) identify two distorting aspects of Australia's payroll tax system:

(a) Different rates apply to firms depending on their location and the size of their payroll. Potentially this could distort the allocation of resources between industries and regions.

(b) In all States, payroll taxes apply with a threshold, e.g. in NSW no tax is payable until a firm has a payroll (or wage bill) of \$0.75 million. A threshold of this type causes two distortions:

   i. The tax base is reduced. Different firms and industries within a region therefore face different payroll tax rates, dependent upon the size of their wage bills;

   ii. It places a downward bias in the size of firms, especially those whose natural wage bill (wage bill in the absence of the threshold) is between 100 and 200 per cent of the threshold size. The downward bias in the size of firms causes an inefficient use of resources.

Our focus is exclusively on the payroll tax system in NSW. In what follows, we describe how the threshold system generates an efficiency loss using a partial equilibrium model of the NSW labour market, where firms are split into two pools: small companies (who pay no payroll tax), and large companies (who pay payroll tax). We use the findings of this analysis to motivate the development of the NSW payroll tax model, which is based on a model developed by Dixon *et al.* (2004) for Victoria. This model facilitates the development of a new baseline for VURMTAX. The new baseline endogenously accounts for dead weight losses caused by firm size resource usage inefficiencies in NSW caused by the NSW payroll tax threshold. This extends previous studies of payroll tax reform in Australia, which have focused exclusively on the first of two impacts of the payroll tax threshold summarised above, i.e., they have studied point (b) i. above but have disregarded (b) ii. We therefore elucidate how changes in the threshold-induced deadweight loss interact with changes in payroll tax deadweight losses caused by the presence of the tax. This allows us to examine how these two deadweight losses impact the excess burden of payroll tax in NSW, as well as the macroeconomic and industry impacts of this tax in an environment of unilateral reform in NSW.

3.1 A partial equilibrium assessment of the current NSW payroll tax system

In this section, we present a partial equilibrium model of the NSW labour market disaggregated into small business (payroll tax exempt due to the threshold) and large business (taxed at a fixed rate of their annual wage bill). This model is used to explore the effects of a payroll tax system with a threshold, relative to a no payroll tax base-case. Our depiction in Figure 1 initially assumes a flexible wage and aggregate full employment labour market in a long-run comparative static assessment. The key features of Figure 1 are:

- Labour demand for the exempt small businesses and taxed large businesses are represented by the downward sloping curves L_S and L_D. Both can be interpreted as the derived demand for the labour input, and also the marginal value product of labour. The downward slope reflects labour-for-capital (and other intermediate input) substitution, comparative advantages and importance of economies and diseconomies of scale, and in some cases product market effects. However, for the purposes of this discussion, we assume that small and large businesses produce the same output for the same product market, and the distinct labour demand curves portrayed in Figure 1 arise from lower labour productivity in small business relative to large business.
- For simplicity, Figure 1 ignores cross-wage by sector effects and assumes a high level of labour mobility at the margin across small and large businesses.
- The right-hand panel of Figure 1 depicts the aggregate labour market. The general consensus is that aggregate labour supply is relatively inelastic compared with aggregate labour demand [Dandie and Mercante (2007)]. Clearly, the disaggregated firm demand functions are more elastic than the aggregate labour demand.
- Before the introduction of a payroll tax with a threshold (or in our long-run base-case), the labour market clears at a wage W with aggregate employment of E, with E_S by small business and E_L by large business, i.e., $E = E_S + E_L$. In the absence of firm-size market failures, the base-case allocation of labour between small and large business is close to an efficient benchmark. The Reserve Bank of Australia (RBA) Conference on Small Business Conditions and Finance[4] highlighted the absence of any rationale to argue that on average small business is the key driver of employment and innovation; rather, there are anecdotal examples from both sectors.
- Under a payroll tax system with a threshold, the payroll tax rate on large business is assumed to be equal to T. The tax shifts the demand curve for labour by large business down to L_D – T, with no change on small business demand, and a smaller downward shift of the aggregate labour demand curve to L'_D.
- Partial equilibrium effects of the payroll tax on large businesses are:

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[4] See http://www.rba.gov.au/publications/confs/2015/ for a catalogue of conference proceedings.

- For the aggregate labour market, a drop of the market wage from W to W', with $W - W' < T$, and a relatively smaller drop in aggregate employment from E to E', because labour demand is more elastic than supply.
- With the lower wage, employment in the small business sector increases from E_S to E_S', and employment in the large business sector contracts from E_L to E_L'.
- Most of the employment adjustment is a reallocation from large to small business, with a (much) smaller change in aggregate employment.

Figure 1 facilitates a discussion of the efficiency impacts of such a payroll tax system.[5]

- The reallocation of labour from large to small businesses incurs efficiency losses of the triangles **a** arising from expanded production in small business and area **b** arising from foregone production in large business (treating the sector labour demand curves as the derived marginal benefit functions). These areas correspond to the higher costs of production of the Dixon *et al.* (2004) model. The efficiency cost of the distorted reallocation of labour from large to small business, $E_{L\text{-}to\text{-}S}$, can be approximated as the sum of the triangles **a** and **b** of Figure 1.

$$E_{L-to-S} = \frac{1}{2} T_p \Delta E, \qquad (4)$$

  where T_p is the payroll tax rate expressed as \$ per unit labour, and ΔE ($\approx E_S' - E_S$ and $E_L - E_L'$) is labour reallocated between sectors. Dividing both sides of (4) by the wage bill, W_E, gives the efficiency cost as a share of the wage bill, $e_{L\text{-}to\text{-}S}$,

$$e_{L-to-S} = \frac{1}{2} \frac{T_p}{W} \frac{\Delta E}{E}, \qquad (5)$$

  where, T_p / W is the payroll tax rate expressed as a proportion of the wage of large business, and $\Delta E / E$ is the proportion of employment reallocated from large to small business. Alternatively, one can use the elasticities of labour demand by small and large business to derive a value for ΔE in (4) or for $\Delta E / E$ in (5).

- Since the pattern of firm sizes (and thus the aggregate average cost per unit of industry output) varies by industry, a narrow base payroll tax will cause some distortions to relative industry output prices and thus to the mix of industry products produced and consumed. These efficiency losses require a CGE assessment.
- As shown in the right-hand panel of Figure 1 for aggregate employment, payroll tax as an addition to the tax wedge between employer labour cost and the effective purchasing power of the employee distorts the aggregate labour market with an efficiency cost of a loss of economic surplus represented by area **c**.

[5] Figure 1 assumes no additional distortions exist in the aggregate labour market, which is of course a simplification. In reality, payroll tax is an additional distortion, which compounds the impacts of national taxes such as the GST and personal income tax, together with the indirect impacts of capital taxes which reduce investment, the capital stock and thus the aggregate labour demand curve.

3.2 Reflecting key insights from the partial equilibrium assessment in a CGE model: The NSW payroll tax model

Accurately reflecting the efficiency costs of the payroll tax system identified in our partial equilibrium assessment within VURMTAX was a two-stage process. Firstly, VURMTAX was updated to reflect 2015-16 NSW payroll tax collection figures ($7.975 b[6]), on both an aggregate and by-industry basis. This process is informed by registered company count data reported by the ABS.[7] Secondly, we develop a model that is run in parallel with VURMTAX to establish baseline estimates of the deadweight loss caused by NSW's prevailing payroll tax threshold (A$0.75m). A model suited to such a task was previously developed for Victoria by Dixon *et al.* (2004). This model reflects two key findings of our partial equilibrium assessment in Section 3.1:

1. Dixon *et al.* (2004) explicitly model the impact of the payroll tax threshold on firm costs. Adjustments in this alters the shape of firm cost curves, which in turn drives a reallocation of employment across firms of different size.
2. The efficiency costs of distorted reallocation of labour from large-to-small business (defined previously as the sum of triangles **a** and **b** or $E_{L\text{-}to\text{-}S}$) is also modelled. Because the average cost curve in Dixon *et al.* (2004) is downward sloping with firm output, the re-allocation of labour from large-to-small firms causes an increase in average costs of production.

