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THE EFFECTS OF ECONOMIC DEVELOPMENT ON CORPORATE FINANCIAL STRUCTURE

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To my husband and my baby.

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ABSTRACT

This dissertation investigates corporate financial structure, ownership structure, and their relationships with economic development. It is composed of three chapters. The first chapter investigates the Modigliani-Miller Irrelevance Theorem under risk-neutrality and positive profit. It models the entrepreneur as the residual risk-bearer in a world of risk-neutral agents. The percentage of entrepreneurial equity holding increases as the firm issues more debt. Stockholders bear greater risk than debt holders, but both receive the same expected rate of return. Using this framework, I obtain a transparent explanation of the effect of capital structure on the cost of capital. The framework is fully operational and suitable for numerical illustrations. It also lays the groundwork for operational agency models of optimal corporate finance.

Chapter 2 examines the relationship between corporate financial structure and economic development (per capita income) using data from four economies: U.S.A., Canada, Australia, and Taiwan. This chapter has two major findings. First, over the last few decades, the corporate financial structure in these four economies did not demonstrate any downward trend during the sample period when all economies experienced income increases. Second, income affects the link between the economic growth rate and the debt-equity ratio. I find that the economic growth rate and the debt-equity ratio move in the same direction in higher-income countries and in opposite directions in lower-income countries.

Chapter 3 models the link between corporate financial structure, ownership structure, and economic development. It shows that the under the assumptions of asymmetric information and moral hazard, debt and outside equity are part of the optimal contract paid to an investor by his manager. The manager receives a profit share that equals his marginal cost of effort. The chapter then shows that economic development raises the reservation utility for all managerial types by increasing the opportunity wage for managers. Consequently, lower types drop out of the managerial group and prefer to be workers. As a result, the average percentage of inside equity (averaged over the higher managerial types) increases as an economy develops. The effect of economic development on the average debt-equity ratio is generally indeterminate.

INTRODUCTION

This dissertation investigates corporate financial structure and its relationship with economic development. The first chapter examines the Modigliani and Miller (MM) Irrelevance Theorem under conditions of risk neutrality and positive profit. One of the fundamental theorems of corporate finance, the MM Irrelevance Theorem provides a benchmark for analyzing optimal capital structure. It claims that under perfect capital market conditions, any effort to increase a firm's value (or decrease its cost of capital) through changes in the composition of debt or equity finance will be made useless, as long as investors can replicate the firm's return by riskless arbitrage.

One important assumption underlying the Modigliani and Miller Irrelevance Theorem is riskless debt. The effects of default risk on the return to each security and on the cost of capital were ignored in Modigliani and Miller's original paper (Modigliani and Miller 1958). Some researchers later provided qualitative conjectures but failed to offer formal models examining these issues (Brealey and Myers 2000). Without a thorough analysis of the returns to each security and the cost of capital in the presence of default risk, the MM Irrelevance Theorem is incomplete, and its contribution is limited to the value of the firm and the cost of capital.

An implicit assumption of the MM Irrelevance Theorem is that firms earn zero profits. This can be inferred from two assumptions: (1) the return to capital can only be distributed via dividend payments to investors and interest payments to bondholders,[1] and (2) the capital market equilibrium condition requires that all investors receive zero economic profits. These assumptions imply that firms do not retain any residual profit after it pays the opportunity cost for its capital. The implicit assumption of zero profits isolates the theory from evolving theories of corporate decision-making and control that assume positive profits (see, for example, Knight 1965 and Hart 1995).

Using a state-preference approach, chapter 1 derives the MM theorem by solving for the expected rates of return to debt and to equity in the presence of default risk and positive profit. I model the entrepreneur as the residual risk-taker in a world of risk-neutral agents. The entrepreneurial equity share increases as the entrepreneur issues more debt. Stockholders bear greater risk than debt holders, but both receive the same expected rate of return. As described in Chapter 1, this framework presents a more general explanation of the effect of capital structure on the cost of capital. The model is fully operational and suitable for numerical illustrations; it also lays the groundwork for operational agency models of optimal corporate finance.

Chapter 2 examines the connection between economic development and corporate financial structure. Existing empirical evidence shows that the aggregate debt-equity ratio for the non-financial sector has an upward trend. This can be seen from time series analysis of the "Anglo-Saxon" financial system (Taggart 1985; Edey and Grey 1996). It is also supported by cross-sectional comparisons of the "Universal Banking" system in India and England (Singh et al. 1992; Singh 1995).

[1] See Modigliani and Miller (1958, 294) where the authors assume that debt is equal to the firm's value when the firm is financed by debt only.

However, the results from these four studies are not robust. First, Taggart (1985) and Edey and Gray (1996) do not provide econometric tests for the presence of a time trend. They compared the debt-equity ratios at the beginning and the end of the sample period but did not consider intra-period fluctuations. Thus, the conclusion that these time series have positive deterministic trends is not convincing. It is possible that the difference in debt-equity ratio between the beginning and the end of the sample period is due to a stochastic trend rather than a deterministic trend. Second, the result from Singh et al. (1992) and Singh (1995) might suffer from selection bias. These authors compared the median debt-equity ratio for the largest 100 firms from each country, but they ignored the corporate financial structure of middle-sized firms and start-ups. Those firms, in general, have a corporate financial structure quite different than large firms (Titman 1988; Cobham and Subramaniam 1998).

The objective of Chapter 2 is to provide robust results on the connection between economic development and the aggregate debt-equity ratio. I investigate the long-term pattern of the aggregate corporate financial structure for the non-financial sector in four economies: the U.S., Canada, Australia, and Taiwan. These four economies represent different income levels. In 1998, the U.S.A. had the third highest gross domestic product (GDP) per capita; Canada and Australia were ranked 8th and 10th, respectively; and Taiwan was ranked 25th (Penn World Table, year). Data from these four economies at different levels of development may allow me to find some common patterns regarding the relationship between the debt-equity ratio and economic development. In addition, this chapter conducts formal statistical analysis by testing for deterministic trends in the time series data for each country's debt-equity and debt-asset ratios. Compared to the previous studies by Singh et al. (1992) and Singh (1995), this chapter uses economy-wide data that include firms of different sizes to avoid selection bias. The chapter is the first to conduct formal econometric analysis on the long-term pattern of debt-equity ratios in the U.S.A. and Australia. It is also the first to formally test for a secular pattern in time series data of corporate financial structure in Canada and Taiwan.

Chapter 2 finds that, although the debt ratios (the debt-equity and the debt-asset ratio) in all four economies have fluctuated over the last 30 to 40 years, none of these ratios show a downward trend. This finding contradicts the theoretical predictions by Boyd and Smith (1996) and Vilasuso and Minkler (2000). In addition, Granger-causality tests show that the links between GDP per capita and the debt ratios are very strong. Positive feedback exists between the debt ratios from the National Balance Sheet and GDP per capita in these four economies. The debt-equity ratio from the Flow of Funds Accounts follows an inverted-U shape; it moves in the same direction as GDP per capita in the relatively lower-income economy of Taiwan and moves in the opposite direction in the higher-income U.S. economy.

The connections between the GDP growth rate and debt ratios are also investigated. There is a positive relationship between the growth rate and the debt ratios from the National Balance Sheet. This is consistent with agency cost theory (Jensen and Meckling 1976). The impact of the growth rate on the debt-equity ratio from the Flow of Funds Accounts depends on the income level. The experience in the U.S. and Taiwan seems to suggest that the GDP growth rate and the debt-equity ratio move in the same direction in higher-income countries and in opposite directions in lower-income countries.

Chapter 3 offers a better understanding of the relationship between economic development and a firm's financial decisions by explicitly modeling corporate financial and corporate ownership decisions. The latter had been neglected in previous theoretical models on the same subject (Boyd and Smith 1996; Vilasuso and Minkler 2000). When considering how to finance a new project, an entrepreneur has to decide how much to invest from personal savings and how much to invest from external funds, such as debt and equity. In other words, the ownership structure and the corporate financial structure are determined simultaneously, and theoretical models of entrepreneurial decision-making should incorporate this stylized fact.

Chapter 3 focuses on two major issues. First, how does the corporate financial structure change with economic development? Specifically, how does the aggregate debt-equity ratio change as per capita national income increases? The second question relates to the long-term pattern of ownership structure. If capital per capita affects the debt–outside equity ratio during economic development, how does it affect inside equity?

Using the optimal contract framework under asymmetric information and moral hazard assumptions, this chapter first demonstrates that the optimal payment contract from a manager to his investor is a mixture of (outside) equity and debt. The manager receives a share of output equal to his marginal cost of effort. This is interpreted as the percentage of inside equity. Economic development then affects the average debt-equity ratio and the average percentage of inside equity through the manager's participation constraints. Other things being equal, a higher opportunity wage leads to a smaller managerial group as the less-able managers drop out of the managerial group. The agents who stay in the managerial group are those with greater managerial abilities. Since the percentage of inside equity increases with managerial ability, an increase in the opportunity wage leads to a larger average percentage of inside equity. The long-term pattern of average debt-equity ratio in this model is indeterminate. A higher opportunity wage results in a decrease in both aggregate debt and aggregate equity. The average debt-equity ratio, defined as the ratio of total debt to total equity, depends on whether debt or equity decreases faster.

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CHAPTER 1. MODIGLIANI AND MILLER IRRELEVANCE WITH POSITIVE PROFIT AND DEFAULT RISK: AN OPERATIONAL APPROACH

1.1 Introduction

This chapter[1] intends to make the Modigliani-Miller Irrelevance Theorem transparent and operational in the presence of risk neutrality and positive profit. As one of the most important theorems in corporate finance, the Modigliani and Miller Irrelevance Theorem provides a threshold for analyzing optimal capital structure. It claims that under perfect capital market conditions,[2] any effort to increase a firm's value (or decrease its cost of capital) through changes in the composition of debt or equity finance would be made useless, as long as investors can replicate the firm's return by riskless arbitrage. The value of the firm (or its cost of capital equivalently) is determined by the firm's revenue and its risk class only. When the firm issues debt to retire equity, a larger fraction of the firm's profit is distributed as dividends to fewer shares of equity. The rate of return on equity therefore increases with the firm's debt-to-equity ratio (Proposition II of MM Irrelevance):

$$r_s = \rho_k + (\rho_k - r_f)\frac{d}{s} \tag{1.1.1}$$

[1] I am really grateful to Professor James A. Roumasset for leading me to the wonderful world of corporate finance and pointing me to this research direction.
[2] According to Fama (1981), a perfect capital market means no taxes, no transaction costs, no bankruptcy costs, and full alignment between the goals of the firm's managers and shareholders.

where r_s is the expected rate of return on equity, ρ_k is the cost of capital to an all-equity firm of risk class k, r_f is the risk free rate, and $\frac{d}{s}$ is the firm's debt-to-equity ratio. The MM Irrelevance Theorem (Modigliani and Miller 1958) assumes implicitly that the firm has no default risk. The expected rate of return on debt is therefore constant, equal to the risk free rate r_f. A linear relationship thus exists between the expected rate of return on equity r_s and the firm's debt-to-equity ratio $\frac{d}{s}$. The difference between r_s and r_f is interpreted as a risk premium. It increases as the debt-equity ratio rises.[3]

Stiglitz (1969) provided conjectures about returns on debt and equity with default risk. The firm's risk of default increases as the firm borrows more and is obliged to pay higher nominal and higher expected interest rates.[4] As a result, the

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[3] Rearrange equation 1.1.1:

$$r_s - r_f = \rho_k + (\rho_k - r_f)\frac{d}{s} - r_f \qquad (1.1.2)$$

and we get

$$\frac{\partial(r_s - r_f)}{\partial(d/s)} = \rho_k - r_f \qquad (1.1.3)$$

which is positive if $\rho_k - r_f > 0$, or if investors are risk averse.

[4] The nominal return on each security is the one from the firm's promised payment to each security (Stiglitz 1969). It is also called the promised return by Ross, Westerfield and Jaffe (1996). If the second period is composed of probabilistic states of nature, the firm might fail to keep its promise when a bad state occurs. In this situation, equity holders receive nothing while bond holders receive the firm's revenue, which is less than the scheduled principle and interest payments on the debt. The expected rate of return is the weighted average of nominal returns, and whatever investors receive when the firm is bankrupt, with weights equal to the probability of each state.

expected rate of return on equity r_s still increases with the firm's debt-equity ratio, but at a slower rate.[5]

The difference between r_s and r_f is interpreted as the risk premium. This interpretation implicitly assumes that investors are risk averse. When investors are risk-neutral, they do not require a risk premium, i.e., r_s equals r_f.[6] The relevant question is as follows: How is the firm's expected rate of return ρ_k, if it exceeds r_f, distributed between payments to debt and equity holders under risk neutrality?

Modigliani and Miller did not mention how ρ_k is determined. The capital asset pricing model (Sharpe 1964, Lintner 1965), however, provides one route to obtaining ρ_k when investors are risk averse. It assumes that an investor's utility function depends only on the first two moments of a random distribution of wealth, or its mean and variance. This assumption holds only in specific situations, e.g., when all assets are normally distributed, or when an investor's expected utility function is quadratic (Varian 1992). As Varian pointed out, the mean-variance utility function could be a rough approximation to a general utility function since risk aversion means that an increase in the expected return is good and an increase in the variance is bad.[7]

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[5] The MM Irrelevance Theorem and the Stiglitz (1969) conjecture are illustrated by Figure 1.1, which is copied from Figure 17.2 of Brealey and Myers (2000). The pattern of the expected rate of return to debt and equity depends on the risk of the debt. When debt is a safe asset, the expected rate of return to equity increases with the debt-equity ratio, i.e., Proposition II of MM Irrelevance Theorem holds. Otherwise, the expected rate of return to equity increases with the debt-equity ratio, but at a slower rate.

[6] r_s could still exceed r_f if the risk-free security is more liquid than equity. This is, however, beyond the scope of this chapter.

[7] Risk is what risk averters pay to avoid (Rothschild and Stiglitz 1970). Sometimes the variance is a good proxy for risk, for example, when investors' utility function is quadratic or if the returns to

Under the above assumptions, whatever the level of investment is, investors want to minimize the variance of the portfolio for a given expected value. That is, investors want to invest in a portfolio that is mean-variance efficient. Sharpe (1964) shows that this leads to a relationship between the expected rate of return r_i of an asset i and its risk β_i. β_i is defined as the ratio of the covariance of the return on asset i and the market portfolio m, to the variance of the return on the market portfolio:

$$r_i = r_f + \beta_i(r_m - r_f) = r_f + \frac{\sigma(i,m)}{\sigma(m,m)}(r_m - r_f) \tag{1.1.4}$$

where r_m represents the expected rate of return on the market portfolio. The expected rate of return on the firm of risk class k is then calculated by:

$$\rho_k = r + \beta(k)(r_m - r_f) = r + \frac{\sigma(k,m)}{\sigma(m,m)}(r_m - r_f). \tag{1.1.5}$$

ρ_k usually exceeds the risk-free rate r_f, as investors are risk averse and require a risk premium (Figure 1.1).

The CAPM model, which applies the rational expectations hypothesis to a representative agent, implies that the expected rate of return on equity is determined not by the risk of the asset, but by its relationship with the market portfolio. This conclusion depends on the key assumption that investors have homogeneous

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investments are normally distributed (Tobin 1958). Sometimes it is a bad proxy for risk. One example is when investors have Kahneman and Tversky preferences, i.e., the preferences are first convex and then concave (Roumasset 1978, Kahneman and Tversky 1979).

expectations with respect to the expected return and standard deviation of each asset as well as the correlation of returns among assets.[8] As a result, every investor in the market holds two assets: the risk-free asset and the market portfolio. The parameter of risk aversion determines the proportions of investment in the risk-free asset and the market portfolio.

This assumption, as Sharpe (1964) admitted, is highly restrictive and unrealistic (p. 434). It is widely believed that it is differences in beliefs and changes in those beliefs that cause trade (Ross 1978). Empirical investigations by Swidler (1988) also indicated the existence of heterogeneous beliefs. Little progress has been made regarding the homogeneous expectation assumption [see, however, Chen (1986), and Sun and Yang (2003)]. In addition, individual investors who hold a single project rather than the market portfolio require a risk premium based on the risk of the project. The CAPM model therefore provides little assistance in estimating the price of a risky asset for risk-averse investors who do not intend to hold a market portfolio.

ρ_k exceeds r_f--the firm earns positive profits--due to asymmetric information, incomplete contracting or risk bearing by entrepreneurs. Under the asymmetric information assumption where entrepreneurs' actions are not observed directly by investors, Ross (1978) showed that profit sharing between entrepreneurs and investors is Pareto efficient and quite likely to arise in practice under very general conditions. This implies that a positive expected profit is a necessary condition for a

[8] See Ross (1978) for earlier comments on the assumptions of the CAPM model.

contractual relationship between entrepreneurs and investors in the case of asymmetric information.

Hart and Moore (1988) showed that when it is impossible for investors and entrepreneurs to indicate all the relevant contingent states, positive expected profit is necessary to induce the entrepreneur to pay back debt to the investor. If he does not, the control of the firm is transferred to the investor, and the entrepreneur loses the private benefit from the control.

Knight (1965) analyzed the link between entrepreneurship and positive profit under uncertainty. He first differentiated duties performed by managers and entrepreneurs. He believed that entrepreneurs shoulder more responsibility than managers do. Compared with the routine duties performed by managers, an entrepreneur's task is accompanied by risks. He makes judgments and is responsible for judgment error. This additional responsibility determines that his compensation is more than opportunity wage, which only compensates for labor services. The additional portion of the entrepreneur's compensation is the positive profit from his risk taking. Knight states these points clearly:

> ...there would be likely to be a concentration of certain control and coordinating functions in a separate person or group of persons in each productive group. But the duties of such persons would be of a routine character merely, in no significant respect different from those of any other operatives;... When, however, the managerial function comes to require the exercise of judgment involving *liability to error*, and when in consequence the assumption of *responsibility* for the correctness of his opinions becomes a condition prerequisite to getting the other members of the group to submit to the manager's direction, ...the manager becomes an entrepreneur. He may, and typically will, to be sure, continue to perform the old mechanical routine functions and to receive the old wages;

> but in addition he makes responsible decisions, and his income will normally contain in addition to wages a pure *differential* element designated as "profit" by the economic theorist. This profit is simply the difference between the market price of the productive agencies he employs, the amount which the competition of other entrepreneurs forces him to guarantee to them as a condition of securing their services, and the amount which he finally realizes from the disposition of the product which under his direction they turn out. (p. 277)

This chapter essentially follows the description of Knight (1965) since neither asymmetric information nor incomplete contract environment are in the model. I assume that the entrepreneur bears all risks after he pays back investors at the market rate of return. As a consequence, the entrepreneur receives all positive profit. There are two ways for the entrepreneur to be paid the positive expected profit. One is by bonus (Fluck 1998). The other is through common stock (inside equity). I am particularly interested in the latter since inside equity is an important component in compensation contracts for entrepreneurs (Holderness, Korszner and Sheehan 1999). Furthermore, inside equity is closely related to the entrepreneur's power within the firm and to his non-pecuniary benefit (Ang, Cole and Lin 2000).

