The Use of Derivatives in a Public Sector Setting

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Abstract
Existing private sector models of derivative use do not readily translate into the public sector that faces the joint objectives of value maximisation and provision of a privately unprofitable mission good. This paper develops and tests a model explaining public sector derivative use in terms of budget discrepancy minimisation. Hypotheses are developed and tested using logistic regression over a sample of Australian Commonwealth Government entities. It is found that public sector derivative use is positively correlated with liabilities and size of the organisation. This is consistent with management of budget discrepancies.

Key words: Derivatives use; risk management; public sector financial management.

JEL Classification: G32, G38, H61, H72

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1. Introduction

The growth in financial derivative use over the past decade and a half has in part been attributed to the private sector with the common assumption that the derivative instruments are typically used in a financial risk management framework for firm value maximization and/or managerial utility maximization. Further, studies concerned with the motivation for derivatives use have focused almost exclusively on the private sector. This paper is among the first to focus on the use of derivatives in the public sector. We rely on a principal-agent framework in explaining derivative use in Government entities. Given the inherent differences between the public and private sectors, the motivation for using derivatives and the attitude toward risk management are likely to differ between the two sectors.

The level of derivative use is expected to be lower in public sector organizations. Public sector organizations have an objective of providing a mission good as well as maximizing firm value (Erus and Weisbrod, 2002). This dual objective results in less incentive for management to maximize firm value relative to the private sector. Therefore, it is likely that there will be less derivative use by public sector organizations relative to private sector organization and that the motivations for derivative use will vary between the public and private sector.

Managerial utility in public sector organizations is less aligned to firm value than for private sector organizations. We argue that managerial utility in the public sector is driven by budget discrepancies. We develop a series of hypotheses concerning the use of derivatives in the public sector based around budget discrepancies and then conduct an empirical test using logistic regression over a
sample of 59 Australian Commonwealth government entities. The focus on the Australian public sector is important given its structure, devolved financial management principles, corporatisation policy, competitive neutrality policy, and the recent introduction of full accrual accounting systems.¹

While the Modigliani and Miller (1958) irrelevance theorem of corporate financial policy implies that the use of derivatives should not add to firm value in complete markets, the presence of market imperfections may explain the propensity of private sector firms to use derivatives. These market imperfection based arguments are generally based on the structure of private corporations and the environment within which they operate. Factors such as taxes, financial distress and agency costs become relevant as they are related to firm value and managerial utility. However, in the public sector, many of these factors are not relevant. For instance, public sector organisations rarely pay taxes or dividends and when they are applied, it is usually a means for government to claw-back cash surpluses that have been generated by the entity. Further, as governments both own and control public sector organisations, some of the traditional agency-based problems are unlikely to apply, although governments still have agents carrying out government objectives. Finally, governments tend to have “deep pockets” when it comes to supporting their own entities and hence arguments based on costly liquidation as an explanation for derivative use also appear to have little practical basis. This paper develops alternative arguments for the use of derivatives in the public sector that draw upon the motivation of the managers of government entities as well as principal-agent relationships.

Managers of government entities generally do not face the same incentives as their counterparts in the private sector, yet the exposure arising from derivatives

¹ The competitive neutrality policy essentially imposes a requirement on the public sector to compete
within the public sector in many countries can be substantial and similar to the private sector. Three widely cited examples of derivative losses in the UK, US and Australia highlight the magnitude of some government exposures. First, the London borough of Hammersmith and Fulham suffered large losses through swap transactions valued notionally at GBP6.2 billion between 1987 and 1989. Second, Orange County in the USA filed for bankruptcy protection in December 1994 after its investment fund lost US$2 billion arising from interest rate speculation based on positions in inverse floaters. Third, the Australian Commonwealth Treasury realised losses of over AUD$2 billion and reported further notional losses of over AUD$6 billion over the late 1990s relating to the use of interest rate swaps.

The paper is organised as follows. An examination of the incentives for the use of derivatives in the public sector is explored in the next section. Section three develops the hypotheses. Section four discusses the construction of the sample that involves a data set based on accounting disclosures and survey findings. We note that only a comparatively small proportion of our sample of government entities (22%) use derivatives compared with the usage rates noted in the more recent private sector literature (greater than 50%). Section five presents an empirical test of the hypotheses and the final section contains the conclusions. We also find that entity size and liabilities are important in explaining the probability of derivative use. To a lesser extent, there is also evidence that entities facing greater budget complexity or incurring taxes and dividends are also more likely to use derivatives.

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on equal terms as the private sector and not abuse its monopoly position. In practice, this translates to the charging of implicit taxes and rents and constrained fee setting.


3 An Appendix provides a brief overview of the Australian Commonwealth public sector environment.
2. Incentives for the Use of Derivatives

The motivation for the use of derivatives in the private sector generally focuses on either hedging requirements in the context of maximising corporate value, or maximising risk-averse manager utility. The context of corporate value maximisation suggests that derivative use arises from convex tax schedules, agency costs, financial distress costs, transaction costs and investor diversification (Smith and Stulz 1985; Smith et al. 1990; Bessembinder 1991; Froot et al. 1993; Tufano 1996; Froot and Stein 1998; Cooper and Mello 1999; Rajgopal and Shevlin 2000). Alternatively, it has been proposed that managers use derivatives to maximise their own utility associated with over-investment problems and compensation packages (Smith and Stulz 1985; Cohen et al. 2000; Rajgopal and Shevlin 2000).

Empirical tests of derivative use in the private sector have produced mixed results (Nance et al. 1993; Mian 1996; Tufano 1996; Geczy et al. 1997; Graham and Rogers 1999; Guay 1999; Hardwick and Adams 1999; Whidbee and Wohar 1999; Rajgopal and Shevlin 2000 and in Australia- Berkman et al. 2002 and Nguyen and Faff 2002). The range of empirical results may reflect the lack of a more general and unifying theory of derivative use in the complex setting of the modern corporation. Nevertheless, a common finding is that the use of derivatives is related to the size of the entity wherein larger firms tend to use derivatives. The typical explanation for this finding is that of economies of scale. Derivatives require some expert knowledge, an initial establishment cost, ongoing monitoring and usually involve minimum contract values.

One of the benefits of conducting a study in the public sector is that there is a natural control for many of the complexities identified in the private sector. Government entities do not pay taxes or distribute dividends, at least not within the
framework in operation in the private sector. Central governments are regarded as the "lender of last resort" and hence financial distress issues are far less relevant in the public sector. Moreover, governments do not suffer from the equity agency cost problem that the private sector faces though there are important principal-agent relationships that exist within government, particularly between the higher levels of government and the managers of statutory authorities and corporations. Essentially, we argue that motivation for derivative use in government entities lies with the preference functions of the managers responsible for the entity. One explanation for this observation is the requirement that government entities must meet the objectives of value maximisation and provision of a mission good. This may also help to explain why derivative use is less evident in our government sector sample, compared with recent private sector derivative use literature.