To study the NSW payroll tax system in VURMTAX, we developed a similar model to the one constructed by Dixon *et al.* (2004) for Victoria, and parameterise it with NSW data.[8] This model is referred to herein as the NSW payroll tax model, and relies on data from the following sources:

- Company size data from ABS cat. no. 8165.0;
- Industry-specific employment data by company size from ABS cat. no. 8155.0;
- Average wage rates inferred from ABS cat. no. 6306.0.

3.2.1 Methodology

This section applies the theory from Dixon *et al.* (2004) to NSW. We conduct a series of computations, each stating from an initial situation where NSW is applying a 3.32 per cent payroll tax rate with a zero threshold and is collecting A$7 975m in payroll tax revenue (equal to the level of payroll tax revenue collected in 2015/16 based on ABS Cat. No. 5506.0). While the counterfactual zero-threshold situation is not the most natural starting point for computations, it is preferred because, as described by Dixon *et al.* (2004), we do not have detailed data on the existing distribution by firm size. We adopt a similar assumption to Dixon *et al.* (2004) and assume the zero-threshold employment distribution across firms is relatively smooth. This yields the employment distribution in Figure 2.[9] We allow for 104 different firm sizes in our discretisation of the NSW employment distribution, which is truncated for

[6] ABS Catalogue Number 5506.0 Taxation Revenue, Australia, 2015-16

[7] ABS Catalogue Number 8165.0 Counts of Australian Businesses, including Entries and Exits, June 2012 to June 2016

[8] For a summary of the theory underlying the model by Dixon *et al.* (2004), we refer the reader to Appendix 4.1.

[9] For a detailed discussion of the effects of a payroll tax threshold on the distribution of employment by firm size, see Dixon *et al.* (2004).

convenience in Figure 2 at a firm size of 48.75 employees. For each of the 104 firms we account for, we use the theory in NSW payroll tax model to study how the size of the firm adjusts to changes in the NSW payroll tax threshold.

The NSW payroll tax model is calibrated so as to allow a user to impose one of two assumptions regarding the nature of firms in NSW: (1) that firms are perfectly competitive, with prices equal to marginal costs; or (2) that firms are monopolistically competitive and face highly elastic (but not infinitely elastic) firm-specific output demand curves. In Table 1, we report the results of a policy simulation in which we increase the threshold from zero to A$750,000. The deadweight loss or efficiency impact of under our preferred assumption of monopolistically competitive firms is shaded in green in Table 1. The other results are briefly summarised below[10]:

1. Deadweight losses (DWLs) due to firm size biases are 0.37% of the wage bill and 11% of total collections. Because firms operate on relatively steep sections of their average cost curves under monopolistic competition, the associated dead weight losses due to the payroll tax threshold are much larger than would be the case if we assumed firms to be perfectly competitive (Dixon *et al*., 2004);
2. The wage bill in NSW is largely invariant to the change in the threshold, which is clear when comparing the entries in columns (1) and (2) of row 5 in Table 1.

3.3.2 Incorporating firm-size deadweight loss estimates into VURMTAX

We translated the firm size DWLs calculated from the NSW payroll tax model into primary factor productivity shocks in VURMTAX. To distribute the aggregate (state-wide) figure for NSW reported in Table 1 ($879.28m) across ANZSIC level 1 industries in NSW, we use the process described in Appendix 4.3 of Nassios (2019a). Finally, using a concordance between the ANSZIC level 1 industries and the 76 industries in VURMTAX, we attribute the aggregate DWL from the NSW payroll tax model across all 76 industries in VURMTAX.

The industry-specific DWLs are then delivered as primary factor productivity shocks. Changes in payroll tax rates and thresholds in the policy simulation, then lead to further productivity shocks, that either compound (when rates are raised) or reduce (when thresholds or rates are reduced) the existing baseline payroll tax threshold DWLs.

4 Simulations and Results

4.1 Overview

Using the excess burden formulae in Section 2.2, we calculate the excess burdens for NSW payroll taxes. Our results are summarised in Table 2.

We report two marginal excess burdens (MEBs), derived from the following two experiments:

1. In row (a) of Table 2, the MEB is derived from a VURMTAX simulation where we raise the NSW payroll tax rate. This rise (8 basis points, from 5.45 per cent to 5.53 per cent) is calibrated to raise an additional A$100m in payroll tax revenue for NSW. The DWL due to the A$750,000 threshold is also adjusted under this simulation, because a rise in the payroll tax rate also raises the DWL due to the threshold by 0.34 per cent (by A$3m, from

[10] For a more detailed discussion of the assumptions underlying the NSW payroll tax model and a sensitivity analysis of our firm size bias DWL estimates, we refer the reader to Appendix 4.2 of Nassios *et al.* (2019a).

A$879m to A$882m). This rise is calculated using the NSW payroll tax model and imposed as a second shock in our simulation;

2. In row (b) the MEB relates to a reduction in the value of the NSW payroll tax threshold (from A$0.75m to A$0.701m), which is calibrated to raise A$100m in additional payroll tax revenue in NSW. This reduces the DWL due to the threshold by 1.54 per cent (by A$13m, from A$879m to A$866m), but also raises the effective payroll tax rate (total collections relative to the aggregate state wage bill) because more firms in each industry are liable to pay payroll tax. Nevertheless, the legislated payroll tax rate for firms with wage bills above the threshold is held constant at 5.45%.

We also report two average excess burdens (AEBs) derived from the following two simulations:

3. The AEB reported in the second column of row (a) relates to a reduction of 95% in NSW payroll tax collections, which is achieved by endogenous determination of the payroll tax rate in NSW. The DWL due to the threshold (the level of which remains unaltered) is also eliminated under this scenario;
4. The AEB in row (b) reflecs the elimination of the payroll tax threshold in NSW. The actual payroll tax rate (5.45 per cent in NSW) is exogenous and unchanged in this simulation; all industries are now, however, required to pay this rate of payroll tax on their wage bill.

4.2 MEB: Rate versus threshold adjustment

As can be seen from Table 2, the MEB of raising additional NSW payroll tax revenue differs depending on whether the mechanism is: (i) a rise in the legislated tax rate of 5.45, under an exogenous threshold [experiment (1) above], or (ii) a reduction in the threshold from A$0.75m, at an exogenous legislated payroll tax rate [experiment (2) above]. We find that the threshold reduction causes less economic damage (a welfare loss of 3 cents for each dollar of net revenue) than a rise in the tax rate at the current threshold (22 cents of foregone leisure-adjusted GNI). This is because each experiment causes a roughly equivalent change in the effective payroll tax rate in NSW, i.e., the change in payroll tax collections relative to the state-wide wage bill is very similar in each experiment. However, the legislated rate rise causes a small rise in resource misallocation due to the threshold. This increases the threshold-induced DWL by A$2.9m. In contrast, a threshold reduction reduces the resource misallocation DWL by A$13.5m. In the threshold reduction experiment, this materialises as a relative productivity gain, mitigating the impact of the effective payroll tax rate rise.

4.3 Marginal versus average excess burdens: payroll tax adjustment

Comparing the MEB and AEB for row (a) of Table 2, we see that the AEB (35 cents per dollar of revenue) exceeds the MEB (22 cents per dollar). This result seems counterintuitive when considered in the context of previous studies of the excess burden of taxation (e.g., Harberger, 1962), which show that the DWL due to an ad valorem tax levied at rate T is proportional to the square of the tax rate at leading-order, i.e., T^2. The average excess burden should therefore always lie below the marginal excess burden of a tax.

It will be recalled, however, that the payroll tax systems in NSW and other Australian states and territories cause two economic distortions:

(1) As described by Harberger (1962), taxes causes distortions. A rise in the payroll tax rate drives a wedge between the real wage as seen by NSW consumers, and the real effective wage as viewed by the employer. With the real producer wage rising (a rise in payroll taxes, ceteris paribus, raise the cost of labour to firms relative to the price they receive for their output), output begins to contract in response to rising input costs. Employment in turn falls, and the real consumer wage therefore begins to fall.