Using a state-preference approach, this chapter makes the MM theorem more transparent by solving for the expected rate of returns on debt and equity in the presence of default risk. To do so, I assume perfect capital markets; this implies zero taxes, brokerage costs, bankruptcy costs, and transaction costs. This assumption is standard in proving MM Irrelevance. A second non-standard assumption is positive profit. As I discussed in the earlier paragraphs, positive profit serves as compensation for entrepreneurship. It also enables the model to integrate capital structure decisions with decisions about corporate ownership and control, thereby enabling these issues to be addressed in future research. A third assumption is investor risk neutrality. This simplifying assumption may not entail much sacrifice, as empirical studies of investor behavior show that investors usually require a very small risk premium due to diversification and risk sharing.[9] The risk neutrality assumption enables us to focus on the capital market equilibrium condition, which is critical in the MM analysis. It isolates the effect of the capital market equilibrium condition from the

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[9] The risk premium, in the conventional sense, is the difference between the return on the risky and the risk-free asset. For investors who hold a well-diversified portfolio, or the market portfolio, the risk premium is the variation between the return on the portfolio and the risk-free asset. The S&P 500 Index is the most commonly-used proxy for a well-diversified portfolio of common stocks. The risk-free asset, however, does not exist since all assets are subject to inflation and bankruptcy risk. The risk premium is then estimated as the "comparison of long-run average real rates of return on a diversified portfolio of common stocks with the average real returns on safe, short-term investments such as (30-day) Treasury bills" (Shoven and Topper 1992). Recently the T-bond has been used as a proxy for the risk-free asset. The rationale is that "there has been a closer relationship between T- bond yields and stocks than between T-bill yields and stocks" (Brigham et al. 2001). The average real rate of return on the S&P 500 is in general estimated by its arithmetic mean return.

The estimated market risk premium depends on asset selected for the measure of the risk-free rate. In general, the risk premium estimated using the long-term Treasury bond rate (20- year maturity) is smaller than the risk premium estimated from using the T-bill rate. Siegel (1998) found that for the 1926-1998 period, the risk premium was 6.7% when estimated with the T-bond rate, and 8.6% with the T-bill rate.

The market risk premium is also affected by the sample period. Using the data from Ibbotson Associates with the T-bill rate, Shoven and Topper (1992) found the market risk premium to be 8.3% for the 1926-1989 period, while Siegel (1998) estimated the risk premium to be 8.6% for the 1926-1998 period.

In addition to the arithmetic mean of annual returns for the S&P 500, the sum of the average yield and the average rate of capital gain is also used as a proxy for the average return on the market portfolio. Using this method, Fama and French (2002) found that the equity premium was 5.57% during the 1872-2000 period when the 30-day T-bill rate was used as the proxy for the risk-free asset.

Although the difference between long-run average real rates of return on a diversified portfolio of common stocks and the average real returns on safe, short-term investments such as (30-day) Treasury bills is usually called the "market risk premium", it does not necessarily mean that this difference is due completely to investors' risk preferences. In addition to risk aversion, this difference may also be partly due to behavioral phenomena. For example, McCurdy and Shoven (1992) found the existence of systematic anomalies at variance with rational behavior.

For our purpose of illustrating the small size of the risk premium, we assume that the market risk premium is indeed due to risk aversion. In our numerical illustration, we follow Shoven and Topper (1992) in taking the risk premium to be the difference between the long-run arithmetic average real rate of return on the S&P 500 and the average real return on 30-day Treasury bills.

effect of investors' risk preferences. Researchers usually use the latter to explain the excess rate of return on equity rather than the former.

1.2 The Model

Consider two periods (0 and 1), with only one current state but two future states (a and b). In the current state, an entrepreneur is endowed with a project that requires a capital outlay K. The entrepreneur has no wealth. He seeks funds in capital markets, either through debt d or equity s. The firm's capital budget is:

$$K = d + s = d + p_0 q_0 \tag{1.2.1}$$

with p_0 and q_0 representing the present value of equity and shares of equity held by investors.[10] Investors are risk-neutral. They may borrow or lend unlimited amounts at the risk-free rate r_f. The gross returns to the firm in states a, b are X_a and X_b. In addition,

$$X_a > K(1 + r_f) > X_b . \tag{1.2.2}$$

This assumption means that the return on the project is uncertain and the project might have default risk. In addition, the project has positive profit. Its expected return EX exceeds the capital outlay K evaluated at period 1:

$$EX = \sum_j \rho_j X_j > K(1 + r_f) \tag{1.2.3}$$

where j represents the state of period 1, with $j = a,b$ and ρ_j is the probability of state j.

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[10] As in Stiglitz (1969), one bond costs one dollar.

According to our previous analysis, the entrepreneur receives the firm's profit. In this model the entrepreneur receives profit via payments to equity.[11] This implies that return X_j in each state is distributed to debt D_j, outside equity S_j and inside equity π_j:

$$X_j = D_j + S_j + \pi_j. \tag{1.2.4}$$

According to Knight (1965), a firm's net profit is given to its entrepreneur for his decision-making and risk bearing. I assume that the entrepreneur gets π_j through common stocks and the percentage of shares held by the entrepreneur is α. α is given as:

$$\pi_j = \alpha[X_j - D_j] \tag{1.2.5}$$

or

$$S_j = (1-\alpha)[X_j - D_j]. \tag{1.2.6}$$

Earnings per dollar invested in the bonds of the firm r_j are given by:

$$r_j = \frac{D_j - d}{d} \tag{1.2.7}$$

with expected rate of return $\hat{r}$:

$$\hat{r} = \sum_j \rho_j r_j. \tag{1.2.8}$$

Return on a dollar invested in the firm's equity e_j depends on state j:

[11] Entrepreneurs also receive firm profits via bonus payments. See, for example, Jensen and Meckling (1976), and Fluck (1998) for models where the entrepreneur receives profit through bonuses.

$$e_j = \frac{S_j - s}{s}. \tag{1.2.9}$$

Its expected rate of return $\hat{e}$ is:

$$\hat{e} = \sum_j \rho_j e_j . \tag{1.2.10}$$

I refer to rates of return on debt and equity in good state as the nominal rate of return on each security. The average cost of capital in each state k_j is simply the weighted average return on *all* the securities, with weights equals to the ratio of each security to the firm's value:

$$k_j = \frac{r_j d + e_j (s + \pi_0)}{v}. \tag{1.2.11}$$

The expected cost of capital for the firm Ek is:

$$Ek = \sum_j \rho_j k_j \tag{1.2.12}$$

where d, e are the present value of debt and equity, and v stands for the firm's value at time 0, which is equal to the value of all outstanding securities:

$$v = d + s + \pi_0. \tag{1.2.13}$$

π_0 represents the present value of inside equity, which depends on the price of common stock p_0 and the number of shares q_e:

$$\pi_0 = p_0 q_e. \tag{1.2.14}$$

q_e is determined by the percentage of inside equity α:

$$\frac{q_e}{q_0 + q_e} = \alpha . \quad (1.2.15)$$

By definition, the market value of the project in any time-state V_j is the sum of the value of all outstanding securities:

$$V_j = D_j + S_j + \pi_j . \quad (1.2.16)$$

EV is the expected value of the project:

$$EV = \sum_j \rho_j V_j \quad (1.2.17)$$

In this model, the firm's value equals its gross return. This becomes obvious when I compare equations (1.2.16), (1.2.17) with (1.2.4) and (1.2.3):

$$X_j = V_j \quad (1.2.18)$$

$$EV = EX . \quad (1.2.19)$$

This system of equations, (1.2.18) and (1.2.19), extends the MM Irrelevance Theorem from *ex ante* to *ex post* status. The firm's *expected* value and its value at time 1--regardless of which state occurs--are independent of the firm's capital structure. The firm's state contingent and its expected value depend on the gross return on the firm and the probability of states of nature. In addition, the MM Irrelevance Theorem holds even when I include the entrepreneur as a shareholder.

This result calls for a clarification concerning Hirshleifer's "investors" (Hirshleifer 1970). The investors of a firm refer to those who offer capital outlays and to entrepreneurs who offer ideas and make the firm grow. What they invest in the firm could be regarded as human capital (Hart and Moore 1988). As long as investors and the entrepreneur (who holds inside equity) form a closed system, i.e., no payment to third parties other than investors and entrepreneur, the firm's value (which includes its state-contingent value and expected value) is irrelevant to its capital structure. This identity holds regardless of whether the capital market is in equilibrium. It only requires the assumption of a perfect capital market.

The capital market equilibrium condition is, however, critical for the expected rate of return on each security of the firm. According to Scott (1976), the equilibrium condition requires that *ex ante*, investors are indifferent to debt and equity. This implies debt and equity holders earn the same expected rate of return, which equals the risk-free rate r_f,

$$\hat{r} = \hat{e} = r_f . \qquad (1.2.20)$$

It follows immediately that p_0 equals the price of debt:

$$p_0 = 1 . \qquad (1.2.21)$$

I also solve for the inside equity π_0 and the number of shares held by the entrepreneur q_e with equations (1.2.1), (1.2.15) and (1.2.21):

$$\pi_0 = q_e p_0 = \frac{ER - K(1 + r_f)}{1 + r_f} . \qquad (1.2.22)$$

The entrepreneur is compensated by the firm's net expected return, which depends on the project's characteristics (capital outlay and gross return in each state) and is independent of the firm's capital structure.

Combining equations (1.2.21) and (1.2.6), I solve for the percentage of inside equity α:

$$\alpha = \frac{EX - K(1+r_f)}{EX - d(1+r_f)}. \tag{1.2.23}$$

This condition ensures that the entrepreneur receives the firm's entire net profit $EX - K(1+r_f)$ after debt payment. It can be shown that α increases as the firm uses more debt:

$$\frac{\partial(\alpha)}{\partial(d)} = (1+r_f)\frac{ER - K(1+r_f)}{[ER - d(1+r_f)]^2} \tag{1.2.24}$$

which is positive when the project has a positive profit. Since the share of inside equity q_e is constant, the percentage of shares held by the entrepreneur increases when the firm uses debt to retire outside equity. This increases the entrepreneur's control rights in a firm that uses one share-one vote and majority voting rules for decision-making.

When $d < \frac{R_{1b}}{1+r_f}$, the firm's revenue in each state is enough to pay the principal and interest payment of debt. The debt is safe and the firm has no default risk. The rate of return on debt in each state equals the risk-free rate r_f:

$$r_j = r_f. \tag{1.2.25}$$

Combining this result with the solution for inside equity q_e and the market equilibrium condition (1.2.20), I solve for e_j:

$$e_j = \frac{(1+r_f)X_j - EX - dr_f(1+r_f)}{EX - d(1+r_f)}. \quad (1.2.26)$$

Notice that e_j is no longer constant. It depends on how much the firm borrows to finance the project. It can be shown that $\frac{\partial e_a}{\partial d} > 0$ and $\frac{\partial e_b}{\partial d} < 0$.[12] As the firm borrows more, equity holders require an increasing nominal rate of return to compensate for their losses in the bad state:

$$k_j = \frac{X_b(1+r_f)}{EX} - 1 \quad (1.2.29)$$

$$Ek = r_f. \quad (1.2.30)$$

Without default risk, the state-contingent cost of capital depends only on the firm's revenue and its capital outlay. This leads to a constant *ex ante* cost of capital.

Default risk changes the returns to the firm's securities in each state. By definition, debt is the senior claimant to the firm's revenue. If the gross return is not enough for principal payments plus interest, the firm goes bankrupt, and debt holders receive the gross return while equity holders receive nothing:

$$D_b = X_b. \quad (1.2.31)$$

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[12] $$\frac{\partial(r_{ea})}{\partial d} = (1+r_f)^2 \frac{R_{1a} - ER}{[ER - d(1+r_f)]^2} > 0 \quad (1.2.27)$$

$$\frac{\partial(r_{eb})}{\partial d} = (1+r_f)^2 \frac{R_{1b} - ER}{[ER - d(1+r_f)]^2} < 0 \quad (1.2.28)$$

I solve for the rate of return on each security and the firm's cost of capital, using equations of equilibrium (1.2.20), inside equity (1.2.15), and debt payment with default risk (1.2.31):

$$r_a = \frac{r_f}{\rho_a} - [\frac{X_b}{d} - 1]\frac{\rho_b}{\rho_a} \tag{1.2.32}$$

$$r_b = \frac{X_b - d}{d} \tag{1.2.33}$$

$$e_a = \frac{r_f + \rho_b}{\rho_a} \tag{1.2.34}$$

$$e_b = -1 \tag{1.2.35}$$

$$k_j = \frac{X_j(1 + r_f)}{EX} - 1 \tag{1.2.36}$$

$$Ek = r_f \tag{1.2.37}$$

It is clear that $\frac{\partial r_a}{\partial d} > 0$ and $\frac{\partial r_b}{\partial d} < 0$. In the presence of default risk, debt holders suffer a greater loss when the firm borrows more, since the same return X_b is distributed to more debt holders. Debt holders therefore require a higher nominal rate of return to compensate for their possible losses in the bad state. The nominal rate of return on debt increases. On the contrary, the nominal rate of return on equity is constant since their loss in the bad state does not change--it continues to be 100%. Comparing the state-contingent cost of capital with and without default risk [equations (1.2.29), (1.2.30) (1.2.36), and (1.2.37)], I find that default risk does not affect the weighted average cost of capital in each state. In this model, k_j depends only on the firm's gross return and is irrelevant to the firm's capital outlay and its capital structure.

Now suppose that investors are risk averse. Assume that an investor's utility function depends on his consumption x:

$$U = u(x). \tag{1.2.38}$$

In addition, I assume that the investor consumes all his income at the end of the period.

First, I need to calculate the value of the firm at the beginning of the period and the rate that the risk-averse investor uses to discount the firm's value. Let ce be the certainty equivalent of the investment in the firm. Then

$$u(ce) = \rho_a u(R_a) + \rho_b u(R_b) \tag{1.2.39}$$

ce is the value of the sure return that brings the same utility level to the investor as that from investing in the firm and getting a risky return of R_j. Discount the certainty equivalent ce with the risk-free rate r_f and solve for the firm's value at the beginning of the period v_0:

$$v_0 = \frac{ce}{1 + r_f}. \tag{1.2.40}$$

The entrepreneur will not finance the firm unless he receives positive profit, i.e.,

$$\pi_0 = v_0 - K > 0. \tag{1.2.41}$$

The rate that the investor uses to discount the value of the firm ρ is solved by:

$$v_0(1 + \rho) = ER. \tag{1.2.42}$$

By assumption, the firm's revenue is distributed as dividend and interest payments. This can be written as:

$$S + D = ER \tag{1.2.43}$$

or

$$(v_0 - d)(1 + \hat{e}) + d(1 + \hat{r}) = ER . \tag{1.2.44}$$

When the firm's debt is small enough that its revenue in the bad state is sufficient for the principle and interest payments, then the firm has no default risk and $\hat{r} = r_f$. This leads to the solution of $\hat{e}$ from equation (1.2.44):

$$\hat{e} = \frac{[ER - d(1 + r_f)](1 + r_f)}{ce - d(1 + r_f)} - 1 . \tag{1.2.45}$$

The constant expected cost of capital Ek is:

$$Ek = \hat{e}\frac{s}{v} + r_f \frac{d}{v} = \frac{ER(1 + r_f)}{ce} - 1 . \tag{1.2.46}$$

If the entrepreneur continues using bonds to retire equity, then the firm's debt will reach a critical value where the firm's revenue in the bad state is just sufficient to make principle and interest payments. Additional borrowing beyond this critical value leads to bankruptcy if the bad state occurs. Let d_0 be the critical value of debt. It satisfies the condition:

$$d_0 = \frac{R_b}{1 + r_f} . \tag{1.2.47}$$

The expected rate of return on equity at this point $\hat{e}_0$ is:

$$\hat{e}_0 = \frac{[ER - d_0(1+r_f)](1+r_f)}{ce - d_0(1+r_f)} - 1. \quad (1.2.48)$$

If the borrowing exceeds d_0, equity holders receive nothing in the bad state. This is exactly what happens when borrowing equals d_0. According to the previous analysis with a risk-neutral entrepreneur, this implies that equity holders require the same risk premium, or the same expected rate of return,

$$\hat{e} = \hat{e}_0 \quad (1.2.49)$$

for any $d > d_0$. The constant expected rate of return on equity is different from the conjectures of Stiglitz (1969) and Brealey and Myers (2000). They proposed that the expected rate of return on equity also increases with default risk. Based on equation (1.2.44), I solve for the expected rate of return on debt $\hat{r}$ when the firm has default risk:

$$d(1+\hat{r}) = ER - (v_0 - d)(1+\hat{e}_0) \quad (1.2.50)$$

and

$$\hat{r} = \frac{ER - (v_0 - d)(1+\hat{e}_0)}{d} - 1. \quad (1.2.51)$$

Thus, the expected cost of capital is constant. It depends only on the expected revenue and the investor's risk preference:

$$Ek = \frac{ER(1+r_f)}{ce} - 1. \quad (1.2.52)$$

1.3 Numerical Illustrations of the Model

In this section, I illustrate my result using numerical examples. For simplicity, assume that the economy in period 1 is represented by mutually exclusive states: boom and recession, each with probability of 50% and 50%. The firm requires a capital outlay of $10,000. It has revenues of $13,000 in the boom state and $8,000 in the recession state (Table 1.1). In addition, the risk-free rate is assumed to be 0.5%. This is the arithmetic-average annual real rate of return on U.S. Treasury bills between 1926 and 1989 (Shoven and Topper 1992).

Assume first that investors and the entrepreneur are risk-neutral. Given the capital outlay and state-contingent revenues above, the entrepreneur receives expected profit of $450, with a present value of $447.74 [Equation (1.2.22)]. The present value of the firm is the sum of debt, outside and inside equity. It equals $10,447.76. The debt-equity ratio is defined as the ratio of debt to the sum of inside and outside equity.