2.1 Motivation of Management

The objective of value maximisation in a government entity is opaque given the lack of an observable value metric, such as a competitive share price. Moreover, government entities and service suppliers are explicit in their goals and these often do not include value maximisation. Issues of access, equity, efficiency and public good arguments are sometimes stated as primary objectives of these organisations. Particularly, Erus and Weisbrod (2002) consider non-profit organisations as producers of two goods- a mission good (M) that is socially desirable but privately unprofitable, and a revenue good ($R^G$) that finances the provision of the mission good. For example, the provision of telephone services in unprofitable locations. The mission good is the provision of telephone services in unprofitable locations, such as in

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4 These arguments are not complete. For instance, governments do go bankrupt, efficiency dividends
country areas. The revenue good is the provision of telephone services in profitable locations, such as in city areas. From a private sector perspective a firm will not provide a mission good, but only a revenue good ($R^p$). If $R^G$ and $R^p$ have the same incentives $M$ will not be produced. Telephone services will not be provided in country areas by private sector firms. Managers of private sector firms have the objective of maximizing the revenue good and hence firm value, whereas managers of public sector organisations must spread their effort across both the provision of the mission good and the revenue good. That is, in our example, the public sector manager must provide telephone services in both the city and the country. If the motivation for derivative use in the private sector is to maximise firm value, but the maximisation of firm value is not the sole objective of the public sector, the motivations for the use of derivatives in the private sector derivative use may not adequately explain motivations for derivative use in the public sector.

The Australian Commonwealth public service has undergone substantial change over the last decade and concepts such as shareholder value have become more relevant. Generally, the public sector has become more accountable with greater financial responsibility being placed on individual business units. Successive governments have embarked on policies of corporatisation and privatisation. Accrual accounting has been implemented across the sector. A consequence of these changes has been the devolution of financial delegation and budget accountability to the managers in charge of organisational units. In part, this has led to managers of

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5 From the early 1990s, the Commonwealth of Australia has been at the forefront of public sector reform. This has resulted in considerable change to the way the Commonwealth public service operates and in turn has affected the fabric of the Australian economic and financial systems. These reforms include the corporatisation and privatisation of many utilities, a new regulatory financial system and a new taxation system. The reforms have followed the recommendations of several inquiries including the National Commission of Audit (1996) and the Financial System Inquiry (1997).
government entities being regarded as, and expected to perform on a level, similar to their private sector counterparts. With the increased responsibility, more varied and complex compensation (and incentive) systems have been introduced. It is not uncommon for senior managers to receive incentive and performance-based compensation packages. These changes have also been commonplace in many other countries.

The recent mimicking of the private sector particularly in relation to management structure and operation combined with the public goals of government have made it difficult to clearly identify the primary sources of management motivation in the public sector. It is inevitable that managers are subject to political pressure. Budget constraints also play a key role in management behaviour, as the ability to provide agreed levels of service within budget has become a prime objective and basis for performance targets.

2.2 Management Utility

Although proposed in the 1980s (Smith and Stulz 1985), it is not until recently that empirical studies have found support for the argument that management compensation could motivate the use of derivatives (Tufano 1996; Geczy et al. 1997; Cohen et al. 2000; Rajgopal and Shevlin 2000). It is argued here that compensation, in a broad sense, may play a role in explaining derivative use within government entities.

In this paper we assume that managers are risk averse and maximise their utility of wealth. Further, we assume that management compensation is (partially) a function of the budget, particularly budget discrepancies (income/allocation less expenditure). While managers would rarely plan for a budget discrepancy, there are two budget outcomes that can eventuate. First, expenditure can exceed allocation
(negative discrepancy). In such cases, although there may not be an immediate effect on remuneration, the impact on reputation and career of substantial budget overruns could include demotion, replacement and forced transfer. These are both feasible and costly to the manager. Second, allocation can exceed expenditure (positive discrepancy). In this case, the impact on the manager is not as clear. It is possible that under-spending could be seen as evidence of superior performance. However, positive budget discrepancies may depress future budget allocations with equally severe impact on longer-term expected remuneration to the manager.

To focus on the motivation for derivative use in more detail, we develop the manager’s utility function from work traced back to Berle and Means (1932) and Mirrlees (1975) and Holmstrom (1979) amongst others. We write the manager’s utility function in state $s$ as:

$$U[W - f(BD_s)]$$  

where $U[.]$ = utility function with $U'>0$ and $U''<0$  
$W$ = salary and fixed benefits of employment not related to the state of the world  
$f(.)$ = budget discrepancy cost, increasing in the absolute value of the discrepancy.  
$BD_s = |B - E_s + D_s(E_s - B)|$, the absolute value of the difference between the budget allocation and income from other sources ($B$), expenditure in state $s$ ($E_s$) and the derivative contract portfolio, paying $D_s$ a function of ($E_s - B$), in state $s$.

Manager wealth in any state of the world is written as a concave function of salaries and fixed benefits as well as the net cost to the manager of budget discrepancies. In this model we assume that at the beginning of the period, managers know the budget allocation ($B$) but do not know the actual expenditure ($E_s$) until the end of the period. The budget discrepancy could be viewed as a short forward contract with forward price equal to the budget allocation. To reduce the magnitude of budget

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6 See Aggarwal and Samwick (1999).
discrepancies the manager could choose to have the entity hold a portfolio of 
derivative contracts whose value at the end of the budget period replicates the payoff 
from a long forward contract, thus reversing the impact of the budget discrepancy. At 
the end of the period the actual expenditure ($E_s$) is known as well as the derivative 
contract portfolio payoff ($D_s$). Assume that the derivative payoff takes the form 
$D_s = \delta(E_s - B)$ with $0 \leq \delta \leq 1$ to allow for the possibility that managers may choose not 
to fully hedge the budget outcome. In effect the parameter $\delta$ is a hedge ratio. Equation 
(1) can be rewritten as:

$$U(W - f(B - E_s + \delta(E_s - B))) \text{ or } U(W - f((B - E_s)(1 - \delta)))$$

Portfolios of derivative contracts can be constructed that help managers to manage 
risk factors such as foreign exchange rates and interest rates and so managers can use 
derivatives to decrease the magnitude of budget discrepancies. The use of derivatives 
in this way decreases the expected budget discrepancy costs to the manager and so 
increases the manager’s level of utility.