(2) The imposition of a payroll tax system with a threshold introduces a second type of distortion: it generates a firm size bias, which acts in addition to the wedge between producer costs of labour and household labour earnings. Importantly, the DWL due to the threshold does not increase with the square of the tax rate. This is evident in experiment (1), as discussed in Section 4.1. With the NSW payroll tax threshold set at A$0.75m, if we impose a 1.5 per cent (8 basis point) change in the payroll tax rate, the threshold DWL rises by A$2.9m, or a much smaller 0.32 per cent.

It is clear from this example, and from Dixon *et al.* (2004), that the threshold firm size bias DWL is positively correlated to movements in the legislated payroll tax rate.

The reason why threshold firm size bias DWLs adjust slowly to changes in legislated tax rates is explained by Dixon *et al.* (2004). We provide a brief summary here with the aid of Figure 3. On the x-axis is a set of firm size buckets for NSW, while for each value of x, we plot on the y-axis the number of employees in firms whose size was between x and $1.5 * x$. Therefore, the y-axis value of approximately 175,000 on Figure 33 at $x = 12.5$ means that, in the absence of the threshold, firms in NSW that employed between 12.5 and 18.75 employees each, would have employed a total of approximately 175,000 people.

As observed by Dixon *et al.* (2004), while payroll tax thresholds cause increases in resource use per unit of output for firms, the firms that experience the most pronounced increases would have paid a wage bill (in the absence of the threshold) of anywhere from the threshold, up to approximately 1.5 times the size of the threshold. For NSW, this means the current threshold of A$0.75m causes a pronounced distortion in the resource use per unit output for firms whose wage bill would otherwise have been between approximately A$0.75m – A$1.125m. When firms are large relative to the threshold, the threshold is insignificant in the calculation of average costs and the determination of the minimum point on their average cost curve. From Figure 3, we observe that employment in firms with size greater than x but less than or equal to $1.5x$ is close to constant, as x goes from approximately 5 to 17. Given the average wage in NSW, this is consistent with a firm wage bill of between A$0.31m and A$1.09m. With the threshold in NSW set at $0.75m, small changes in the legislated payroll tax rate at the current threshold therefore impose resource misallocation over an approximately constant quantity of resources. Small threshold changes within this range therefore generate an approximately constant DWL.

Large adjustments in the legislated payroll tax rate, e.g., the kind imposed when remove the tax altogether, do however drive significant responses in the magnitude of the DWL caused by the threshold. Removing the payroll tax, as well as removing the wedge between producer cost of labour and labour income, also removes the firm size distortion. As such, when estimating the excess burden by examining a removal of payroll tax in NSW, the result exceeds the marginal results calculated using small changes in the payroll tax rate.

4.4 AEB for NSW payroll tax threshold adjustment

It can be seen from Table 2 that the AEB for the NSW payroll tax threshold is minus 17, implying an improvement in welfare accompanying a removal of the threshold. That is, when the threshold is removed, extra payroll tax revenue is generated, but there are two opposite effects on welfare. The increase in the effective payroll tax rate causes an inter-industry (and inter-regional) distortion, which acts to reduce welfare. However, this is more than offset by the elimination of the DWL associated with the intra-industry distortion generated by the threshold.

4.5 Macroeconomic impacts

In this section we study the macroeconomic effects of changes in the NSW payroll tax system. For brevity, we focus on two sets of results only: those from experiments (1) and (4) described in Section 3.1. The impact of a small rise in the payroll tax rate [experiment (1)] and a small reduction in the payroll tax threshold [experiment (2)] are similar; differences between the two arise due to the productivity improvement that accompanies a threshold reduction. With this in mind, we focus our discussion of marginal changes in either payroll tax rates or thresholds on the macroeconomic effects of experiment (1). Results for experiment (2) are summarised in Table 3. Rather than providing the full-time paths for all variables, i.e., the year-on-year deviations from baseline from 2019 – 2040, we provide macroeconomic results for one year only: 2040. All outputs are measured as deviations from the baseline forecast.

An interesting policy question is to explore the economic impact of abolishing the NSW payroll tax threshold. We therefore also discuss the macroeconomic impacts of experiment (4), where the removal of the payroll tax threshold drives strong productivity gains. These gains offset the impact of increases in the effective payroll tax rate at the national level, as evidenced by the negative average excess burden of the NSW payroll tax threshold [see Table 2(b)]. For brevity, we do not provide a detailed summary of the macroeconomic impacts for payroll tax removal [experiment (3)]. We do however report the results for readers in Table 4.

Tables 3 and 4 summarise both state- and national-outputs. Part (a) of each table focuses on NSW state-level results, while national results are provided in Parts (b) and (c).

We begin by studying the impact of a small rise in the payroll tax rate in NSW; see the results for experiment (1) in Table 3. Recall from Section 2.1.3 that our NSW labour market is characterised by short-run stickiness in the real consumer wage. In the first year of a rise in the payroll tax rate, the real effective wage as viewed by the employer [reported as the real producer wage in Table 3(a)] rises relative to the business-as-usual baseline forecast, causing a negative deviation in short-run employment. In VURMTAX, region-specific real consumer wage adjustment drives the region-specific unemployment rate back to its baseline forecast in the long-run. In the long-run, region-specific employment can deviate from baseline due to inter-regional migration or changes in region-specific participation rates. We observe such long-run employment deviations in NSW, in response to a small rise in the payroll tax rate in NSW [-0.026 per cent under experiment (1) in Table 3(a). We observe similar impacts due to threshold removal, albeit of larger magnitude [-0.818 under experiment (4) Table 4(a)]. In each experiment, lower long-run employment is largely due to the fall in the long-run NSW participation rate, which falls because the real consumer wage in NSW lies below baseline.

These (negative) long-run employment deviations are caused by two DWLs that interact when we increase the payroll tax rate, or remove the threshold. As discussed in section 4.1, a small rise in the payroll tax rate drives correspondingly small (+A$2.9m) increases in the threshold-induced DWL. This diminishes NSW productivity and reinforces the negative employment result caused by a rise in the effective payroll tax rate in NSW. In contrast, removing the threshold drives material productivity gains in NSW, which partly offset the negative impact of the higher effective tax rate.

In the absence of a change in the relative price of labour and capital, with employment lower in NSW in the long-run (row 4 of Table 3 and Table 4), we would expect a similar fall in the long-run NSW capital stock. However, we see that the fall in the NSW capital stock (row 2 of Tables 3 and 4) is slightly smaller than the fall in NSW employment. What accounts for this rise in the NSW capital / labour ratio? The rise in the effective payroll tax rate raises the producer price of labour relative to the producer price of capital. This rise in the cost of labour relative to capital induces NSW firms to substitute towards capital. At the level of the NSW macroeconomy, this is manifested as a rise in the NSW capital / labour ratio. With both the state capital stock and long-run employment below baseline, real GSP also falls relative to the baseline in each case, by 0.023 per cent and 0.464 per cent Table 3(a) and Table 4(a), respectively. A rise in the NSW payroll tax rate, and removal of the NSW payroll tax threshold, both drive real GSP below baseline.

Shifting from the income side of the state economy to the expenditure side, with long-run employment and capital stocks below baseline, so too is real private consumption. Because regional real public consumption is tied to real private consumption in our simulations (see Section 2.1.3), real public consumption also lies below baseline in each case. The most noticeable impact of effective rate adjustment is however the change in state exports. Because the effective payroll tax rate in NSW rises in both experiment (1) and (4), NSW production prices rise (0.026 per cent and 0.748 per cent in row 1 of Table 3(a) and Table 4(a), respectively), and so too does the terms of trade (by 0.002 per cent and 0.041 per cent in row 26 of Table 3(a) and Table 4(b) respectively). A rise in the payroll tax rate, and removal of payroll tax threshold, are therefore expected to negatively impact import-competing sectors such as manufacturing.