When debt is no more than $7,960, or when the debt-equity ratio is smaller than 3.20,[13] debt is safe and the firm has no default risk. In this case, the rate of return on debt is 0.5% in both the good and bad states. The rate of return on equity in the bad state decreases with the debt-equity ratio:

$$e_b = \frac{-2500 - 0.005d}{10500 - 1.005d}. \tag{1.3.1}$$

The rate of return on equity in the good state is solved by:

[13] This is obtained as follows: 7960/(10,447.76-7960)=3.20.

$$e_a = \frac{2565 - 0.005d}{10500 - 1.005d} \quad (1.3.2)$$

which increases as debt rises because e_a compensates for the increasing loss to equity holders in the bad state.

When debt exceeds \$7,960, debt holders suffer a loss in the bad state. The rate of return on debt decreases as debt rises:

$$r_b = \frac{8000 - d}{d}. \quad (1.3.3)$$

The rate of return on debt in the good state is:

$$r_a = 1.01 - \frac{8000}{d}. \quad (1.3.4)$$

According to equations (1.2.34) and (1.2.35), I obtain the numerical solutions for the rate of return on equity in each state:

$$e_a = 1.01 \quad (1.3.5)$$

$$e_b = -1. \quad (1.3.6)$$

The solutions to the numerical example in the risk-neutral world are summarized in Table 1.2 and illustrated in Figures 1.2 and 1.3.[14] They show that the state-contingent cost of capital is constant, regardless of the firm's capital structure. The cost of capital takes the value of 24.43% in the good state and -23.43% when the bad state occurs. Starting from an all-equity firm, e_a and e_b deviate from the risk-

[14] Figures 1.2 and 1.3 differ from each other only by the x axis. Figure 1.2 plots rates of return and costs of capital on the firm's debt to equity ratio $\frac{d}{s}$. Figure 1.3 plots the same dependent variable on the firm's debt to asset ratio $\frac{d}{v}$.

free rate of 0.5%. The deviation rises as the firm borrows more. If the borrowing exceeds $7,960, the rate of return on equity in each state and the deviation between e_j and $\hat{e}$ remain constant.

Rates of return on debt have a different pattern than rates of return to equity. Debt is safe when the firm borrows less than $7,960. Within this range, there is no uncertainty with respect to debt repayment; debt holders are paid at the risk-free rate and require no risk premium. When the firm's borrowing exceeds $7,960 and continues to increase, more and more default risk is transferred to debt holders. Debt holders suffer increasing losses as debt rises. As a consequence, debt holders require a higher rate of return in the good state. These patterns are represented by the growing distances between r_j and $\hat{r}$ when the debt-equity ratio exceeds 3.20.

In an all-debt firm, debt does not always become equity. This can be seen from Figure 1.3 where $\frac{d}{v}$ is smaller than 1. This phenomenon stems from the assumption that the entrepreneur receives residual income from inside equity. Under this assumption, debt holders do not share the firm's gross return with the entrepreneur. Therefore, they do not get the expected rate of return as shareholders do in an all-equity firm.

The expected rates of return on debt and equity in the risk-averse world can also be solved with the parameters provided above. Following Mehra and Prescott

(1985), I assume that a representative investor's utility function exhibits constant relative risk aversion:

$$u(x) = (1-\gamma)^{-1} x^{1-\gamma} \tag{1.3.7}$$

where γ is the coefficient of relative risk aversion. Given the fact that equity holders receive nothing in the bad state when the firm has default risk, I restrict γ to be smaller than 1. For a reason I discuss later, I choose γ to be 0.63. By equation (1.2.39), the certainty equivalent of the investment in the firm is solved from:

$$\frac{ce^{1-\gamma}}{1-\gamma} = 0.5[\frac{R_a^{\ 1-\gamma} + R_b^{\ 1-\gamma}}{1-\gamma}] \tag{1.3.8}$$

which implies that $ce = \$10{,}310$. This indicates that the entrepreneur's profit at the beginning of the period is equal to $\frac{ce}{1+0.005} - K = \$258$, and the firm's value at the beginning of the period is \$10,258. From equation (1.2.42), I solve for the expected rate of return on the firm ρ:

$$\rho = \frac{ER}{v_0 - 1} = 0.02\,. \tag{1.3.9}$$

As discussed in the previous section, the expected rate of return on debt equals the risk-free rate when the firm does not have default risk, or $\hat{r} = r_f$. The expected rate of return on equity is solved from equation (1.2.45):

$$\hat{e} = \frac{10500 - 1.005d}{10447.76 - d} - 1\,. \tag{1.3.10}$$

It increases with the borrowing d. From equation (1.2.46), I obtain the expected cost of capital:

$$Ek = \frac{v-d}{v}\hat{e} + \frac{d}{v} r_f = 0.024. \qquad (1.3.11)$$

The critical value of borrowing occurs where the revenue of the firm in the bad state is just sufficient for the principle and interest payments. This means that:

$$d_0 = \frac{R_b}{1+r_f} = \$7{,}960. \qquad (1.3.12)$$

The threshold debt-equity ratio is:

$$\frac{d_0}{s_0} = \frac{d_0}{v_0 - d_0} = 3.46. \qquad (1.3.13)$$

The expected rate of return on equity at d_0, by equation (1.2.48), is:

$$\hat{e}_0 = \frac{10500 - 8040}{10447.76 - 7960} - 1 = 0.088. \qquad (1.3.14)$$

This is exactly the arithmetic-average annual real rate of return on the S&P 500 over the 1926-1989 period. The solution for $\hat{e}$ leads to the solution for $\hat{r}$ when the firm has default risk:

$$\hat{r} = \frac{10500 - 1.088(10258 - d)}{d} - 1 \qquad (1.3.15)$$

and for the expected cost of capital:

$$Ek = \frac{10500}{10310} - 1 = 0.02. \qquad (1.3.16)$$

Figure 1.4 graphs the expected rate of return on each security from the above example. The expected rate of return on equity is 8.8% with default risk, which is the average annual real rate of return on the Standard and Poor's 500 over the 1926-1989 period (Shoven and Topper 1992). Figure 1.4 shows the threshold debt-to-equity ratio which determines the pattern of the expected rate of return to equity. The threshold debt-to-equity ratio is obtained where firm assets--when liquidated in the bad state--are just sufficient to pay all debt obligations with nothing left for equity holders. The threshold debt-to-equity ratio is 3.46 under the above assumptions on the project, the return to the risk-free asset, and the representative investor's risk parameter [equation (1.3.12)].

When the debt-equity ratio is less than 3.46, debt is a safe asset and the firm has no default risk. Debt holders require no risk premium and the expected rate of return to debt is 0.5%. In contrast, equity holders bear the firm's risk. If the firm is financed by equity only, the expected rate of return required by the representative investor is 2%. This is determined by the firm's state-contingent revenue, the probability distribution of each state, and the coefficient of relative risk aversion, which is assumed to be 0.61 in our example. The expected rate of return to equity then increases as the firm borrows more, until the debt-equity ratio reaches its threshold value of 3.46.

If the debt-equity ratio is 3.46, the firm's assets—when liquidated—are just sufficient to cover debt obligations with a 0.5% risk-free rate. Equity holders receive nothing when the bad state occurs. They require an expected rate of return equal to

8.8%. This is obtained from the expected return to the firm minus all debt obligations and profit paid to the entrepreneur.

When the debt-equity ratio exceeds 3.46, the firm's assets--when liquidated--are insufficient to meet debt obligations; no payments are made to equity holders. To equity holders, this is the same result found at the threshold debt-equity ratio of 3.46. Thus, equity holders require the same expected rate of return of 8.8%. This is illustrated in Figure 1.4; the expected rate of return to equity is constant once the debt-equity ratio exceeds 3.46, or when debt becomes a risky asset.

1.4 Conclusion

This chapter makes the Modigliani and Miller Irrelevance Theorem transparent and operational. In a risk-neutral world, entrepreneurs obtain residual incomes as compensation for their decision making and risk bearing, either to promote better investment ideas or more efficient monitoring on production. Under the capital market equilibrium condition, debt and equity holders obtain the same expected rate of return, although stockholders bear greater risk than debt holders. This framework enables the development of a transparent explanation of the MM Irrelevance Theorem in a risk-neutral world. The reason that the MM Irrelevance Theorem holds ex ante is that the firm's value and its cost of capital are constant in each state.

Table 1.1. Assumed Parameter Values in the Numerical Example

Investment scale	$10,000
Revenue in good state	$13,000
Revenue in bad state	$8,000

Table 1.2. Rates of Return on Debt and on Equity With Risk Neutrality

	No Default Risk	Default Risk
Entrepreneur's profit	$200	$200
Rate of return on debt in good state	0.03	(1.6d-8000)/d
Rate of return on debt in bad state	0.03	(8000-d)/d
Expected rate of return on debt	0.03	0.03
Rate of return on equity in good state	(2809-0.0309d)/(10500-1.03d)	1.06
Rate of return on equity in bad state	(-2260-0.0309d)/(10500-1.03d)	-1
Expected rate of return on equity	0.03	0.03

Note: The solutions are from page 19 to 21.

Figure 1.1. Traditional View of the Relationship between Expected Rates of Return on Equity and Debt and the Debt-equity Ratio (Brealey and Myers 2000)

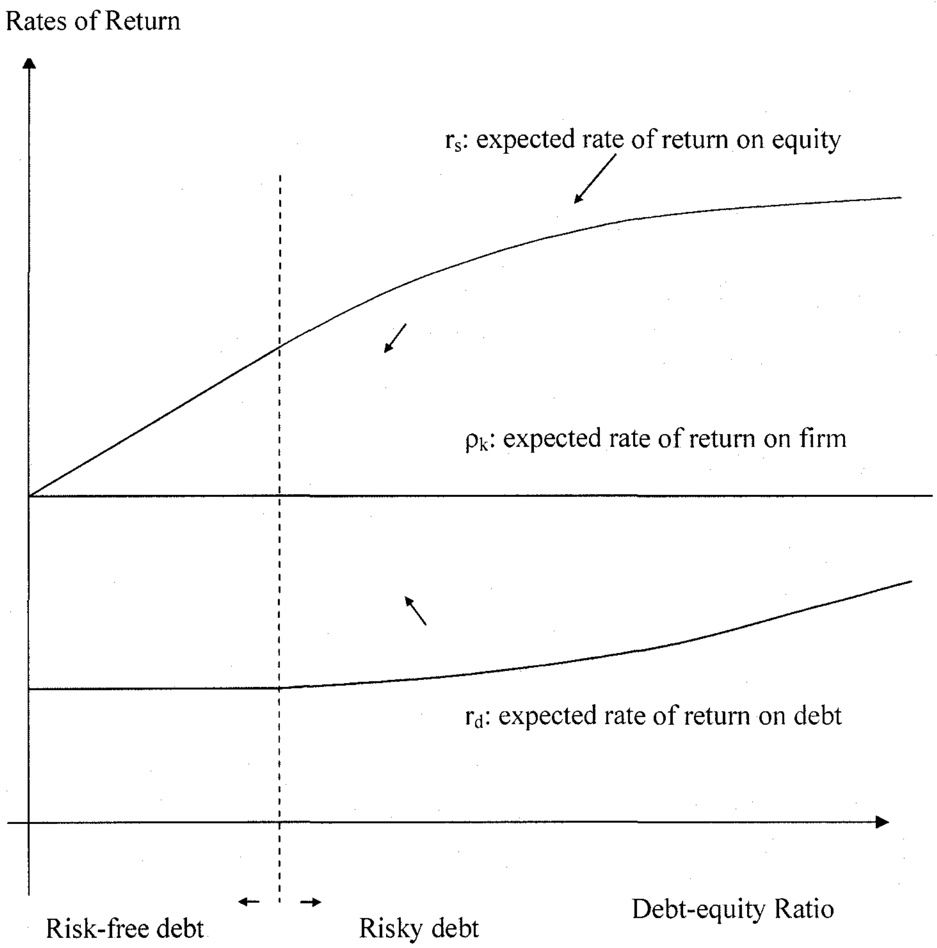


Figure 1.2. State-contingent Rates of Return on Equity and Debt Under Risk Neutrality

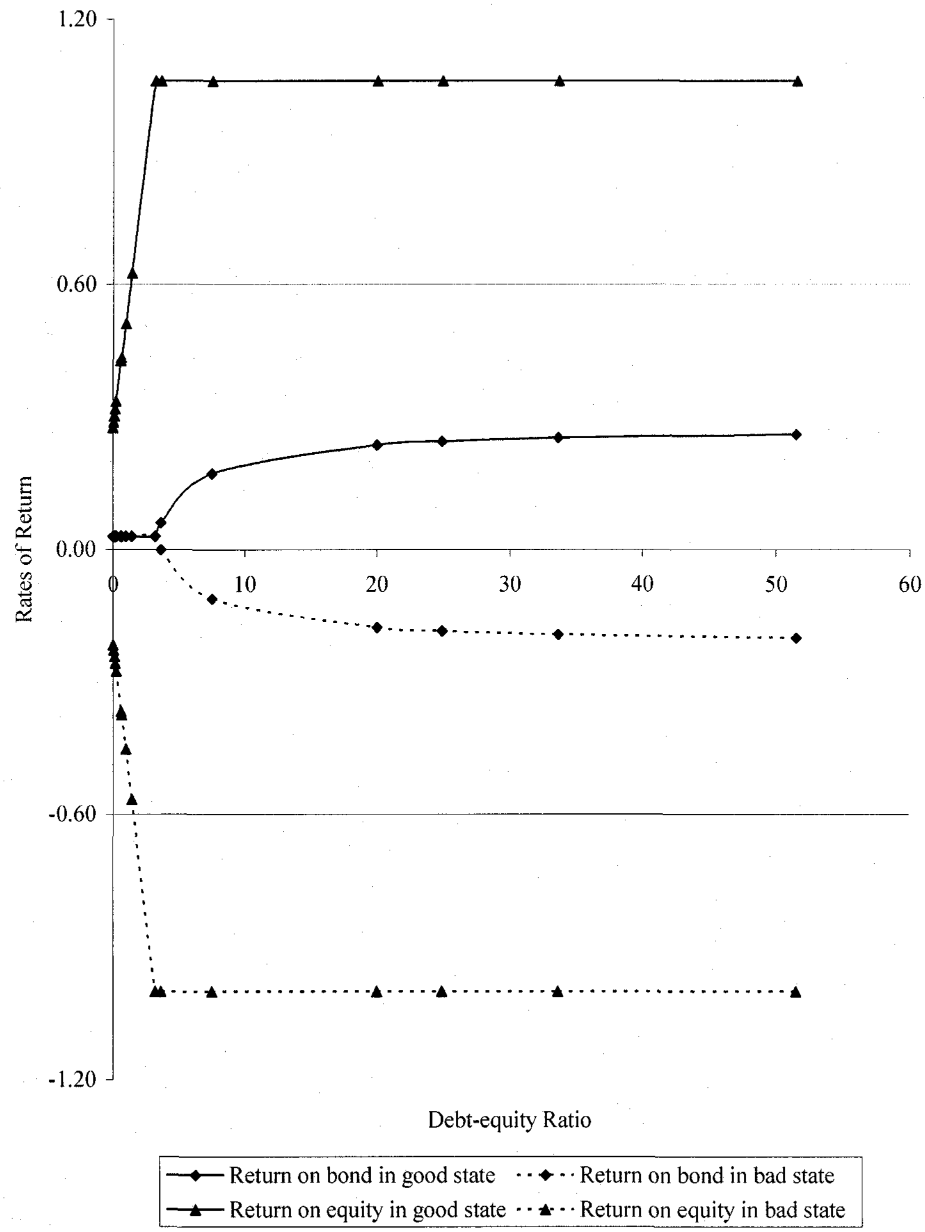


Figure 1.3. State-contingent Rates of Return on Equity and Debt Under Risk Neutrality