We concentrate on the first-order conditions of a risk-averse manager, as 
modelled in equation (2), to analyse the propensity to use derivatives. Assuming that 
managers maximise expected utility then their utility maximisation problem can be 
written as:

$$\text{Max } EU = \sum_{s=1}^{S} p_s U[W - f(BD_s)]$$

There are $S$ states of the world ($s = 1, \ldots, S$) and $p_i$ is the probability of state $i$ 
occuring. We assume that a risk-averse manager will choose to maximise expected

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For a clear explanation of this work see Zhou (2002).
utility and thus minimise the impact of budget discrepancies because budget discrepancies, whether positive or negative, could adversely affect a manager’s wealth.

We assume that the impact of budget discrepancies is symmetric and let the function, \( f \), be a power function of order 2, \( f = \pi (BD_s)^2 \), with \( \pi \) being a scaling factor. Utility is modelled using a constant relative risk aversion function of the form:

\[
U(w) = \frac{1}{1-\alpha} w^{1-\alpha}
\]  

(4)

where \( w = \text{wealth} \)

\( \alpha = \text{constant relative risk aversion parameter} \) and \( \alpha \neq 1 \)

We can write the manager’s problem as:

\[
\text{Max } EU = \sum_{s=1}^{S} p_s \left( \frac{1}{1-\alpha} \left[ W - \pi (B-E_s)(1-\delta) \right]^2 \right)^{1-\alpha}
\]  

(5)

The first-order condition with respect to the change in the derivative sensitivity to expenditure is:

\[
\frac{\partial EU}{\partial \delta} = \sum_{s=1}^{S} p_s \left( \frac{2\pi BD_s (B-E_s)}{W - \pi (BD_s)^2} \right) = \sum_{s=1}^{S} p_s \left( \frac{2\pi (B-E_s)^2 (1-\delta)}{W - \pi (BD_s)^2} \right)
\]  

(6)

In equilibrium a manager will choose that level of derivative use that maximises expected utility. It is assumed that the manager’s final wealth \([W-(BD_s)^2]\) is non-negative in all states of the world, consistent with current bankruptcy laws. The impact of derivative use on manager utility is independent of the sign of the budget discrepancy though expected utility is increasing in the hedge ratio \( (\delta) \). Further, the sensitivity of expected utility to changes in the hedge ratio \( (\delta) \) is increasing in the wealth impact parameter \( (\pi) \). It is argued that derivative use is a function of the
expected magnitude of the budget discrepancy and the sensitivity of the manager’s utility of wealth to budget discrepancies.

The level of hedging increases with increases in the level of costs to the manager arising from budget discrepancies. For example, the more visible the entity, the greater the cost in terms of tarnished reputation that the manager faces with budget discrepancies, and so the more likely the use of derivatives to avoid budget discrepancies. In essence, the more sensitive a manager’s personal wealth is to budget discrepancies the more likely the manager will choose to hedge. Factors that could affect sensitivity of manager wealth include size, where size captures costs such as political costs.

We expect derivative use to occur where entities face a more complex or volatile environment. Thus entities with high salary concentration, considerable levels of budget complexity, greater levels of highly skilled staff, substantial liabilities and Government levied taxes and dividends are expected to be the most likely users of derivatives as these entities will tend to have greater difficulty in managing their budget. The likelihood of budget discrepancies could also be captured using measures such as the variance in budget discrepancies before the impact of derivatives. Finally, although size will tend to capture political costs, it will also capture economies of scale such that only the larger entities will tend to use derivatives.

We argue that risk averse managers use derivatives to avoid budget discrepancies where economically feasible, and that the level of hedging is related to the cost to managers of budget discrepancies.

3. Hypotheses

3.1 Management of Cash Holdings
If managers choose to control the risk of budget discrepancies, they can do so in a number of ways. Superior negotiation skills could allow them to build slack into the current budget allocation and thus minimise the possibility of budget discrepancies occurring in the future. However, there are reputation effects from such a strategy that could adversely affect future budget negotiations. Nevertheless, such a strategy may work in the short-term while its longer-term effectiveness is dependent on the ability of more senior staff, perhaps at the ministerial level, to access and understand financial reports.

It is difficult to measure the ability of an entity to build up slack, particularly when relying on external reports. However, one measure of slack is the level of net cash equivalents (cash, marketable securities and current receivables less current liabilities) on hand at year-end. If an entity has surplus cash, then the need to manage cash flows is reduced. Managers may have control over the level of liquid assets, and some of the liabilities. If an entity can build up and control cash balances then the entity may reduce the probability of negative budget discrepancies in the future and thus reduce the need for derivatives. As a measure of expected slack at the end of the period, we employ the prior period year-end slack. This leads to our first hypothesis:

\[ H1: \text{Prior period cash holdings, as measured by net cash equivalents as a percentage of total assets for the previous period, is negatively related to the use of derivatives.} \]

3.2 Budget Discrepancy History

From the above, risk-averse managers will tend to avoid budget discrepancies due to the impact on utility. Given this argument it is expected that derivative use will be positively related to the volatility of the budget discrepancy (before hedging). That is,
the more volatile the budget discrepancy, the greater the benefits from derivative use. The volatility of the current budget discrepancy is difficult to measure. However, past volatility is likely to be related to current volatility, and past volatility has often been used in the literature in similar contexts (eg. Bradley et al. 1984). A further complication arises because it is not possible to identify the volatility of the budget discrepancy before hedging.

The variable used to capture budget discrepancy history is the standard deviation of the percentage change in cash inflows calculated over a five-year period. This choice is based on the assumption that changes in total cash inflow will tend to capture a major source of budget discrepancy and are clearly related to the variation in budget discrepancy. This leads to our second hypothesis:

\textit{H2: The volatility of budget discrepancy, as measured by the standard deviation of past cash inflows, is positively related to the use of derivatives.}

3.3 \textit{Salary Level Concentration}

The magnitude of payroll may affect derivative use. It is reasonable to assume that the salary level is positively related with manager’s level of responsibility. As the salary rises, so the costs of budget discrepancies increase. In comparison with the private sector, salary scales are fairly rigid in the Commonwealth public service. However, budget discrepancies will undoubtedly have an impact on the more senior, better-paid managers. Moreover, it could be argued that the greater the relative proportion of such staff in an entity, the greater the chance of budget discrepancies and so the greater the incentive for the senior managers to use derivatives. Hence, derivative use will be an increasing function of the concentration of higher ranked and more highly paid staff.
The variable used to measure this effect is the sum of payments made to the board of directors, the executive and the senior officers as disclosed in the annual report scaled by total employee expenses plus payments to the directors, the executive and managers. This leads to our third hypothesis:

\( H3: \) The concentration of senior manager salaries is positively related to the use of derivatives.

