

**THE DETERMINANTS OF CORPORATE LEVERAGE:
A PANEL DATA ANALYSIS**

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Research Discussion Paper
9313

December 1993

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Reserve Bank of Australia

We would like to thank Warren Tease for comments and Denzil Fiebig for technical guidance. The views expressed herein are those of the authors and do not necessarily reflect those of the Reserve Bank of Australia.

ABSTRACT

Widespread increases in corporate leverage occurred over the 1980s in Australia. There was also considerable variation in leverage across firms. This paper uses a sample of 209 firms, observed annually between 1973 and 1991, to explore both cross-sectional and time variation in financial structure. The paper begins with a survey of the literature on corporate financial structure. This leads to a model that incorporates the major determinants of leverage. The empirical model takes into account the influence of both firm-specific and time-specific effects. The dynamics of leverage are also tentatively explored. The results suggest that a number of firm-related factors influence the relative costs of debt, the level of demand for and the availability of funds. Most important among these are firm size, growth, collateral and cash flow. A number of macro-economic variables are also found to influence leverage. Most important among these are real asset prices which play a significant role in the post-financial deregulation period.

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1. INTRODUCTION

This paper examines the determinants of capital structure decisions made by Australian non-financial corporations.

In a fundamental sense, the value of a firm is the discounted stream of expected cash flows generated by its assets. The assets of a firm are financed by investors who hold various types of claims on the firm's cash flows. Debt holders have a relatively safe claim on the stream of cash flows through contractual guarantees of a fixed schedule of payments. Equity holders have a more risky claim on the residual stream of cash flows. The mix of debt funds and equity funds (leverage) employed by a firm define its capital structure. Firms attempt to issue the particular combination of debt and equity, subject to various constraints, that maximises overall market value. The mix of funds affects the cost and availability of capital and, thus, firms' real decisions about investment, production and employment.¹

Under certain restrictive assumptions, a firm's value is independent of its mix of debt and equity. This hypothesis is embodied in the original Modigliani and Miller (1958) value-invariance proposition. It relies upon the argument that the weighted average cost of capital remains constant as leverage changes (Copeland and Weston, 1983, p. 384). Assuming that the returns to investment projects are independent of the means used to finance them, this framework implies that leverage has no influence on the value of a firm's discounted stream of expected cash flows.

This controversial proposition has prompted a thorough investigation of the reasons why we observe a majority of firms placing a great deal of importance on their

¹ See Mills, Morling and Tease (1993), Lowe and Rohling (1993), Cantor (1990), Bernanke and Campbell (1988) and the references cited therein.

financial structure.² As Merton Miller (1988, p. 100) observed, “looking back now, perhaps we should have put more emphasis on the other, upbeat side of the “nothing matters” coin: showing what *doesn't* matter can also show, by implication, what *does*.” The burgeoning literature relating financial structure to firm value has generated a number of theories predicting that a variety of firm, institutional and macro-economic factors should influence leverage decisions. In this paper we model leverage as a function of these suggested factors.

Panel data techniques are used to explore the relationship between leverage and its suggested determinants.³ Lowe and Shuetrim (1992) describe, in full, the database used in this study. Models of leverage are estimated using both balanced and unbalanced samples of firms. The balanced sample contains 105 companies, each of which has data extending from 1973 to 1990. The unbalanced sample is comprised of 209 firms, each of which had a contiguous series of observations over a subset of the time dimension.⁴

Our results suggest that firms prefer to finance investments using retained earnings. We also find that leverage is positively related to size, growth and the percentage of a firm's assets that are collateralizable. In addition to these firm-related factors, we note an upward trend in leverage over the 1980s, much of which can be explained by movements in real asset prices. Finally, our results highlight the fact that unobserved characteristics of firms account for a large proportion of the cross-sectional variation in financial structure.

The rest of the paper is organised as follows. Section 2 reviews the recent theoretical and empirical literature on capital structure choice and outlines some general themes that emerge. Section 3 presents an empirical model of leverage

² A management survey by Allen (1991) found that 75 per cent of companies sampled had a leverage target. Over 90 per cent of companies indicated that they had a policy of maintaining spare debt capacity.

³ Recent empirical studies on corporate financial structure in Australia include Gatward and Sharpe (1992) and Allen (1992).

⁴ We omit two types of firms from our sample: those that had negative equity and those that made losses that were greater than the value of the firm. These restrictions reduced the original sample of 224 firms used in the paper by Lowe and Shuetrim (1992) to a sample of 209 firms.

based upon the determinants that emerge in the literature review. Section 4 reports estimation results from the balanced panel of firms. Finally, Section 5 summarises and concludes. The results from the unbalanced panel of firms are reported in Appendix 2.

2. CAPITAL STRUCTURE: THEORY AND EVIDENCE

Theories of capital structure have been well documented in the literature and we provide only a short review here.⁵ In this section we identify the main strands of the theoretical literature and draw out general principles that have enjoyed some empirical support in econometric studies and/or in management surveys. We also look at some macro-economic and institutional factors that may affect financial structure choices. These general themes provide a useful framework for assessing the recent Australian experience.

Modigliani and Miller's (1958) seminal paper on corporate financial structure is founded upon a number of restrictive assumptions. These assumptions include no transaction costs, no taxes or inflation, the equality of borrowing and lending rates, no bankruptcy costs and independence of financing and investment decisions. There is a substantial body of literature explaining the consequences of relaxing one or more of these assumptions. This literature demonstrates that, once the restrictive assumptions are relaxed, firms are able to alter their discounted stream of expected cash flows (their value) by varying leverage.

There are two main strands in the literature following Modigliani and Miller. The first strand implies an internal solution to the problem of optimising leverage. The internal solution (target leverage ratio) is defined as that mix of debt and equity which maximises the value of the firm. Firms equilibrate the costs of debt, relative to equity, to determine their optimal leverage. The second strand, in its strongest form, is distinguished by the implication that internal funds (retained earnings) are always cheaper than debt funds which are always cheaper than funds raised on external equity markets. As a result, leverage is determined by the demand for funds in excess of limited internal resources. This "fund cost hierarchy" tends to

⁵ See literature surveys by Harris and Raviv (1991) and Masulis (1988).

arise from models that focus upon a single determinant of the relative costs of different fund types. When other wrinkles are introduced into the Modigliani-Miller framework, the fund cost differentials become blurred. This blurring helps explain why we tend to observe firms adopting a mix of fund types. Section 2.1 explores the first approach while Section 2.2 explores the second approach.

2.1 Target Leverage Models

Many papers have been written, beginning with Modigliani and Miller (1958), about the effects of introducing taxation into the Modigliani-Miller framework. Other papers have introduced the costs associated with bankruptcy and financial distress while others have added various transaction and agency costs (costs associated with conflicts of interest between debt holders, equity holders and firm management) to the models of financial structure. All of these costs are influenced by leverage. Below, we consider these various wrinkles in the original Modigliani-Miller framework.

2.1.1 Taxation

When taxation is introduced into the model, cash flows are divided between debt holders, equity holders and the government. The value maximising capital structure becomes that which minimises the portion of cash flows that goes to the government. By incorporating a tax on corporate profits, Modigliani and Miller (1958 and 1963) show that tax deductibility of interest payments make it optimal for firms to rely *entirely* upon debt. Miller (1977) extends this work, deriving an expression for the gain from leverage when different tax rates are applied to corporate profit, personal earnings from stocks and personal interest earnings. He shows that the incentive to finance completely through debt disappears under a variety of tax regimes. Most significantly for Australia, the gains from leverage are zero if full dividend imputation occurs and the marginal income tax rate for the investor is equal to the corporate tax rate. Pender (1991) gives a thorough analysis of the tax bias toward debt in Australia while Pender and Ross (1993) and Callen, Morling and Pleban (1992) discuss the effects of dividend imputation.

In his 1977 paper, Miller also suggests that clientele effects (whereby firms attract those investors that suit their degree of leverage) may reduce or negate the tax related gains from leverage for any single firm.

DeAngelo and Masulis (1980) emphasise that the tax induced gains from leverage are reduced if a firm's expected income stream, against which interest expenses can be deducted, is less than the firm's total interest expenses. Importantly, they note that the presence of deductions from taxable income, other than interest payments, reduces the expected gains from leverage. These non-interest tax deductions are generally known as "non-debt tax shields". Examples include accelerated depreciation allowances and investment tax credits.

Despite these offsetting factors, it appears that the tax system remains an important influence on capital structure choice. In Allen's (1991) survey of listed Australian companies, 85 per cent of firms stated that tax issues have a major impact on capital structure decisions.

Two implications of the influence of taxation on capital structure choices are: (i) optimal leverage may increase as corporate tax rates rise (Furlong, 1990), and (ii) optimal leverage may increase with the amount of income against which firms expect to be able to offset interest expenses (Kale, Noe and Ramirez, 1991).

2.1.2 Bankruptcy and Financial Distress Costs

In the Modigliani-Miller world there are no bankruptcy costs. In the event that a firm is unable to meet contractual obligations, the firm is costlessly transferred to its bondholders. In reality, bankruptcy imposes *both* direct and indirect costs on the firm. Direct costs include legal expenses, trustee fees and other payments that accrue to parties other than bondholders or shareholders. Indirect costs include disruption of operations, loss of suppliers and market share and the imposition of financial constraints by creditors. These indirect costs of bankruptcy (and the financial distress costs that may occur even if the firm does not enter bankruptcy) can be very significant. Altman (1984) finds that indirect bankruptcy costs average 17.5 per cent of firm value one year prior to bankruptcy. These bankruptcy/financial distress costs carry a number of implications for capital structure choices.

First, optimal debt levels may be inversely related to measures of financial risk (for example, cash flow volatility). Empirical support for this relationship is mixed. Castanias (1983) and Bradley, Jarrell and Kim (1984) find an inverse relationship between corporate leverage and business risk but Long and Malitz (1985) find evidence of a positive relationship. Titman and Wessels (1988) conclude there is no significant relationship between the variables.

