Habit Persistence in Effective Tax Rates: Evidence Using Australian Tax Entities*

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Abstract

This paper uses administrative data from the Australian Tax Office, to model the effective tax rates (ETRs) of large Australian corporates. The extent to which there is any habit persistence in ETRs is also examined. The results suggest that unobserved entity heterogeneity is important in explaining ETRs. In terms of observed heterogeneity, entity size, level of leverage, capital intensity, foreign income and R&D, are all important explanators of ETRs. There is also evidence of a significant amount of habit persistence, implying that ETRs converge monotonically towards the statutory rate of corporation tax.

1. Introduction

Governments provide tax incentives for firms subject to high levels of risk due to large amounts of capital, a lengthy production process or uncertainty in activities such as exploration (Stickney and McGee, 1982). Tax incentives reduce the tax burden of firms and imply non-neutrality of the tax system. Proponents of neutrality argue that the market would more effectively price the risk factors faced by some firms. Further, tax burdens varying across firms is sometimes used to suggest that the tax system is inequitable and subsequently, a justification for tax reform (Gupta and Newberry, 1997).

Effective Tax Rates (ETRs) provide a convenient summary statistic of tax performance, describing the amount of tax paid by a firm *relative* to its gross profit (for example) – a measure which incorporates the use of both tax shelters and incentives. ETRs are of great interest and use to the public and policy makers alike, as a tool to help identify the level of neutrality of the tax system and the characteristics of firms with higher and lower (relative) tax burdens.

There are numerous measures of ETRs, the appropriate use of which depends upon the nature of the research issue in question (see Fullerton, 1984, Callihan, 1994 and Wickerson *et. al*, 2000). In broad terms, a corporate Effective Tax Rate is a measure of the amount of tax payable (paid) by a firm to, typically, a financial characteristic of the firm. Examples of numerators are tax paid and, more commonly, income tax expense. Examples of denominators are: taxable income; gross profit; earnings before interest and tax; and assets. Studies based on published accounts commonly relate to worldwide group data and use income tax expense as the numerator of the dependent variable. Income tax expense includes provisions for tax paid in later and earlier periods.

This paper investigates the variation of ETRs in a multivariate framework and adds to the existing literature in three ways. Firstly, access to the Australian Tax Office (ATO) tax return database allows tax entities to be the unit of analysis. Previous studies have relied on firm level data. Each tax entity is asked to allocate itself an ANZSIC industry classification code based upon the activity which yields the greatest amount of revenue.

As firms commonly operate in more than one market, the use of entity level data has the great advantage that industry dummy variables will more accurately reflect the activities of the entity.

Secondly, previous studies have used income tax expense as the numerator in the calculation of ETRs (Gupta and Newberry, 1997 and Harris and Feeny, 2000). Income tax expense may not be a good indication of the amount of tax a company has paid in a year due to permanent and timing differences (see, for example, Harris and Feeny, 1999). In this paper, these potential problems are overcome by using tax payable as the numerator. Group income tax expense also includes tax and provisions for tax paid in all jurisdictions outside Australia.

Finally, this paper investigates whether the same firms (entities) consistently pay more or less than the statutory rate of tax. If so, entities are said to have habit persistence in ETRs. A dynamic panel approach is adopted to investigate if an entity's ETR this year is related to its ETR next year. Habit persistence in ETRs has strong policy implications. Firstly, habit persistence may indicate that the tax system is inequitable and provides an argument for tax reform. Secondly, there is a financial cost to the Treasury if some entities consistently achieve an ETR lower than the statutory rate.

2. The Data

This paper investigates the ETRs of Large Business and International (LB&I) tax entities from the ATO tax return database for the period 1993/94 to 1996/97. These data are confidential and remote access was authorised only to Melbourne Institute researchers under a specific research project agreement. The ATO database contains tax return information on an annual basis. Each year approximately 500,000 tax entities return data on their income, expenses, and other financial activities.