3.4 Budget Complexity

In a complex setting, organisations may find that derivatives provide a flexible method of handling the variability of cash. In the private sector, such a factor may relate to the diversity of products, intensity of research and development, and scope of operations. However, in the public sector, budget complexity relates to two broad elements – the budget allocation and other income derived from commercial activities. The budget allocation is fixed, usually at the start of the period whereas other income is volatile. In settings where other income represents a relatively large proportion of the total income available, the management of cash and the budget is more complex. In such situations there is an incentive to use derivatives to smooth the budget outcome. We use the ratio of other income to total income for the period as a measure of budget complexity. This leads to our fourth hypothesis:

\( H4: \) Budget complexity is positively related to the use of derivatives.

3.5 Economies of Scale and Political Costs

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8 However, we note that this is an imperfect measure and will be more so in periods where derivatives
Arguments for economies of scale are well known in the literature (Smith and Stulz 1985; Nance et al. 1993; Mian 1996). Economies of scale may work to restrict the use of derivatives by smaller government entities due to the large nominal amounts involved in most derivative contracts (Smith and Stulz 1985; Nance et al. 1993). Further, the use of derivatives involves initial set-up costs, ongoing consulting costs, expert staff and costs of monitoring and operating (dynamic) hedging strategies. Moreover, larger entities are more visible and face greater political costs associated with budget discrepancies that ultimately impact on manager utility. Thus it is expected that derivative use will vary positively with entity size. The proxy for size used in empirical studies is the natural log of (book value) total assets. This leads to our fifth hypothesis:

\[ H_5: \text{The size of an entity, as measured by total assets, is positively related to the use of derivatives.} \]

### 3.6 Liabilities

Where an entity uses liability financing, the importance of short-term cash control becomes more critical and derivatives provide a means for the management of cash. This is not a financial distress story, but rather one of the management of the short-term budget and the implications of budget discrepancies on managers. As noted earlier, financial distress is unlikely to be a significant factor in government entities, at least in the short-term. It is expected that there will be a positive relationship between the level of liabilities and the level of derivative use. The ratio of the book value of liabilities to the book value of total assets is used to proxy cash flow management problems arising from liabilities. This leads to our sixth hypothesis:

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generate cash.
**H6:** *The level of liability financing is positively related to the use of derivatives.*

### 3.7 Taxes and Dividends

Finally, there is also the additional cash flow complication that some entities face with central government levies such as implied taxes and efficiency dividends based on perceptions of efficiency and driven by the perceived need for government to relieve entities of excess cash. This factor provides managers with a further incentive to manage their cash flows. Thus, it is expected that there is a positive relation between the incidence of tax and dividend levies and the use of derivatives. Taxes and dividends are scaled by total cash inflows. This leads to our final hypothesis:

**H7:** *The level of implied taxes and dividends is positively related to the use of derivatives.*

The hypotheses and variable definitions are summarised in Table 1.

[Insert Table 1 about here]

### 4. Data

The sample is drawn from the population of Commonwealth government entities identified in the Commonwealth Consolidated Annual Report for the year ended 30 June 1999.\(^9\) This report identifies 180 entities that consist of 80 statutory authorities, 16 companies and 84 entities that fall under the *FMA Act*. The study focuses on the derivative use by those entities covered by the CAC Act as these entities most closely resemble private sector organisations. Consequently, the 84 entities falling under the *FMA Act* are excluded from the study. This leaves 96 statutory authorities and

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\(^9\) This was obtained from the Commonwealth Department of Finance and Administration.
corporations in the sample which is the population of potential derivative users in the Australian public service. A questionnaire was distributed to all entities to study the risk management practices of Commonwealth government entities.\textsuperscript{10} The response rate to the survey resulted in 61 usable responses representing a response rate of 64\%.\textsuperscript{11,12}

Accounting information from annual reports was obtained for all entities. Each annual report was inspected for evidence of disclosure of derivative holdings or trading activity. Of the 96 eligible entities, 13 (or 14\%) were identified as derivative users. Consistent with the annual report disclosures, the same 13 derivative users were self-identified from the survey representing a response rate from derivative users of 100\%. Hence, the survey responses confirm the reported accounting information. Moreover, this confirmatory evidence supports the validity of the respondents. There were 48 usable survey responses among the derivative non-users. No accounting information was available for the year-end 2000 for two (non-user) organisations. Hence, the final sample size is 59 entities, including all derivative users and 55\% of derivative non-users.

As noted above, the level of derivative use in the public sector sample (22\%) is considerably less than that evident in private sector. In two Australian studies, Berkman et al. (2002) who use a small sample of Australian private sector firms sampled over the 1990s and Nguyen and Faff (2002) who use a sample of large

\textsuperscript{10} The survey was conducted in February 2000 addressed to the Chief Executive Officer or Chief Finance Officer of each organisation in the sample with a self-addressed return envelope. Follow-up telephone conversations with a sample of organisations, as well as reply letters included with responses, indicated that either a CEO or CFO completed the surveys as requested.

\textsuperscript{11} Sixty-three responses were received but two were deleted, as identification of the organisation was impossible. Both observations were from derivative non-users. Not all respondents provided answers to all questions.
Australian private sector firms from 1999 and 2000, report derivative use rates exceeding 50% and 70% respectively. It is clear that government sector derivative use is less common than private sector derivative use as argued above. Table 2 provides a detailed breakdown of the sample.

[Insert Table 2 about here]

The explanatory variable descriptive statistics are reported in Panel A of Table 3. There is some non-normality in the variables SLK, TAX and VOL with median values less than their means and large skewness and kurtosis estimates. The variable SLK has a mean of 35%, indicating a strong liquidity position for the sample though the standard deviation of 216% suggests substantial variation across the sample. TAX has a mean of 0.5% implying that “efficiency dividends” are infrequent across the sample. This variable generally takes a value of zero. VOL is particularly affected by a small group of entities that have seen dramatic change over the period from 1996 to 2000. This accounts for the difference between the average value of 116% per annum and the median value of 18% per annum.

Of the other variables, EXC, averages 18.3% with standard deviation of 23.3%. TOT averages 10.7 with standard deviation of 2.5. The importance of commercial income for the entities is apparent given the CPX average of 31.5%. Liabilities are apparent with LIAB averaging 36.0% of the book value of assets.13

12 Non-response bias was considered by sorting the responses from non-users according to the date they were received. t-tests on the mean scores for the first 10 (20) and last 10 (20) responses received could not reject the null of equal means.
13 The extreme values for SLK, VOL and TAX require some comment. The minimum value for SLK of −7.487 is attributable to the Reserve Bank of Australia and arises from the definition of liquid assets including only cash, marketable securities and account receivable along with the relatively low levels of operating cash received. If we were to use the current ratio, the SLK value would be positive and very small for this entity. The maximum value of SLK of 12.709 is attributable to the Stevedoring Industry Finance Committee that had few liabilities and relatively low levels of operating cash received. The VOL maximum of 3,457% is attributable to the Indigenous Land Corporation that saw phenomenal growth over the period of the study. Dropping this one variable results in a reduction of
Panel B of Table 3 presents the correlation matrix for the variables described in Table 1. There are statistically significant correlations between size (TOT) and three variables, TAX, EXC and CPX. That is, larger entities tend to pay more taxes and dividends, have lower percentages of senior executive salaries and generate greater relative levels of non-government revenue. Further, there is a positive correlation between non-government income and the level of tax and dividend payments consistent with the more commercial nature of the entities that pay taxes and dividends. Similarly, tax and dividend payments are related to the level of liabilities. Financial slack in the previous period is also positively correlated with executive salary concentration suggesting the entities with relatively high proportions of senior management tend to hold greater levels of cash.