Second, optimal leverage ratios may be positively related to firm size. If bankruptcy costs include a fixed component, these costs constitute a larger fraction of the value of a firm as firm size decreases (Ang, Chua and McConnell, 1982). Large companies may also have lower risk through diversification, more stable cash flows and established operating and credit histories. These factors provide large firms with greater access to alternative sources of finance in times of financial distress. This may reduce the present value of expected bankruptcy costs for large firms, thus encouraging them to take on relatively high debt burdens.

Third, leverage may be positively related to the value of firms' collateralizable assets or liquidation values (Gertler and Gilchrist, 1993, Bradley, Jarrell and Kim, 1984 and Chaplinsky and Niehaus, 1990). Higher liquidation values reduce the expected losses accruing to debt holders in the event of financial distress, thus making debt less expensive.

2.1.3 Agency Costs

Agency costs of debt are borne by firm owners as the result of potential conflicts between debt holders and equity holders and between managers and equity holders (see Harris and Raviv, 1991, and references cited within). The choice of capital structure can, in some circumstances, reduce the costs arising from these conflicts.

Jensen and Meckling (1976) highlight the agency costs arising from the fact that equity holders have limited liability while debt holders have fixed maximum returns. In the event that an investment is successful, equity holders capture most of the gain. If the investment is unsuccessful, however, debt holders share the burden with equity holders. This asymmetry of expected returns may provide incentives for managers, acting on behalf of equity holders, to pursue risky investment projects, even where those projects have a *negative* net present value.

Alternatively, agency costs may arise between managers and equity holders if projects are financed using debt. Because managers stand to lose their jobs, their reputation and their firm-specific capital in the event of financial failure and because they cannot diversify this risk, managers may choose not to engage in projects with positive net present values if they must use debt finance (Lowe and Rohling, 1993). This type of agency cost can be reduced by the use of equity fund sources.

Jensen (1986) also proposes a "control hypothesis" that focuses upon a type of agency cost which can be reduced by high debt levels. He argues that if a firm has large free cash flows (cash flows in excess of those required to finance all projects with positive net present values) then managers may spend funds on projects with negative net present values. Jensen suggests that managers have an incentive to waste funds in this way because management remunerations are positively correlated with firm size. High debt may diminish this incentive because the interest burden reduces free cash flow. Jensen postulates that this incentive towards debt eventually balances the other agency costs associated with high debt levels to determine the firm's optimal leverage.

While the agency cost literature is replete with theoretical models, testable implications are scarce. One testable implication is that a negative relationship exists between leverage and firms' growth opportunities. This negative relationship arises in two ways. Titman and Wessels (1988) note that, because growth opportunities are not fully collateralizable (they are very difficult to monitor and value), creditors demand a relatively high return when providing finance for these opportunities. Thus, firms with significant growth opportunities are expected to look to equity rather than debt as a source of finance. Similarly, firms in growing industries may have greater flexibility in their choice of investments, allowing equity holders greater freedom to expropriate wealth from bondholders. Either way the costs of debt for rapidly growing firms may lead to a preference for equity funds.

In summary, agency cost theories imply that corporate leverage is chosen, in a rather complex fashion, to reduce the capacity of shareholders to act in a manner contrary to the welfare of bondholders and to reduce managers' capacity to act in a manner contrary to shareholders' interests. Empirical support for the implications of agency costs is mixed. Titman and Wessels (1988) find that leverage is inversely related to firms' growth opportunities while Kester (1986) does not find a significant relationship. The results in Long and Malitz (1985) are inconclusive. The

theoretical predictions that leverage is positively associated with default probability and with free cash flow are rejected by Castanias (1983) and Chaplinsky and Niehaus (1990) respectively.

2.2 Financing Hierarchies

Some theories of corporate financial structure suggest that internally generated cash flows are the cheapest form of finance, debt is the next most expensive form and external equity is the most expensive form. To minimise the total cost of funds, managers use the cheapest fund sources first. However, given that internal fund sources are limited, firms are often forced to look beyond their internal resources to credit and equity markets and to pay the premiums attached to these external sources.

Fund cost hierarchies are consistent with a variety of wrinkles in the Modigliani-Miller framework, the most commonly referenced being those related to asymmetric information issues. However, transaction costs, flexibility, liquidity constraints and ownership dilution considerations can all lead to an overriding preference for internally generated funds. These theories are outlined below.

2.2.1 Asymmetric Information

In their most basic form, asymmetric information theories argue that managers have more information about the firm than do investors. Investors, knowing this, infer that managers are more likely to raise equity when share prices are over-valued. With this understanding, investors price equity issues at a discount. This discounting of share issues can force firms to forego projects even though they have positive net present values. The prohibitive costs of external equity can be sidestepped, however, if firms are able to use retained earnings. The problem can also be partly overcome by firms if they develop a reputation of providing true and accurate information.

Asymmetric information can also generate a premium on debt funds through the same mechanism. Again, the premium can force firms with exhausted internal funds to forego some projects with positive net present values. However, the premium on debt will be less than that on external equity because debt contracts involve less risky streams of income and hence debt is less prone to sharp revaluations when the

true values of investments are revealed. As a result, firms may tend to use internal funds first, then debt and finally externally raised equity. See, for example, Myers and Majluf (1984) and references cited in Harris and Raviv (1991).

2.2.2 Transaction Costs, Flexibility, Liquidity Constraints and Ownership Dilution

A variety of market imperfections are also capable of explaining variation in the relative costs of different fund types. First, costs and delays involved in raising funds on equity markets (for example, broker charges, underwriting fees and the issue of prospectuses) may lead to a preference for internal equity and debt over external equity. An assumption in the Modigliani-Miller value-invariance proposition is that capital markets are frictionless (there are no transaction costs and transactions occur instantaneously). In practice, however, this is not the case. As noted in Allen (1991, p. 113), "many [companies] stated that equity issues were costly and time consuming ... debt funding had the advantage of being quick to obtain". Firms may prefer internal funds and debt because transaction costs are lower, especially for smaller firms, and because they give firms the flexibility to respond quickly as investment opportunities arise. This is supported by the Industry Commission's "Availability of Capital" report (1991, p. 155) which suggests that the larger the equity issue, the cheaper are the fees associated with issuance.

It should be noted that debt involves slower access and higher transaction costs than internal fund sources which can be brought to bear almost immediately. This may lead to a preference for internal funds over debt.

Second, some firms may prefer to maintain informational asymmetries. If internal funds are used, there is no requirement to subject the firm to external scrutiny. Similarly, where debt finance is used, information is provided to bankers, but there is no requirement for the disclosure of information to the capital market, competitors, or to shareholders. The advantages of privacy and the costs of releasing information may generate a fund cost hierarchy.

Third, when new equity is issued to new owners, it may dilute the claims of existing shareholders. Pinegar and Wilbricht (1989) list the dilution of shareholders' funds as an important consideration in the capital structure decisions of US managers.

A financing hierarchy implies that the observed mix of debt and equity reflects firms' cumulative requirements for external finance and this, in turn, reflects the relationship between cash flows and investment demands. Which of these various factors are primarily responsible for the observed preferences for internal funds over debt is conjectural. However, it is likely that each factor has some influence. In any event, empirical support for financial hierarchies is strong. Fund cost hierarchies imply a negative relationship between cash flow and leverage because, as cash flows increase, firms are able to rely more heavily on internal funds. Also, if firms operate under a fund cost hierarchy, those with large growth opportunities should assume larger debt burdens. This behaviour is anticipated because firms will have exhausted their internal fund resources.

These predictions are borne out in recent papers by Chaplinsky and Niehaus (1990) and Amihud, Lev and Travlos (1990). These papers find evidence that there is a "pecking order", with firms preferring internally generated funds over external securities. Allen's (1991) management survey found that more than half of the firms had a preference for internal funds and the remainder generally preferred a mix of internal funds and some debt. Where new finance was required, debt was preferred. The issue of equity was not the preferred source of funds for any of the respondents. These findings are consistent with the US management survey by Pinegar and Wilbricht (1989) which found that 84 per cent of respondents ranked internal equity as their first choice of finance.

A caveat must be placed upon the predictions of the fund cost hierarchy models. There are significant costs associated with extreme reliance upon a single fund source. For example, a strong preference for internal funds, resulting in very low levels of debt, may expose a firm to takeovers that could be financed using the firm's own debt capacity. Also, a heavy reliance upon debt results in high risks of bankruptcy. Nevertheless, the cost structures underlying the fund cost hierarchy may well govern firms' preferred fund sources over moderate ranges.

2.3 Macro-economic and Institutional Characteristics

The evolution of Australian corporate balance sheets, over the last two decades, has been documented by Lowe and Shuetrim (1992).⁶ After remaining relatively

⁶ Mills, Morling and Tease (1993) examine changes over the last few years.

constant through the 1970s, leverage increased substantially between 1982 and 1988. In large part, this rise was facilitated by the liberalisation of Australia's financial markets during the first half of the 1980s.⁷

Prior to liberalisation, banks were often forced to ration credit. Controls on both lending growth and interest rates meant that banks could not use prices to equate loan supply and demand. As a result, increased demand for debt often meant that the queue of borrowers simply lengthened. Following deregulation, this need to ration credit disappeared.

At around the same time as the deregulation of Australia's financial markets, there was a cyclical pick-up in economic activity and a change in factor shares towards profits. To some extent, an increase in asset prices was justified in terms of fundamentals; higher profits and dividends for equity holders and higher rents for property owners. However, the improvement in fundamentals led, not only to legitimate increases in real asset prices, but set off speculative increases over and above those justified by the fundamentals.⁸ The increase in real asset prices raised the value of "collateral" for many firms and, as Lowe and Rohling (1993) suggest, this collateral increased both the willingness of financial institutions to extend credit and the willingness of firms to seek credit. This process may have added further stimulus to asset prices. More recently, falls in real asset prices have worked in the opposite direction, both increasing the difficulty of obtaining debt finance and reducing the willingness of managers to apply for debt finance.