Because the productivity gain that results when the NSW payroll tax threshold is removed accrues to the domestic economy, at the national level both public and private consumption are elevated relative to baseline when the threshold is removed (see rows 15 and 16 for experiment (4) in Table 4(b)). This materializes in our excess burden analysis via a negative national average excess burden of payroll tax threshold removal in NSW. Finally, by comparing row 13 and row 30 in Tables 3 and 4, we see that the impact of payroll tax rate or threshold adjustment is more pronounced on NSW aggregate tax collections, than it is at the national level. For example, in experiment (1) [see Table 3] NSW tax collections increase by A$197m in 2040 when the payroll tax rate rises, while national collections rise by only A$87m. This is because payroll tax is largely a tax on labour; hence, an increase (decrease) in payroll tax collections in NSW drive countervailing movements in personal income tax collections at the federal level.

4.6 Industry impacts

Tables 5 and 6 show the effects of payroll-tax reform on output by ANZSIC level-1 industry. As in Tables 3 and 4:

- The columns titled experiment (1) and (2) give the impacts of a small rise in the payroll tax rate, and a small reduction in the payroll tax threshold, respectively;
- The columns titled experiment (3) and experiment (4) give the impacts of payroll tax removal and payroll tax threshold removal.

As in section 4.5, we focus on experiments (1) and (4) here. Interestingly, the relative impacts across industries differ whether we are increasing the rate under a fixed threshold [experiment (1)], or removing the threshold and keeping the legislated rate fixed [experiment (4)]. This is because some industries (such as Agriculture, forestry and fishing) comprise more firms whose wage bills lie below the threshold. Threshold removal sees these industries experience a large rise in their effective payroll tax rate, which reduces the wage rate they can offer workers significantly. For Agriculture, forestry and fishing, the effective payroll tax rate rises from 1.76 per cent to the statutory rate of 5.45 per cent. This increases production prices in these industries, driving long-run output below baseline by 1.29 per cent [row 1, experiment (4) in Table 6]. Under the current system of payroll taxes, Mining is taxed heavily (with an effective payroll tax rate of 4.93 per cent, respectively). The impact on Mining output of threshold removal (-0.79 per cent from row 2, experiment (4) in Table 6), is therefore muted relative to the impact on Agriculture, forestry and fishing. When the statutory payroll tax rate rises however (under a constant threshold), the pattern is reversed; in this case, the percentage change in the payroll tax rate faced by industries is uniform, and Mining [-0.07 per cent in experiment (1) of Table 5] is more heavily impacted than Agriculture, forestry and fishing [-0.03 per cent in experiment (1) of Table 5]. Other industries, such as Education and training, and Health care, are negatively impacted by the fall in state private consumption, despite being modelled as payroll tax exempt in VURMTAX.

5. Concluding remarks

In this paper we have uncovered the effects of the NSW payroll tax system and found excess burden results that contradict studies that focus only on inter-industry tax distortions, ignoring intra-industry distortions arising from tax thresholds. We began by studying the efficiency impact of that system using a partial equilibrium model. This partial equilibrium model was used to motivate the development of the NSW payroll tax model, which is based upon a model for Victoria by Dixon *et al.* (2004). We described how the NSW payroll tax model is used to model the dead weight losses caused by the current threshold (A$0.75m) in NSW, and how these dead weight loss figures are accommodated within the VURMTAX CGE model of Australia's states and territories. We then summarised two simulations that were conducted with VURMTAX, which were used to generate marginal and average excess burdens. The values of these economic damage indicators and welfare metrics are described, with particular attention to why average excess burden of payroll taxation in NSW can exceed the corresponding marginals. We concluded with a brief analysis of the long-run macroeconomic and NSW industry impacts.

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APPENDICES

Appendix 1. Payroll-tax thresholds and the size of firms: Theory

Dixon *et al.* (2004) explain in detail how a payroll tax threshold affects the shape of a firm's average cost curve and thereby affects the size of the firm. In this explanation they use diagrams similar to Figure 4 and Figure 5. AA′ in Figure 4 is a firm's average cost curve in the absence of a payroll tax. The imposition of a payroll tax without a threshold raises the average cost curve vertically to position BB′. In particular, the imposition of the payroll tax does not affect the output level corresponding to the low point on the firm's average cost curve.

Now assume that a threshold is introduced such that no payroll tax is charged on the wage bill that the firm incurs if its output is below $Q_{critical}$. In the figure, $Q_{critical}$ is a little under 40 per cent of output at efficient scale: That is, output at the low point of the AA′ or BB′ curves. We can trace out the average cost curve with the threshold in place by imagining that the firm pays payroll tax on its entire wagebill but gets a refund on payments made on the wagebill up to the threshold. Thus the average cost curve with the threshold in place follows AA′ up to $Q_{critical}$. After $Q_{critical}$, average costs are the same as on the BB′ curve minus the refund divided by output. That is

$$AC(H,T,Q) = AC(\mathbf{0},T,Q) - T*H/Q \qquad \text{for } Q > Q_{critical} \qquad \text{(A1)}$$

where H is the threshold wagebill (the wagebill at $Q_{critical}$), T is the rate of the payroll tax, Q is output and AC is average cost. Thus, AC(0,T,Q) is the average cost of output Q with a payroll tax at rate T and no threshold; that is AC(0,T,Q) is a point on the BB′ curve. AC(H,T,Q) is a point on the average cost curve with the threshold in place, curve AA″ in Figure 4. As Q gets larger, the AA″ curve gets closer and closer to the BB′ curve. At large values of Q the refund is insignificant.

From (A1) we see that

$$\frac{\partial AC(H,T,Q)}{\partial Q} = \frac{\partial AC(0,T,Q)}{\partial Q} + \frac{T*H}{Q^2} \qquad \text{for } Q > Q_{critical}\ . \qquad \text{(A2)}$$

At efficient scale, the minimum point on either the AA′ or BB′ curve $\partial AC(0,T,Q)/\partial Q = 0$. Thus, at efficient scale

$$\frac{\partial AC(H,T,Q)}{\partial Q} > 0 \qquad \text{if H and } T > 0\ . \qquad \text{(A3)}$$

Consequently, the imposition of the threshold changes the shape of the average cost curve so that its minimum point occurs to the left of efficient scale, at 90 per cent of efficient scale in Figure 4.

If we were dealing with a purely competitive industry, where firms operate at minimum average cost, then in Figure 4 the imposition of the threshold causes the firm to operate at 90 per cent of efficient scale. Hence the average cost of the resources that it uses rises from EF to CD. We calculate the deadweight loss of this movement away from efficient scale as (CD-EF) per unit of output by the firm. Figure 5 shows how a threshold biases firm size in a monopolistically competitive industry. In such an industry, firms operate at a point on their average cost curve where the ratio of marginal to average cost equals 1 plus the reciprocal of the elasticity of demand for their product. Thus, if firms perceive an elasticity of demand for their product of -5, they will operate at a point on their average cost curve where marginal cost is 80 per cent of average cost. As shown in Dixon *et al.* (2004), under reasonable assumptions concerning the shape of average cost curves, the introduction of a threshold reduces the output at which the ratio of marginal to average cost is equal to any given fraction. Thus, we conclude that the introduction of a threshold biases firm sizes down not only in competitive industries but also in monopolistically competitive industries. Again, dead-weight losses can be calculated by looking at the increase in average costs on the zero-tax curve, AA′.

Appendix 2. Payroll-tax thresholds and the size of firms: Results from the NSW Payroll Tax model

While our preferred assumption of firm structure in NSW is monopolistic competition, we simulated a wide range of threshold values assuming both perfect competition (Table 7) and monopolistic competition (Table 8). Key findings are summarised below:

1. Because firms operate on relatively steep sections of their average costs curves under monopolistic competition (see Figure 4 and Figure 5, the associated DWLs due to the payroll tax threshold are much larger than under perfect competition; and
2. The wage bill is largely invariant as the threshold is increased (see also Dixon *et al.*, 2004).