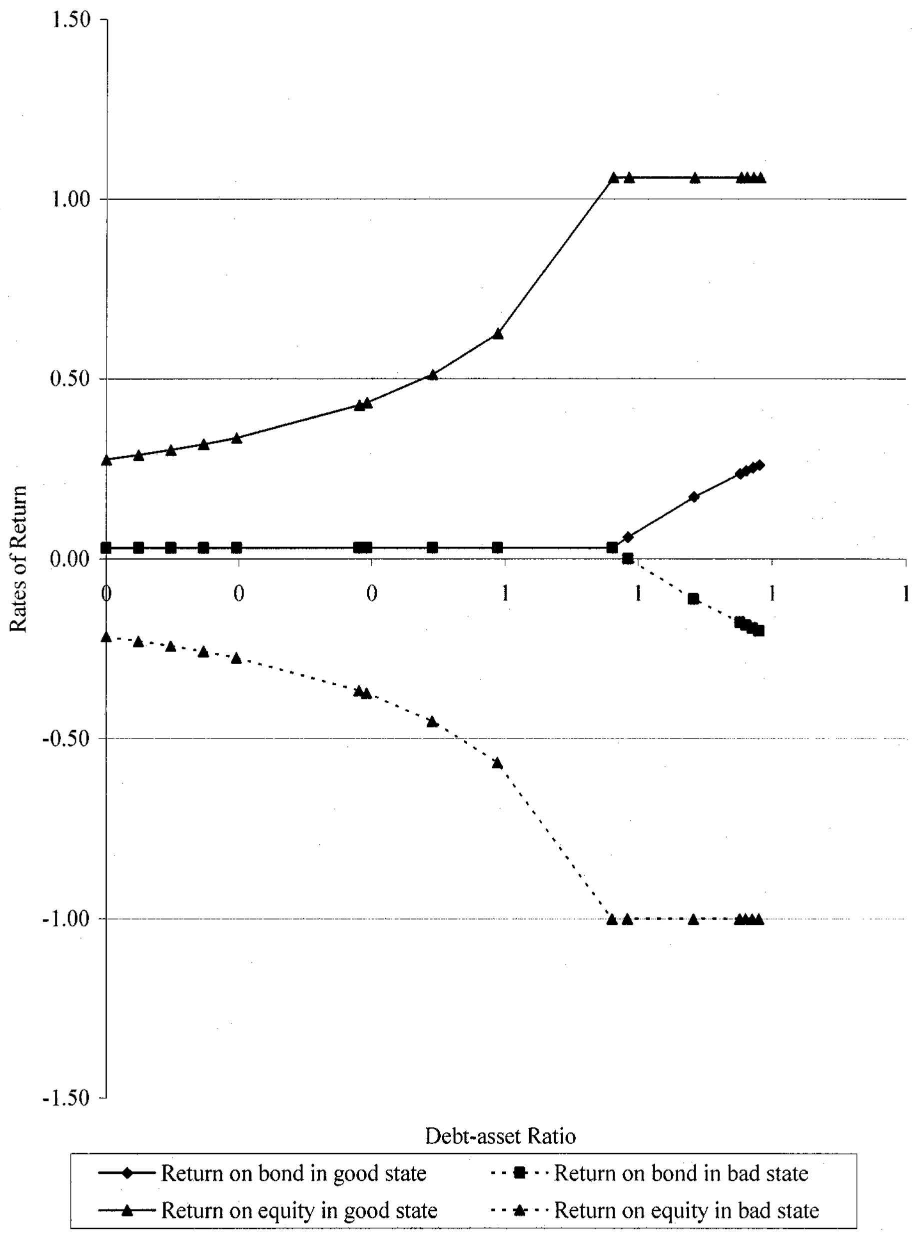
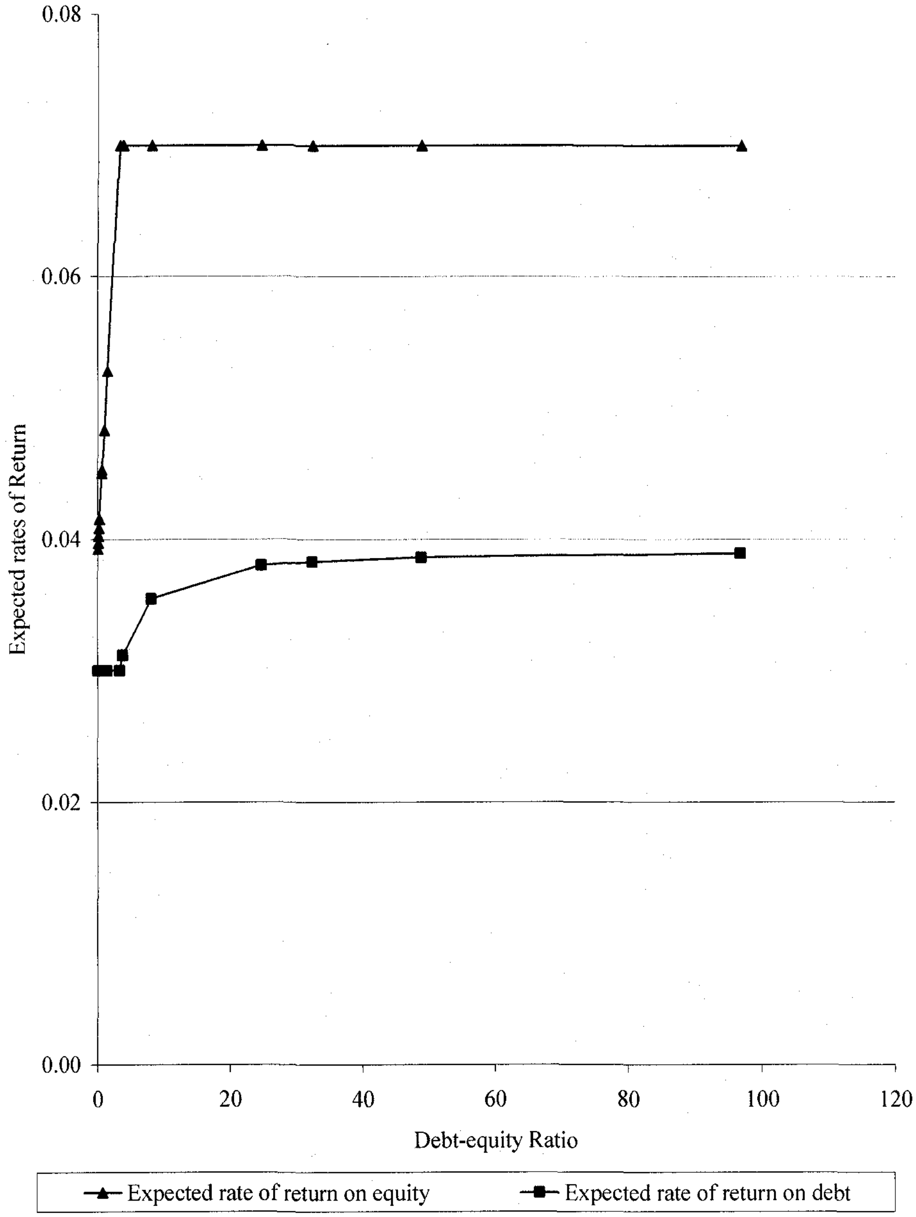


Figure 1.4. Expected Rates of Return on Equity and Debt With Risk-aversion: an Illustration



CHAPTER 2. THE LONG-TERM CORPORATE FINANCIAL STRUCTURE IN FOUR ECONOMIES

2.1 Introduction

Research on the relationship between economic development and financial market development has focused primarily on the link between the economic growth rate and financial market activities. Economic growth is affected by financial market activities by channeling funds to the best user (Goldsmith 1969, Greenwood and Jovanovic 1990, Levine 1991, King and Levine 1993, and Fase and Abma 2003). Economic growth also affects financial market structure through demands for different securities (Korajczyk and Levy 2003, Booth et al. 2001).

Goldsmith (1969) also observed a link between economic development and the growth of financial intermediaries. He found that the ratio of financial institutions' assets to gross national product increased steadily for both developed and less-developed countries from 1860 to 1963. This indicates a positive relationship between the level of economic development and the demand of financial instruments. But his study does not answer the following questions. How does economic development affect firms' financial structure? Do countries with higher income have relatively more debt or more equity? The answer to this question provides an important benchmark to evaluate corporate financial health as an economy develops.

Boyd and Smith (1996) were the first to examine theoretically the relative use of debt and equity in economic development. Debt holders incur monitoring costs that increase with GDP per capita. When entrepreneurs predict such a tendency, they use less debt and more equity to minimize the total cost. Their model predicts a downward trend in the debt-equity ratio as the level of economic development increases.

Vilasuso and Minkler (2000) developed a dynamic model, where the optimal debt-equity ratio is one that minimizes the total agency cost, which also depends on asset specificity. Assuming that the asset specificity of a firm increases with the level of economic development, their model expected that the debt-equity ratio would decrease with GDP per capita.

The theoretical predictions of the relationship between the debt-equity ratio and the level of economic development seem to contradict empirical results. Taggart (1985) studied the long-term pattern of the debt-equity ratio in the USA in the 1900-1981 period using a variety of sources for the non-financial corporations' data. He found that debt financing grew significantly after World War II. During this period, GDP per capita in the USA also increased steadily. The same upward trend shared by GDP per capita and debt financing might suggest some positive links between these two series.

Edey and Gray (1996) investigated the long-term financial structure in Australia. Analyzing the data of companies surveyed, they noticed that the debt-equity ratio in Australia shares the same pattern as those in the USA and Canada.[15] Starting from a very low level in the 1950s and 1960s, the debt-equity ratio in Australia increased steadily, until the sample period ended in 1986. Edey and Gray (1996) suggested that one reason for the upward trend in the debt-equity ratio shared among the USA, Canada and Australia might be that all three have so-called "Anglo-Saxon" financial systems.

The upward trend in the debt-equity ratio, however, is also found within the "Universal Banking" Financial System. Singh et al. (1992) and Singh (1995) compared the corporate structure in India and UK. Using the median of the largest manufacturing corporations quoted on the stock market from 1980 to 1990, he observed that the Indian manufacturing sector tends to use relatively more equity than its counterpart in the UK. But their paper might suffer from selection bias, as they did not consider the corporate financial structure of middle-sized firms and start-ups, which, in general, have a different corporate financial structure than large firms. The effect of firm size on the corporate finance structure of Indian firms is confirmed by Cobham and Subramaniam (1998). Using the Reserve Bank of India's cumulative firm-level data set, they found that there was a significant difference between large and small firms in their user of internal financing and bank loans. In particular, small firms tend to have higher total borrowings and bank loans than larger firms. This is consistent with Titman and Wessles (1988), who found that a firm's size is inversely related to its debt-equity ratio in USA. Cobham and Subramaniam (1998) also

[15] The data was provided by the Reserve Bank of Australia.

pointed out that the conclusion from Singh et al. and Singh is, at least in part, the result of the different methodologies used in these two papers. Specifically, when Singh et al. calculated the corporate financial structure for India, they netted out the depreciation from both the sources of finance and the changes in net assets, while Singh kept the depreciation in both sources and uses of finance. This makes the equity-total source ratio in Singh et al. for Indian firms larger than their counterparts in Singh for UK firms.

There is no consensus from the previous studies on the relationship between corporate structure and economic development. This chapter examines the long-term pattern of corporate financial structure and its relationship with income, using data from four economies: USA, Canada, Australia, and Taiwan. Compared to the previous studies by Singh et al. and Singh, this chapter has economy-wide data that include different sizes of firms. Such data avoids the selection bias from Singh et al. and Singh. In addition, the chapter presents and analyzes data from four economies, which represent different income levels. In 1998, U.S.A. had the third-highest GDP per capita in the world, Canada and Australia were ranked at 8th and 10th, respectively, and Taiwan was ranked 25th.[16] Data from these four economies allows me to search for common patterns regarding the relationship between the debt-equity ratio and economic development. Data for each economy are unbroken time-series, dating back more than thirty years. The data enable us to examine the evolving debt-equity ratio within the same country. Finally, this chapter conducts formal statistical

[16] Data are from Penn World Table, calculated by the Chain Method.

analysis by testing for the presence of deterministic trends in each series. The chapter is the first to conduct formal econometric analysis on the long-term pattern of the debt-equity ratio in U.S.A. and Australia. It is also the first to investigate a secular pattern of corporate financial structure in Canada and Taiwan.

The aggregate corporate financial structure from two sources is examined in this chapter: the National Balance Sheet and the Flow of Funds Accounts. The National Balance Sheet measures the amount of debt and equity outstanding per period, usually at the end of the year. It records stock variables such as total assets, total liabilities, and net worth.[17] Data from the National Balance Sheet reflect the current financial health of corporations. The disadvantage of the National Balance Sheet is that it is subject to estimation error in the market value of debt and assets.

The flow of funds data report flow variables. They track funds as they move across sectors through different financial intermediaries within certain a period of time, usually one year. Thus, the flow of funds approach reflects firms' actual corporate financial decisions at the margin. The disadvantage of using data from the Flow of Funds Accounts is that the data are based on the acquisition cost, or the book value, of debt and equity. This could lead to a deviation from the debt-equity ratio's real market value.

This chapter focuses on two measures of debt ratios (Table 2.2). The first is the debt-equity ratio, which is defined as the value of credit market instruments

[17] See Table 2.1 for the breakdown of the National Balance Sheet.

divided by stock.[18] The debt-equity ratio is a standard measure of corporate financial structure. It has very good theoretical applications. For example, the debt-equity ratio from the Flow of Funds Accounts is the closest to the concept used by Boyd and Smith (1996), and Vilasuso and Minkler (2000). The second measure is the debt-asset ratio, which is often considered the most important balance sheet ratio of an enterprise. It reflects the extent to which total assets are represented by debt, net worth, and accounts payable.

This chapter finds that, although the debt-equity ratio and the debt-asset ratio fluctuated in each economy over the last 30 to 40 years, none of the debt-ratios in all four economies exhibited a downward trend. In addition, the links between GDP per capita and the debt ratios are very strong. In particular, debt ratios from the National Balance Sheet increase with GDP per capita. The income level in each economy also rises with higher debt ratios. The debt-equity ratio from the Flow of Funds Accounts seems to follow an inverted-U shape: it first increases with GDP per capita and then begins to decline.

The relationship between the economic growth rate and debt ratios is also investigated. Debt ratios from the National Balance Sheet generally decrease with the growth rate. This is consistent with agency cost theory, which predicts an inverse relationship between the growth rate and debt ratios. The impact of the growth rate on the debt-equity ratio from the Flow of Funds Accounts depends on the income level. For economies with lower income, the debt-equity ratio decreases with the

[18] Some economies record the value of credit market instruments and equity by their book values, some by market values.

growth rate. For wealthier economies, a higher growth rate leads to a higher debt-equity ratio.

2.2 Long-term Corporate Financial Structure from the National Balance Sheet

The National Balance sheet is the aggregation from balance sheets for each individual corporation. Table 2.1 shows the breakdown of the National Balance Sheet. Following the Flow of Funds Accounts, debt in this chapter is defined as credit market instruments, including mortgages, commercial paper, municipal securities, corporate bonds, bank loans n.e.c., and other loans and advances. The value of structures is estimated by the replacement cost approach.[19]

Three sources of the National Balance Sheet are available for non-financial corporations in the USA. They are provided by Goldsmith et al. (1963) and Goldsmith (1982) from 1900 to 1974, Von Furstenberg (1977) from 1952 to 1978, and the Federal Reserve Board (FRB) from 1945 to 2002.[20] Debt and equity in these three sources are recorded by market value. The main difference between the Goldsmith et al. data and the FRB data is summarized by Table 20 of Goldsmith et al.

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[19] Replacement cost is used to estimate an asset's value. Goldsmith et al. (1963) stated, "In this approach, each asset is valued at the price at which it could be acquired at the balance sheet date". For assets that have a current market, replacement cost equals market value. For assets that do not have current markets, replacement cost equals the original cost multiplied by an index measuring the change between the date on which the asset was acquired and the balance sheet date in either the general price level or the price level for the type of assets in question. These assets include commercial and industrial structures, governmental structures and most types of producer and consumer durables.
[20] Data from the Federal Reserve Board are derived from Table B. 102, Flow of Funds Accounts, Federal Reserve Board.

(1963).[21] Basically, data from the FRB consolidates sectors, netting out most inter-corporate assets except for trade credit. Compared to the FRB's and Goldsmith et al.'s Balance Sheet, Von Furstenberg eliminates non-interest-bearing liabilities from the assets and interest-bearing financial assets from the liability side of the Balance Sheet.

Figure 2.1 plots the debt-asset ratio in the USA from these three sources.[22] The first tentative conclusion from these three series is that debt is not the major source for corporate assets in the U.S.A after World War II. The maximum debt-asset ratio is 0.28 in von Fursternberg, 0.17 in Goldsmith et al., and 0.26 in the FRB data. Net worth, including equities and real asset value, remain the major source of corporate assets.

Among the three sources of data, the Goldsmith et al. data set is the only one that covers the debt-asset ratio before and after 1929. It is the year when the Great Depression began and the stock market crash occurred. The stock market crash not only led to the decline of equities measured by the market value, but also to the rise of the debt-asset ratio in Goldsmith et al.'s data set over the 1929-1933 period. If the Great Depression were considered as an anomaly, the debt-asset ratio would be declining over the 1900-1945 period.

Revisions of security laws may have accelerated the decline of the debt-asset ratio after 1933. As Fox (1998) noted, the Securities Act of 1933 and the Securities Exchange Act of 1934 imposed a set of disclosure obligations on issuers of public

[21] Goldsmith et al., Vol. 2, pp. 24-25.

[22] The debt-asset ratio from Goldsmith et al. and from von Furstenberg is taken from Taggart (1985). Goldsmith (1982) updated his series to include data from 1965 and 1974. The debt-asset ratios for the years 1954-1963 and 1965-1974 are interpolated ratios.

shares. Those disclosure obligations were intended to keep U.S. resident investors from making damaging securities choices due to poor information. Disclosure is effective in aligning managerial and shareholder interests, which in turn leads to lower agency cost of equity and lower debt-asset ratio (Jensen and Meckling 1976).

All three sources of data from the National Balance Sheet in the USA show that the debt-asset ratio increased after the World War II, except for some temporary declines. These include the troughs in 1950 from Goldsmith et al, those in 1955, 1959, 1969 and 1975 from Von Furstenberg data, and those in 1981, 1996 and 2000 from FRB data. All these troughs are closely related to economic recessions except for the trough in 1996 from the FRB data. Economic recessions are accompanied by sharp declines in investments and the demand for funds. It seems that during economic recession, the decline in debt exceeds the decline in total assets so that the debt-asset ratio declines around economic recessions in USA.

Canadian data are available from the National Balance Sheet Accounts, CANSIM II, Statistics Canada.[23] Unlike the USA National Balance Sheet, Canada uses book value for its debt and equity. Its equity is composed of two parts: retained earnings and the acquisition cost of equity. The pattern of the debt-equity ratio from the book value might be similar to that from the market value, since the book values of debt and equity are closely related to their market values.[24]

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[23] Table 378-0004.

[24] Table V of Titman and Wessels (1988) shows that the correlation coefficient between the book value and the market value of the ratio of long-term debt to total asset is 0.73, the correlation coefficient between the book value and the market value of the ratio of short-term debt to total asset is 0.75.

As in the USA, debt is not the major source for corporate assets in Canada. The maximum debt-asset ratio was 0.284 in 1992. But unlike in the USA, the debt-asset ratio in Canada remained relatively stable from 1961 to 2000. It fluctuated within a small range, from 0.23 to 0.28 (Figure 2.2). In addition, the upward trend for Canada's debt-asset ratio is not as obvious as the upward trend in the USA debt-asset ratio.

The debt-equity ratios from the National Balance Sheets for the USA, Canada and Australia are plotted in Figure 2.3. The debt-equity ratio in the USA decreased until 1965 and then began to rise. It remained relatively stable from 1974 to 1990 and then declined again. The high level of inflation rate in 70s and 80s may explain the large debt-equity ratio during 1974 to 1990. The inflation rate averaged approximately 7 percent during the 70s and 5.5 percent during the 80s.[25] As Tatom and Turley (1978) and Feldstein et al. (1978) pointed out, under the current tax system in USA, inflation makes debt a more attractive source of funds than equity. If the effect from inflation were eliminated, the debt-equity ratio might have been fairly stable from 1945 to 2002.

Overall, the debt-equity ratio in Canada is larger than that in the USA, although the USA has higher GDP per capita than Canada. One reason might be the different methodology used to record the value of equity. As mentioned before, equity in the USA is recorded by its market value, and in Canada, is recorded by the

Bowman (1980) shows that the book and the market value of debt have a high correlation coefficient of 0.992.

[25] The inflation rate is taken from the Bureau of Labor Statistics data, available at ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt. The average inflation rate is calculated by author.

book value. It is possible that as a country becomes wealthier, the market value of equity increases and therefore, is larger than its book value (Wongbangpo and Sharma 2002).

The debt-equity ratio in Canada also seems to follow an inverted U-shape. It first increased up until 1986 and then declined, despite its temporary spike from 1986 to 1997. One reason is again the inflation rate. Johnson and Gerlich (2002) found that the average rate of inflation in Canada was higher in the 1964-1988 period than in the 1989-2001 period. As we discussed before, inflation leads to a higher debt-equity ratio in the presence of the corporate tax.[26]

The Australian debt-equity ratio--analyzed by Edey and Gray (1996)--should be used with great caution. The data are compiled from aggregate balance sheet data for all non-financial companies included in the Company Supplement Survey. However, the detailed information on the survey, such as the sample size and the distribution of firm size, is unavailable. There is also no indication whether the data are recorded by market value or book value.