In addition to increases in real asset prices, general goods price inflation may also provide an incentive towards high leverage because of the tax deductibility of *nominal* interest payments. Nominal interest payments can be separated into two components, one compensating creditors for the decline in the expected real value of their principal and the other for the use of the borrowed funds (the real interest paid). The borrower receives a tax deduction, not only on that component which reflects the real cost of funds but also on that part which represents compensation for reduction in the real value of the principal. The higher is inflation, the greater is

⁷ Underlying these developments has been a trend rise in the use of external financing in other parts of the world (Masulis, 1988).

⁸ For greater detail see Macfarlane (1989 and 1990) and Stevens (1991).

the tax deduction gained through this second component. However, as discussed earlier, the tax advantages of debt disappear under certain conditions. In particular, if borrowing rates increase more than one for one with inflation (to keep after tax real returns unchanged) the increased tax deduction that inflation creates may be completely offset by higher borrowing costs.

It is also likely that an aggregate measure of the real cost of debt and an aggregate measure of the real cost of equity influence firms' gearing decisions. In equilibrium, the cost of debt, plus some risk premium, should be equal to the cost of equity. However, equilibrium conditions may not hold continuously. If this is the case, and if the deviations in the relative real cost of debt are not just firm-specific, then this factor may influence managers' gearing decisions. When the real cost of debt rises relative to the real cost of equity, firms can be expected to increase their gearing.

2.4 An Overview

Our review of the literature reveals several general principles that have some empirical support and which may be reflected in the Australian data.

- Within moderate ranges, firms should exhibit a preference for internal funds over external securities. Again within moderate ranges, when external funds are required, firms should prefer debt to equity. The preference for internal funds should be evident in a negative relationship between firms' cash flow and their reliance on debt.
- The various costs (explicit and implicit) associated with external finance may be lower for those firms with smaller informational asymmetries between the various stakeholders (debt holders, equity holders, managers, creditors, customers, and employees). They may also be smaller for large firms.

If firms require external funds, then their leverage is determined by the tradeoff between the relative costs of debt and equity as proposed by the first strand in the corporate financial structure literature. Most importantly:

- Leverage should be negatively related to firms' inherent riskiness through the effect of risk on the expected costs of bankruptcy and financial distress. This implies that leverage may be positively related to collateral (the proportion of a firm's assets that are readily resaleable) and negatively related to cash flow volatility.
- Leverage should be set by firms to minimise their effective tax rates. This link ought to vary across firms but will not be clearly observed. Also, the tax advantages of debt should decline if interest payments cannot be fully deducted from earnings.
- Leverage may be positively or negatively related to growth depending upon whether the fund cost hierarchy approach or the leverage target approach is of primary importance.

Above and beyond these firm-specific considerations are more general determinants of leverage. These fall within two categories:

- General macro-economic factors such as real asset prices, consumer price inflation and the differential between the real cost of debt and the real cost of equity may affect capital structure decisions by altering the availability of funds, the relative costs and benefits of alternative funding sources and by changing the demand for funds.
- Institutional factors such as the degree of regulation may also affect firms' capital structure choices.

These general themes provide a guide towards the determinants of leverage that are included in our empirical model.

3. EMPIRICAL MODEL

The literature review suggests a number of factors that may influence financial structure. Some of these factors vary only across firms, while others vary only across time and still others vary across both firms and time. These variables are outlined below with more detailed definitions given in Appendix 1.

We assume a linear relationship between leverage and its determinants. That is:

$$\frac{D_{it}}{A_{it}} = \mathbf{a} + \mathbf{b}'X_{it} + \mathbf{r}'Z_t + \mathbf{p}'W_i + u_{it} \quad (1)$$

where:

- leverage, our dependent variable, is firm debt, D_{it} , expressed as a percentage of total assets, A_{it} . Both debt and total assets are measured at book value. Debt is measured as the difference between total assets and shareholders' funds.
- X_{it} is a vector of determinants that vary across both firms and time.
- Z_t is a vector of determinants that vary only over time.
- W_i is a vector of determinants that vary only across firms.
- α , β , ρ and π are vectors of coefficients that are assumed, in the standard model, to be constant over time and across firms.
- u_{it} is a composite residual comprised of a firm-specific component, μ_i , a time-specific component, λ_t , and a component that varies over both firms and time, v_{it} .

$$u_{it} = \mathbf{m}_i + \mathbf{l}_t + v_{it} \quad (2)$$

3.1 The Determinants of Leverage

3.1.1 Variables that vary across both firms and time: X_{it}

- Earnings before interest, tax and depreciation have been deducted, expressed as a percentage of total assets (Cash flow);
- The percentage growth in real assets (Growth);
- The natural log of real total assets (Size);
- Real tangible assets, measured as a percentage of total assets (Real tangible assets) and
- Income against which interest expenses can be offset, again expressed as a percentage of total assets (Potential debt tax shield).

To motivate the expected signs on these determinants of leverage, we draw upon our review of the literature. If firms face a fund cost hierarchy then cash flow should have a negative sign. As cash flow increases, more internal funds become available to firms, allowing them to reduce their reliance on more expensive debt funds. Likewise, firms facing a fund cost hierarchy are likely to have a positive relationship between leverage and their rate of growth. Higher growth rates are accompanied by greater demand for funds which will force firms to adopt external fund sources (debt first and then external equity). We also anticipate that an increase in real tangible assets, by increasing the quality of collateral, will lead to higher leverage. The coefficient on firm size is expected to have a positive sign because of the increased access to credit markets that is available to large firms. Finally, the potential income against which firms can offset their interest expenses (the potential debt tax shield) should have a positive sign because the gains from debt are reduced if interest cannot be deducted in the current period.

The precise definitions of these firm-related variables are given in Appendix 1. However, the complexity of the potential debt tax shield variable (denoted E_{it} hereafter) warrants further discussion. DeAngelo and Masulis (1980) and Titman and Wessels (1988) consider the relationship between non-interest tax deductions and the leverage of firms. They hypothesise that as these "non-debt tax shields", S_{it} , increase, firms have less incentive to engage in debt financing for the purposes of tax minimisation. We take this a step further by recognising that firms focus on the

amount of income that can be shielded from tax using interest payments, E_{it} . To determine this amount, one must first quantify the non-debt tax shields, S_{it} .

If the amount of tax paid by firm i in period t , T_{it} , is greater than zero then S_{it} can be obtained by working back from the expression for tax payable.

$$T_{it} = \begin{cases} \tau_C(Y_{it} - I_{it} - S_{it}) & \text{if } Y_{it} - I_{it} - S_{it} > 0 \\ 0 & \text{if } Y_{it} - I_{it} - S_{it} \leq 0 \end{cases} \quad (3)$$

Thus, if a firm pays tax, the non-debt tax shields can be expressed as:

$$S_{it} = Y_{it} - I_{it} - \frac{T_{it}}{\tau_C} \quad (4)$$

where Y_{it} is gross earnings, I_{it} is interest payments and τ_C is the corporate rate of tax. However, when firms pay no tax (ie., they are tax exhausted) we do not observe the extent to which non-debt tax shields plus interest payments exceed gross earnings. Thus non-debt tax shields are not observed. Because the earnings against which interest payments can be offset, E_{it} , are equal to gross earnings less non-debt tax shields, the following expression for E_{it} arises.

$$E_{it} = \begin{cases} Y_{it} - S_{it} = I_{it} + \frac{T_{it}}{\tau_C} & \text{if } T_{it} > 0 \\ 0 & \text{if } T_{it} = 0 \end{cases} \quad (5)$$

E_{it} , our measure of the potential debt tax shield, is unobserved when a company is paying no tax (i.e. is tax exhausted) because we cannot determine the relative proportions of income shielded by interest payments and by non-debt tax shields.

To allow for the fact that the potential debt tax shield is unobserved in some cases, firms' state of tax exhaustion is included as a regressor. It is a dummy variable that is set to one for all observations when the tax paid by a firm is equal to zero. This technique is referred to by Maddala (1977, p. 202) as the modified zero order regression method.

Given that the effects of the potential debt tax shield are always non-negative, we would expect a positive coefficient on the tax exhaustion dummy variable. Its value

can be interpreted as the mean effect on leverage of the potential debt tax shields taken over all the observations with missing data.

3.1.2 Variables that vary only over time: Z_t

- Real asset prices;
- Consumer price inflation; and
- The differential between the real cost of debt and the real cost of equity where both costs are measured as aggregates for the Australian economy (Fund cost differential).⁹

The expected signs on these variables are motivated by the discussion in Section 2 of the macro-economic influences on corporate leverage. We anticipate that increases in real asset prices will generate upward pressure on firms' demands for funds and, thus, raise leverage. Consumer price inflation should also have a positive relationship with debt if higher inflation increases the wealth transfer to debtors generated by the tax deductibility of nominal interest payments. Finally, we anticipate a negative sign on the fund cost differential variable because, as the relative cost of debt rises, profit maximising firms should tend to restructure their financing arrangements in such a manner as to reduce their debt dependence (leverage).

The summary of our literature review also highlights the importance of the effective rates of tax faced by firms. As Pender (1991) highlights, these effective tax rates depend upon five factors: (i) the tax status of shareholders, (ii) the non-debt tax shields associated with investment projects, (iii) earnings retention ratios, (iv) the rate of inflation and (v) the tax system. Because information is not readily available about investment projects or the tax status of shareholders, effective tax rates are not observed. Rather than deriving complicated approximations, we allow for time effects and individual firm effects which capture the influence of the major changes

⁹ We use the measure of the real cost of equity devised by Dews, Hawkins and Horton (1992). It is the sum of the average earnings yield and the ten year average growth rate in real non-farm gross domestic product. This is an approximate measure of the expected earnings prospects of firms after taking into account firms' current yields and the past growth of the economy (excluding the farm sector).

in the tax system (capital gains tax, dividend imputation and the steady reduction of corporate and personal tax rates).

3.1.3 Variables that vary only across firms: W_i

- Industry dummy variables;
- Listing category dummy variable.