The sensitivity of our outputs under the assumption of monopolistically competitive firms was also tested, with the resulting DWLs compared in Table 9 at the current payroll tax threshold in NSW. As we move to the right across the columns of Table 9, we are operating on steeper and steeper sections of the firm average cost curves (because we are reducing the elasticity of demand for firm-specific outputs). Thus, the imposition of the threshold causes smaller reductions in output per firm (effect one) but greater DWLs per unit reduction in output (effect two). Initially the second effect (the extra damage per unit of output reduction) dominates and DWL rise, but eventually the first effect (less reduction in output per firm) dominates, and the DWL falls.[11]

Appendix 3. Payroll-tax rates and the distribution of threshold productivity losses across industries

Table 10 is Australian Bureau of Statistics cat. no. 8165.0 data for June 2016 on the number of businesses classified by number of employees and ANZSIC Level 1 industry in NSW. The table implies that in June 2016 there were 15 510 businesses in Agriculture, forestry and fishing that employ workers. Of these, 11 945 had between 1 and 4 employees, etc.

In Table 11 we have summarised ABS data (cat. no. 8155.0) for 2014-15 on number of workers classified by number of employees in employing business and by ANZSIC Level 1 industry. This data, however, is not reported by state or territory. To disaggregate the number of workers in NSW (as reported in Table 4.5 of Australian Bureau of Statistics cat. no. 6291.0, Total

[11] For brevity, we avoid a detailed description of why deadweight losses fall uniformly as we move from row 1(current model specification) to row 2 (alternative specification) and refer the reader to Dixon *et al.* (2004) for a detailed description of the model parameters. We simply summarise the effect by stating that it is due to effect one described herein dominating effect two.

employed persons in NSW at February 2015 by number of employees in employing business and by ANZSIC Level 1 industry, i.e., to derive a table similar to Table 11 for NSW, we followed the process summarised below:

1. We began by dividing each cell in Table 11 by aggregate employment to derive employment shares by number of employees in employing business and by ANZSIC Level 1 industry.
2. These national employment shares were then scaled using the company size data for NSW in Table 10. For example, ignoring companies with no employees in Australian Bureau of Statistics 8165.0, we found that a greater proportion of NSW private companies employ over 200 people (4.79 per cent) than the corresponding share for the rest of Australia (4.23 per cent). For each ANZSIC Level 1 industry, we constructed company size shares for NSW and the rest of Australia using this approach. We then multiplied the ratio of these shares, by the national employment shares. These modified shares were then normalised (to sum to one) and multiplied by the number of workers in NSW (Australian Bureau of Statistics cat. no. 6291.0, Total employed persons in NSW at February 2015), which yields Table 12.

We then used national average wage rate data classified by ANZSIC level 1 industry and by firm size from Australian Bureau of Statistics 8155.0 for 2014/15 (re-scaled by the NSW average annual wage rate from Australian Bureau of Statistics cat. no. 6302.0 from November 2016) to derive a wage bill matrix for NSW, which is reported in Table 13. From this wage bill data, we estimated payroll tax collections by industry for NSW by assuming a payroll tax rate of 5.45% of the wage bill and a threshold of A$0.75m. Our estimated payroll tax collections (A$7 573m) via this method lies within 5% of reported payroll tax revenue for NSW in 2015/16 (A$7 975m). Taking the ratio of our derived payroll tax collections to our derived wage bills, then yielded the effective annual payroll tax rates by industry for NSW also reported in Table 13. Finally, we used our calculated wage bills to attribute the DWL due to firm size biases caused by the payroll tax threshold (which are derived in the NSW payroll tax model) across the various ANZSIC level 1 industries that pay payroll tax. The final attributed DWL for the baseline forecast in VURMTAX (rate 5.45 per cent, threshold A$0.75m) is shown in the final column in Table 13.

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Tables and Figures

Figure 1: Partial equilibrium analysis of a payroll tax system with a threshold

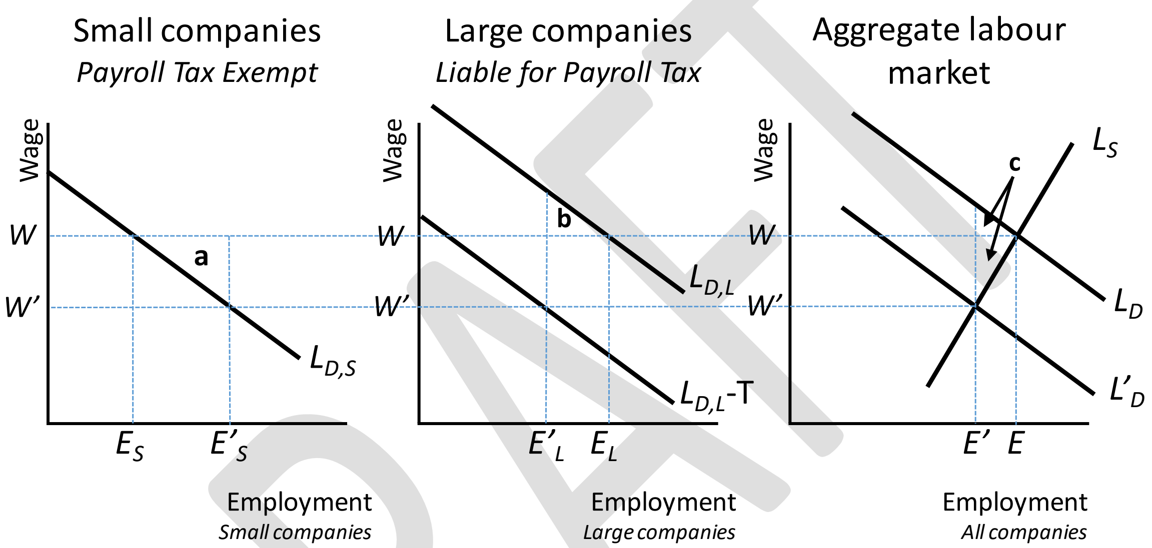
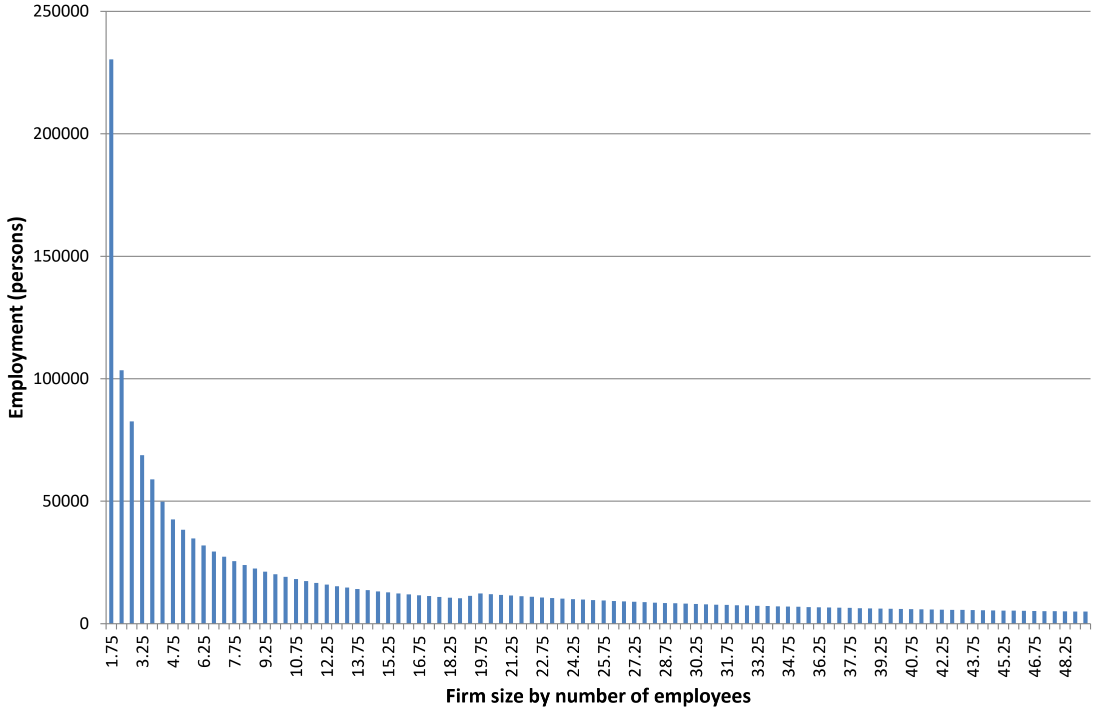


Figure 2: Employment by firm size in NSW



Notes: This is the base case distribution of NSW aggregate employment (in persons) by firm size, when we assume there exists no payroll tax threshold and the employment distribution is mostly smooth. The payroll tax rate in this case is uniform across firms and set equal to 3.32 per cent to match 2015/16 payroll tax collections in NSW.