The ATO database facilitates the use of both tax paid and taxable income. However, there appears to be little to gain in defining an ETR as the ratio of gross tax payable (before rebates and credits) to taxable income as, by definition, this will be equal to the statutory rate of corporation tax. A more fruitful approach is to define an ETR as tax payable (paid) to gross profits, which will differ from the statutory rate due to the use of tax shields, credits and rebates (or, in general, "reconciliation items")[1]. This is often termed the "classical definition" (in terms of the Australian tax system, it records the effect of reconciliation items only). This definition is used as interest is in how the use of reconciliation items, lead to divergences from the statutory rate of corporation tax (Wickerson *et. al*, 2000). Note that non-taxable entities (with zero ETRs) are excluded from the analysis.

Table 1 below compares the statutory rate of corporation tax in Australia with the median ETR of entities included in the data (the median is used as the measure of central tendency as it is not affected by outliers as is the mean). The table illustrates that the median ETR is very close to the statutory rate for all four years. However, there is a wide range in values of ETRs as indicated by the large values for the standard deviation in ETRs. Indeed, it is the purpose of this paper to explain such divergences.

Table 1: ETRs versus the Statutory Rate of Corporation Tax

	1994	1995	1996	1997
Statutory Rate (%)	33	33	36	36
Median ETR (%)	33.0	32.7	34.9	35.3
Standard deviation of ETRS (%)	16.3	16.3	17.3	17.3

3. Theoretical Background

Since the focus of this paper is to compare ETRs to the statutory rate of corporation tax, an appropriate ETR is defined as tax payable (paid) to gross profits (Wickerson *et al.*, 2000).

The method employed closely follows that of Gupta and Newberry (1997) and Harris and Feeny (2000). However, although both of these studies use longitudinal data, only Harris

[1] Gross profit reported in a tax return may include tax exempt profits repatriated from overseas. However, tax paid is derived excluding these exempt profits.

and Feeny (2000) recognise how this can be utilised and related to the statutory rate of corporation tax (SRCT). The following exposition draws heavily on Harris and Feeny (2000).

Assuming that entity *i* earns positive taxable income in financial year *t*, its gross tax burden tax_{it}^{g}, will be

$$tax_{it}^{g} = \tau_t y_{it}^{tax}, \tag{1.1}$$

where τ_t is the statutory rate of corporation tax and y_{it}^{tax} the entity's taxable income. To obtain tax payable tax_{it}, from this amount one has to subtract any appropriate credits and rebates cr_{it}^{p}. Moreover as taxable income is given by gross profit $\left(\pi_{it}^{g}\right)$ minus any tax shields and exemptions $\left(\delta_{it}^{j}\right)$, one can write

$$tax_{it} = \tau_t \pi_{it}^{g} - \tau_t \sum_{j=1}^{J} \delta_{it}^{j} - \sum_{p=1}^{P} cr_{it}^{p}. \tag{1.2}$$

Equation (1.2) can be expressed as an *average* ETR by dividing through by gross profits yielding

$$\frac{tax_{it}}{\pi_{it}^{g}} = \tau_t - \frac{\tau_t}{\pi_{it}^{g}} \sum_{j=1}^{J} \delta_{it}^{j} - \frac{1}{\pi_{it}^{g}} \sum_{p=1}^{P} cr_{it}^{p}. \tag{1.3}$$

Equation (1.3) is useful in that it indicates that if there are no reconciliation items, rebates or credits, the ETR is simply the statutory rate. As such it forms the basis for the estimated equations of both Gupta and Newberry (1997) and Harris and Feeny (2000).

Following the literature, generically the estimated equations take the form

$$y_{it} = \lambda_t + x_{it}\beta + \alpha_i + u_{it}. \tag{1.4}$$

Equation (1.4) relates to (1.3) in the following manner. Firstly, y_{it} is the measured ETR. The λ_t is a *time effect* (dummy), which proxies the SRCT, τ_t (Harris and Feeny, 2000). That is, Gupta and Newberry (1997), effectively omit τ_t (λ_t) from equation (1.3) (equation (1.4)) and as a result their model could be deemed as being misspecified. x_{it} is a vector of firm characteristics thought to influence cr_{it}^p and δ_{it}^j with unknown weights β. That is, the quantity $\tau_t - \sum_{j=1}^{J} \delta_{it}^j - \sum_{p=1}^{P} cr_{it}^p$ is being predicted (modelled) by $x_{it}'\beta$. However, as this prediction is unlikely to be "exact", the usual disturbance term u_{it}, is also added. Finally, in addition to the variables implied by equation (1.3), *individual effects* α_i, are also included. These allow for the fact that potentially, there may be unobserved firm (entity) heterogeneity, for example management strategy, that helps an entity drive its ETR away from the SRCT.