We include these categorisation variables to pick up commonalities across industries and across listed and unlisted firms.

Many factors that influence individual firms' capital structure may be common within organisational structures and industrial groupings. Also many characteristics of firms may be reasonably similar within industry groupings but cannot be captured elsewhere. For example, industry classifications are strongly correlated with cash flow volatility; mining firms generally have more volatile earnings than firms in the service industry. Also, firms in the same industry often face common product and/or factor markets and are likely to have similar capital requirements and lumpiness of investment opportunities. For these reasons the industry classifications of firms are included in our specification. There is some previous support for the importance of industry groupings for capital structure decisions (Bradley, Jarrell and Kim, 1984).

The six broad industry classifications that we use are manufacturing, mining, wholesale trade, retail trade, services and conglomerates. To avoid perfect collinearity with the intercept term, the dummy variable representing the manufacturing firms (the largest category) is omitted.¹⁰

Because listed firms are likely to have greater access to equity markets, we include a dummy variable that is set to one for all unlisted firms. This allows us to detect

¹⁰ Measures of the volatility of cash flow were also initially included in our specification. The various measures were insignificant. This may reflect the difficulty of obtaining an accurate measure of ex ante volatility of cash flow. An examination of macro-economic data indicates that particular sectors of the economy have considerably more volatile cash flows than other sectors. For this reason, our industry dummy variables may be capturing the effects of cash flow volatility on leverage.

any differences in leverage between the listed and unlisted firms after allowing for the other observed factors.

4. RESULTS

4.1 Estimation Issues

We estimate the model of leverage using a balanced sample of 105 firms, each of which has data for the entire period from 1973 to 1990.¹¹ Results from the larger, unbalanced panel of firms are reported in Appendix 2.

Our model of leverage can be estimated in several ways. The appropriate technique depends upon the structure of the error term, u_{it} , and the correlation between the components of the error term and the observed determinants of leverage.

In the simplest case, in which there are no firm- or time-specific effects, $m_i = 1$, $\lambda_t = 0$, Ordinary Least Squares (OLS) is appropriate. However it might be expected that both unobservable firm-specific and unobservable time-specific factors will have an effect on leverage. For example, the managers of one firm may be consistently more risk averse than other managers and as a result, the firm that they manage may have consistently low gearing ($\mu_i < 0$). Similarly, changes in taxation regulations may make debt relatively more expensive in some years than in others and for some firms more than others. As a result, desired leverage would be lower in those periods and for those firms ($\lambda_t, \mu_i < 0$).

In estimating Equation 1, unobservable effects can be accommodated using one of two techniques. First, the unobservable effects can be included in the error term. The variance-covariance matrix of the resulting non-spherical errors must be transformed to obtain consistent estimates of the standard errors. In this case, the "random effects" estimator is appropriate (Hsiao, 1989).

¹¹ Only 105 of the 110 firms with complete data are used because five had negative equity in some years or made losses that were greater than fifty per cent of their end-of-period total assets. These firms were treated as outliers. We also only estimated over the time interval from 1974 to 1990 because the 1973 data was used in calculating firms' growth rates.

However, a problem arises with the random effects estimator if the unobservable effects, which have been included in the error term, are correlated with some or all of the regressors. For example, managers' risk aversion may cause them to invest in fewer positive net present value projects and thus slow the growth of their firm. This would imply that the omitted variable measuring risk is correlated with both leverage and growth. This simultaneity would make the random effects estimator inconsistent. As a consistent alternative to the random effects estimator, a dummy variable can be included for each firm. This estimation approach, known as "fixed effects", yields consistent estimates regardless of correlation between firm-specific error components and the regressors. However, it is less efficient than the random effects estimator. The inefficiency arises because the fixed effects estimator requires a separate parameter to be estimated for each firm in the sample in place of the single variance estimate that is required for the random effects estimator.

The above discussion of the random and fixed *firm* effects applies equally to the random and fixed *time* effects. The same techniques are also appropriate.

Before we discuss parameter estimates, two questions are addressed. First, is there evidence of individual and time effects? Second, if these effects exist, are they correlated with the observable regressors?

There are a number of ways in which we can examine the importance of the firm and time effects. First we test the joint significance of the firm and/or the time dummy variables in the fixed effects specification.¹² These tests, reported in Table 1, point to the existence of both firm and time effects.

The fixed firm and time effects specification only includes the firm dummy variables, the time dummy variables and those variables that vary over both firms and time, X_{it} . The variables that vary only over time, Z_t , are linear combinations of the time dummy variables and the variables that vary only over firms, W_i , are linear combinations of the firm dummy variables. This perfect collinearity prevents us from being able to incorporate Z_t and W_i in the fixed firm and time effects specification.

¹² Baltagi and Chang (1992) conducted Monte Carlo experiments which suggested that F-tests of the firm intercepts and the time intercepts perform well in finite samples.

Table 1: F Tests of the Significance of the Firm and Time Intercept Terms

	Null Hypothesis	Test Statistic	Statistic Distribution	P-Value
Time Intercepts	$\lambda_t=0,$ $\forall t=1..T$	2.25	$F_{16,1658}$	0.003
Firm Intercepts	$\mu_i=0,$ $\forall i=1..N$	31.07	$F_{104,1658}$	0.000

Given that both the firm and the time effects are significant at the 5 per cent level, the interesting question becomes, can the information in these effects be more parsimoniously captured by our variables that vary only over firms or only over time? More specifically, can our firm dummy variables be replaced by the industry and listing dummy variables without a loss of explanatory power? Likewise, can the time dummy variables be replaced by our macro-economic variables? It turns out, as shown in Appendix 4, that replacing the T (N) time (firm) dummy variables with the K_z (K_w) variables that vary only over time (firms), implies a set of T- K_z (N- K_w) linear restrictions on the coefficients of the time (firm) dummy variables. These restrictions can be tested by comparing the residual sums of squares of the restricted and unrestricted models in the usual manner. Table 2 reports these tests on the firm and time effects.

At the 5 per cent level, we cannot reject the restrictions that are required to validly replace the time dummies with the macro-economic variables. This suggests that, after allowing for the effects of the variables that vary over both firms and time, the macro-economic variables explain most of the residual variation in leverage, over the time dimension. In contrast, the restrictions implied by replacing the firm dummy variables with the industry and the listing dummy variables are rejected. This rejection implies that the industry and listing dummy variables do not have rich enough structures to adequately describe the unobserved firm-specific factors (firm risk and management risk aversity, effective marginal tax rates and investment opportunities etc.).

Table 2: F Tests of the Explanatory Power of the Firm Varying Variables and the Time Varying Variables

	Test Statistic	Statistic Distribution	P-Value
Time Intercepts vs the Macro-economic Variables	1.55	F _{13,1658}	0.09
Firm Intercepts vs the Industry and Listing Dummy Variables	21.23	F _{98,1658}	0.00

Note.

1. The null hypotheses are expressed in full in Appendix 4.

In summary, these two sets of F tests indicate that the fixed firm effects specification (which includes the macro-economic variables - the real asset price, consumer price inflation and the differential between the real cost of debt and the real cost of equity) is the most parsimonious and informative fixed effects specification.¹³

To examine the issue of whether or not the firm effects are uncorrelated with the regressors, we use the Hausman (1978) specification test. This test rejects exogeneity in the random effects model at the 5 per cent significance level.¹⁴ In a comparison of the fixed and random effects models where time effects are also included, the Hausman statistic also rejects the null hypothesis of exogeneity.¹⁵ As a result, we prefer to focus on the fixed effects estimates. For comparison, we still present estimates using the random effects estimator.

¹³ The importance of the firm and time effects was also examined in the random effects framework. This was done by testing whether the variance of the firm error component and/or the variance of the time error component were significantly different from zero. We performed tests devised by Breusch and Pagan (1980), Honda (1985), Baltagi and Chang (1992) and Moulton and Randolph (1989). These all indicated that the firm effects were an important aspect of the specification. They were more mixed in their analysis of the time effects. The two-sided Breusch Pagan test rejected the null hypothesis while the one-sided Honda and Moulton and Randolph tests both failed to reject the null hypothesis.

¹⁴ The test statistic is 28.82 and it has a χ^2_9 distribution under the null hypothesis.

¹⁵ The test statistic is 48.47 and it has a χ^2_6 distribution under the null hypothesis.

4.2 Estimation Results

The results of estimating the leverage equation are reported in Table 3. We present results using a range of different estimators. The estimates in the second column are from the OLS estimator with no firm or time effects. The third column presents the fixed firm effects estimates while the results in the fourth column include both firm and time fixed effects. Finally, the random effects estimates are included in the last two columns. The results are generally consistent with our *a priori* expectations, outlined in Section 2.4, and suggest that firm, institutional and macro-economic factors combine to affect capital structure decisions.

The estimated coefficient on cash flow is negative and significantly different from zero. The fixed firm effects model predicts that a 5 percentage point increase in a firm's cash flow, relative to its total assets, will induce a 1 percentage point decline in its leverage, other factors being held constant.

This finding is consistent with other studies including Chaplinsky and Niehaus (1990), Titman and Wessels (1988), Kester (1986) and the management survey by Allen (1991). It is also consistent with the predictions of the financing hierarchy models described in Section 2.2. The importance of cash flow (the availability of retained earnings) in determining leverage may reflect the agency/financial distress costs of using external finance.

Other factors may also be responsible, in part, for the preference for internal finance. These include the need to maintain financing flexibility and the desire to minimise the flow of information to outsiders. Also firms may prefer internal finance because it reduces monitoring by the marketplace, and because it prevents dilution of existing stockholder claims. A reliance on internal funds may also reflect the inability of some firms to access external capital markets. All of these factors potentially explain the negative coefficient on the cash flow variable in our leverage equation.