[Insert Table 3 about here]

5. Analysis

The dependent variable, derivative use, identifies whether the organisation uses or does not use derivatives in the year 2000. As noted above, the classification of the organisations is made with a high degree of confidence as we are able to cross check financial report disclosure against survey information. The derivative use variable is dichotomous and so logit analysis is applied. The logit model takes the form:

$$\text{Prob}(y_i = 1) = \Lambda(X_i, \beta) = \frac{\exp(X_i, \beta)}{1 + \exp(X_i, \beta)}$$

where $\text{Prob}(y_i = 1) = \text{the probability that the entity uses derivatives}$

$X_i = \text{matrix of explanatory variables}$

the average from 115.7% to 58%. Three other entities, Medibank Private (510%), Export Finance Insurance Corporation (429%) and Australian Dairy Corporation (904%), accounted for the remainder of the extremely volatile operating cash receipt observations. With the removal of these four entities the average volatility falls to 28% across the remainder of the sample. To reduce the impact of these large values the natural log of volatility was used in regressions but this transformation had little impact on the final results. Finally, the larger entities with substantial non-government revenue tend to report tax and dividends values (TAX). Most entities have a zero value for this variable.
\[ \beta = \text{vector of estimated parameters} \]

The full model including all variables, takes the form:

\[ X_i \beta = \alpha_0 + \alpha_1 SLK_i + \alpha_2 VOL_i + \alpha_3 EXC_i + \alpha_4 CPX_i + \alpha_5 TOT_i + \alpha_6 LIAB_i + \alpha_7 TAX_i \]

(7)

where

- \( SLK \) = the ratio of net cash equivalents (sum of cash, accounts receivable and marketable securities less current liabilities) over operating cash received in the immediate past period,
- \( VOL \) = the standard deviation of the percentage change in operating cash received over the period 1996 to 2000 inclusive,
- \( EXC \) = the sum of payments made to directors, executives and officers scaled by total employee expenses,
- \( CPX \) = ratio of non-government income to total income,
- \( TOT \) = the natural log of book value of total assets and,
- \( LIAB \) = book value of liabilities scaled by book value of total assets, and
- \( TAX \) = implied tax charges plus (efficiency) dividends scaled by operating cash received.

Table 4 reports the results of the logit analysis for both the full model and restricted models. In Panel A we report the full model and a series of univariate regressions. In Panel B we assess the impact of the multicollinearity by excluding size (TOT) and other correlated variables. In both panels, two t-statistics are reported based on the traditional Logit standard errors and on bootstrap standard errors.

[Insert Table 4 about here]

First, focus on the full model in Table 4, Panel A and the Logit standard errors. The two statistically significant variables are TOT and LIAB.\(^\text{14}\) The regression is statistically significant with a McFadden R-square value of 0.46. The positive sign on TOT indicates that larger entities are more likely to use derivatives. This finding is consistent with the corporate sector (Smith and Stulz 1985; Nance et al. 1993; Mian

\(^{14}\) There are two large entities whose core business is financial. The Reserve Bank of Australia and the Export Finance Insurance Corporation. The full model was also run excluding these entities with little impact on the regression results.
1996). It would appear that the economies of scale and political costs arguments carry some weight in the public sector. The positive sign on LIAB suggests that the greater the level of liabilities the more likely derivative use will occur. With greater levels of liabilities it is necessary to manage cash flows more carefully and so there is greater incentive to use derivatives. This finding is consistent with evidence from the corporate area. However, the motivation for derivative use in the public sector is in terms of cash flow management rather than financial distress. The remaining coefficients are not statistically significant in the full regression. However, the signs on the coefficients are generally consistent with the hypotheses.

In the univariate regressions, the McFadden R-square statistics vary considerably from 0.00 to 0.34. The univariate regressions that include the variables CPX, TOT, LIAB and TAX are statistically significant. All of these significant coefficients are consistent in sign with the hypotheses. That is, budget complexity, entity size, the level of liabilities and the presence of taxes are all positively related to the probability of derivative use. Further, SLK, although not statistically significant, has a negative sign consistent with the argument that derivative use is less likely if the entity has sufficient cash reserves to provide a buffer for contingencies.

Given the significant correlation between TOT, CPX, EXC and TAX we repeat the analysis in Table 4, Panel B, but selectively exclude these variables. The size variable (TOT) is excluded from all the regressions. In the first regression only the size variable is excluded to identify the impact of this variable. The only statistically significant coefficient remaining in the regression is for the LIAB variable and the McFadden R-square falls from 0.46 to 0.23. The results are consistent with Panel A suggesting that these two variables, TOT and LIAB, capture different motivations for derivative use. When both TOT and LIAB are dropped from the
regression, the model is no longer statistically significant. In the third regression, the TOT and TAX variables are dropped and both CPX and LIAB coefficients are now statistically significant. These variations in the results are not unexpected given the correlations reported in Table 3 and the two univariate regressions reported in Table 4, Panel A.

The results reported so far are based on the fitting of a logistic regression to a sample of 59 observations, albeit that this sample size is close to the population. In order to overcome deficiencies of a small sample, we use the bootstrap technique to re-estimate the standard errors. This technique involves the generation of a distribution of parameter values based on 10,000 iterations of the Logit analysis over resampled data. The bootstrap parameter distribution is used to generate standard errors used in calculation of t-statistics and these bootstrap adjusted t-statistics are reported in brackets below the standard Logit t-statistics. The main result from the bootstrap analysis in Table 4 is the confirmation of the importance of the level of liabilities, and to some extent size, in explaining derivative use. Of note the CPX and TAX parameters are not statistically significant in any of the regressions where the bootstrap method is used in estimation of the standard errors. Size is also less consistent as an explanation of derivative use with statistical significance only evident in the univariate regression in Table 4, Panel A. In Table 5, Panel B the significance of the parameter estimates are not affected by inclusion or exclusion of TOT, LIAB or TAX, and only the level of liabilities is significant at the 10% level.