In the subsequent estimation procedures (Section 5), there are two approaches one can adopt in estimating an equation such as (1.4). That is, they can be treated as either fixed or random. The former approach entails splitting the constant into N (where N is the number of economic units in the dataset) parts, and estimating the model by the usual Ordinary Least Squares method (essentially, this involves estimating the model with a dummy variable for each of the cross-sectional units). The latter involves a Generalised Least Squares approach, as disturbance term now becomes composite ($v_{it} = \alpha_i + u_{it}$) and as such the variance of v_{it} is no longer a scalar, but a matrix (as the individual effects are time invariant). The techniques for estimating this specification, allow one to decompose the variance of v_{it} into its component parts (see, for example, Mátyás and Sevestre, 1996).

There is much debate in the literature, as to which is the "correct" specification. However, empirically the choice appears to be one of how exogenous the explanatory variables are deemed to be. If they are correlated with the individual effect and a random effects model is estimated, the resulting estimator will suffer from the usual endogeneity bias. Treating the effects as fixed however, alleviates this problem.

4. Explanatory Variables

The basic model used in this paper follows that of Stickney and McGee (1982), Gupta and Newberry (1997) and Harris and Feeny (2000). The ATO database contains a number of entity characteristics which might influence ETRs. Table 1 below provides a description of the independent variables used in the subsequent regression analyses.

Table 2: Variable definitions

Variable Name	Description
Effective Tax Rate	Tax Payable/ Profit Before Tax
Capital Intensity	Depreciation Deducted / Total Income
Leverage	Interest Expenses/Total Income
Size	Log of Total Assets
Extent of Foreign Operations	Net Foreign Income/Total Income
Return on Assets	Profit Before Tax/Total Assets
R&D Ratio	R&D Expense (Syndicated and Non-syndicated) / Total Income

As previously mentioned, this paper uses an effective tax rate defined as the ratio of tax payable to gross profit. The use of gross profit as the denominator implies that the difference between an entity's effective tax rate and the statutory rate of corporation tax will be due to the use of reconciliation items.

Following Stickney and McGee (1982) and Gupta and Newberry (1997), capital intensity is included as an explanatory variable. The variable is defined as the ratio of depreciation deducted to total income. It is expected to be negatively associated with ETRs due to the tax benefits associated with capital investments. Depreciation deducted is a reconciliation item for Australian tax entities and can therefore be used to reduce taxable income. Both of the aforementioned studies found the expected negative correlation between ETRs and capital intensity.

Leverage is included as an explanatory variable to allow for entities relying more heavily on debt financing paying a higher or lower ETR (leverage is defined as the ratio of interest payments to total income). The sign on the leverage variable is expected to be positive as there are no direct tax incentives for more highly leveraged firms and interest payments are classed as an expense rather than a reconciliation item. Therefore, as interest payments lower the numerator (gross profit) of the ETR, a positive association between leverage and ETRs is implied. This is true even though "high" leverage may also lower the numerator of the ETR, if an entity has achieved its desired low level of tax it does not need to resort to reconciliation items.

The relationship between entity size and ETRs is uncertain. The relationship is positive under the political cost hypothesis, where the greater visibility of larger firms exposes them to greater regulatory actions (Watts and Zimmerman, 1986). In contrast, the relationship will be negative if large firms have greater scope for tax planning or to adopt accounting practices which lower their ETRs (Siegfried, 1972). In this paper, size is defined as the log of total assets. Previous results relating to firm size have generally been inconclusive (see *inter alia* Stickney and McGee, 1982, Zimmerman, 1983, Gupta and Newberry, 1997, Holland, 1998 and Harris and Feeny, 1999). Note that size is defined at an entity level and is therefore different from the size of a firm or group.