Table 3: Static Leverage Model Estimates

Variables	Series Mean	OLS	Fixed Effects: Firms	Fixed Effects: Firms and Time	Random Effects: Firms	Random Effects : Firms and Time
Constant	1.00	5.44 (5.71)	0.49	3.25	-4.18	-6.50
Cash Flow	14.36	-0.36 (0.14)	-0.17 (0.09)	-0.18 (0.09)	-0.18 (0.06)	-0.18 (0.06)
Firm Growth	8.79	0.06 (0.01)	0.03 (0.01)	0.03 (0.01)	0.03 (0.01)	0.03 (0.01)
Real Tangible Assets	78.18	0.23 (0.03)	0.11 (0.03)	0.11 (0.03)	0.12 (0.02)	0.10 (0.01)
Firm Size	7.70	2.88 (0.44)	5.60 (0.86)	5.46 (0.89)	5.35 (0.26)	5.91 (0.19)
Potential Debt Tax Shield	10.07	0.36 (0.15)	0.13 (0.11)	0.15 (0.11)	0.15 (0.07)	0.16 (0.07)
Tax Exhaustion	0.08	5.06 (2.41)	4.70 (1.64)	4.71 (1.64)	4.78 (1.04)	5.27 (1.04)
Real Asset Prices	0.98	5.41 (2.08)	2.48 (1.56)	--	3.17 (1.10)	2.60 (1.30)
CPI Inflation	9.83	0.14 (0.17)	0.12 (0.13)	--	0.12 (0.16)	0.12 (0.20)
Fund Cost Differential	-15.96	0.20 (0.12)	0.10 (0.08)	--	0.10 (0.08)	0.11 (0.11)
Mining	0.16	-1.37 (1.76)	--	--	-3.43 (3.02)	-3.40 (3.00)
Wholesale	0.06	20.93 (2.35)	--	--	20.25 (4.75)	20.23 (4.72)
Retail	0.05	3.62 (1.04)	--	--	3.85 (5.12)	3.81 (5.08)
Service	0.14	10.10 (1.56)	--	--	9.24 (3.19)	9.24 (3.16)
Conglomerate	0.02	15.37 (3.19)	--	--	8.32 (7.93)	8.55 (7.87)
Unlisted	0.24	9.02 (1.28)	--	--	9.65 (2.57)	9.65 (2.55)

Notes.

1. Leverage, the dependent variable, has a mean of 53.45 per cent.
2. Numbers in parentheses are standard errors.
3. Newey West standard errors, calculated with 2 lags, have been reported for the OLS and fixed effects specifications.

The coefficient on the firm growth variable is also significantly different from zero and it has a positive sign. Its magnitude indicates that a 33 percentage point increase in growth is required to induce a 1 percentage point rise in leverage. Thus, differences in the predicted leverage of firms with growth rates within the "usual" 5 to 10 per cent band tend not to be driven by firms' growth rates. However, some firms in our sample experienced massive growth or shrinkage over the sample period. For these firms, growth could explain up to 15 percentage points of the variation in corporate leverage.

The positive relationship between leverage and firm growth is consistent with the view that rapid growth exhausts firms' internal fund reserves. This may result in increased dependence on debt, the next least expensive fund source. In this light, the positive coefficient on firm growth is consistent with a fund cost hierarchy.

Alternatively, assuming that past growth is an adequate proxy for future prospects, the positive coefficient on firm growth may reflect creditors being far sighted enough to lend in anticipation of higher future cash flows. However, this view is contrary to the arguments found in the agency cost literature that suggest that rapidly growing firms are not able to use their growth potential as collateral against which loans can be secured. Agency cost theories also suggest that firms in growing industries have greater flexibility in their choice of investments and, thus, equity holders have greater freedom to expropriate wealth from bondholders. Again this increases the agency costs of debt and creates a negative relationship between leverage and growth. Hence, our evidence conflicts with these aspects of the agency cost view of financial structure.

The coefficients on the real tangible assets variable and firm size variable are both positive and significantly different from zero. This is consistent with the view that there are various costs (agency costs and expected bankruptcy/financial distress costs) associated with the use of external funds and that these costs may be moderated by size and collateral. Large firms often have more diversified operations and longer operating and credit histories. Likewise, firms with high quality collateral can obtain debt at lower premiums because of the greater security for creditors.

The ratio of real tangible assets to total assets is also significant in an economic sense. A 10 percentage point increase in real tangible assets, relative to total assets,

is required to increase leverage by 1 percentage point. Given the possibility that real tangible assets vary between 0 and 100 per cent of firms' assets, our measure of "quality collateral" is capable of explaining up to 10 percentage points of the cross-sectional variation in leverage predicted by our fixed firm effects model.

The coefficient on firm size is more difficult to interpret. Because we have taken the natural log of real total assets, percentage change comparisons cannot easily be made. Instead we observe that as real assets increase, so does predicted leverage but at a diminishing rate. The leverage of a firm worth 100 million dollars is expected to be 3.8 percentage points higher than the leverage of a firm worth 50 million dollars.¹⁶ In comparison, the leverage of a firm with 250 million dollars is expected to be only 1.2 percentage points higher than a firm worth 200 million dollars. In our balanced sample, firms' real assets vary between less than one million dollars to almost 13 billion dollars. Thus, firm size explains a significant proportion of the variation in corporate leverage within our balanced panel.

The coefficient on the potential debt tax shield variable is insignificant, suggesting that we have been unable to detect a role for the tax system in determining corporate leverage. In comparison, the tax exhaustion dummy variable has a positive and significant coefficient. Its significance suggests that the distortions caused by the tax system are more important to firms that are tax exhausted. The coefficient estimate of 4.70 implies that, for the observations where the potential debt tax shield is unobservable, the mean effect of the tax distortion is to increase predicted leverage by 4.70 percentage points.

The results in Table 3 suggest a relatively unimportant role for the macro-economic variables over the full sample. However, in Appendix 3, the split sample results suggest that the real asset price index is important following financial deregulation. Asset prices are strongly significant in the post-deregulation period whereas, in the pre-deregulation period, asset prices are insignificant. In this light, it would appear that the pooled results, in Table 3, under-estimate the role of asset prices in the post-deregulation period and over estimate the role of asset prices in the pre-deregulation period. Based upon the estimated asset price coefficient, movements in asset prices between 1982 and 1988 explain 34 per cent of the average movements in leverage over the same period.

¹⁶ Firms' assets are valued at 1990 prices.

The insignificance of the consumer price inflation variable suggests that general goods price inflation has played little independent part in the trend towards higher leverage over the sample period. This may be because creditors are able to compensate themselves for the wealth transfer to debt holders created by inflation through increases in nominal interest rates. The issue is confused, however, by the fact that the periods of highest inflation coincided with the presence of financial controls which limited the ability of firms to respond with increased leverage.

The fact that the aggregate fund cost differential fails to add explanatory power to our model may reflect the difficulty in accurately measuring the relative costs of debt and equity rather than the unimportance of relative funding costs.¹⁷

The insignificance of the fund cost differential can also be understood in the context of financial deregulation. Prior to deregulation nominal equity costs were able to incorporate inflationary shocks. In contrast, interest rate controls prevented inflationary shocks from being built fully into nominal interest rates. Thus, the increase in inflation in the mid 1970s reduced the real cost of debt while leaving the real cost of equity relatively unaffected. Firms were prevented from taking advantage of the relatively low real interest rates by the controls placed on monetary growth. Hence, the credit rationing caused by financial regulations partially severed the anticipated relationship between relative fund costs and financial structure.

Following deregulation, the equity cost and the debt cost could adjust to inflation shocks. This flexibility caused the fund cost differential to stabilise. However, in the period following deregulation, firms were increasing their gearing in response to a wide variety of other influences. This behaviour made it more difficult to identify any relationship between our measure of the fund cost differential and corporate leverage.

It is interesting to compare the estimated effect on leverage of the three macro-economic variables with the estimated coefficients on the time dummy variables. Figure 1, below, shows both the time effect coefficients (the black line) and the combined impact of the macro-economic variables (the grey line). The impact of the macro-economic variables is estimated as follows:

¹⁷ See Appendix 1 for a description of the construction of these aggregate cost estimates.

$$\alpha + \beta Z_t \quad (6)$$

The constant term, α , is included to make the predicted impacts on leverage, from the macro-economic variables, directly comparable with the estimated time intercepts.

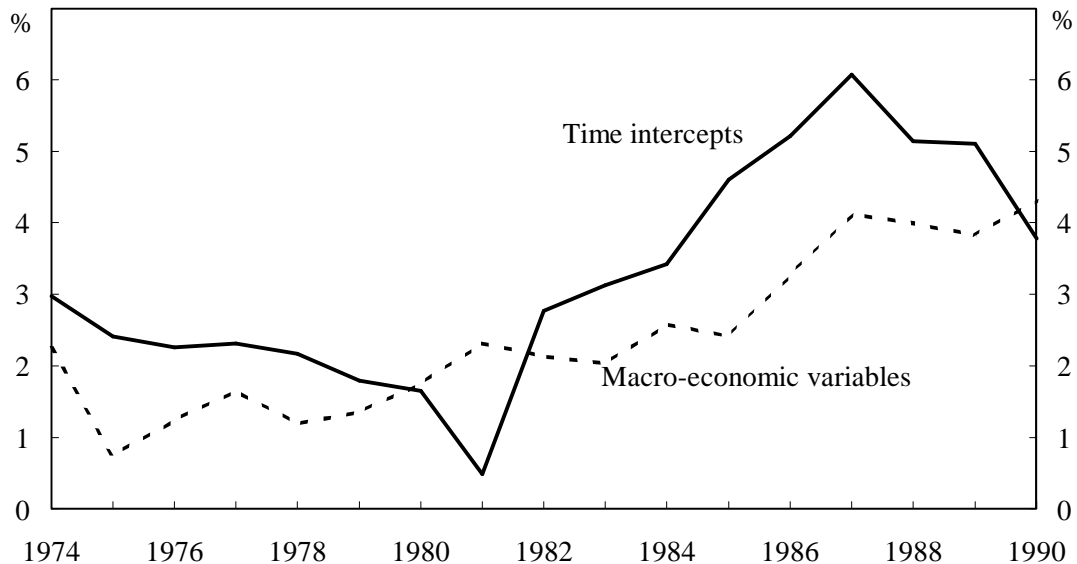
The tests presented in Table 1 reject the hypothesis that, if the macro-economic variables are excluded, the time dummy variables are insignificant. This finding is supported by the profile of coefficients on the time dummy variables shown in Figure 1. This profile suggests that significant variation in the time dimension is not explained by the variables that vary over both firms and time, X_{it} . We argued, based upon the tests reported in Table 2, that replacing the time dummy variables with our macro-economic variables, Z_t , did not cause significant deterioration in the fit of the fixed effects model while improving the parsimony of the model. This finding is borne out in Figure 1 which shows that relatively high impacts on leverage from the macro-economic series coincide with high coefficients on the time dummy variables. However, it is also apparent that the macro-economic series do not capture some of the more subtle features of the evolution of corporate leverage.