Figure 3: Employment in firms in which the number of employees is greater than *x* but less than or equal to 1.5*x* (smoothed distribution)

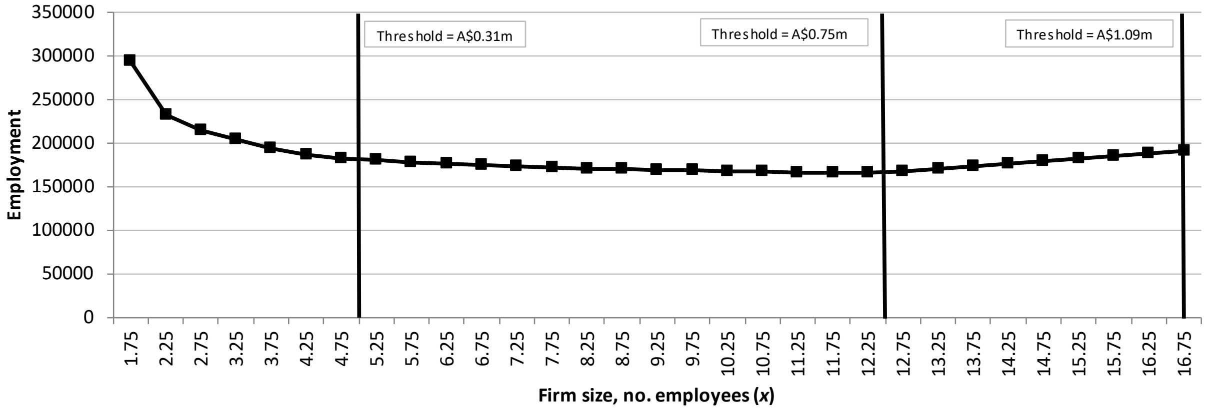
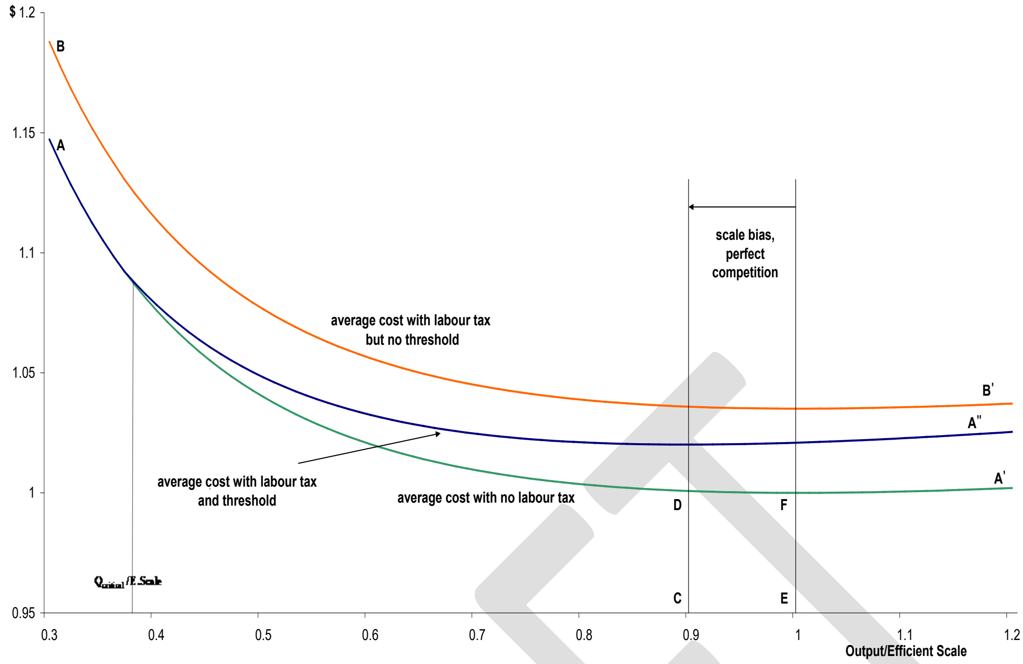
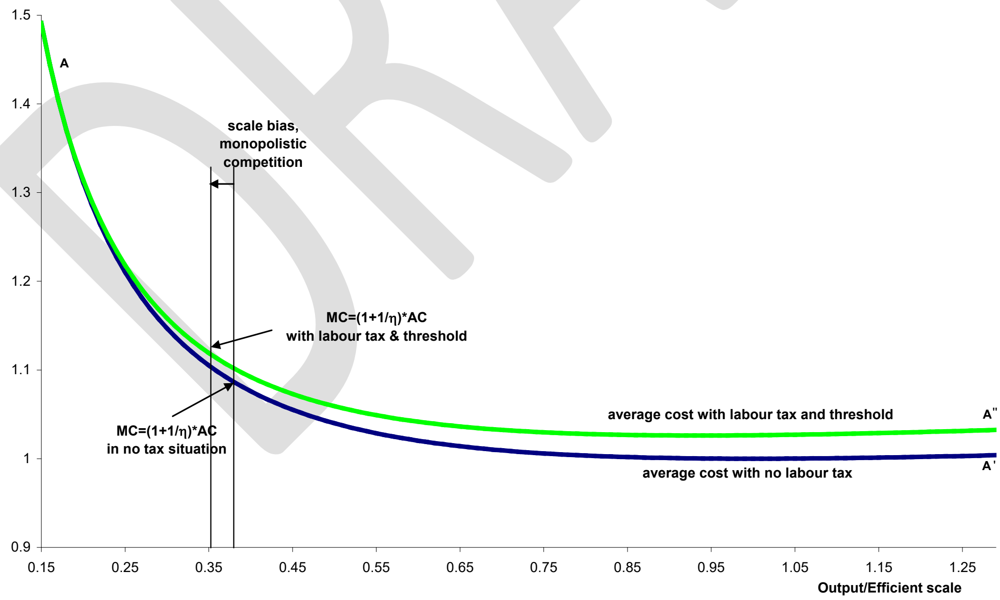


Figure 4: Average cost curves and scale bias under perfect competition



Notes: These curves are drawn for a firm facing a payroll tax of 5.45 per cent with a threshold that corresponds to about 40 per *cent of the firm's employment in a situation of zero tax. The curves incorporate the assumption that average costs in the no-tax situation are 4 per cent higher at 50 per cent of efficient scale than they are at efficient scale.*

Figure 5: Average cost curves and scale bias under monopolistic competition



Notes: In drawing this diagram we set η at –5, that is MC/AC = 0.8. The curves are drawn for a firm facing a payroll tax of 5.45 per cent with a threshold that corresponds to 60 per cent of the firm's employment in a situation of zero tax. The curves incorporate the assumption that average costs in the no-tax situation are 4 per cent higher at 50 per cent of efficient scale than they are at efficient scale.

Table 1: Outputs from the NSW payroll tax model

		Base case (1)	Current NSW system (2)
1	Threshold ($m)	0	0.75
2	Payroll collections ($m)	7,975	7,975
3	Tax rate (per cent)	3.32	5.46
4	Deadweight loss (DWL, $m)	0	879.28
5	Wage bill ($m)	240,020	239,498
6	DWL / collections (per cent)	0	11.02
7	DWL / wage bill (per cent)	0	0.37
8	Employment (persons)	3,672,927	3,664,949

Notes: In column (1), we summarise the zero-threshold base case NSW payroll tax model inputs, and compare these to the situation under a threshold of A$750,000, under our preferred assumption of monopolistically competitive firms.