Following Gupta and Newberry (1997) and Wilkie (1988), return on assets, defined as the ratio of pretax income to total assets, is included to control for changes in entity profitability. Wilkie (1988) recognises that an entity's ETR is a function of its tax preferences to pretax income and is able to change simply because of changes in pretax income. Holding an entity's tax preferences constant and increasing its profitability will increase its ETR. A positive between return on assets and ETRs is therefore expected (see Gupta and Newberry, 1997, p. 15 for a further discussion). Gupta and Newberry (1997) do indeed find the expected positive relationship between ETRs and return on assets.

The R&D expenses ratio is defined as syndicated and non-syndicated R&D expenditure to total income. The R&D expense ratio is expected to be negatively associated with entity ETRs as R&D expenses are classed as a reconciliation item and are therefore directly deductible.

5. Static Results

Table 3 below reports the results of OLS regressions carried out on each separate year of data. These regressions are partly carried out to ascertain whether subsequent "pooling" of the data is appropriate. The regression analysis is extended in Table 4 by firstly simply pooling the data and subsequently by estimating fixed and random effect specifications, which account for any unobserved entity heterogeneity (see equation (1.4)). Finally, the implicit restrictions stated in Harris and Feeny (2000), that the λ_t of equation (1.4) are equal to the SRCT are enforced in the last two columns.

In the fixed and random effects models the response coefficients are interpreted as in a normal regression framework (that is they are marginal effects), however unobserved entity heterogeneity (for example, management strategy) has also been conditioned on. As noted previously, in the fixed effects (FE) specification this unobserved heterogeneity is assumed to be a fixed constant for each entity, whereas in the random effects (RE) version it is assumed to be a random variable. *A priori* one might favour the FE version if one is specifically interested in the unobserved heterogeneity, or the model is to be used for forecasting and/or prediction. Any concerns about the strict exogeneity of any of the explanatory variables, again lends support to the FE model. On the other hand, for strictly policy analysis, the RE specification might be preferred, as the inclusion of dummy variables for each entity often has the impact of swamping the effects of other (possibly more important) explanatory variables.

The results presented in Table 3 indicate that between 15 and 18 per cent of the variation in the ETRs of tax entities can be explained by the annual regressions. In general, the coefficients are stable across time suggesting that pooling of the separate individual years is indeed appropriate. Size of tax entity is negatively and significantly related to ETRs for all years at the 1 per cent level. These results provide strong evidence that larger tax entities have lower effective tax rates.

The leverage variable is positively and significantly related to ETRs for all years as expected. This result provides evidence that tax entities use interest payments to minimise their profit and thus tax. The capital intensity variable is negative for two years of the data and positive for two but the coefficient is never statistically significant. This is a surprising result and indicates that many tax entities are not using the "depreciation deducted" reconciliation item to lower their taxable income.

With respect to the foreign income variable, the expected negative sign is present for all four years and the coefficient on this variable is significant for the latter two years of data. This indicates that tax entities may be using their foreign operations to lower their domestic ETR. The R&D expenses ratio exhibits a negative relationship with ETRs for all of the individual years. The relationship between ETRs and R&D expenses is expected to be negative and provides evidence that tax entities use R&D expenses as a reconciliation item to lower their taxable income. The return on assets variable, included to control for changes in entity income is positive and significant for all years as expected, indicating that it is important to control for changes in profitability when modelling ETRs.

Table 3: OLS by Year Regressions

Explanatory variable	1993-94	1994-95	1995-96	1996-97
Intercept	0.561**	0.419**	0.928**	0.462**
	(0.028)	(0.013)	(0.023)	(0.012)
Capital Intensity	0.021	-0.010	0.060	-0.024
	(0.065)	(-0.046)	(0.051)	(-0.038)
Leverage	0.066*	0.043*	0.049*	0.071**
	(0.026)	(0.019)	(0.021)	(0.021)
Size	-0.012**	-0.011**	-0.017**	-0.014**
	(-0.001)	(-0.001)	(-0.001)	(-0.001)
Foreign Income	-0.097	-0.030	-0.074*	-0.098**
	(-0.059)	(-0.058)	(-0.034)	(-0.029)
Return on Assets	0.003**	0.004**	0.004**	0.004**
	(0.001)	(0.001)	(0.001)	(0.001)
R&D Expenses	-1.032**	-1.303**	-1.752**	-2.213**
	(-0.297)	(-0.247)	(-0.278)	(-0.493)
Industry Dummies (3-digit)	Yes	Yes	Yes	Yes
Observations	6,093	6,887	7,926	7,777
R-squared (adjusted)	0.15	0.18	0.18	0.16

Standard errors in parentheses with $p<0.05$ = *, $p<0.01$ = **. All standard errors are corrected using White's method.