The Australian debt-equity ratio, in general, is smaller than those of the USA and Canada. It is clear from Figure 2.3 that the Australian debt-equity ratio has a clear upward trend. The increase in the debt-equity ratio was very prominent during the 1980-1985 period.

In order to examine the relationship between corporate financial structure and the level of economic development, this chapter also plots the debt-equity ratio

[26] Shoven and Topper (1992) indicated that corporate taxes in USA and in Canada are similar in many features.

against GDP per capita. GDP per capita for each economy is obtained from the Penn World Tables, which cover data for each country from 1950 to 1998. The purchasing power parity measure of GDP per capita from the Penn World Tables makes income levels comparable across countries by considering the difference in the purchasing power of different currencies (Summers and Heston 1991).

Figure 2.4 plots the debt-equity ratio vs. GDP per capita in the USA, Canada, and Australia. The inverted U-shape of the debt-equity ratio is more obvious for Canada and the USA. The debt-equity ratio in Canada first demonstrated an upward trend when GDP per capita rose to 18,072 International dollars[27] and then declined. The debt-equity ratio in the USA increased with GDP per capita until income levels reached 18,732 international dollars and then began to fall. The two economies share very similar turning points with regard to GDP per capita. Different from the debt-equity ratio in the USA and Canada, the Australia debt-equity ratio didn't show an inverted u-shape pattern. It followed the pattern of the USA very closely until its GDP per capita reached 18,798 international dollars; rather than reversing and following the inverted U-shape pattern, it continued to increase to levels well above those observed in the USA and Canada.

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[27] International dollar currency is obtained when "the relative prices of individual goods are set at the (weighted) average of relative prices for the same goods in all countries, and the level of prices is normalized so that the GDP of the United States is the same in international dollars as in American dollars", where the average of relative prices is acquired by first expressing a country's item prices as ratios of the corresponding item prices of a numeraire country, the United States, and then averaged. The average process is a specialized multiple regression, allowing for the fact that every item i is not priced in each country (Summers and Heston 1991).

2.3 Long-term Corporate Financial Structure from the Flow of Funds Data

Flow of Funds Accounts are available for two economies: the USA for 1946 to 2002, and Taiwan for 1965 to 2001.[28] The same methodology in data aggregation used by the USA and Taiwan Flow of Funds Accounts allows comparison across these two economies (Table 2.3).

Different than the definition of debt in the National Balance Sheet, debt in the Flow of Funds refers to the net increase in liabilities minus net new equity issues (Taggart 1985). It equals the sum of credit market instruments, trade payables, tax payables, and miscellaneous liabilities. Equity refers to the net new equity issues. In addition, the debt-equity ratio is comparable across these two economies' non-financial sectors, which includes non-financial corporations, government enterprises, and proprietorships. Compared to that of the National Balance Sheet, the debt-equity ratio from the Flow of Funds Accounts is the closest to the actual corporate financial decisions described in Boyd and Smith (1996).

Figure 2.5 plots the debt-equity ratio from the Flow of Funds Accounts for the USA and Taiwan. Several outliers in the USA debt-equity ratio are adjusted in order to make the graph readable. The debt-equity ratio in 1962 was adjusted from 181 to 22, which is the maximum debt-equity ratio during 1946 to 2002. The ratio in 1981 was changed from -136.0714 to -50, the minimum ratio during the same period.

[28] Data for the USA are from Table F.102, Flow of Funds, Federal Reserve Board; Taiwan data are from Accounts System of Flow of Funds, Central Bank of Taiwan, Taiwan.

The debt-equity ratio for the non-financial sector was stable at about 3.6 until 1970. During the high inflation period of 1970-1982, the debt-equity ratio fell to an average of around 1.5. It was then followed by the 1982 to 2000 period when the average of the debt-equity ratio was 3.

The debt-equity ratio for Taiwan's non-financial sector can be broken into two stages: the first is from 1965 to 1986, with decreases in the debt-equity ratio; the second is from 1986 to 2001, when the debt-equity ratio increased steadily. It is not clear why the trend changes in 1974 for the USA data and in 1986 for Taiwan data.

Figure 2.6 plots the debt-equity ratio on GDP per capita for each economy. The debt-equity ratio in Taiwan and the USA share the same pattern when GDP per capita increased from approximately 11,097 to 14,463 international dollars.

2.4 Econometric Analysis

This section first examines the long-term trend in corporate financial structure for each economy. Unit-root tests are used to examine the trend properties of the debt-equity or debt-asset ratio. The main issue is to determine whether these two measures of corporate financial structure have a unit root or a deterministic time trend. I then use Granger causality tests to investigate the relationship between income and the debt-equity ratio.

There are two ways to conduct a unit-root test: Dickey-Fuller tests and Augmented Dickey-Fuller (ADF) tests with a time trend and a constant:

$$\Delta y_t = \alpha + \mu t + (\beta - 1) y_{t-1} + \varepsilon_t \qquad (2.4.1)$$

where the ADF test includes $\sum_{i=1}^{s} \gamma_i \Delta y_{t-1}$ on the right side of the regression to "whiten" residuals. Results from both tests are reported. Compared to that of the ADF test, the result of DF test might not be efficient, because it does not consider possible serial correlation, which leads to upwardly biased standard errors and possibly invalid conclusions. The null hypothesis for both tests is that the debt-equity ratio and the debt-asset ratio contain a unit root; the alternative hypothesis is that the variables have a deterministic trend. The null hypothesis can be rejected if the coefficient of y_{t-1} is significantly smaller than 0, or β is significantly smaller than 1.

This chapter adopts general to specific procedure to find the appropriate econometric model (Charemza and Deadman 1997). It starts with a constant, a time trend, and a reasonably large value of s for ADF test. $s = 3$ is appropriate for annual data. I then systematically reduce the lag length if its estimated coefficient is statistically insignificant. An independent variable is treated in the same way. It is deleted from equation (2.4.1) if its estimated coefficient is statistically insignificant, and the regression is run again without it. In addition, the unit root test on the first difference of a series is not conducted unless its level is determined to be non-stationary.

The trend property of each variable is reflected by the estimated coefficients for the constant and the time trend. If both α and μ are significantly different than zero, the variable has a quadratic trend. If only α is significantly than zero, the variable has a linear trend. The variable does not trend at all if neither α nor μ are significant.

Table 2.4 provides the regression results for the debt-equity ratio from the National Balance Sheets in the USA, Canada and Australia. ADF tests show that the debt-equity ratio in the USA and Canada are random walk processes ($I(1)$). The first difference of each series is a series of identically distributed continuous random variables with zero means.

The tests result for the Australian debt-equity ratio shows that $\beta - 1 = 0.041$. This means that the expected growth rate of Australia's debt-equity ratio is constant, equal to 0.041. This confirms that Australia's debt-equity ratio increased from 1955 to 1986, despite the fact that the estimated coefficients for the time trend μ and constant α are not significantly different from zero.[29]

The USA's debt-asset ratio from the National Balance Sheet is a trend-stationary process. It has a positive and statistically significant constant and trend. This means that the USA debt-asset ratio has a quadratic trend. The hypothesis that economic recession causes the decline of the debt-asset ratio in the USA is also tested by adding a dummy variable for the year of recession to the right hand side of equation (2.4.1). The test confirms this hypothesis.[30] Like the test results for

[29] The expected growth rate g of Australian debt-equity ratio is calculated as:

$$g = \frac{E(y_t) - E(y_{t-1})}{E(y_{t-1})} = 0.041 \qquad (2.4.2)$$

[30] The coefficient for recession dummy is negative and statistically significant using Von Fursteneerg's data and is negative but statistically insignificant using Goldsmith et al. and FRB debt-asset ratio.

Canada's debt-equity ratio, Canada's debt-asset ratio is also a random walk process with its first difference found to be stationary.

The debt-equity ratios from the Flow of Funds Accounts in the USA and Taiwan are both stationary (Table 2.6). The difference is that the data in Taiwan has a positive mean, which indicates that Taiwan's debt-equity ratio has a positive linear trend. The debt-equity ratio in the USA is stationary without any linear trend.

Table 2.7 summarizes the long-term pattern of aggregate corporate financial structure in the USA, Australia, Canada, and Taiwan. Debt-equity ratios from the National Balance Sheet in the USA, Australia and Canada share one common feature: none of them show a downward trend, although one is stationary with a positive linear trend, one has positive growth rate, and one is a random walk. The debt-equity ratios from the Flow of Funds Accounts in the USA and Taiwan do not show downward trend either. This implies that if both aggregate debt and equity increase with economic development, the rate of increase of debt is at least as large as that of equity.

The second purpose of this chapter is to examine empirically the relationship between economic development and the debt-equity ratio (debt-asset ratio). A consensus from the previous empirical works on aggregate corporate structure is that debt from the National Balance Sheet typically increases with economic development (Taggart 1985, Singh et al. 1992, Singh 1995, Edey and Gray 1996). In addition, economic theories also point out that the debt-equity ratio from the Flow of Funds decreases with GDP per capita (Boyd and Smith 1996, Vilasuso and Minkler 2000).

It is worth noting that in addition to the income level, other factors may affect the trend of the debt-equity (debt-asset) ratio. These factors include, among others, changes in the inflation rate and in securities law. In addition, changes in stock market and credit market development (Demirgüc-Kunt and Maksimovic 1996) and trends in the composition of industries (Titman and Wessels 1988, Jensen and Meckling 1976) also contribute to the trend in the debt-equity (debt-asset) ratio. Since the purpose of this paper is to investigate whether and how the corporate financial structure and the income level move together, it is appropriate to ignore these factors and conduct causality tests between the income level and the corporate financial structure.

The co-movement between the corporate financial structure and GDP per capita is tested using the Granger-causality test. It is conducted by a linear regression of the current value of Y on past values of Y and X. If the inclusion of the past value of variable X predicts the present value of Y better than the past value of Y alone, X is said to Granger-cause Y. The causality relationship from Y to X is implemented similarly by regressing the present value of X on the past values of Y and X. If the present value of X is better predicted by the inclusion of the past value of Y than by the past value of X alone, Y is Granger-causing X. Feedback between Y and X occurs if both directions of Granger causality holds. The Granger-causality test is considered to be the simplest and the most powerful method (Charemza and Deadman 1997) to test causality relationships between two variables.

The Granger-causality test is conducted as follows. First, estimate the equation

$$y_t = c_1 + \sum_{i=1}^{j} \alpha_j y_{t-j} + \zeta_t \qquad (2.4.3)$$

and then compare the sum of squared residuals with those from the estimation

$$y_t = c_1 + \sum_{i=1}^{j} \gamma_j y_{t-j} + \sum_{i=1}^{j} \beta_j x_{t-j} + \xi_t . \qquad (2.4.4)$$

x is said to Granger-cause y if s_1, calculated as

$$s_1 = \frac{\sum_{t=1}^{T} \hat{\xi}_t^2 / j}{\sum_{t=1}^{T} \hat{\zeta}_t^2 / (T - 2j - 1)}, \qquad (2.4.5)$$

exceeds the 5% critical value for an $F(j, T-2j-1)$ distribution, where T is the total number of observations.

For time-series data, the Granger test is strictly valid only when the variables included are stationary (Lütkepohl 1991). In order to have appropriate causality tests between GDP per capita and the debt-equity ratio, it is necessary to first test the stationarity of each variable.

Table 2.8 reports the integration test results on the level and logged value of real GDP per capita in Canada, the USA, Australia and Taiwan. The level of real GDP per capita should be used in the Granger-causality test according to theoretical models (Boyd and Smith 1996, and Vilasuso and Minkler 2000). The logged value of GDP per capita is also investigated, because its first difference is the economic growth rate. The link between the economic growth rate and the debt equity ratio is strong. Titman and Wessels (1988) pointed out the negative relationship between the economic growth and debt-asset ratio. A higher growth rate means more flexibility in firms' choice of future investments. Equity holders, therefore, have more opportunities to expropriate wealth from bondholders. In addition, economic growth affects financial market development, which in turn, changes firms' financial decisions. But it is not clear whether the debt-equity ratio increases with the economic growth rate (Levine 1997).

GDP per capita for Australia and Canada is trend stationary. The positive and statistically significant coefficient on time trends for these two economies implies that GDP per capita in Australia and Canada is a quadratic function of time trend. GDP per capita in Taiwan is non-stationary. It has a growth rate of 6% from 1951 to 1998. GDP per capita in the USA has a stochastic and quadratic time trend. The results from the unit-root test imply that the first difference of GDP per capita should be used in the Granger-causality tests for Taiwan and the USA, while the level of GDP per capita should be used in the Granger-causality tests for Australia and Canada.

Table 2.9 presents the trend property of logged value of real GDP per capita. The logged value of GDP per capita in the USA has a stochastic and quadratic trend. Australia and Canada GDP per capita (logged value) were non-stationary ($I(1)$), while Taiwan GDP per capita is stationary with quadratic time trend.

The results of the Granger-causality test are given in Table 2.10. I specify $j = 3$ which is the rule of thumb for annual data. In order to obtain valid test results, GDP per capita in the USA and Taiwan, and Canada's debt-asset and debt-equity ratio are first differenced to obtain stationary variables. F statistics are significant for all Granger-causality tests. They imply that feedback occurs between the GDP per capita (change in GDP per capita) and the corporate financial structure (change in the debt-equity or debt-asset ratio). Feedback also occurs between the growth rate and the debt-equity (debt-asset) ratio.

The question of whether the debt-asset (debt-equity) ratios are moving in the same direction as GDP per capita is answered by their correlation coefficient, r, calculated as:

$$r = \frac{\sum (X_T - \bar{X})(Y_t - \bar{Y})}{[\sum_{t=1}^{T} (X_T - \bar{X})^2 \sum_{t=1}^{T} (Y_T - \bar{Y})^2]^{1/2}} \tag{2.4.6}$$

where T is the number of observation, and $\bar{X}$ and $\bar{Y}$ are the mean values for variables X and Y, respectively. A positive r implies that X increases as Y rises. A negative r means that X declines as Y rises.

Table 2.11 reports estimated coefficients between GDP per capita and the debt-equity (debt-asset) ratio from the National Balance Sheet. r is positive for the USA, Canada and Australia. These positive correlation coefficients indicate that there exists a positive relationship between income and the aggregate debt-equity ratio. This result is consistent with the conclusions from earlier studies using time series (Taggart 1985, Edey and Gray 1996) and cross-sectional analysis (Singh et al. 1992 and Singh 1995).

The correlation coefficients between GDP per capita and the debt-equity ratio from the Flow of Funds Accounts have opposite signs in the USA and Taiwan (Table 2.11). It is positive in Taiwan and negative in USA. The positive correlation coefficient between GDP per capita and the debt-equity ratio in Taiwan should not be a surprise, as both of them increase during the years 1965 to 1998. GDP per capita in Taiwan also gets positive feedback from increases in the debt-equity ratio. The positive relationship between GDP per capita and the debt-equity ratio in Taiwan contradicts the theoretical predictions by Boyd and Smith (1996) and Vilasuso and Minkler (2000)--that the debt-equity ratio from the Flow of Funds Accounts will decrease with the level of economic development. This theoretical prediction, however, does not contradict the evidence from the USA data. This can been seen from the statistically significant s_1, and the negative correlation coefficient between GDP per capita and the debt-equity ratio from the Flow of Funds Accounts in USA.

The opposite sign of the correlation coefficients between GDP per capita and the debt-equity ratio in Taiwan and the USA indicates an inverted U-shape between income and the debt-equity ratio from the Flow of Funds Account. Feedback between GDP per capita and the debt-equity ratio from the Flow of Funds Account indicates that the debt-equity ratio first increases with GDP per capita. It then decreases as a country becomes wealthier. The alternate causality direction also holds. In other words, increases in the debt-equity ratio initially lead to increases in GDP per capita, but later to a decline in income.

Table 2.11 also shows the negative signs of the correlation coefficients between the growth rate and the debt-equity ratio, derived from the National Balance Sheet. Together with the results from the Granger causality test, the negative correlation coefficients indicate a negative feedback between the economic growth rate and the debt-equity ratio. A higher growth rate leads to a decrease in the debt-equity ratio, at least in the USA, Australia and Canada. The negative correlation coefficient between the growth rate and the debt-equity ratio is consistent with the findings in Titman and Wessel (1988), and Booth et al. (2001).[31] It is also consistent with the prediction from agency cost theory. As Titman and Wessel (1988) pointed out, higher economic growth implies more alternative investment opportunities, and more difficulties for debt-holders to monitor entrepreneurs' investments. In addition, increases in the debt-equity ratio also cause economic growth. The reason might be that financial innovations make it easy for firms to issue debt and therefore affect economic growth.

The links between economic growth and the debt-equity ratio from the Flow of Funds Accounts seem to depend on the level of economic development. The correlation coefficient between the growth rate and the debt-equity ratio from the Flow of Funds Accounts in Taiwan is negative. This indicates that economic growth in Taiwan decreases the debt-equity ratio, and that the increase in equity leads to economic growth. One reason for the negative relationship between the growth rate and the debt-equity ratio is that, during 1965 to 2001, economic growth in Taiwan

[31] Their coefficients are statistically insignificant.

was accompanied by a surge in foreign direct investment, which is regarded as equity.[32]

For the last 50 years in the USA, economic growth has led to an increase in the debt-equity ratio from the Flow of Funds Accounts. On the other hand, increases in the debt-equity ratio help to predict economic growth. The positive relationship between growth and the debt-equity ratio in the USA might indicate that firms increases their debt in order for their equity holders to secure the increased profitability from growth.

2.5 Conclusion

This chapter provides an important benchmark to evaluate corporate financial health as an economy develops. It investigates the link between economic development and the corporate financial structure, using the data from the USA, Canada, Australia and Taiwan. This paper finds first, that the long-term pattern of the corporate financial structure depends on its measurement and the data sources. Second, the corporate financial structure, either measured by the debt-asset ratio or the debt-equity ratio, did not exhibit a downward trend during the sample period when all four economies experienced increases in income. This contradicts the theoretical predictions from Boyd and Smith (1996) and Vilasuso and Minkler (2000). The non-decreasing pattern in the debt-equity ratio in these four economies indicates that although the monitoring cost and the agency cost of debt might be important

[32] The foreign direct investment in the Flow of Funds Accounts in Taiwan refers to those that own more than 10% of the invested firm's equity.

factors for the long term pattern of corporate financial structure, other factors contribute as well. For example, higher income leads to more active financial markets, and to the reduction of the transaction costs related with debt. Entrepreneurs and firms thus increase their debt as income rises. In addition, the increase in the agency cost of equity, which is caused by decreases in the percentage of inside equity during economic development, might contribute to the non-decreasing property of the debt-equity ratios in each country.