As argued earlier, it is not expected that value maximising incentives generally applicable to the corporate sector will also explain derivative use in the public sector. The important finding in this paper is that size and the level of liabilities are determinants of derivative use by government entities, albeit the significance of the
size variable is dependent on the estimation method of the standard errors. These variables are often associated with transaction costs and cash management issues yet the traditional literature (Smith and Stulz 1985; Bessembinder 1991) says little about these motivations. We argue that, in the public sector, a reticence for budget discrepancies may drive management derivative use.

6. Conclusions
The question of the motivation for derivatives use is complex. This study is the first to examine derivative use in the public sector. In the main, this is an exploratory paper that presents a framework and base for future research. We observe that the proportion of public sector organisations using derivatives in our sample (22%) is considerably less than evident in studies of Australian private sector derivative use (>50%). We also observe that the reasons advanced for the use of derivatives in the private sector do not readily apply to the public sector. For instance, there is little reason to expect government entities to focus on wealth maximisation as their prime objective or to be overly concerned with financial distress costs. In addition to maximizing value, maximizing managerial utility is often cited as a reason for derivative use in the private sector. Thus in the more complex setting, where managers must attain multiple goals including value maximisation and the provision of mission goods, we argue that management utility will be important in determining derivative use in these organisations. We argue that management utility will be a function of budgets and budget discrepancies. From this it is argued that managers will use derivatives to maximise utility by avoiding budget discrepancies. A series of hypotheses is developed surrounding this argument.

The hypotheses are tested on a sample of Australian Commonwealth government entities. The sample of Australian entities is chosen because of the advanced public sector setting and its structure, devolved financial management principles, corporatisation policy, competitive neutrality policy and the recent introduction of full accrual accounting systems. The results of statistical tests suggest that derivative use is most likely to occur in larger entities consistent with the existence of economies of scale and political costs. Larger entities are better able to absorb the costs of derivative use and the managers in larger entities are also sensitive
to greater political costs. Further, the strongest result is that the greater the level of liabilities, the greater the probability of derivative use. The introduction of liabilities to these entities creates a responsibility to pay interest and this leverage increases the likelihood of budget discrepancies and the complexity of the budgeting process. These results are consistent with the argument that utility maximising managers use derivatives for budget management. There is also some evidence that entities that pay taxes and/or dividends or those that earn greater levels of non-government revenue tend to use derivatives more than their counterparts which also supports the argument that the more complex the management of the budget, the greater the propensity for derivatives use.
Acknowledgements

We thank staff in the various Australian Commonwealth government entities, particularly the respondents to a long and detailed questionnaire, the Commonwealth Department of Finance and Administration and the ACT Branch of CPA Australia for their support. We acknowledge funding support under the Australian Research Council Grants Scheme (A79906283).
Appendix

The Australian Commonwealth Public Sector Environment

The system of Commonwealth government in Australia is based on the Westminster tradition with two houses, the House of Representatives and the Senate. Members of Parliament are elected at least once every three years. The Prime Minister and other Ministers are appointed from the political parties that control a majority of seats in the House of Representatives. The governing Ministers are assigned specific portfolio responsibilities. There are currently 19 ministerial portfolios.

Within each portfolio there are typically many smaller and sometimes separate organisations, that effectively operate as business units. These organisations comprise three types - (1) Commonwealth-owned companies, governed under the Australian Corporations Act; (2) Commonwealth authorities, governed under individual enabling legislation (i.e. their own Acts of the Commonwealth Parliament); and (3) organisations without any separate legal power who derive their power from the power vested in their Commonwealth Departments through various statutes (which in some cases may be Acts of the Commonwealth Parliament specific to the organisation). This final group of organisations are not legally separate from the Commonwealth and have limited contractual powers. For example, they do not have the power to borrow.

Commonwealth authorities and companies (irrespective of whether they are governed by the Corporations Law or their own enabling legislation) are also bound

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15 Legislation must pass through two houses. The House of Representatives is where the governing body resides and legislation generally first passes through the House of representatives before being reviewed by the Senate.
16 The precise number of portfolios is a function of the elected government in power.
17 Oliver (1999) presents a discussion on the legal powers of Commonwealth entities and provides commentary on their powers to enter into derivative contracts.
by the *Commonwealth Authorities and Companies Act 1997* (CAC Act). The CAC Act regulates certain aspects of the financial affairs of Commonwealth authorities. In particular, the Act includes detailed rules for financial reporting, accountability measures and covers other financial matters such as banking, investment and the conduct of managers. For Commonwealth-owned companies, the CAC Act sets out reporting requirements and other requirements that apply in addition to the generic requirements of the *Corporations Law*.

Organisations that are not legally separate from the Commonwealth are bound by the legislation authorising their establishment and the *Financial Management and Accountability Act 1997*. The main purpose of this Act is to provide a framework for the management of public money and property. This study focuses on those organisations governed by the CAC Act, excluding those covered by the FMA Act given the limited autonomy of these latter entities.

In brief, the use of derivatives by Australian Commonwealth government entities is governed both by the law and the underlying nature of the entities. In some instances, entities have been initially barred from using derivatives yet managers within the entity have been successful in having the enabling legislation altered to allow the use of derivatives. Thus although legal impediments may exist to prevent the use of derivatives, they need not represent a permanent block to the use of derivatives.
References


Table 1
Hypotheses and Variable Definitions

This table details the hypotheses, the expected relationship with derivative use, the variable and how it is measured.

<table>
<thead>
<tr>
<th>Hypothesis (expected sign)</th>
<th>Variable</th>
<th>Proxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 Management of cash holdings (-)</td>
<td>SLK</td>
<td>Ratio of net cash equivalents (sum of cash, accounts receivable and marketable securities less current liabilities) over operating cash received in the immediate past period</td>
</tr>
<tr>
<td>H2 Volatility of budget discrepancy (+)</td>
<td>VOL</td>
<td>Standard deviation of percentage change in the operating cash received over the period 1996 to 2000 inclusive</td>
</tr>
<tr>
<td>H3 Salary level concentration (+)</td>
<td>EXC</td>
<td>Concentration of executive salaries measured using the sum of payments made to directors, executives and officers scaled by total employee expenses</td>
</tr>
<tr>
<td>H4 Budget complexity (+)</td>
<td>CPX</td>
<td>Non-government income scaled by total income</td>
</tr>
<tr>
<td>H5 Economies of scale (+)</td>
<td>TOT</td>
<td>Size is measured using natural log of book value of total assets</td>
</tr>
<tr>
<td>H6 Liability management (+)</td>
<td>LIAB</td>
<td>Book value of liabilities scaled by book value of total assets</td>
</tr>
<tr>
<td>H7 Taxes and dividends (+)</td>
<td>TAX</td>
<td>Implied tax charges plus (efficiency) dividends scaled by operating cash received</td>
</tr>
</tbody>
</table>
Table 2
Sample of Organisations of the Commonwealth of Australia

This table details the composition of the sample of organisations used in the analysis (n=59). It commences with the population of government organisations (n=180) identified from the Commonwealth Consolidated Annual Report for the year ended 30 June 1999 and then indicates why some organisations are excluded from the analysis.