Table 4 reports a selection of different regression specifications. In the first column the data is pooled which allows the inclusion of time dummies. (Note that excluding the constant term allows all time dummies to be included in the regression). The second column reports the results of the same specification with the inclusion of industry dummies. Results from a fixed effects specification are reported in the third column followed by a random effects specification in the fourth column. The final two columns report results from restricted fixed and random specifications, where the restrictions are that the implicit time effects – the λ_t of equation (1.4) – are equal to the statutory rate of corporation tax in year *t*, τ_t.

The time dummies are significant for all four years. Given their theoretical relationship with the SRCT, their strong significance is not surprising. When industry dummies are additionally included (column 2), they remain strongly significant, but are further away from the SRCT (33, 33, 36 and 36%, respectively). Indeed, the significance of many of these industry dummies, suggest that different industries have different average ETRs due to, say, industry specific tax shelters such as immediate write-off of mining exploration expenditure. The coefficient on capital intensity is surprisingly positive and significant in the pooled regression with no industry dummies, but exhibits the expected negative association with ETRs in the fixed effects specifications. Leverage is positively and significantly associated with ETRs across all specifications.

In the panel specifications (fixed and random effects models), one of the time dummies (1994) is dropped and the coefficients on the remaining ones are transformed into differences from the omitted one. All of the remaining time dummies are still strongly significant, with 1996 and 1997 being significantly larger than 1994, as expected (Table 1), and 1995 being marginally smaller than 1994. Restricting the time dummies to be equal to the appropriate SRCT, results in the estimates presented in the final two columns of Table3. Enforcing these restrictions has little effect on the results, suggesting that the restrictions are indeed valid, implying that the time varying constants are equal to the SRCT, as implied by theory (this was also confirmed by an *F*-test). It also suggests that previous studies that have ignored these restrictions are therefore based on misspecified models. As a consequence, any inference drawn from the results is likely to be erroneous.

There are some interesting differences between the panel estimators. The first is that while size is negatively and significantly related to ETRs in the random effects models, it is not in the fixed effects models. Leverage has the expected positive relationship and R&D expenses the expected negative relationship with ETRs in both models. However, the foreign income variable is negatively associated with ETRs in the random effects model (as expected) but positively associated with ETRs in the fixed effects model. Further, the return on assets variable loses its expected positive relationship with ETRs in the fixed effects model.

Table 4: Pooled OLS and Panel Regressions

Explanatory variable	Pooled No	Pooled Ind.	Fixed	Random	Restricted	Restricted
Intercept	-	-	0.269**	0.436**	0.016	0.000
	-	-	(0.040)	(0.158)	(0.038)	(1980.97)
1994	0.415**	0.621**	-	-	-	-
	(0.008)	(0.009)	-	-	-	-
1995	0.398**	0.616**	-0.007**	-0.004	-	-
	(0.008)	(0.008)	(-0.002)	(-0.002)	-	-
1996	0.420**	0.627**	0.010**	0.010**	-	-
	(0.008)	(0.008)	(0.002)	(0.002)	-	-
1997	0.423**	0.630**	0.017**	0.016**	-	-
	(0.008)	(0.009)	(0.002)	(0.002)	-	-
Capital Intensity	0.055**	0.006	-0.119**	-0.028	-0.133**	-0.036
	(0.021)	(0.025)	(-0.035)	(-0.022)	(-0.035)	(-0.022)
Leverage	0.017**	0.056**	0.10**	0.066**	0.099**	0.067**
	(0.009)	(0.011)	(0.019)	(0.011)	(0.019)	(0.011)
Size	-0.010**	-0.014**	0.001	-0.013**	-0.005	-0.013**
	(0.000)	(-0.001)	(0.003)	(-0.001)	(-0.002)	(-0.001)
Foreign Income	-0.127**	-0.080**	0.055*	-0.039*	0.052*	-0.041*
	(-0.018)	(-0.020)	(0.026)	(-0.018)	(0.026)	(-0.018)
Return on Assets	0.016**	0.004**	-0.001	0.003**	-0.001	0.003**
	(0.000)	(0.001)	(-0.001)	(0.001)	(-0.001)	(0.001)
R&D Expenses	-0.872**	-1.461**	-1.018**	-1.290**	-1.002**	-1.268**
	(-0.101)	(-0.176)	(-0.220)	(-0.162)	(-0.220)	(-0.163)
Industry dummies (3 digit)	Yes	Yes	No	Yes	No	Yes
Observations	28,683	28,683	32,762	28,683	32,762	28,683
R-squared (adjusted)	0.80	0.80	0.70	na	na	na