Table 2: Marginal and average excess burdens for NSW payroll tax reform, measured in cents per dollar of net revenue raised.

	Column [1] Marginal	**Column [2]** Average
(a) Due to adjustment in the NSW payroll tax rate		
Excess burden	22	35
(b) Due to adjustment in the NSW payroll tax threshold		
Excess burden	3	-17

Table 0-1: State and national level macroeconomic impacts in 2040, due to a A$100m rise in payroll tax revenue in NSW resulting from a (1) rate rise; or (2) threshold reduction.

		Experiment (1) Payroll tax rate rise Macroeconomic impacts % deviation from baseline (unless otherwise indicated), 2040	**Experiment (2)** Payroll tax threshold reduction Macroeconomic impacts % deviation from baseline (unless otherwise indicated), 2040
	(a) NSW state-level results		
1	Price deflator, GSP	0.026	0.025
2	Capital stock (rental weights)	-0.018	-0.017
3	Real investment	-0.022	-0.020
4	Employment	-0.026	-0.027
5	Real GSP	-0.023	-0.019
6	Real private consumption	-0.013	-0.011
7	Real public (state) consumption	-0.013	-0.011
8	Imports, volume	-0.019	-0.017
9	Exports, volume	-0.086	-0.074
10	Real post-tax consumer wage	-0.015	-0.014
11	Real producer wage	0.011	0.015
12	Tax base ($m)	-86.240	3749.250
13	Aggregate tax revenue ($m)	197.120	204.450
	(b) National results		
14	Real GDP	-0.003	-0.002
15	Real private consumption	-0.003	-0.001
16	Real public (state and federal) consumption	-0.002	-0.001
17	Real investment	-0.002	-0.002
18	Real exports	-0.006	-0.005
19	Real imports	-0.004	-0.003
20	Real GNI	-0.002	-0.001
21	Capital stock (rental weights)	-0.002	-0.002
22	Employment	-0.002	-0.002
23	Capital rentals (investment-price deflated)	0.001	0.002
24	Real post-tax consumer wage	-0.014	-0.013
25	Real producer wage	-0.001	0.000
26	Terms of trade	0.002	0.002
27	Price deflator, consumption (CPI)	0	0
28	Price deflator, GDP	-0.001	-0.001
29	Tax base (all states and federal, $m)	-148.989	3690.212
30	Aggregate tax revenue (all states and federal, $m)	125.659	142.100
	(c) Change expressed as percent of GDP		
31	Balance of trade	0.000	0.000

Table 0-2: State and national level macroeconomic impacts in 2040, due to removal of payroll tax in NSW or removal of the NSW payroll tax threshold

		Experiment (3) Payroll tax removed Macroeconomic impacts % deviation from baseline (unless otherwise indicated), 2040	**Experiment (4)** Payroll tax threshold removed Macroeconomic impacts % deviation from baseline (unless otherwise indicated), 2040
	(a) NSW state-level results		
1	Price deflator, GSP	-2.054	0.748
2	Capital stock (rental weights)	1.542	-0.448
3	Real investment	1.897	-0.543
4	Employment	2.099	-0.818
5	Real GSP	1.958	-0.464
6	Real private consumption	1.163	-0.242
7	Real public (state) consumption	1.163	-0.242
8	Imports, volume	1.699	-0.445
9	Exports, volume	7.324	-1.940
10	Real post-tax consumer wage	1.209	-0.408
11	Real producer wage	-0.714	0.591
12	Tax base ($m)	6817.580	126957.000
13	Aggregate tax revenue ($m)	-14799.300	6971.180
	(b) National results		
14	Real GDP	0.273	-0.004
15	Real private consumption	0.264	0.009
16	Real public (state and federal) consumption	0.231	0.019
17	Real investment	0.232	-0.020
18	Real exports	0.554	-0.111
19	Real imports	0.408	-0.065
20	Real GNI	0.250	0.004
21	Capital stock (rental weights)	0.220	-0.027
22	Employment	0.202	-0.070
23	Capital rentals (investment-price deflated)	-0.111	0.035
24	Real post-tax consumer wage	1.116	-0.387
25	Real producer wage	0.138	0.070
26	Terms of trade	-0.176	0.041
27	Price deflator, consumption (CPI)	0	0
28	Price deflator, GDP	0.087	-0.040
29	Tax base (all states and federal, $m)	11783.540	125208.910
30	Aggregate tax revenue (all states and federal, $m)	-8950.009	5189.639
	(c) Change expressed as percent of GDP		
31	Balance of trade	-0.007	0.000

Table 0-3: NSW industry impacts of payroll tax reform in NSW in 2040, caused by a A$100m rise in payroll tax revenue via a (1) rate rise; or (2) threshold reduction

		Experiment (1) $100m rise in payroll tax via rate adjustment Effects on real industry output % deviation from baseline, 2040	**Experiment (2)** $100m rise in payroll tax collections via threshold reduction Effects on real industry output % deviation from baseline, 2040
1	Agriculture, forestry and fishing	-0.03	-0.03
2	Mining	-0.07	-0.04
3	Manufacturing	-0.06	-0.06
4	Electricity, gas, water and waste services	-0.03	-0.02
5	Construction	-0.02	-0.02
6	Wholesale trade	-0.03	-0.03
7	Retail trade	-0.02	-0.02
8	Accommodation and food services	-0.03	-0.01
9	Transport, postal and warehousing	-0.05	-0.04
10	Information media and communications	-0.03	-0.03
11	Financial and insurance services	-0.01	-0.01
12	Dwelling ownership	-0.01	0.00
13	Business services	-0.02	-0.02
14	Public administration and safety	-0.01	-0.01
15	Education and training	-0.01	-0.01
16	Health care and social assistance	-0.01	-0.01
17	Other services	-0.02	-0.03

Table 0-4: NSW industry impacts of payroll tax reform in NSW in 2040, caused by removal of the tax or removal of the threshold.

		Experiment (3) Payroll tax rate removed Effects on real industry output % deviation from baseline, 2040	**Experiment (4)** Payroll tax threshold removed Effects on real industry output % deviation from baseline, 2040
1	Agriculture, forestry and fishing	2.57	-1.29
2	Mining	5.88	-0.79
3	Manufacturing	5.09	-1.43
4	Electricity, gas, water and waste services	2.95	-0.54
5	Construction	1.76	-0.44
6	Wholesale trade	2.74	-0.81
7	Retail trade	2.11	-0.64
8	Accommodation and food services	2.79	-0.30
9	Transport, postal and warehousing	4.62	-0.96
10	Information media and communications	2.67	-0.72
11	Financial and insurance services	1.20	-0.21
12	Dwelling ownership	0.64	-0.06
13	Business services	1.79	-0.45
14	Public administration and safety	0.76	-0.13
15	Education and training	1.03	-0.26
16	Health care and social assistance	0.85	-0.15
17	Other services	1.74	-0.55

Table 0-5: Effects of different payroll tax thresholds in NSW
Perfect Competition, *MC = P*

Perfect Competition Experiment Design	1	2	3	4	5	6	7	8
Threshold ($m)	0	0.15	0.3	0.45	0.6	0.75	0.9	1.05
Payroll collections ($m)	7,975	7,975	7,975	7,975	7,975	7,975	7,975	7,975
Tax rate (per cent)	3.32	4.22	4.70	5.04	5.31	5.55	5.77	5.97
Dead-weight loss ($m)	0.00	78.84	89.76	103.84	117.04	130.29	144.11	158.01
Wage bill ($m)	240,020	239,605	239,580	239,548	239,515	239,486	239,455	239,430
Dead-weight loss to collections (per cent)	0	0.99	1.13	1.30	1.47	1.63	1.81	1.98
Dead-weight loss to wage bill (per cent)	0	0.03	0.04	0.04	0.05	0.05	0.06	0.07
Employment (persons)	3,672,928	3,666,584	3,666,201	3,665,712	3,665,201	3,664,756	3,664,285	3,663,899

Table 0-6: Effect of different payroll tax thresholds in NSW: Monopolistic Competition, *MC* = 0.8 x P