Most clearly, the macro-economic variables fail to capture the move towards equity finance during the resources boom of the late 1970s and very early 1980s (See Lowe and Shuetrim, 1992, p. 14). Credit rationed firms, facing risky projects, concentrated in the primary resources sector, turned to external equity with the result that, even though asset prices were increasing, leverage fell.

During the 1980s the picture is somewhat different. Firms were more easily able to access debt finance to accumulate assets. Rising asset prices increased the perceived collateral of firms, increasing their demand for funds and increasing the financial sector's willingness to supply those funds. This change in the relationship between asset prices and leverage is made clear in Appendix 3 where we report estimates from the fixed firm effects model for the pre-deregulation part of our sample and for the post-deregulation part of our sample. The coefficient on real asset prices is insignificant when estimating with the sub sample that runs from 1974 to 1981. This supports the view that, prior to deregulation, rising asset prices simply led to a lengthening of the queue of borrowers. The coefficient becomes positive and significant when estimating using the sub sample from 1982 to 1990,

supporting the view that financial deregulation removed the constraints on credit supply, enabling a more direct link from asset prices to credit.

Figure 1: Macro-economic Variables vs Time Dummy Variables



Also, the macro-economic variables do not fully capture the turnaround in leverage in the late 1980s that is suggested by the profile of the time dummy variable coefficients. In part, this reflects the fact that there had been no generalised fall in asset prices by the end of our sample, yet there was rising concern in the business community, in the late 1980s, about high debt levels. It may also reflect the fact that the macro-economic variables do not incorporate the effects of changes in the tax system, which were occurring from 1985 onwards. The impacts on the effective tax rates of firms and the potential tax advantages of debt are not measured among our macro-economic variables, except in as much as the real cost of debt is measured after tax.

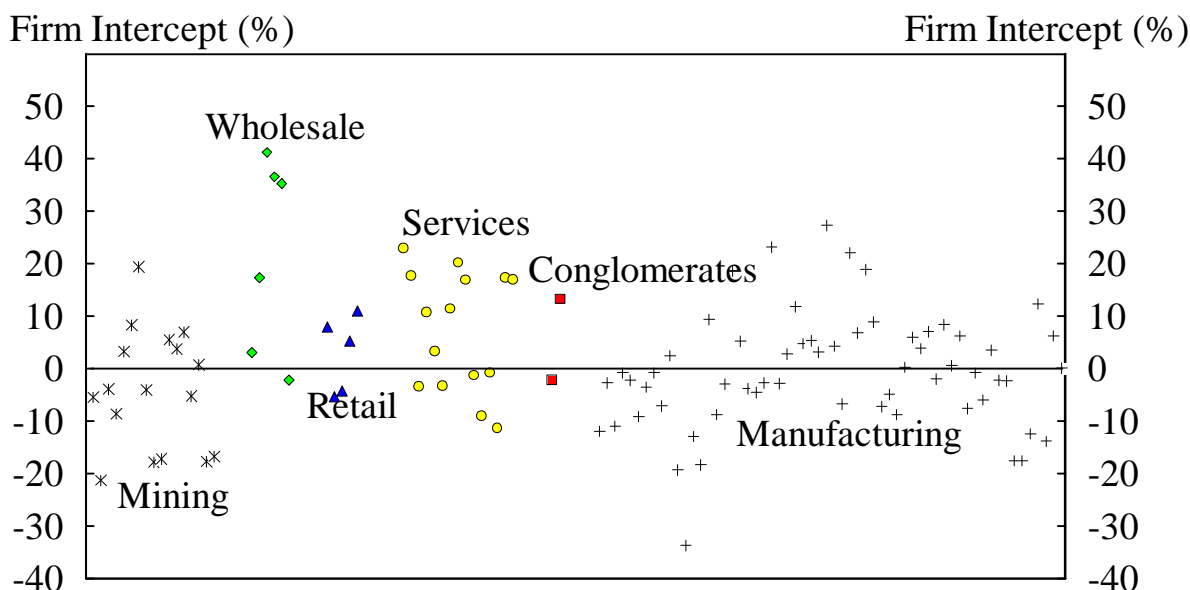
Coefficients on the industry dummy variables have been estimated using the OLS and the random effects approach. They cannot be estimated within the fixed effects framework because they are linear combinations of the firm dummy variables. The coefficients estimated for the OLS model are inconsistent because the firm effects have been incorrectly omitted. They are also likely to be inconsistently estimated for the random effects models given our *a priori* belief that the industry dummy variables are correlated with the unobserved determinants of leverage. More specifically, we feel that the industry dummy variables are correlated with the risks

of financial distress that are captured by the firm effects (Lowe and Shuetrim, 1992). Also, the Hausman tests in Section 4.1 suggest that the random effects model may be inconsistently estimated because of endogeneity in the variables that vary over both firms and time.¹⁸

Instead of relying on inconsistent estimates of the industry effects, the average intercept terms for each of the firms (estimated from the fixed firm effects model) have been plotted in Figure 2. The firms are randomly ordered within each of the industry groups across the horizontal axis. The vertical axis is measured in percentage points of leverage explained by each firms' intercept term.

Figure 2 makes three points. First, even after controlling for other relevant and observed variables, mining and manufacturing firms do tend to have lower leverage than firms in the other industry groupings. This is consistent with the findings in Lowe and Shuetrim (1992) which suggest that firms in the wholesale, retail and service industries and conglomerates generally have higher leverage than do mining and manufacturing firms. Second, Figure 2 shows considerable variation within industry groupings that is not captured by the observed variables. Third, the individual effects are important, in an economic sense, relative to the observed variables. In some cases they dominate the explained components of leverage.

¹⁸ Hausman and Taylor (1981) suggest a consistent instrumental variable estimator which can be used to estimate the coefficients on the endogenous industry dummy variables using the firm averages of the X_{it} regressors as instruments. However, this technique is dependent upon the X_{it} regressors being exogenous with respect to the error components.

Figure 2: Fixed Firm Effects

4.3 Specification Evaluation

4.3.1 Heteroscedasticity Tests

As a first step towards examining our specification, we calculated White tests for heteroscedasticity. In both the fixed firm and the fixed firm and time effects specifications, these tests reject the null hypothesis of homoscedasticity at the 5 per cent level which suggests that the residuals are non-spherical, even after allowing for firm and/or time effects.¹⁹ The standard errors calculated for the OLS and fixed effects models take this heteroscedasticity into account.

4.3.2 Residual Autocorrelation Tests

Because of adjustment costs, firms may alter their financial structure slowly, as opportunities for new investments arise and as free cash flow becomes available to retire undesired debt. For this reason, a partial adjustment mechanism may well underlie movements in leverage over time.

¹⁹ For the fixed firm effects model, the Wald test statistic is 590 while the LM test statistic for the fixed firm and time effects model is 489. These two statistics are distributed χ^2_{54} and χ^2_{27} respectively under the null hypotheses.

To test the adequacy of the static specification, tests of the null hypothesis of no first or second order autocorrelation were conducted on the residuals from the fixed effects models. Only first and second order autocorrelation were considered because of our limited time dimension. In both cases, residuals were regressed on the independent variables from the original model and the first and second lags of the residuals. We tested the joint significance of the lagged residuals using Wald tests based upon White corrected variance-covariance matrices. These tests rejected the null hypothesis of no autocorrelation at the 5 per cent level.²⁰

These rejections support the view that an autoregressive process is present in the error structure. For this reason, we report robust errors (which take into account both the heteroscedastic structure and the serial correlation in our residuals) for the OLS and fixed effects models in Table 3.

4.3.3 Tests for Non-linearities

As a final test of our static specification, we examine the validity of imposing a linear functional form upon our model of leverage. This is done within the broader context of the following general hypothesis:

$$H_0: E(u_t | X_t, \mathbf{x}_t) = 0 \quad (7)$$

where u_t is a residual, X_t is the t th observation on the regressors and ξ_t is a vector of other potential explanators of the residuals. In this case, we replace the general term, ξ_t , with $(\mathbb{Y}_t^2, \mathbb{Y}_t^3, \mathbb{Y}_t^4)$, a series of powers of the predicted values from the original model. A relationship between the residuals and the powers of the predicted values can be interpreted as evidence of non-linearity in the original regression.²¹ Three tests are reported in Table 4 for each of the fixed effects models. For the RESET 1 test, we regress the residual on a constant and the square of the predicted value. For the RESET 2 test we also include the cube of the predicted value and for the RESET 3 test we also include the fourth power of the

²⁰ For the fixed firm effects model the statistic was 490. For the fixed firm and time effects model, the test statistic was 494. Both statistics are χ^2_2 under the null hypothesis.

²¹ This form of the general hypothesis is known as the Regression Specification Error Test (RESET) (Ramsey, 1969).

predicted value. The null hypothesis in each test is that the regressors explaining the residuals are jointly insignificant.