This paper expands the findings from Korajczyk and Levy (2003) using the Flow of Funds data. It first confirms that economic growth is associated with changes in demands for different securities. In addition, the debt-equity ratio does not merely decrease with economic growth rate as indicated by Korajczyk and Levy (2003). The relationship between economic growth rate and the debt-equity ratio depends on the income level. The experience from the USA and Taiwan seem to suggest that the economic growth rate and the debt-equity ratio move in the same direction in higher income countries, and in opposite directions in lower income countries. Furthermore, the feedback between the debt ratios (debt-asset and debt-equity ratio) and GDP per capita (growth rate) does not contradict the prediction of Greenwood and Jovanovic (1990). They expected that more developed financial markets allowing for more debt issues would promote economic growth. This paper points out that their theoretical prediction might be true for countries with low incomes. For countries with higher incomes, increases in debt-equity are accompanied by the decline of the economic growth rate.

It is possible that data for each country might be revealing a secular trend in corporate financial structure. Stiglitz and Uy (1996) indicated that a firm's corporate financial structure was closely related to financial market development. They pointed out that before there were banks, firms were financed mainly by their retained earnings. As banks were developed, more debt was used and the debt-equity ratio rose. Later, equity markets developed and the debt-equity ratio declined again. This might explain the different trends of the debt-equity ratio in Taiwan and in USA: the higher debt-equity ratio in Taiwan might be due to the development of banks, and the lower debt-equity ratio in USA might be the result of the development of equity markets. In addition, measurement problems, policy distortions and macroeconomic fluctuations could conceal more fundamental underlying trends.

Table 2.1. The National Balance Sheet from the Federal Reserve Board

Assets	New worth and liabilities
Tangible assets	Net worth
Real estate	Value of structures*
Equipment and software	Market value of equities outstanding
Inventories	
Financial assets	Liabilities
Foreign deposits	Credit market instruments
Checkable deposits and currency	Commercial paper
Time and savings deposits	Municipal securities (**)
Money market fund shares	Corporate bonds
Security RPs	Bank loans n.e.c.
Commercial paper	Other loans and advances
U.S. government securities	
Municipal securities	Trade payables
Mortgages	Tax payables
Consumer credit	Miscellaneous liabilities
Trade receivables	
Mutual fund shares	
Miscellaneous assets	

*: Estimated by replacement cost approach.
**: Industrial Revenue bonds. Issued by state and local governments to finance private investment and secured in interest and principal by the industrial user of the funds.

Table 2.2. Measures of Corporate Financial Structure

National Balance Sheet*	
Debt-asset ratio	=credit market instruments/total assets
Debt-equity ratio	=credit market instruments /market vale of equities outstanding
Flow of Funds	
Debt-equity ratio	=(net increase in liabilities-net new equity issues) /net new equity issues.

*: National Balance Sheet in U.S.A. is recorded by market value; in Canada by book value; no detailed information on Australian Balance Sheet.

Table 2.3. Flow of Funds Account

Net acquisition of financial assets	Net increases in liabilities
Foreign deposits	Net funds raised in markets
Checkable deposits and currency	Net new equity issues
Time and savings deposits	Credit market instruments
Money market fund shares	
Security RPs	Trade payables
Commercial paper	Tax payables
U.S. government securities	Miscellaneous liabilities
Municipal securities	
Mortgages	
Consumer credit	
Trade receivables	
Mutual fund shares	
Miscellaneous assets	

Table 2.4. Time Series Property of the Debt-equity Ratio from the National Balance Sheet

	U.S.A. (1945-2002)		Canada (1961-2000)		Australia (1955-1986)	
Levels	ADF	DF	ADF	DF	ADF	DF
Constant		0.09				
		(1.87)				
y_{t-1}	-0.01	-0.16**	-2.09E-03	-8.15E-04	0.041	0.041
	(-0.55)	(-2.16)	(-0.25)	(-0.09)	(3.54)	(3.54)
Number of lags	2		1		0	
DW	1.87	1.94	1.9	1.26	1.77	1.77
P value of Portmanteau test	0.18	0.14	0.61	0.15	0.76	0.76
Difference						
Constant			0.04		0.01	0.01
			(2.17)		(2.21)	(2.21)
Trend			-1.79E-03			
			(-2.30)			
y_{t-1}	-1.06 ***		-0.78***	-0.66***	-0.84 ***	-0.84 ***
	(-2.87)		(-4.69)	(-4.16)	(-3.19)	(-3.19)
Number of lags	3		0		0	
DW	1.95		1.97	1.92	1.95	1.95
P value of Portmanteau test	0.66		0.7	0.66	0.66	0.66

Numbers in parenthesis are t-statistics.
***: significant at 1% level; **: at 5% level; *: at 10% level.

Table 2.5. Time Series Property of the Debt-asset Ratio from the National Balance Sheet

	U.S.A. (1945-2002)		Canada (1961-2000)	
Levels	ADF	DF	ADF	DF
Constant	0.03 (3.61)			
Trend	2.46E-04 (2.68)			
y_{t-1}	-0.16*** (-3.55)	7.02E-03 (1.51)	-1.83E-3 (-0.33)	-1.83E-03 (-0.33)
Number of lags	3		0	
DW	2.11	1.08	1.86	1.68
P value of Portmanteau test	0.46	2.80E-03	0.8	0.64
Difference				
Constant				
yt-1		-0.53*** (-4.44)	-0.94*** (-5.41)	
Number of lags			0	
DW		2.05	1.95	
P value of Portmanteau test		0.11	0.79	

Numbers in parenthesis are t-statistics.
***: significant at 1% level; **: at 5% level; *: at 10% level.

Table 2.6. Time Series Property of the Debt-equity Ratio from the Flow of Funds Accounts

	U.S.A. (1946-2002)		Taiwan (1965-2001)	
Levels	ADF	DF	ADF	DF
Constant			0.72 (3.38)	0.72 (3.38)
y_{t-1}	-0.83*** (-6.06)	-0.83*** (-6.06)	-0.61*** (-3.75)	-0.61*** (-3.75)
Number of lags	0		0	
DW	2.05	2.05	1.69	1.69
P value of Portmanteau test	0.65	6.50E-01	0.53	0.53

Numbers in parenthesis are t-statistics.
***: significant at 1% level; **: at 5% level; *: at 10% level.

Table 2.7. Long-term Patterns on the Aggregate Corporate Financial Structure

Data from the National Balance Sheet		
U.S.A	Debt-equity ratio	Stationary with positive linear trend
	Debt-asset ratio	Stationary with quadratic trend (u-shaped)
Canada	Debt-equity ratio	Random walk
	Debt-asset ratio	Random walk
Australia	Debt-equity ratio	Increases with constant growth rate
Data from Flow of Funds Accounts		
U.S.A	Debt-equity ratio	Stationary
Taiwan	Debt-equity ratio	Stationary with positive linear trend

Table 2.8. Augmented Dicky-Fuller Unit Root Test for Real GDP Per Capita

		Australia (1950-1998)	Canada (1950-1998)	U.S.A. (1950-1998)	Taiwan (1951-1998)
Level	Constant	2696.9 (3.43)	2246 (3.44)	1920.1 (2.454)	
	Trend	115.45 (3.32)	107.76 (3.31)	101.47 (2.605)	
	y_{t-1}	-0.36* (-3.24)	-0.30* (-3.25)	-0.22 (-2.34)	0.06 (19.908)
	Number of lags	1	1	0	0
	Number of Observations	44	44	44	43
	DW	2.06	2.01	1.55	1.38
	P value of Portmanteau test	0.84	0.99	0.47	0.11
Difference					
	Constant			357.36 (3.87)	-140.8 (-2.28)
	Trend				14.83 (-4.14)
	y_{t-1}			-0.81*** (-5.39)	-0.73*** (-4.75)
	Number of lags			0	0
	Number of Observations			44	43
	DW			1.86	1.92
	P value of Portmanteau test			0.57	0.27

Numbers in parenthesis are t-statistics.
***: significant at 1% level; **: at 5% level; *: at 10% level.

Table 2.9. Augmented Dicky-Fuller Unit Root Test for Logged Real GDP Per Capita

		Australia	Canada	U.S.A.	Taiwan
Levels					
	Constant			2.41 (-2.49)	1.50 (3.59)
	Trend			5.71E-03 (2.45)	0.01 (3.55)
	y_{t-1}	2.12E-03 (5.56)	2.08E-03 (4.62)	-0.26 (-2.47)	-0.22 (-3.51)
	Number of lags	0	0	0	1
	Number of Observations	44	44	44	43
	DW	1.78	1.64	1.52	1.97
	P value of Portmanteau test	0.46	0.72	0.48	0.37
Difference					
	Constant	0.03 (4.67)	0.02 (3.78)	0.02 (4.40)	
	y_{t-1}	-1.40 *** (-5.82)	-0.88 *** (-6.12)	-0.94 *** (-6.39)	
	Number of lags	2	0	0	
	Number of observations	44	44	44	
	DW	1.92	1.72	1.8	
	P value of Portmanteau test	0.64	0.42	0.5	

Numbers in parenthesis are t-statistics.
***: significant at 1% level; **: at 5% level; *: at 10% level.

Table 2.10. Causality Test on GDP Per Capita and the Debt-equity (Debt-asset) Ratio

	Null Hypothesis	n	s_1
Data from the National Balance Sheet			
Australia	DE ratio not Granger caused by GDP per capita	32	6.28
	GDP per capita not Granger caused by DE	32	10.39
	Growth rate not Granger-caused by change in DE	32	8.02
	Change in DE not Granger-caused by growth rate	32	7.30
Canada	DA ratio not Granger caused by GDP per capita	38	13.16
	GDP per capita not Granger caused by DA	38	15.18
	DE not Granger caused by GDP per capita	38	10.21
	GDP per capita not Granger caused by DE	38	16.05
	Change in DA not Granger-caused by growth rate	38	7.26
	Growth rate not Granger-caused by change in DA	38	7.54
	Change in DE not Granger-caused by growth rate	38	9.97
	Growth rate not Granger-caused by change in DE	38	8.02
USA	DA not Granger caused by the change in GDP per capita	48	14.31
	DE ratio not Granger caused by the change in GDP per capita	48	13.97
	Change in GDP per capita not Granger caused by DA	48	14.83
	Change in GDP per capita not Granger caused by DE	48	8.22
	Growth rate not Granger-caused by DA	48	13.03
	DA not Granger-caused by Growth rate	48	12.85
	Growth rate not Granger-caused by DE	48	8.78
	DE not Granger-caused by Growth rate	48	12.83

Table 2.10. (Continued) Causality Test on GDP Per Capita and the Debt-equity (Debt-asset) Ratio

	Null Hypothesis	n	s_1
Data from the Flow of Funds			
USA	DE ratio not Granger caused by change in GDP per capita	48	14.04
	Change in GDP per capita not Granger caused by DE	48	14.12
	Growth rate not Granger-caused by DE	48	13.24
	DE not Granger-caused by Growth rate	48	13.36
Taiwan	DE ratio not Granger caused by change in GDP per capita	34	8.34
	Change in GDP per capita not Granger caused by DE	34	5.29
	Growth rate not Granger-caused by DE	34	5.81
	DE not Granger-caused by Growth rate	34	8.34

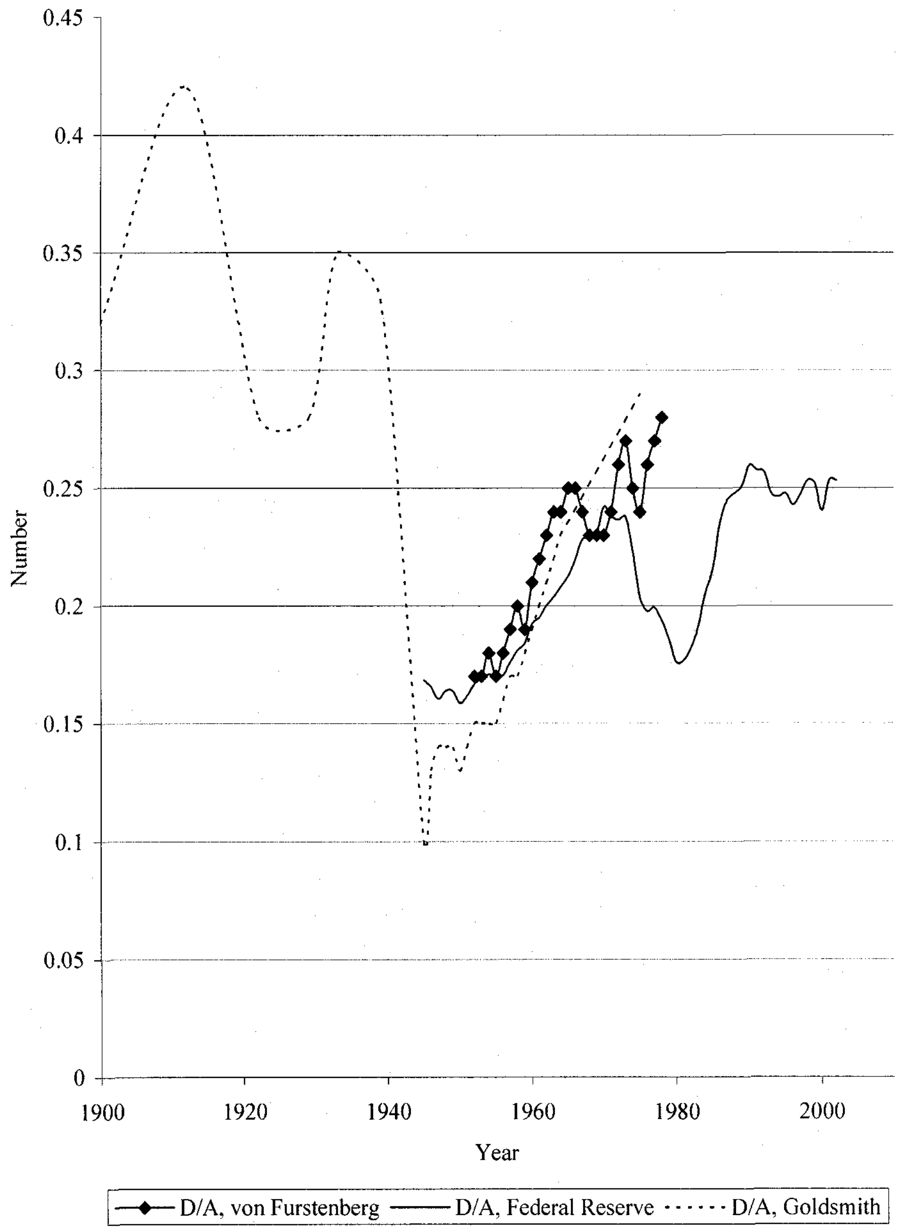
n: Number of observations
GDPPC: GDP per capita; DA ratio: Debt-asset ratio; DE ratio: Debt-equity ratio.
The critical value is 2.99 for F(3,25), 2.96 for F(3,27), 2.92 for F(3,31), and 2.82 for F(3.41).

Table 2.11. Correlation Coefficient between GDP Per Capita, Growth Rate, Debt-equity and Debt-asset Ratios

		GDPPC	Growth rate
Canada			
	DA	0.46	-0.31
	DE	0.63	-0.37
	Change in DA	0.01	-0.11
	Change in DE	0.11	-0.15
U.S.A.			
	DA	0.72	0.13
	Change in DE	0.37	-0.09
	DEFOF	-0.26	0.12
Australia			
	DE	0.89	-0.13
	Change in DE	0.31	-0.41
Taiwan			
	DEFOF	0.74	-0.02

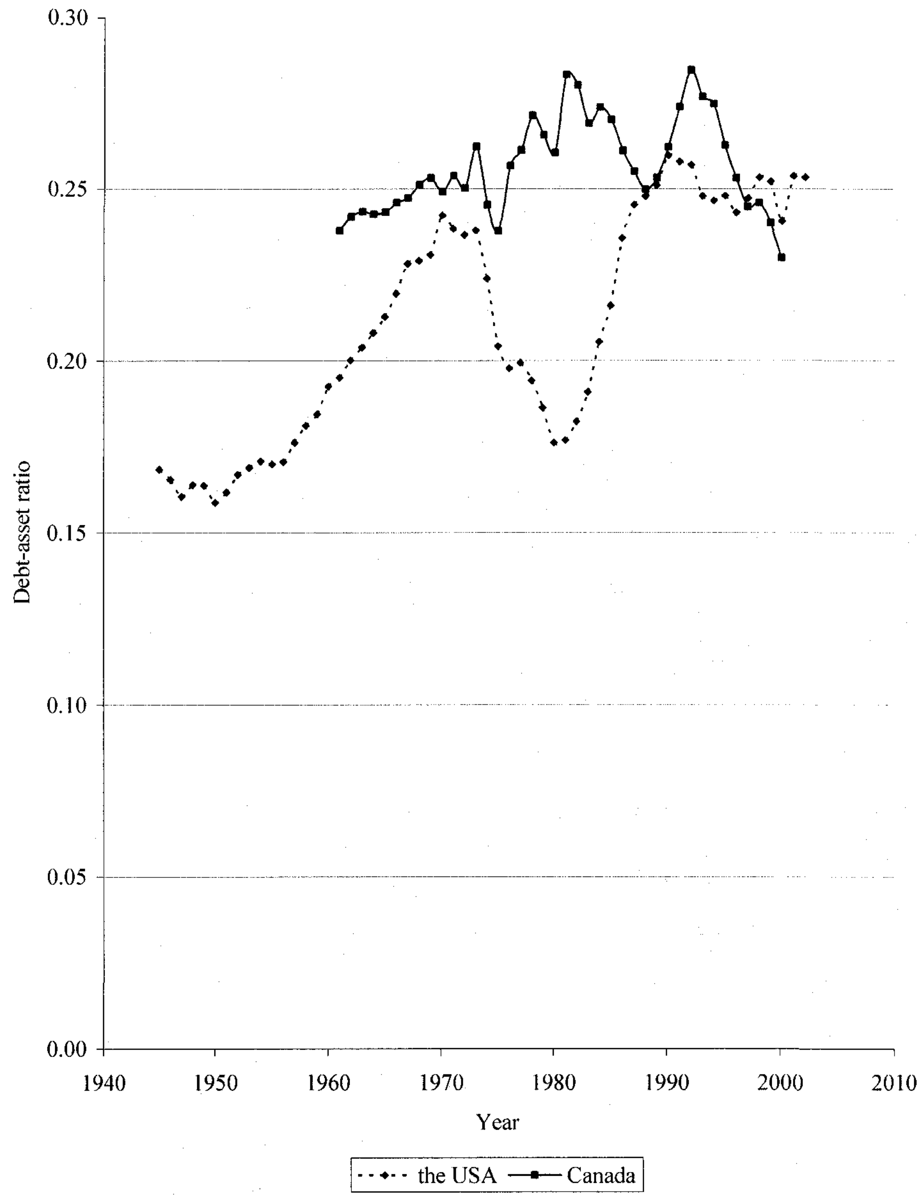
GDPPC: GDP per capita.
DA: Debt-asset ratio from the National Balance Sheet.
DE: Debt-equity ratio from the National Balance Sheet.
DEFOF: Debt-equity ratio from the Flow of Funds Account.