<table>
<thead>
<tr>
<th>Type of organisation</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>The total number of Commonwealth organisation included in the Commonwealth Consolidated Annual Report for the year ended 30 June 1999</td>
<td>180</td>
</tr>
<tr>
<td><strong>Less</strong></td>
<td></td>
</tr>
<tr>
<td>FMA organisations (these are organisations that are not separate legal entities of the Commonwealth and are governed wholly or in part under the FMA Act (1997))</td>
<td>84</td>
</tr>
<tr>
<td>Possible derivative users consisting of:</td>
<td>96</td>
</tr>
<tr>
<td>Commonwealth companies (these are organisations that have separate legal status and are governed under Corporations Law and the CAC Act (1997))</td>
<td>16</td>
</tr>
<tr>
<td>Commonwealth statutory authorities (these are organisations that have separate legal status and are governed by their own enabling legislation and the CAC Act (1997))</td>
<td>80</td>
</tr>
<tr>
<td><strong>Possible derivative users</strong></td>
<td>96</td>
</tr>
<tr>
<td><strong>Less</strong></td>
<td></td>
</tr>
<tr>
<td>Non-response or inadequately completed questionnaire</td>
<td>35</td>
</tr>
<tr>
<td>Validly completed questionnaires</td>
<td>61</td>
</tr>
<tr>
<td><strong>Less</strong></td>
<td></td>
</tr>
<tr>
<td>No accounting information</td>
<td>2</td>
</tr>
<tr>
<td><strong>Final sample used in the study, consisting of:</strong></td>
<td>59</td>
</tr>
<tr>
<td>Commonwealth companies (these are organisations that have separate legal status and are governed under Corporations Law and the CAC Act (1997))</td>
<td>4</td>
</tr>
<tr>
<td>Commonwealth statutory authorities (these are organisations that have separate legal status and are governed by their own enabling legislation and the CAC Act (1997))</td>
<td>55</td>
</tr>
</tbody>
</table>
Table 3
Explanatory Variables

This table reports descriptive statistics and the correlation matrix of explanatory variables. SLK - the ratio of net cash equivalents (sum of cash, accounts receivable and marketable securities less current liabilities) over operating cash received in the immediate past period; VOL - the standard deviation of the percentage change in operating cash received over the period 1996 to 2000 inclusive; EXC - the sum of payments made to directors, executives and officers scaled by total employee expenses; CPX - the ratio of non-government income to total income; TOT - the natural log of book value of total assets; LIAB - the book value of liabilities scaled by book value of total assets; TAX - implied tax charges plus (efficiency) dividends scaled by operating cash received.

Panel A: Descriptive Statistics of Explanatory Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Median</th>
<th>Max.</th>
<th>Min.</th>
<th>Std. Dev.</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPX</td>
<td>0.315</td>
<td>0.176</td>
<td>1.000</td>
<td>0.006</td>
<td>0.344</td>
<td>1.159</td>
<td>2.810</td>
</tr>
<tr>
<td>LIAB</td>
<td>0.360</td>
<td>0.297</td>
<td>1.098</td>
<td>0.001</td>
<td>0.315</td>
<td>0.758</td>
<td>2.486</td>
</tr>
<tr>
<td>EXC</td>
<td>0.183</td>
<td>0.082</td>
<td>1.000</td>
<td>0.000</td>
<td>0.233</td>
<td>1.985</td>
<td>6.512</td>
</tr>
<tr>
<td>SLK</td>
<td>0.352</td>
<td>0.023</td>
<td>12.709</td>
<td>-7.487</td>
<td>2.163</td>
<td>2.837</td>
<td>22.717</td>
</tr>
<tr>
<td>TAX</td>
<td>0.005</td>
<td>0.000</td>
<td>0.094</td>
<td>0.000</td>
<td>0.020</td>
<td>3.598</td>
<td>14.371</td>
</tr>
<tr>
<td>TOT</td>
<td>10.697</td>
<td>10.167</td>
<td>17.835</td>
<td>6.262</td>
<td>2.456</td>
<td>0.530</td>
<td>2.831</td>
</tr>
<tr>
<td>VOL</td>
<td>1.157</td>
<td>0.183</td>
<td>34.570</td>
<td>0.015</td>
<td>4.647</td>
<td>6.556</td>
<td>47.033</td>
</tr>
</tbody>
</table>

Panel B: Correlation Matrix of Explanatory Variables

<table>
<thead>
<tr>
<th></th>
<th>CPX</th>
<th>LIAB</th>
<th>EXC</th>
<th>SLK</th>
<th>TAX</th>
<th>TOT</th>
<th>VOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPX</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIAB</td>
<td>0.090</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXC</td>
<td>0.012</td>
<td>-0.002</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLK</td>
<td>0.086</td>
<td>-0.058</td>
<td>0.271*</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAX</td>
<td>0.499*</td>
<td>0.249*</td>
<td>-0.109</td>
<td>0.107</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOT</td>
<td>0.292*</td>
<td>0.106</td>
<td>-0.252*</td>
<td>-0.132</td>
<td>0.307*</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>VOL</td>
<td>-0.023</td>
<td>-0.055</td>
<td>0.134</td>
<td>0.007</td>
<td>-0.006</td>
<td>0.140</td>
<td>1.000</td>
</tr>
</tbody>
</table>

* Statistically significant at the 5% level of significance.
Table 4
Analysis of Derivative Use

Results of logistic regression analysis of the derivative use question are reported in this table. The derivative use dummy variable is regressed on the variables: SLK - the ratio of net cash equivalents (sum of cash, accounts receivable and marketable securities less current liabilities) over operating cash received in the immediate past period; VOL - the standard deviation of the percentage change in operating cash received over the period 1996 to 2000 inclusive; EXC - the sum of payments made to directors, executives and officers scaled by total employee expenses; CPX - the ratio of non-government income to total income; TOT - the natural log of book value of total assets; LIAB - the book value of liabilities scaled by book value of total assets; TAX - implied tax charges plus (efficiency) dividends scaled by operating cash received. Logit is used for estimation.

\[
\text{Prob}(y_i = 1) = \Lambda(X, \beta) = \frac{\exp(X_i\beta)}{1 + \exp(X_i\beta)}
\]

\[
X_i\beta = \alpha_0 + \alpha_1SLK_i + \alpha_2VOL_i + \alpha_3EXC_i + \alpha_4CPX_i + \alpha_5TOT_i + \alpha_6LIAB_i + \alpha_7TAX_i
\]

Prob\((y_i=1)\) is the probability that the company uses derivatives, \(X_i\) is a matrix of explanatory variables, \(\beta\) is a vector of estimated parameters. The full regression is run over 59 observations.