Table 4: RESET Tests on the Fixed Effects Models

Tests	Distribution	Fixed Firm Effects		Fixed Firm and Time Effects	
		Test Statistic	P-Value	Test Statistic	P-Value
RESET 1	c_1^2	0.67	0.41	0.20	0.65
RESET 2	c_2^2	1.58	0.45	4.14	0.13
RESET 3	c_3^2	1.60	0.66	5.49	0.14

Wald tests of the joint significance of the regressors explaining the estimated residuals are reported. They have been calculated using the robust variance-covariance matrices which take into account both heteroscedasticity and autocorrelation. The tests fail to reject the null hypotheses at the 5 per cent level of significance. This supports the decision to adopt a simple linear relationship between leverage and its hypothesised determinants.

We also applied RESET tests to the full sample (which included firms with negative book values of equity in some periods and firms which made losses that were greater than 50 per cent of their end of period value). In this full sample, all of the RESET tests rejected the null hypothesis at the 1 per cent level. This finding suggests that the RESET tests do have power. It also supports our decision to omit the firms with negative book values of equity, or with massive losses which cut our sample from the available 224 firms to 209 firms. In the balanced sample, 5 firms were excluded on this basis.

4.3.4 The Dynamics of Leverage

To investigate the dynamic aspects of leverage, suggested by the presence of autocorrelation, we consider a single lag of the dependent variable. This primitive specification is adopted because of the relatively short time dimension in our panel. The model is estimated in differences to eliminate the fixed firm effects. We do not address the issue of non-stationarity in the leverage series, because, ignoring the exceptional cases where firms have negative equity, the book value of leverage is bounded between zero and unity.

An instrumental variable estimator is used to consistently estimate the parameters of the dynamic model (Hsiao, 1989).²² This technique, unlike maximum likelihood estimation, is independent of the assumptions made about initial conditions. The results from the dynamic specification are reported in Table 5.

Table 5: Lagged Dependent Variable Specification

Variables	Fixed Effects: Firms
Leverage₋₁	0.80 (0.27) [0.00]
Cash Flow	-0.17 (0.05) [0.00]
Firm Growth	0.03 (0.01) [0.01]
Real Tangible Assets	0.06 (0.03) [0.02]
Firm Size	3.73 (2.45) [0.06]
Potential Debt Tax Shield	0.03 (0.07) [0.35]
Tax Exhaustion	1.78 (0.95) [0.03]
Real Asset Prices	-2.67 (1.93) [0.08]
CPI Inflation	-0.09 (0.10) [0.19]
Fund Cost Differential	-0.02 (0.11) [0.44]

Notes.

1. The numbers in round parentheses are standard errors.
2. The numbers in square brackets are p-values.

The coefficient on the lagged dependent variable is significantly different from zero, supporting the view that leverage adjusts slowly to exogenous shocks. The speed of adjustment coefficient suggests that only 60 per cent of the full impact has been felt

²² The second lag of the dependent variable and the second lagged difference in leverage are used as instruments for the lagged difference in leverage (Hsiao, 1989).

after 4 years. This estimate is fairly imprecise, however, and is not particularly robust to small changes in our specification. For example, the dynamic model estimated using the unbalanced panel of firms suggests that leverage is an explosive series. Given that leverage is bounded between zero and unity, this would appear difficult to support. In summary, our findings are consistent with the view that transaction costs are an important aspect of financial structure. However, further work is required to obtain precise estimates of the speed of adjustment.

The estimates reported for the dynamic model are qualitatively similar to those obtained from the static specification. The signs on the significant coefficients do not change (except for the coefficient estimate on the real asset price series which becomes insignificant at the 5 per cent level). Nevertheless, it is clear that further work towards an improved specification is required, especially in relation to the nature of the dynamic relationships involved.

5. SUMMARY AND CONCLUSIONS

The theoretical and empirical literature identifies a wide variety of possible influences on corporate capital structures. It is difficult to define tests that accurately discriminate between the competing theories. The approach adopted in this paper is to identify and estimate a fairly broad empirical model that incorporates many of the variables that have received support in the literature. This approach allows us to draw fairly general conclusions but does not allow us to distinguish between competing models of leverage.

Our results suggest that both firm-related and macro-economic factors influence the leverage of Australian corporations. The dominant factor driving variation in leverage across firms is firm size. Our results suggest that large firms enjoy considerable advantages over their smaller competitors in the credit markets. Furthermore, this advantage would appear to have been maintained after financial deregulation. Other factors that are important in explaining the variation in leverage across firms include cash flows, real tangible assets and growth in the real size of firms' balance sheets.

Over the time dimension, size is again an important factor, explaining a large proportion of the increase in leverage between 1974 and 1990. Much of the

remaining variation in leverage over time can be explained by the macro-economic variables and, more specifically, by real asset prices. Our fixed firm effects model suggests that, over the 1980s, rising real asset prices explain, on average, approximately 25 per cent of the average increase in leverage over the same period.

In contrast to the prominent role of real asset prices, consumer price inflation is not significant in our specification. This finding suggests that perhaps the importance of the tax deductibility of interest rates has been exaggerated. Instead, the insignificance of inflation is consistent with creditors adjusting the nominal rate of interest on a more than one for one basis with changes in the rate of inflation. In this way they compensate themselves for the reallocation of wealth implicit in the nominal tax system.

The deregulation of the Australian financial system would also appear to have an important role in explaining movements in leverage over the time dimension. The results in Appendix 3 show how the relationship between leverage and its determinants vary between the pre- and post-deregulation periods. Prior to deregulation, increases in asset prices had an insignificant influence on leverage because firms were credit constrained. Following deregulation, increasing asset prices stimulated firms to increase their leverage and to increase the size of their balance sheets. Firms, observing that the rates of return from assets were increasing, accelerated their asset accumulation and largely financed their purchases using credit. These newly purchased appreciating assets were then used, in many cases, as collateral when applying for further credit. Because market values were increasing so rapidly, and because, to a large extent, these market values were being used when evaluating credit worthiness, the increasing asset prices sparked rising dependence upon debt and a corresponding increase in exposure to economic shocks. Thus, although deregulation is not included specifically in our model of leverage, it can be seen to have had a pervasive and significant influence on firms' corporate financial structures.

Finally we place two related caveats upon our results. First, the panel data specification imposes the same model, with the same coefficients, in both the cross section and in the time domain. While this is standard practice, it may be inappropriate. Second, although leverage is clearly determined on the basis of many real factors, our understanding of the dynamic relationships between these factors and leverage is incomplete. Our results suggest an extremely slow rate of

adjustment. However, the partial adjustment mechanism used to describe these dynamics is imprecise. The response of leverage may vary depending upon the nature of the shock and depending upon the duration of the shock. These issues are important topics for future research, especially in light of the uncertainty about the speed with which firms can reconstruct their balance sheets.

APPENDIX 1: DATA

Consumer price index	is the "All Categories" Consumer Price Index (CPI), calculated at 1984/85 prices and rebased to 1990.
Consumer price inflation	is measured as the annual percentage change in the CPI.
Asset price index	is a weighted average of a stock price index and a commercial properties price index. Both indices are based on March 1983 prices. The stock price index is given a weight of 0.585 and the commercial property price index is given a weight of 0.415. The stock price index is the All Ordinaries Index. The commercial property price index uses internal sources.
Real asset price index	is the ratio of the asset price index to the CPI after rebasing both series to 1981 prices.
Real cost of debt	is the prime interest rate charged on large business loans deflated by the consumption price deflator as reported in the Australian National Accounts (5204.0). The real cost of debt is also adjusted by the corporate tax rate to obtain an "after tax" measure.
Prime interest rate	is the maximum of the business indicator rates. It is reported in Table F3 of the Reserve Bank of Australia Bulletin.
Real cost of equity	is estimated using a simple earnings-price model in which the required rate of return on equity equals the sum of the after tax earnings-price ratio and the expected growth in real earnings.
The aggregate earnings-price ratio	is the index linked ratio calculated from a sample of companies from the All Ordinaries Firms. Each firm is weighted by its market capitalisation. It is available from the Australian Stock Exchange.

Expected growth in real earnings	is estimated as a 10-year moving average of growth in real non farm Gross Domestic Product (GDP), as deflated by the non-farm GDP deflator (also from the Australian National Accounts, 5204.0).
Financial statement data	is measured in book values. The data is described in full in Lowe and Shuetrim (1992).
Real total assets	is the book value of total assets divided by the Consumer Price Index.
Cash flow	is the ratio of earnings before depreciation, interest and taxation to the total assets of the firm. It is expressed as a percentage.
Firm growth	is the annual percentage growth in firms' real total assets.
Real tangible assets	includes net fixed assets, stock, debtors, government securities and bank deposits. Excluded are investments, equity holdings in other firms, inter-company accounts, intangibles and the residual category of "other assets". It is expressed as a percentage of total assets.
Firm size	is measured by the natural logarithm of real total assets. Real total assets were divided by 100000 before the logarithm transformation.
Potential debt tax shield	is the sum of interest paid and taxable income after all allowable non-debt tax deductions have been made. This sum is expressed as a percentage of total assets.
Tax exhaustion	is a dummy variable that is set to unity for any observation where a firm pays no tax.
Industry dummy variables	is based upon the industry classifications in the Reserve Bank of Australia Bulletin, Company Finance Supplement.

Listing dummy variable is set to unity for all firms that are listed. Again the listing classification is based upon the Reserve Bank of Australia Bulletin, Company Finance Supplement.

APPENDIX 2: UNBALANCED PANEL RESULTS

In this appendix we report results using the unbalanced panel of 209 firms (Table A1).²³

These results from the full sample of 209 firms are similar to those generated by the smaller balanced sample of 105 firms.²⁴ The coefficients on the financial statement related variables are consistent (in sign, magnitude and significance) with those reported in Table 3 for the balanced sample. While remembering that most of the firms in our sample are large relative to the average firm in the Australian corporate sector, the consistency of our results between the balanced and unbalanced panels of firms suggests that our results are reasonably robust.

On the other hand, the dynamic model estimates, generated from the unbalanced panel, are considerably different to those generated from the smaller, balanced panel of firms. Most importantly, the speed of adjustment coefficient estimated using the unbalanced panel indicates that leverage is explosive. This finding, given that leverage is bounded between zero and unity, highlights the imprecise nature of our dynamic estimates. Clearly, the results from the unbalanced panel of firms reinforce the need for further extensive research into the dynamic processes driving corporate financial structures.