Figure 2.1. The Debt-asset Ratio in U.S.A. from the National Balance Sheet



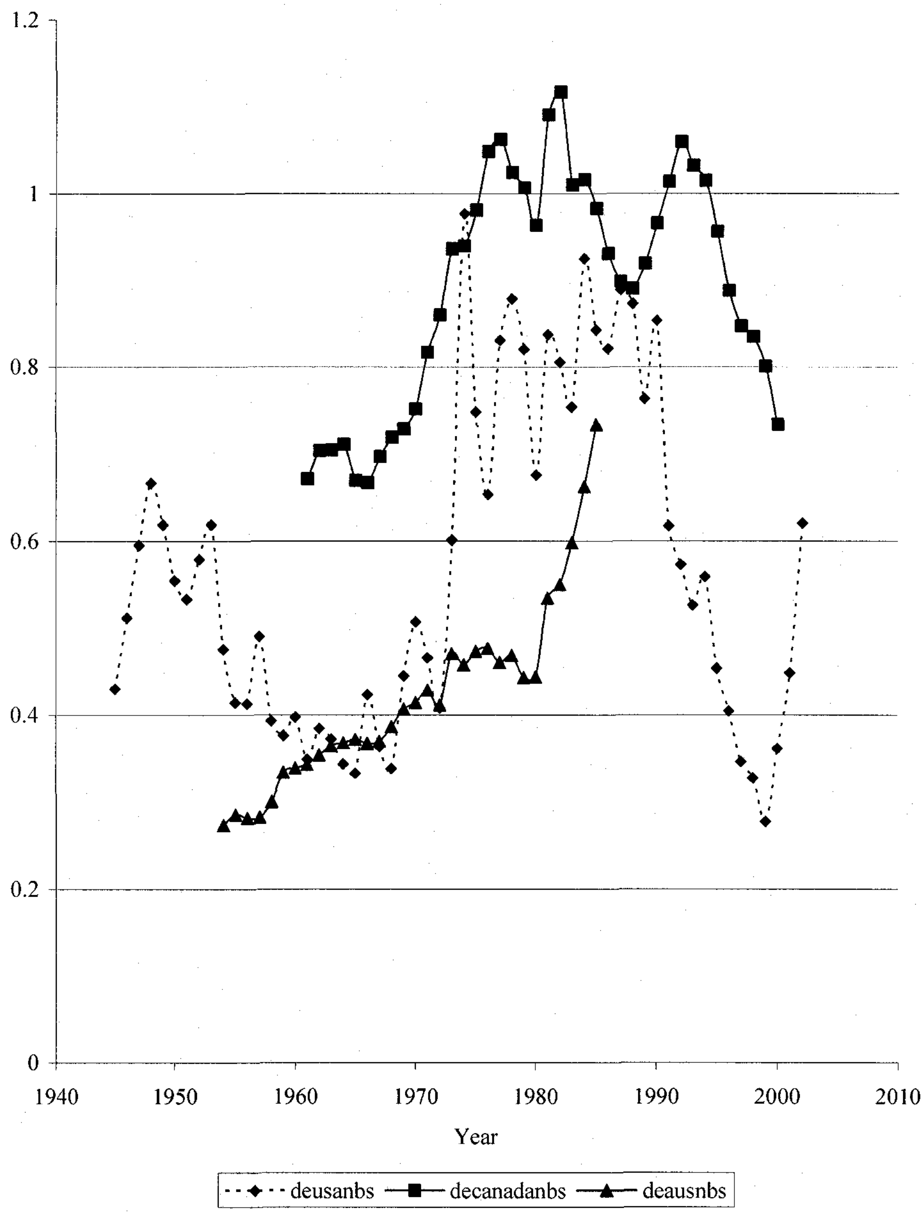
Data Source: Taggart (1985); Goldsmith (1985); and Flow of Funds Account, US Federal Reserve Board.

Figure 2.2. The Debt-asset Ratio from the National Balance Sheet: U.S.A. (1945-2002) and Canada (1961-2000)



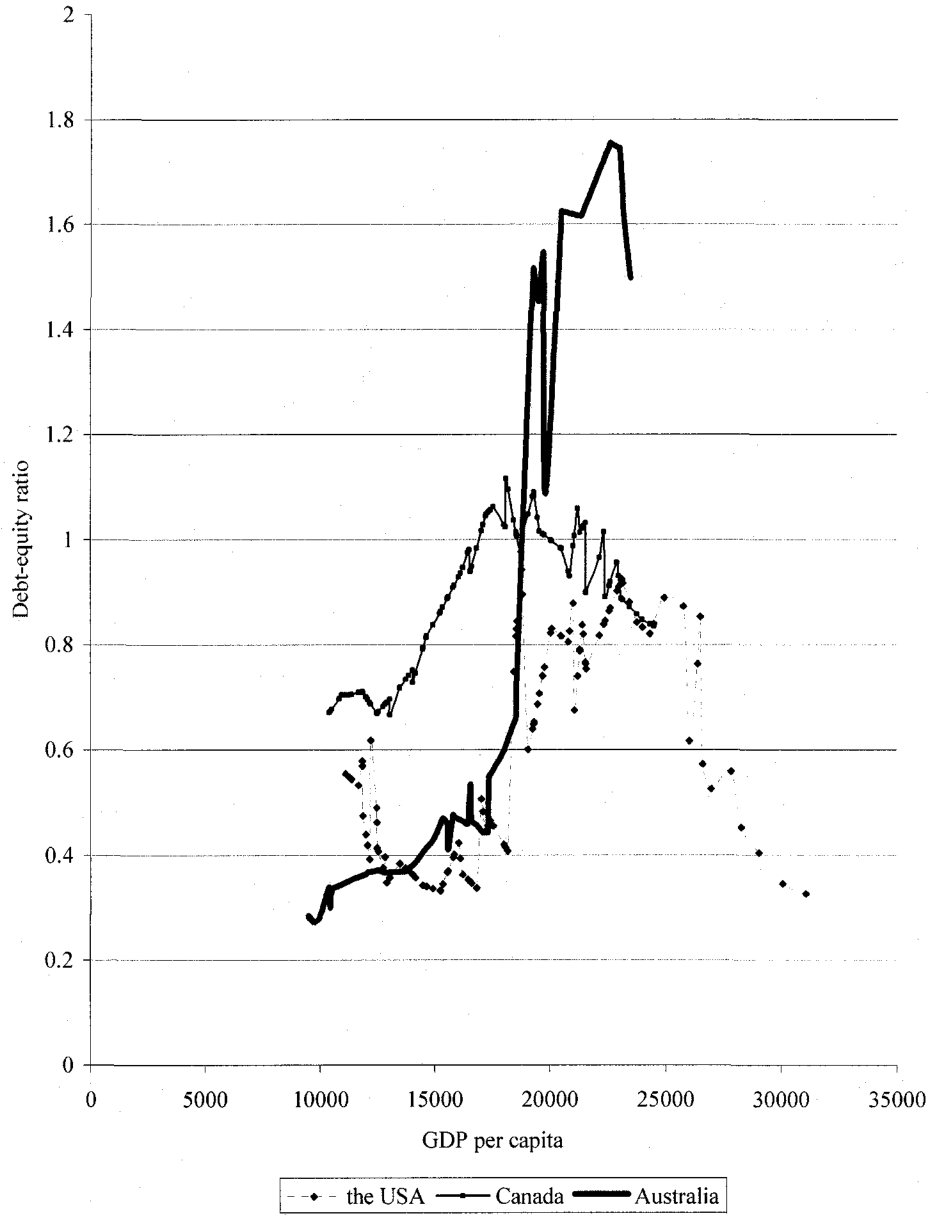
Data Sources: Table B.102, Flow of Funds Account, US Federal Reserve Board; and Table 378-0004, the National Accounts, CANSIM II, Statistic Canada.

Figure 2.3. The Debt-equity Ratio from the National Balance Sheet: USA (1945-2002), Canada (1961-2000), and Australia (1955-1985)



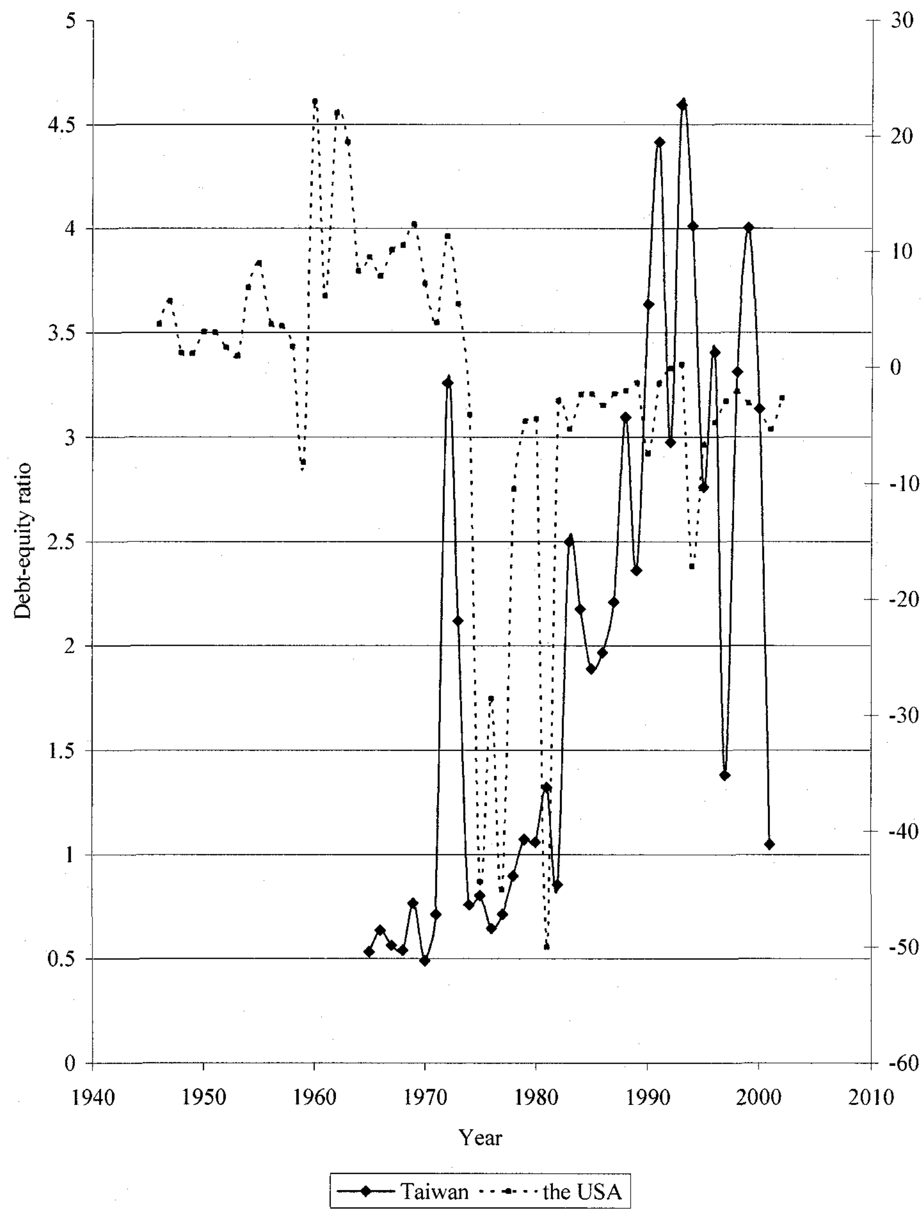
Data Sources: Flow of Funds Account, US Federal Reserve Board; and the National Accounts, CANSIM II, Statistic Canada.

Figure 2.4. The Debt-equity Ratio vs. GDP Per Capita: the National Balance Sheet in U.S.A., Canada and Australia With Interpolated Values



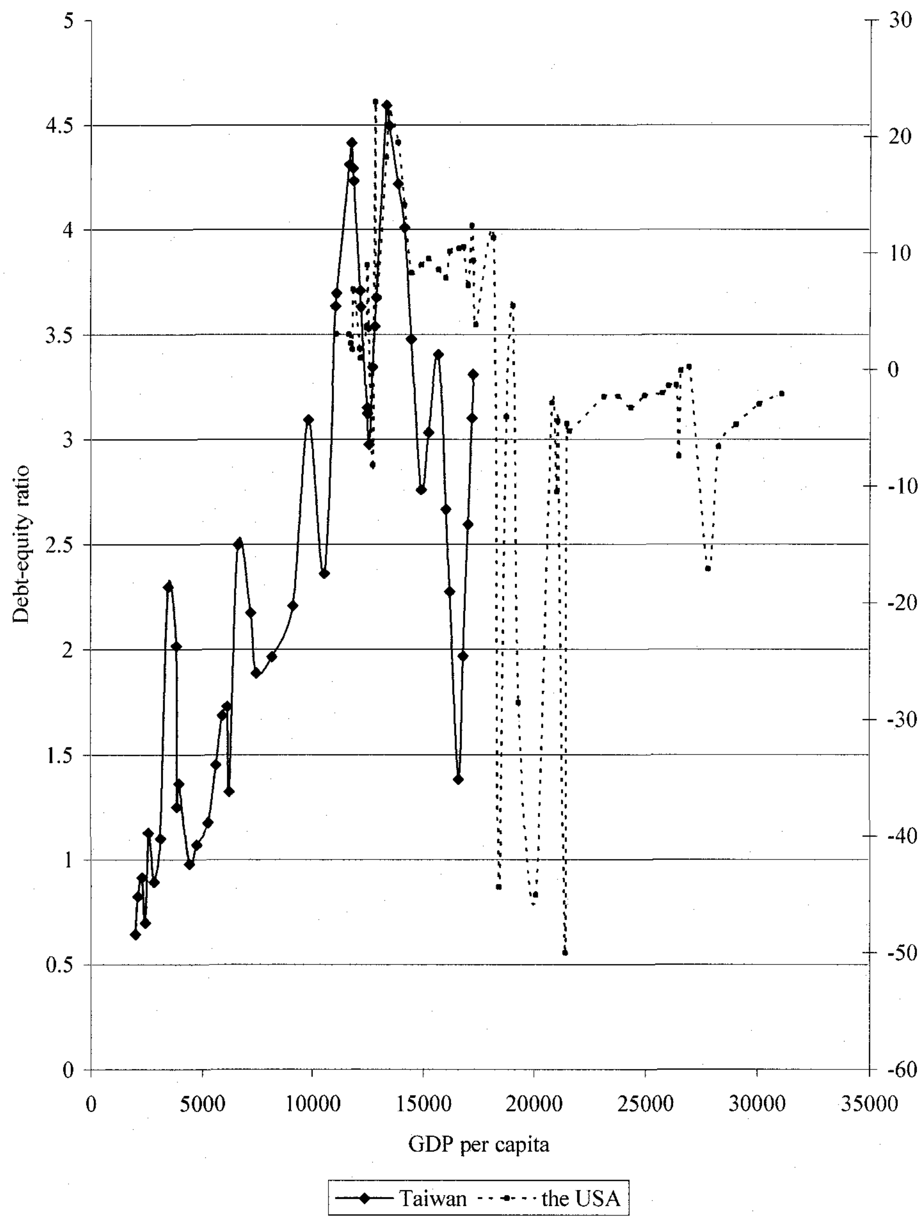
Data Sources: Flow of Funds Accounts, US Federal Reserve Board; CANSIM II, Statistics Canada; and Penn World Table.

Figure 2.5. Debt-equity Ratio from the Flow of Funds Accounts: USA (1946-2002) and Taiwan (1965-2001)



Data Sources: Flow of Funds Accounts, US Federal Reserve Board; and Central Bank of China, Taiwan.

Figure 2.6. Debt-equity Ratio vs. GDP Per Capita in U.S.A. and Taiwan With Interpolated Values



Data Sources: Flow of Funds Accounts, US Federal Reserve Board; Central Bank of China, Taiwan; and Penn World Table.

CHAPTER 3. ECONOMIC DEVELOPMENT, CORPORATE FINANCIAL STRUCTURE AND OWNERSHIP STRUCTURE

3.1 Introduction

Economic development is accompanied by the development of financial markets and the ways in which firms finance their capital formation. Gurley and Shaw (1955, 1960) predicted that the long-term pattern of a firm's financial decisions was closely related to the level of economic development. In poor economies, a firm is financed mainly by its entrepreneur's savings. As an economy becomes richer, banks appear, and bank lending becomes an important source of firm finance. During this period, the entrepreneur is the only source of equity financing. Further increases in income and wealth lead to the emergence of markets specializing in tradable securities such as debt and equity. The firm's new capital formation is then financed by the entrepreneur's personal savings, bank lending, and tradable securities such as debt and equity.

Gurley and Shaw's analysis implied a long-term pattern relationship between corporate financial and ownership structures. The secular pattern of the corporate financial structure or, specifically, the debt-equity ratio, is an inverted U-shaped curve in national income. Debt first increases from the emergence of bank lending and tradable debt, and later declines due to the appearance of outside equity. The ownership structure, the share of entrepreneurial equity holding, has a downward trend, due to the development of equity markets as national income increases.

Boyd and Smith (1996), and Vilasuso and Minkler (2000) formalized the link between economic development and the corporate financial structure. Both papers predicted that the aggregate debt-equity ratio decreases as national income increases. Their models considered only the debt-equity ratio and did not differentiate between inside and outside equity, which I believe is a critical consideration in a firm's financial decisions and its choice of organizational structure.

The neglect of the ownership structure in these models cuts off any relationship between inside equity and the debt-equity ratio, especially when the market for tradable securities emerges, following the Curley and Shaw pattern. When considering the finance of new capital, an entrepreneur has to decide how much he wants to invest from his personal savings, and how much he wants to invest from external funds, such as debt and equity. In other words, the ownership structure and the corporate financial structure are determined simultaneously.

This chapter offers a better understanding of the relationship between economic development and a firm's financial decisions. By explicitly modeling corporate ownership and corporate finance decisions, two major questions are addressed. First, how does the corporate financial structure change with economic development? Specifically how does the aggregate debt-equity ratio change as per capita national income increases?