Standard errors in parentheses with $p<0.05$ = *, $p<0.01$ = **. All standard errors are corrected using White's method.

6. Habit Persistence in ETRs

So far it has been seen that entity ETRs appear to be well modelled by the observed heterogeneity of the entity. Moreover, unobserved heterogeneity also appears important, as do the time effects, which proxy the SRCT. However, this section attempts to build on these results by examining the extent of any *habit persistence* in entities' ETRs. That is, are entities with low (high) ETRs this period, more likely to have low (high) ETRs the next period?

If there is any habit persistence in ETRs whereby the same firms (entities) consistently pay more or less than the statutory rate of tax, this will have significant implications for the appropriate tax authorities and, in aggregate, the Treasury/Department of Finance *etc.* It is expected that, in the long-run, entities cannot keep paying under (over) the SRCT in addition to that explained by tax planning and reconciliation items (note this does allow long run ETRs to differ across industry, for example). However, this issue, is, in part, an empirical question, as is the speed of convergence of ETRs to the SRCT. (It should be noted though, that by using tax entity level data the habit persistence of firms ETRs may be somewhat disguised. This will be true if firms use different entities within their group to claim reconciliation items which changes on an annual basis.)

The way to answer such a question of habit persistence, is to augment the standard set of explanators to include a lagged dependent variable. That is, the entity's observed ETR from the previous period is included as an additional explanator of this period's ETR.

As noted above, the SRCT changes between the years included in our panel. This implies that, once one has conditioned on the other variables affecting ETRs, the *a priori* effect of the lagged ETR is ambiguous. The reason for this is that if the SRCT fell, one might expect last period's ETR to have a *negative* effect. However, if it rose, a *positive* relationship might be expected. Only if the SRCT remained unchanged would the coefficient on the lagged dependent variable have any meaningful interpretation. In addition to this, there may also be tax-planning strategies in an environment of changing SRCT's. For example, if firms (entities) foresee changes in the SRCT (or these are known with certainty in advance), they are likely to adopt accounting practices which alter the tax paid in the current year. The SRCT fell from 39 per cent in 1992/93 to 33 per cent in 1993/94 (Table 1). Some firms (entities) may have used accounting practices to carry forward some taxable items to the latter year. In this scenario, firms (entities) may have an ETR lower than the SRCT in 1992/93 and an ETR higher than the SRCT in 1993/94. This would yield a negative coefficient on the lagged ETR variable.

There are two methods one can employ to remove (lessen) these effects. Effectively, the dependent variable – the ETR – needs to be "cleansed" of the effects of changes in the SRCT. This can be done by estimating the model in levels and including year dummies, or by transforming the dependent variable from ETRs into the excess of ETRs over the SRCT (that is, $ETR^* = ETR - SRCT$).

Both of these have already been undertaken in the static case. As before, the second method simply involves transforming the model by subtracting the appropriate SRCT from the entity's recorded ETR. A *negative* relationship between the lagged excess of the entity's observed ETR over the SRCT implies that this excess follows a cyclical pattern over time. A *positive* relationship indicates that entities paying under (over) the SRCT in one year, are likely to be doing so in the following one. If it is insignificant, the implication is that the quantity ETR *minus* SRCT in the current period is not dependent upon last period's quantity. This set of equations are termed "restricted" (and accordingly, the previous, "unrestricted") as implicitly this specification again enforces the restrictions that the λ_t of equation (1.4) are equal to the SRCT (which was, in fact, found to be valid).