²³ The random effects model is estimated using the technique described in Baltagi (1985).

²⁴ The unbalanced sample has 3028 useable observations compared to the 1680 useable observations in the balanced sample. Thus the similarity between the results from the two panels is not forced by the common observations.

Table A1: General Specification: Unbalanced Panel

Variables	Ordinary Least Squares	Fixed Effects: Firms	Random Effects: Firms	Dynamic Fixed Effects: Firms
Leverage₋₁	--	--	--	1.36 (0.38)
Constant	11.01 (2.99)	2.24	-5.99	--
Cash Flow	-0.31 (0.06)	-0.17 (0.05)	-0.29 (0.06)	-0.22 (0.06)
Firm Growth	0.05 (0.01)	0.04 (0.01)	0.05 (0.01)	0.07 (0.02)
Real Tangible Assets	0.24 (0.02)	0.15 (0.02)	0.27 (0.01)	0.05 (0.03)
Firm Size	2.67 (0.23)	5.22 (0.39)	3.76 (0.20)	-0.60 (2.86)
Potential Debt Tax Shield	0.10 (0.07)	0.17 (0.06)	0.18 (0.07)	0.03 (0.07)
Tax Exhaustion	2.68 (1.00)	3.22 (0.79)	3.38 (0.94)	2.22 (0.91)
Real Asset Prices	2.88 (1.13)	0.71 (0.82)	4.88 (0.95)	-3.05 (1.63)
CPI Inflation	0.18 (0.19)	0.14 (0.13)	0.16 (0.17)	-0.12 (0.12)
Fund Cost Differential	0.25 (0.10)	0.15 (0.07)	0.09 (0.09)	0.06 (0.08)
Mining	-2.42 (0.78)	--	-3.64 (2.62)	--
Wholesale	13.65 (1.03)	--	14.24 (3.27)	--
Retail	2.94 (1.20)	--	2.96 (3.79)	--
Service	12.16 (0.84)	--	13.98 (2.70)	--
Conglomerate	21.82 (2.11)	--	19.41 (6.75)	--
Unlisted	9.36 (0.57)	--	11.62 (1.82)	--

Note.

1. Numbers in parentheses are standard errors.

APPENDIX 3: SPLIT SAMPLE RESULTS

Financial deregulation might be expected to have far reaching implications for firms' gearing decisions. Prior to the deregulation of financial markets, firms were credit rationed because of interest rate controls and restrictions on credit creation. This constraint may have forced firms to access relatively more expensive equity funds to finance investment opportunities. Thus, firms' leverage decisions over the 1970s may have been driven by fund availability considerations rather than fund cost considerations.

However, the analysis in the main body of our paper has not explicitly allowed for the easing of financial controls that occurred in the early 1980s. In an effort to allow the effects of financial deregulation to be reflected in our findings, we have estimated the static version of our fixed firm effects model over two sample periods: the first running from 1975 to 1981 and the second running from 1982 to 1990. The results are reported in Table A2 below.

We tested the importance of the structural break between the period of regulation and the period during which financial markets were deregulated using a test described in Chow (1960). The test comfortably rejected the null hypothesis of no structural break at the 5 per cent level.²⁵

Two points stand out from these split sample results.

1. The coefficient on the real asset price index changes sign between the two sub-samples. Between 1975 and 1981, the sign on real asset prices is negative, although insignificantly different from zero. In comparison, from 1982 to 1990, the coefficient on the real asset price index is positive and highly significant. This switch suggests that the response of managers to increased investment opportunities underwent a fundamental change with the introduction of financial deregulation. After financial deregulation, managers were able to access debt funds rather than being forced to rely on equity

²⁵ The test statistic is 8.69. It is distributed according to an $F_{114,1557}$ distribution which implies a 5 per cent critical value of 1.25.

finance to take advantage of higher returns from assets. This point is consistent with Lowe and Rohling (1993).

2. Firm size has a much greater role in explaining variation in leverage during the pre-deregulation period. This may be because larger firms were able to find access to credit markets despite regulation. Deregulation opened up many credit markets to smaller firms, reducing the financing advantages of the larger players. The other variables provide little explanatory power in the pre-deregulation period.

Table A2: Split Sample Results for the Fixed Firm Effects Model

Variables	Fixed Firm Effects	
	1974-1981	1982-1990
Constant	-18.16	13.89
Cash Flow	-0.02 (0.17)	-0.26 (0.13)
Firm Growth	-0.003 (0.017)	0.04 (0.01)
Real Tangible Assets	0.004 (0.04)	0.12 (0.04)
Firm Size	8.72 (1.47)	3.94 (1.09)
Potential Debt Tax Shield	0.11 (0.16)	0.06 (0.14)
Tax Exhaustion	6.09 (2.90)	1.58 (1.32)
Real Asset Prices	-1.49 (1.73)	4.15 (1.68)
CPI Inflation	0.25 (0.14)	-0.06 (0.14)
Fund Cost Differential	0.03 (0.08)	0.05 (0.12)

Note.

1. Numbers in parentheses are robust standard errors.

APPENDIX 4: TESTING THE FIRM AND TIME SPECIFIC VARIABLES

In a panel data context, the time dummy variables are perfectly correlated with the observed variables that vary only over the time dimension. It is of interest to determine whether the variables that vary in the time dimension only, can adequately describe all of the variation in the dependent variable that is captured by the time dummy variables.

In an OLS regression model, using data with a single dimension, one would test this hypothesis by comparing the residual sum of squares from a general model in which all variables were included with the residual sum of squares from a restricted model in which the restriction had been incorporated. However, in our panel data framework, formulating the general model is not possible because of the perfect collinearity between the variables of interest.

In the following analysis, we show that the restricted model, which includes the variables that vary only across time but excludes the time dummy variables, is nested within the model that includes only the time dummy variables. In moving from the general model to the restricted model, we are enforcing a set of linear restrictions on the coefficients of the time dummy variables. Thus, we are still able to compare the residual sums of squares from the restricted and unrestricted models in the usual fashion. The problem described above extends simply to the case where the firm dummy variables are being replaced by variables that vary only across firms.

The proof that the models of interest are nested is as follows.

Stacking the observations by firm within each time period, the "unrestricted" fixed firm and time effects model can be written as:

$$y = \mathbf{a} + D^F \mathbf{g} + D^T \mathbf{d} + X\mathbf{b} + u \quad (\text{A1})$$

where:

$$\sum_{n=1}^N \mathbf{g}_i = 0 \quad (\text{A2})$$

$$\sum_{t=1}^T \mathbf{d}_t = 0 \quad (\text{A3})$$

$D^F = e_T \otimes I_N$ is the (NT×N) matrix of firm dummy variables and D_n^F is the n th firm dummy variable;

$D^T = I_T \otimes e_N$ is the (NT×T) matrix of time dummy variables and D_s^T is the s th time dummy variable;

e_s is a (S×1) vector of ones;

y is the (NT×1) vector representing the dependent variable;

X is the (NT×K) matrix of observed variables which vary over both firms and time;

u is the (NT×1) vector of residuals and

γ , δ and β are parameter vectors.

Alternatively, by dropping the intercept term, the normalisation restriction on the time dummy variable coefficients can be omitted. This reparameterisation of the "unrestricted" model can be done without loss of generality.

$$y = D^F \mathbf{g} + D^T \mathbf{d} + X\mathbf{b} + u \quad (\text{A4})$$

where:

$$\sum_{n=1}^N \mathbf{g}_n = 0 \quad (\text{A5})$$

The "restricted" specification involves replacing the T time dummy variables with K_Z variables that vary only over time, Z .

$$y = D^F \mathbf{g} + Z\mathbf{r} + X\mathbf{b} + u \quad (\text{A6})$$

where ρ is the coefficient vector on Z . We can rewrite Z as a set of K_Z linear combinations of the time dummy variables.

$$Z = D^T \bar{z} \quad (\text{A7})$$

Where \bar{z} is the (T× K_Z) matrix containing the unique elements of Z . Hence, we can rewrite the "restricted" specification in terms of the time dummy variables.

$$y = D^F \mathbf{g} + \left(D^T \bar{z} \right) \mathbf{r} + X\mathbf{b} + u \quad (\text{A8})$$

Comparing equation A4 and equation A6, the linear restrictions implicit in the "restricted" model can be represented as:

$$D^T \mathbf{d} = D^T \bar{z} \mathbf{r} \quad (\text{A9})$$

This relation involves T restrictions, each repeated N times. The T unique restrictions can be written as:

$$\mathbf{d} = \bar{z} \mathbf{r} \quad (\text{A10})$$

To represent this set of linear restrictions in the standard form, " $R\beta=r$ ", ρ must be eliminated. This involves projecting δ and $\bar{z} \mathbf{r}$ on \bar{z} to yield:

$$\bar{z} (\bar{z}' \bar{z})^{-1} \bar{z}' \mathbf{d} = \bar{z} \mathbf{r} \quad (\text{A11})$$

Hence, from equation A10 and A11:

$$\bar{z} (\bar{z}' \bar{z})^{-1} \bar{z}' \mathbf{d} = \mathbf{d} \quad (\text{A12})$$

Expressing in the $R\beta=r$ form yields:

$$\left[I_T - \bar{z} (\bar{z}' \bar{z})^{-1} \bar{z}' \right] \mathbf{d} = 0 \quad (\text{A13})$$

The orthogonal projection matrix $\left[I_T - \bar{z} (\bar{z}' \bar{z})^{-1} \bar{z}' \right]$ has rank $(T-K_z)$. Thus, moving from the unrestricted specification to the restricted specification involves $T-K_z$ linearly independent, linear restrictions.

When replacing the N firm dummy variables by a set of K_w variables that vary only across firms, an analogous procedure can be used to show that $N-K_w$ linearly independent, linear restrictions are implied.

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