Monopolistic Competition Experiment Design	1	2	3	4	5	6 *Baseline Scenario*	7	8
Threshold ($m)	0	0.15	0.3	0.45	0.6	0.75	0.9	1.05
Payroll collections ($m)	7,975	7,975	7,975	7,975	7,975	7,975	7,975	7,975
Tax rate (per cent)	3.32	4.18	4.65	4.97	5.24	5.46	5.66	5.84
Dead-weight loss ($m)	0.00	636.89	729.20	780.25	836.48	879.28	925.85	966.38
Wage bill ($m)	240,020	239,638	239,585	239,556	239,523	239,498	239,471	239,448
Dead-weight loss to collections (per cent)	0	7.99	9.14	9.78	10.49	11.02	11.61	12.12
Dead-weight loss to wage bill (per cent)	0	0.27	0.30	0.33	0.35	0.37	0.39	0.40
Employment (persons)	3,672,928	3,667,078	3,666,267	3,665,823	3,665,325	3,664,949	3,664,535	3,664,177

Table 0-7: Deadweight losses ($m) from a payroll tax threshold of $0.75 m

AC increase at 0.5 x Efficient Scale	Perfect Competition	MC = 0.9 X P	MC = 0.8 X P	MC = 0.7 X P	MC = 0.6 X P	MC = 0.5 X P
4%	130.293808	693.743652	879.275146	908.392944	849.077759	738.744019
8%	86.138039	459.103546	651.436096	725.524902	712.583496	630.480042

Table 0-8: Australian Bureau of Statistics 8165.0 data for the numbers of private sector businesses by employment size and ANZSIC Level 1 industry in NSW, June 2016.

	1-4 employees	5-19 employees	20-199 employees	200+ employees	*Total companies*
Agriculture, Forestry and Fishing	11945	3124	428	13	*15510*
Mining	444	151	55	31	*681*
Manufacturing	8635	4922	1612	171	*15340*
Electricity, Gas, Water and Waste Services	612	215	59	13	*899*
Construction	42878	7596	1129	53	*51656*
Wholesale Trade	9230	4547	1414	134	*15325*
Retail Trade	16604	7375	1602	117	*25698*
Accommodation and Food Services	11951	8171	2192	103	*22417*
Transport, Postal and Warehousing	12442	1883	594	74	*14993*
Information Media and Telecommunications	2659	587	322	57	*3625*
Financial and Insurance Services	11502	1533	477	101	*13613*
Rental, Hiring and Real Estate Services	9360	2429	410	37	*12236*
Professional, Scientific and Technical Services	35948	6927	1759	131	*44765*
Administrative and Support Services	10055	3326	1228	175	*14784*
Public Administration and Safety	1044	343	139	12	*1538*
Education and Training	3041	1482	608	61	*5192*
Health Care and Social Assistance	13558	5512	1116	110	*20296*
Arts and Recreation Services	2346	795	239	30	*3410*
Other Services	13199	3229	355	12	*16795*
Currently Unknown	2091	387	71	8	*2557*
TOTAL	*219544*	*64534*	*15809*	*1443*	*301330*

Table 0-9: Australian Bureau of Statistics 8155.0 data on aggregate national employment of employing businesses, classified by employment size and ANZSIC Level 1 industry in Australia, 2014-15.

	Up to 19 employees	20-199 employees	200+ employees	*Aggregate employment*
Agriculture, forestry and fishing	390.00	67.00	19.00	*476.00*
Mining	17.00	23.00	133.00	*173.00*
Manufacturing	286.00	260.00	311.00	*857.00*
Electricity, gas, water and waste services	14.00	21.00	77.00	*112.00*
Construction	729.00	158.00	151.00	*1038.00*
Wholesale trade	206.00	175.00	162.00	*543.00*
Retail trade	472.00	257.00	587.00	*1316.00*
Accommodation and food services	436.00	305.00	222.00	*963.00*
Transport, postal and warehousing	233.00	95.00	246.00	*574.00*
Information media and telecommunications	38.00	28.00	105.00	*171.00*
Financial and insurance services	70.74	37.17	50.09	*158.00*
Rental, hiring and real estate services	312.00	60.00	31.00	*403.00*
Professional, scientific and technical services	498.00	269.00	197.00	*964.00*
Administrative and support services	285.00	208.00	319.00	*812.00*
Public administration and safety (private)	23.00	27.00	35.00	*85.00*
Education and training (private)	91.00	168.00	139.00	*398.00*
Health care and social assistance (private)	351.00	233.00	496.00	*1080.00*
Arts and recreation services	65.00	59.00	78.00	*202.00*
Other services	318.00	90.00	65.00	*473.00*
TOTAL	*4834.74361*	*2540.1686*	*3423.0878*	*10798*

Table 0-10: Derived NSW number of workers of employing businesses, classified by employment size and ANZSIC Level 1 industry in Australia, 2014-15.

	Up to 19 employees	20-199 employees	200+ employees	*Aggregate employment*
Agriculture, forestry and fishing	69.87	9.81	3.81	*83.49*
Mining	3.26	3.61	28.60	*35.47*
Manufacturing	94.87	70.49	115.55	*280.91*
Electricity, gas, water and waste services	5.25	6.44	32.36	*44.05*
Construction	218.51	38.70	50.69	*307.91*
Wholesale trade	49.58	34.42	43.67	*127.68*
Retail trade	132.63	59.02	184.74	*376.39*
Accommodation and food services	127.24	72.74	72.56	*272.53*
Transport, postal and warehousing	78.28	26.08	92.56	*196.92*
Information media and telecommunications	17.09	10.29	52.90	*80.28*
Financial and insurance services	82.06	35.23	65.07	*182.37*
Rental, hiring and real estate services	49.79	7.83	5.54	*63.16*
Professional, scientific and technical services	174.22	76.91	77.19	*328.32*
Administrative and support services	43.86	26.16	54.98	*125.00*
Public administration and safety (private)	54.67	52.44	93.17	*200.28*
Education and training (private)	65.21	98.38	111.55	*275.14*
Health care and social assistance (private)	148.07	80.33	234.35	*462.75*
Arts and recreation services	19.52	14.48	26.23	*60.23*
Other services	111.18	25.71	25.45	*162.35*
TOTAL	*1545.16094*	*749.07548*	*1370.9941*	*3665.2305*

Table 0-11: Derived NSW wage bills by firm size and ANZSIC Industry, effective payroll tax rate and attributed DWL

	Calculate wage bills (A$m)				
	Up to 19 employees	20-199 employees	200+ employees	Ratio of payroll tax collections to the wage bill (effective tax rate)	Attributed DWL by industry (A$m)
Agriculture, forestry and fishing	1,055	477	195	1.08%	7.52
Mining	426	650	6,053	5.23%	31.01
Manufacturing	5,108	5,826	13,540	4.13%	106.47
Electricity, gas, water and waste services	419	644	4,920	5.16%	26.03
Construction	10,484	4,151	8,991	2.95%	102.78
Wholesale trade	2,861	3,260	4,927	3.47%	48.06
Retail trade	4,746	2,917	8,047	3.36%	68.34
Accommodation and food services	3,226	2,749	2,630	2.32%	37.43
Transport, postal and warehousing	2,693	2,148	11,213	4.40%	69.84
Information media and telecommunications	879	931	7,093	4.82%	38.73
Financial and insurance services	7,364	5,786	13,208	4.40%	114.67
Rental, hiring and real estate services	1,685	721	659	1.86%	13.33
Professional, scientific and technical services	10,634	8,299	11,628	3.54%	132.95
Administrative and support services	1,633	2,025	4,549	3.67%	35.70
Public administration and safety (private)	2,626	2,708	7,679	0.00%	0.00
Education and training (private)	2,491	6,979	7,846	0.00%	0.00
Health care and social assistance (private)	6,998	4,781	14,904	0.00%	0.00
Arts and recreation services	463	670	1,394	4.02%	10.99
Other services	4,428	1,984	1,733	2.67%	35.43
TOTAL	*70,220*	*57,706*	*131,209*	*2.92%*	*879.28*