To account for any potential habit-persistence, equation (1.4) becomes

$$y_{it}^* = \delta y_{i,t-1}^* + x_{it}'\beta + v_{it},\; v_{it} = \alpha_i + u_{it} \qquad (1.5)$$

where $y_{it}^* = ETR_{it} - SRCT_t$ and $x_{it}'\beta$, α_i and u_{it} are as before. There are problems in estimating a model such as equation (1.5). Essentially these arise from the lagged dependent variable being correlated with the individual effect, which is time-invariant. This implies that the usual panel data methods yield inconsistent estimators in the dynamic setting (Nickel, 1981 and Sevestre and Trognon, 1985).

Numerous consistent estimators have been proposed in the literature. However, the most popular fall into the general class of *instrumental variables* (IV) estimators, or more generally, *Generalised Method of Moments* (GMM) estimators (see, Harris and Mátyás, 1996, for a useful summary). In this paper, the nonlinear GMM approach is followed. This approach appears to be a more appropriate method of handling any potential endogeneity of variables other than the lagged dependent one, and also there is evidence to suggest that it is more robust to model misspecification (Harris *et al*, 1996).

The GMM estimator operates in levels and is based on a set of (moment) conditions which one expects the model to exhibit. All such potential conditions are summarised in Table 5 below (Crépon *et al*, 1998).

Table 5: GMM Orthogonality Conditions

1)	$\mathrm{E}(v_{i0}) = 0$
2)	$\mathrm{E}(v_{i0}^2) = \sigma_0^2$
3)	$\mathrm{E}(v_{i0} v_{it}) = \sigma_\alpha^2, \ \forall t$
4)	$\mathrm{E}(v_{it}) = 0, \ \forall t$
5)	$\mathrm{E}(v_{it} v_{is}) = \sigma_\alpha^2, \ \forall t \neq s$
6)	$\mathrm{E}(v_{it}^2) = \sigma_u^2 + \sigma_\alpha^2, \ t = 1, \ldots, T$
7)	$\mathrm{E}\left([v_{it} - v_{i,t-1}]\, y_{i,t-l}\right) = 0, \ t = 2, \ldots, T, \ l \geq 2$
8)	$\mathrm{E}(v_{i0} x_{it}^k) = 0, \ \forall k, t = 1, \ldots, T$
9)	$\mathrm{E}(v_{it} x_{i0}^k) = 0, \ \forall k, t = 1, \ldots, T$
10)	$\mathrm{E}(v_{it} x_{it}^k) = 0, \ \forall k, t = 1, \ldots, T$
11)	$\mathrm{E}(v_{it} x_{is}^k) = 0, \ \forall k, \ t \neq s, \ t = 1, \ldots, T, \ s = 1, \ldots, T$

There is much attention in the literature paid to the initial conditions, y_{i0} (see, for example, Blundell and Bond, 1998). Due to their specific nature, the conditions pertaining to v_{i0}, 1), 2), 3) and (8), in Table 5 are not used. If they are used, one is forced to make assumptions concerning the specification of the initial conditions, which if incorrect may bias the resulting GMM estimator. Moreover, the strict endogeneity implied by condition 11) is not used and the return on assets variable was treated as endogenous (as the numerator of ROA is also the denominator of the defined dependent variable).

7. Results for Restricted Dynamic Model

The results for dynamic model are reported below in Table 6. Firstly, it is important to note that the model clearly passes the Hansen test for over-identifying restrictions. That is, the moment conditions used are valid.[2]