Due to the problems associated with the application of Logit to small sample sizes, alternative standard error estimates were obtained through bootstrapping. There were 10,000 iterations conducted for each model. This technique involves re-sampling cases and repeating the Logit analysis on this resampled data. The estimated parameters were saved and at the end of the 10,000 iterations the standard error was calculated for each parameter using the distribution of parameter estimates. The technique is further discussed in Lunneborg (2000) and Johnston and DiNardo (1997).
Panel A – Full Model and Univariate Models

There are eight regressions run. The first regression includes all variables and the remaining seven regressions are simple regressions with the dependent variable regressed on one of the explanatory variables.

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-11.95</td>
<td>-1.23</td>
<td>-1.29</td>
<td>-1.07</td>
<td>-10.01</td>
<td>-2.34</td>
<td>-1.52</td>
</tr>
<tr>
<td></td>
<td>(-3.54*)</td>
<td>(-3.89*)</td>
<td>(-3.97*)</td>
<td>(-2.68*)</td>
<td>(-4.02*)</td>
<td>(-3.78*)</td>
<td>(-3.93*)</td>
</tr>
<tr>
<td></td>
<td>[-4.32*]</td>
<td>[-3.60*]</td>
<td>[-3.35*]</td>
<td>[-2.43*]</td>
<td>[-4.23*]</td>
<td>[6.21*]</td>
<td>[-4.43*]</td>
</tr>
<tr>
<td>SLK</td>
<td>-0.65</td>
<td>-0.20</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>(-1.50)</td>
<td>(-0.96)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>(-0.03)</td>
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<td></td>
</tr>
<tr>
<td></td>
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<td>[0.02]</td>
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</tr>
<tr>
<td>EXC</td>
<td>0.70</td>
<td>-1.19</td>
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</tr>
<tr>
<td></td>
<td>(0.29)</td>
<td>(-0.73)</td>
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<tr>
<td></td>
<td>[0.11]</td>
<td>[-0.54]</td>
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</tr>
<tr>
<td>CPX</td>
<td>-0.28</td>
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<tr>
<td>TOT</td>
<td>0.82</td>
<td>0.75</td>
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</tr>
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<td></td>
<td>(3.07*)</td>
<td>(3.51*)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.37]</td>
<td>[5.05*]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIAB</td>
<td>3.03</td>
<td>2.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.95*)</td>
<td>(2.46*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[14.76*]</td>
<td>[2.11*]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>TAX</td>
<td>27.80</td>
<td>37.67</td>
<td></td>
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<td>(2.17*)</td>
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<td>[0.10]</td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>LR statistic (7 df)</td>
<td>28.91</td>
<td>1.18</td>
<td>0.12</td>
<td>0.61</td>
<td>4.98</td>
<td>21.39</td>
<td>6.55</td>
</tr>
<tr>
<td>Probability (LR stat)</td>
<td>0.00*</td>
<td>0.28</td>
<td>0.73</td>
<td>0.44</td>
<td>0.03*</td>
<td>0.00*</td>
<td>0.01*</td>
</tr>
<tr>
<td>McFadden R-squared</td>
<td>0.46</td>
<td>0.02</td>
<td>0.00</td>
<td>0.01</td>
<td>0.08</td>
<td>0.34</td>
<td>0.11</td>
</tr>
<tr>
<td>Obs with Dep=0</td>
<td>46</td>
<td></td>
<td></td>
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<tr>
<td>Obs with Dep=1</td>
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<td></td>
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<tr>
<td>Total obs</td>
<td>59</td>
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</table>

* significant at the 5% level, + significant at the 10% level, terms in parentheses are Logit t-statistics and terms in brackets are Logit based bootstrap t-statistics.
Panel B – Restricted Full Models

There are three regressions reported in this panel. The first includes all the variables excluding the size (TOT) variable. The second consists of all variables except for size (TOT) and liabilities (LIAB). The final of the three regressions consists of all the variables excluding size (TOT) and tax and dividends (TAX).

<table>
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<th></th>
<th>C</th>
<th>SLK</th>
<th>VOL</th>
<th>EXC</th>
<th>CPX</th>
<th>LIAB</th>
<th>TAX</th>
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<td>-2.68</td>
<td>-0.23</td>
<td>0.05</td>
<td>-1.14</td>
<td>1.22</td>
<td>2.35</td>
<td>22.94</td>
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<td>(-3.37*)</td>
<td>(-0.87)</td>
<td>(0.78)</td>
<td>(-0.63)</td>
<td>(0.94)</td>
<td>(2.02*)</td>
<td>(0.98)</td>
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<td>[-3.15*]</td>
<td>[-0.23]</td>
<td>[0.04]</td>
<td>[-0.42]</td>
<td>[0.79]</td>
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<td>[0.09]</td>
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<tr>
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<td>-0.26</td>
<td>0.03</td>
<td>-0.41</td>
<td>0.96</td>
<td>2.70</td>
<td>35.79</td>
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<tr>
<td></td>
<td>(-3.06*)</td>
<td>(-1.08)</td>
<td>(0.52)</td>
<td>(-0.25)</td>
<td>(0.83)</td>
<td>(2.07*)</td>
<td>(1.51)</td>
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<tr>
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<td>[-2.64*]</td>
<td>[-0.30]</td>
<td>[0.03]</td>
<td>[-0.15]</td>
<td>[1.32]</td>
<td>[1.89+]</td>
<td>[0.13]</td>
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<tr>
<td></td>
<td>-2.94</td>
<td>-0.14</td>
<td>0.06</td>
<td>-1.61</td>
<td>2.03</td>
<td>2.07</td>
<td>12.98</td>
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<tr>
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<td>(-3.74*)</td>
<td>(-0.64)</td>
<td>(0.88)</td>
<td>(-0.90)</td>
<td>(2.07)</td>
<td>(2.40*)</td>
<td>(1.51)</td>
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<tr>
<td></td>
<td>[-3.60*]</td>
<td>[-0.17]</td>
<td>[0.05]</td>
<td>[-0.60]</td>
<td>[1.32]</td>
<td>[1.89+]</td>
<td>[0.13]</td>
</tr>
</tbody>
</table>

LR statistic (6 df) | 14.11 | 9.85 | 12.98
atóprobability (LR stat) | 0.03* | 0.08 | 0.02*
McFadden R-squared | 0.23 | 0.16 | 0.21
Obs with Dep=0 | 46
Obs with Dep=1 | 13
Total obs | 59

* significant at the 5% level, + significant at the 10% level, terms in parentheses are Logit t-statistics and terms in brackets are Logit based bootstrap t-statistics.