Table 6: Restricted Dynamic Panel Estimations

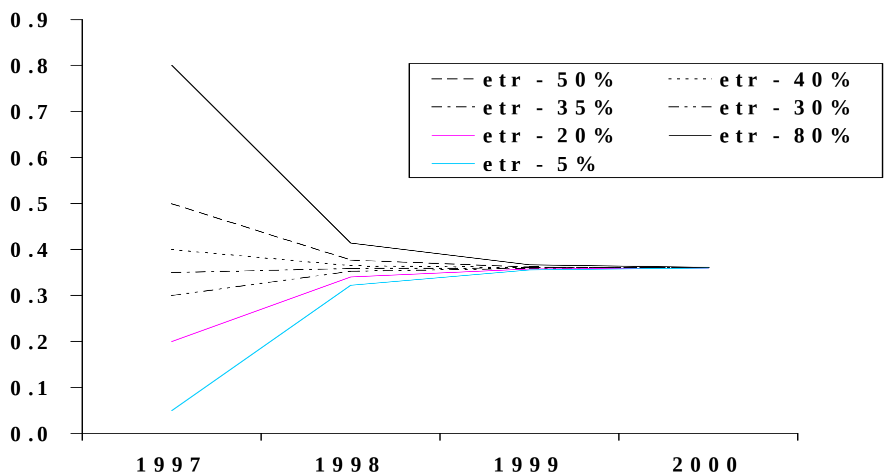
	Coefficient	Standard Error
Constant	0.013	0.060
Lagged ETR	0.122	0.053*
Capital Intensity	-0.778	0.360*
Leverage	-0.058	0.091
Size	-0.006	0.001*
Foreign Income	-0.463	0.330
Return on Assets	0.031	0.002*
R&D Expenses	-4.501	3.926
Observations, *NT*	9,072	
Hansen test for over-identifying restrictions, χ^2_{32}	33.39	$\chi^2_{32,0.05} \approx 46.2$

The results indicate that there is positive habit persistence in the difference between observed entity ETRs and the SRCT. The size and sign of this coefficient suggests that there is a smooth convergence to the equilibrium value of the SRCT. Indeed, in Figure 1 below, the time path of several ETRs are extrapolated out from 1997, assuming that the SRCT remains unchanged at 36% and that all other variables are evaluated at sample

[2] Note that due to the complexities involved in estimation, the full data set could not be used. The original data was randomly sampled such that the final sample had about 1/3 of the total observations.

means. It can be seen that even entities with very high or low ETRs in the first year, will converge to the SRCT within two to three years. Note that this confirms with *a priori* expectations that the path of entity ETRs is not explosive, but exhibits a monotonic (and relatively fast) return to equilibrium.[3]

Figure 1: Estimated ETR Convergence to SRCT



The results also provide more evidence that larger tax entities are associated with lower ETRs. This result is consistent with the static estimators (with the exception of the fixed effects specifications where the coefficient on size was not statistically significant). The coefficients on the R&D expenses and foreign income variables have the expected negative signs, but are not precisely estimated.

As expected, the more capital intensive tax entities are, the lower are their ETRs. This result was also found in the static random effects specification and indicates that tax entities utilise "depreciation deducted" to lower their taxable income. The positive and significant coefficient on the return on assets variable indicates once again that it is important to control for entity profitability in an investigation of ETRs.

[3] Note that these imputations are indicative for a "typical" entity only. For example, it is likely that these long-run ETR equilibria will vary across industry, for example, due to differing tax concessions. However, for a typical firm one would not expect its long-run equilibrium ETR to diverge from the SRCT.

8. Conclusion

This paper has attempted to model the ETRs of entities using administrative data obtained from the Australian Tax Office. These data appear to be superior to that previously used in the literature. Data used in previous studies are based on firm level data and income tax expense is used to proxy for tax paid. Income tax expense can vary from tax paid due to timing and permanent differences.

The results suggest that the restrictions identified by Harris and Feeny (2000), in that the model should contain time dummies which proxy the SRCT, are justified. There is also evidence to suggest that lower ETRs are associated with entity size, foreign income, R&D expenditure, and capital intensive entities. Results from fixed and random effects specifications indicated that unobserved heterogeneity appears to be important. Finally, there was evidence that ETRs are influence by past values, and that in response to shocks, they converge relatively quickly, and monotonically, to the SRCT. That is, a one off shock in any of the explanatory variables or a genuine random shock in the unmeasured error term, drives the ETR away from the SRCT. However, if this shock is transitory, convergence to equilibrium (to the SRCT) is relatively quick and monotonic.

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