The second question pertains to the long-term pattern of ownership structure. If capital per capita affects the debt-outside equity ratio during economic development, how does it affect the percentage of inside equity? This is a key question for stock market development and economic growth, as the percentage of inside equity affects a firm's cost of external equity and its stock market activities (Jensen and Meckling 1976), which in turn affects economic growth (Atje and Jovanovic 1993, Levine and Zervos 1998, Demirgüç-Kunt and Levine 1996). The ownership structure also affects the power distribution within a firm. Under the assumption of a one share-one vote rule, the entrepreneur's power increases with his equity share, as a higher entrepreneurial ownership share makes it easier for the entrepreneur to expropriate wealth from outside investors, especially debt holders.

This chapter adapts the optimal contract framework under asymmetric information and moral hazard to model corporate financial and ownership structure. Unlike McAfee and McMillan (1988), there is no competition among agents in this model. It shows that the optimal contract between a principal and his agent is linear in output. Following the standard interpretation of the optimal contract by Boyd and Smith (1996), and Boot and Thakor (1993), I interpret the (positive) payment that is independent of the firm's performance as debt, and the payment that is contingent on the firm's actual output as equity. The manager receives a share of output that equals his marginal cost of effort. This is interpreted as the percentage of inside equity. The optimal contract between the principal and his agent is shown to be a mixture of debt, inside equity, and outside equity.

This chapter differentiates an investor from a manager. In this model, the investor invests capital in a firm, and hires a manager who has specific knowledge of production processes associated with the firm's product. The inside equity, therefore, is defined as the managerial equity holding, since the manager has inside information on his own effort. Investors in this model become outside investors.

This chapter investigates how an agent's outside opportunities affects his decision to become a manager, and also how it affects the corporate financial structure. I assume that all agents have two choices: either accepting the contract and working as managers, or becoming workers and earning wage from the competitive labor market. The wage rate therefore becomes their reservation utility. As a result, wages from competitive labor market affects *all* agents' individual rationality constraints, rather than just those of the "good types" managers, as assumed in Boyer and Laffont (2003). Since the emphasis in this chapter is to study how changes in opportunity wages affect agents' incentives, I assume that all principals are identical.[33]

The opportunity wage impacts the corporate financial structure mainly through three channels. This first is that it affects the optimal contract between managers and investors. The payment in the optimal contract that is independent of the firm's performance could either be positive or negative. Only those positive are interpreted as debt, while those negative are interpreted as fixed salary. A higher opportunity wage leads to a smaller debt for each manager. It also results in a smaller

[33] Novshek and Thoman (1993) assumed heterogeneous principals.

group of managers who would like to pay debt rather than receive a fixed salary. The aggregate debt therefore decreases as opportunity wages rise. The third channel is how a higher opportunity wage affects the manager group. Since the higher wage increases a manager's opportunity cost, agents with lower types drop out of the manager group as a result of the wage increases, *ceteris paribus*. The manager group therefore is composed only of those with higher types. As a result, aggregate output (and aggregate equity) decreases because fewer projects are implemented. The effect of a wage rate increase on the aggregate debt-equity ratio is, therefore, indeterminate. It depends on which effect dominates: the decreases in aggregate debt, or the decrease in aggregate equity.

The manager's opportunity wage also affects the percentage of inside equity. In this model, managers with higher types require a larger fraction of profit, i.e., a higher percentage of inside equity. Wage increases result in a smaller manager group, which is now composed of those with higher types only. As a result, the aggregate of the percentage of inside equity rises as wage increases. The prediction of increases in the percentage of inside equity as income increases is consistent with the findings of Holderness et al. (1999). They found that managerial ownership of publicly traded U.S. firms was significantly higher in 1995 than that in 1935. The mean ownership by the group of managers and directors increased from 13% in 1935 to 21% in 1995; while the median ownership by the same group doubled from 7% in 1935 to 14% in 1995.

Economic development in this paper is proxied by the manager's opportunity wage. The standard measure of economic development is GDP per capita. The use of the manager's opportunity wage rather than GDP per capita as a measure of economic development is motivated by the strong positive relationship between income and wage (Kravis 1959, Johnson 1954, Kuznets 1959).

3.2 The Model

This is a two-period model with a risk-neutral investor (Figure 3.1). He has an investment project. At time 0, he contributes all the required capital outlay K, and hires a manager to implement the project because he lacks the relevant skills. For example, an investor wants to enter the shoe business. He does not have relevant knowledge on the shoe industry such as current shoe styles, color combinations, and materials. Thus, the investor contributes the capital and hires a manager to run the project.

The manager is characterized by his type θ. θ is private information, known only to the agent. The investor knows that θ lies within an interval $[\underline{\theta}, \bar{\theta}]$, with the cumulative probability distribution function $P(\theta)$. The probability density function is assumed to be positive: $p(\theta) > 0$ for $\theta \in [\underline{\theta}, \bar{\theta}]$.

The manager determines his effort e to the project at time 1. The investor can not directly observe his effort. The investor only observes output x at time 2. It is assumed that the Monotonic Likelihood Ratio Property holds, i.e.,

$$\frac{\partial}{\partial x}(f_e(x;e)/f(x;e)) > 0 \text{ for } e > 0 \text{, and } x > 0 \qquad (3.2.1)$$

where $f(x;e)$ is the output density function. In addition, $f(x;e) > 0$ and is differentiable. The Monotonic Likelihood Ratio Property states that higher effort leads to higher probability of larger x. Thus there is one-to-one correspondence between the manager's effort and the *expected* output u. As a result, this chapter suppresses the choice of effort, and assumes instead that each agent chooses an expected output u.[34]

At time 2, output x realizes, and the manager pays the investor according to the repayment contract t. There are only two variables known to the investor that are relevant to managerial compensation: the manager's reported type $\hat{\theta}$ and the output x. As a result, the payment t is a function on $\hat{\theta}$ and the output x: $t = t(\hat{\theta}, x)$.

Since a manager's choice of a higher u implies more effort, it brings him disutility. Denote the value of the disutility by C. C is assumed to depend on the manager's effort u and his type θ: $C = C(u,\theta)$. Assume that $C(0,\theta) = 0$. In addition, $C(u,\theta)$ is such that both the cost and marginal cost of effort increases with expected output u: $C_u(u,\theta) > 0$, $C_{uu}(u,\theta) > 0$. In addition, lower types have higher total cost and higher marginal cost: $C_\theta(u,\theta) < 0$, $C_{\theta u}(u,\theta) < 0$. Assume also that $C_{\theta uu}(u,\theta) < 0$ and $C_{\theta\theta u}(u,\theta) > 0$.

[34] In their adverse selection and moral hazard models, McAfee and McMillan (1988), and Rhodes-Kropf and Viswanathan (2000) also used expected output to represent effort.

Figure 3.1. The Two-Period Model in a Risk Neutral Economy

Time 0	Time 1	Time 2
An investor has a project. He will contribute all the capital K if he hires a manager to work for him. A payment contract t is designed.	The investor contributes capital outlay K if a manager is hired. The manager combines the capital outlay K and effort to obtain output.	The output x is realized. The manager pays the investor according to the payment contract t.

At time 2, output x realizes and the manager pays his principal according to the payment contract $t(\hat{\theta}, x)$. I will only consider incentive compatible contracts where the manager reports his type truthfully, $\hat{\theta} = \theta$. Therefore, the investor receives expected gain v_0 from his investment,

$$v_0 = \int_{\underline{\theta}}^{\bar{\theta}} [Et(\theta, x) - RK] p(\theta) d\theta \qquad (3.2.2)$$

where R is the gross return to risk-free assets.

The manager receives residuals after he pays to the investor $t(\hat{\theta}, x)$. His net expected gain therefore depends on the expected output $u(\hat{\theta})$, expected payment to the investor $Et(\hat{\theta}, x)$, and his disutility, which is a function on his reported type $\hat{\theta}$ and his true type θ:

$$v_1(\hat{\theta}, \theta) = u(\hat{\theta}) - Et(\hat{\theta}, x) - C(u(\hat{\theta}), \theta). \qquad (3.2.3)$$

3.2.1 Case I: The Manager's participation constraint is zero

In this asymmetric information and moral hazard setting, the incentive contract $t(\hat{\theta}, x)$ given to the manager has to satisfy two conditions. First, it should create the incentives to act according to the manager's true type. Using the revelation principle, my model focuses on the direct mechanisms $(u(\theta), t(\theta))$ that induces the manager to report his true type θ. This requires that the manager receives maximum compensation when he reports his type truthfully, i.e.,

$$\max_{\theta} v_1(\hat{\theta}, \theta) = \max_{\theta}[u(\hat{\theta}) - Et(\hat{\theta}) - C(u(\hat{\theta}), \theta)] = u(\theta) - Et(\theta, x) - C(u(\theta), \theta).$$

The first-order condition is:

$$\frac{\partial v_1}{\partial \hat{\theta}} = u'(\hat{\theta}) - Et'(\hat{\theta}, x) - C_u(u(\hat{\theta}), \theta)\Big|_{\theta=\theta} = 0$$

or

$$[1 - C_u(u(\theta), \theta)]\frac{du}{d\theta} - \frac{\partial Et}{\partial \theta} = 0. \tag{3.2.4}$$

The local second-order condition requires that $\frac{\partial^2 v_1}{\partial \hat{\theta}^2} \leq 0$. Totally differentiating equation (3.2.4) obtains:

$$\frac{\partial^2 v_1}{\partial \hat{\theta} \partial \theta} + \frac{\partial^2 v_1}{\partial \hat{\theta}^2}\Big|_{\theta=\theta} = 0.$$

The local second order condition therefore is equivalent to $\frac{\partial^2 v_1}{\partial \hat{\theta} \partial \theta}\Big|_{\theta=\theta} \geq 0$, i.e.,

$$\frac{du}{d\theta} \geq 0. \tag{3.2.5}$$

This is the monotonicity condition in standard asymmetric information models. It can be shown that equation (3.2.5) is also the sufficient condition for the truth-telling effect.[35]

The second feature of the incentive scheme $t(.)$ is that given his true type θ and the transfer function $t(.)$, the manager chooses the effort to maximize his own expected profit,

$$\frac{\partial v_1}{\partial u} = 1 - \frac{\partial Et(\theta,x)}{\partial u} - C_u(u(\theta),\theta) = 0 . \tag{3.2.6}$$

This is the implicit function of the optimal effort u^* on θ and $Et(\theta,x)$.

Under the conditions that the manager reports his type truthfully and selects his best effort, the investor then selects a contract to maximize the investor's expected gain:

$$\max_{u(\theta),t(\theta,x)} v_0 = \int_{\underline{\theta}}^{\bar{\theta}} [Et(\theta,x) - RK] p(\theta) d\theta$$

s.t.

$$\frac{du}{d\theta} \geq 0 \tag{3.2.5}$$

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[35] The proof of the sufficient condition follows Laffont (1989). The agent has the tendency to pretend to be the lower type, so that $\theta < \theta$. Under the condition $\left.\frac{\partial^2 v_1(\theta,\theta)}{\partial\theta\partial\theta}\right|_{\theta=\theta} > 0$, then $v_1(\theta,\theta) - v_1(\theta,\theta) = \int^{\theta} \frac{\partial v_1}{\partial\theta}(s,\theta)ds \geq \int^{\theta} \frac{\partial v_1}{\partial\theta}(s,s)ds = 0$. The last equal sign comes from the first-order condition $\left.\frac{\partial v_1(\theta,\theta)}{\partial\theta}\right|_{\theta=\theta} = 0$.

$$1-\frac{\partial Et(\theta,x)}{\partial u}-C_u(u(\theta),\theta)=0 \tag{3.2.6}$$

$$v_0>0 \tag{3.2.7}$$

$$v_1(\theta,\theta)\geq 0\,. \tag{3.2.8}$$

Equations (3.2.7) and (3.2.8) are the individual rationality conditions for an investor and a manager, respectively. It is assumed that the manager's opportunity cost is zero (This condition is relaxed in case II). Rewrite equation (3.2.3) given that the manager reports his true type:

$$Et(\theta,x)=u(\theta)-C(u(\theta),\theta)-v_1(\theta,\theta)\,. \tag{3.2.9}$$

Applying the envelope theorem on equation (3.2.3):

$$\frac{dv_1}{d\theta}=\frac{\partial v_1}{\partial\theta}=-C_\theta(u(\theta),\theta)\,. \tag{3.2.10}$$

This leads to:

$$v_1(\theta)=v_1(\underline{\theta})-\int_{\underline{\theta}}^{\theta}C_\theta(u(\theta),\theta)d\theta \tag{3.2.11}$$

and

$$Et(\theta,x)=u(\theta)-C(u(\theta),\theta)-v_1(\underline{\theta})+\int_{\underline{\theta}}^{\theta}C_\theta(u(\theta),\theta)d\theta\,. \tag{3.2.12}$$

The principal's expected gain therefore becomes:

$$v_0=\int_{\underline{\theta}}^{\bar{\theta}}[u(\theta)-C(u(\theta),\theta)-v_1(\underline{\theta})+\int_{\underline{\theta}}^{\theta}C_\theta(u(\theta),\theta)d\theta-RK]p(\theta)d\theta \tag{3.2.13}$$

and thus, the principal's optimization problem can be simplified to:

$$\max_{u(\theta),t(\theta,x)} v_0 = \int_{\underline{\theta}}^{\bar{\theta}} [u(\theta) - C(u(\theta),\theta) - v_1(\underline{\theta}) + \frac{1-P(\theta)}{p(\theta)} C_\theta(u(\theta),\theta) - RK] p(\theta) d\theta$$

(3.2.14)

subject to conditions (3.2.5) to (3.2.7). The investor's expected gain from the contract equals the social surplus $u(\theta) - C(u(\theta),\theta) - RK$, minus the informational rent $v_1(\underline{\theta}) - \frac{1-P(\theta)}{p(\theta)} C_\theta(u(\theta),\theta)$.

To solve this problem, I begin by finding the solutions to the unconstrained optimization problem (3.2.14); then I check to see if the set of solutions satisfies the monotonicity condition of (3.2.5). Within the set of solutions to (3.2.14), I then find a specific payment $t(\theta,x)$ that satisfies the manager's incentive compatibility condition (3.2.6).

Define a function $A(\theta)$ by the investor's expected gain from type θ:

$$A(\theta) = u(\theta) - C(u(\theta),\theta) - v_1(\underline{\theta}) + \frac{1-P(\theta)}{p(\theta)} C_\theta(u(\theta),\theta) - RK. \qquad (3.2.15)$$

From equation (3.2.14), type θ is hired only when the investor receives non-negative expected gain, i.e.,

$$A(\theta) \geq 0. \qquad (3.2.16)$$

The other solutions to equation (3.2.14) are

$$v_1(\underline{\theta}) = 0 \qquad (3.2.17)$$

and

$$1 - C_u(u^*(\theta),\theta) + \frac{1-P(\theta)}{p(\theta)} C_{\theta u}(u^*(\theta),\theta) = 0. \qquad (3.2.18)$$

if type θ is hired. Equation (3.2.17) states that the manager with the lowest type never collects a rent. Equation (3.2.18) is an implicit function of the optimal output u^* on θ. Denote this function as $u^*(\theta)$. Notice that except for the highest type $\bar{\theta}$, the optimal effort $u^*(\theta)$ is less than the efficient level of effort $u_e^*(\theta)$, which is solved by $1 - C_u(u(\theta),\theta) = 0$. The inefficiency stems from the manager's informational rent $-\frac{1-P(\theta)}{p(\theta)} C_\theta(u(\theta),\theta)$. Equation (3.2.18) says that the investor pays lower informational rents by inducing effort below the efficient level. Thus the investor trades-off expected output for lower informational rents.

Another source of inefficiency stems from the investor's decision not to invest if the agent's type is less than the cut-off type $\theta^{'}$, which is defined as $A(\theta^{'}) = 0$, or $u^*(\theta^{'}) - C(u^*(\theta^{'}),\theta^{'}) - RK + \frac{1-P(\theta^{'})}{p(\theta^{'})} C_\theta(u^*(\theta^{'}),\theta^{'}) = 0$. Under symmetric information, the cut-off type $\theta^{''}$ is defined as: $u_e^*(\theta^{''}) - C(u_e^*(\theta^{''}),\theta^{''}) - RK = 0$. $\theta^{'}$ exceeds $\theta^{''}$ for two reasons. The first is that the investor wants to trade-off efficiency for a share of the informational rents. For every type $\theta \geq \theta^{'}$, he wants to reduce the informational rent that he pays to the manager. The cut-off type $\theta^{'}$ is therefore larger than $\theta^{''}$. The second reason is that the optimal effort level for the lowest type $\theta^{'}$ is less than the efficient effort. As a result, θ' has to exceed θ'' to make the manager's disutility smaller.

According to equation (3.2.12), the expected transfer payment to the investor $Et(\theta)$, given that type θ is hired, is:

$$Et(\theta) = u^*(\theta) - C(u^*(\theta),\theta) + \int_{\underline{\theta}}^{\theta} C_\theta(u^*(s),s)ds\,. \qquad (3.2.19)$$

Equation (3.2.19) states that a risk-neutral investor does not care about the specific form of payment $t(\theta,x)$, only that the expected payment equals $Et(\theta)$ defined in equation (3.2.19).

The next step is to show that the implicit function of $u^*(\theta)$ defined in equation (3.2.18) satisfies the monotonicity condition (3.2.5). Totally differentiating equation (3.2.18) with regards to u and θ:

$$-C_{uu}du^* - C_{u\theta}d\theta + [C_{\theta uu}du^* + C_{\theta\theta u}d\theta]\frac{1-P(\theta)}{p(\theta)} + C_{\theta u}\frac{\partial[(1-P(\theta))/p(\theta)]}{\partial\theta}d\theta = 0$$

or

$$\frac{du^*}{d\theta} = \frac{(1-\frac{\partial[(1-P(\theta))/p(\theta)]}{\partial\theta})C_{\theta u} - C_{\theta\theta u}\frac{1-P(\theta)}{p(\theta)}}{-C_{uu} + C_{\theta uu}\frac{1-P(\theta)}{p(\theta)}}\,.$$

The sufficient condition for $\frac{du^*}{d\theta} > 0$ is that

$$\frac{d}{d\theta}[\frac{p(\theta)}{1-P(\theta)}] \geq 0 \qquad (3.2.20)$$

or that the monotonic hazard rate condition holds.

The monotonic hazard rate condition implies that an investor's expected gain increases in managerial type. Differentiating equation (3.2.15) with regard to θ obtains:

$$\frac{\partial A}{\partial \theta} = [1 - C_u(u^*(\theta),\theta) + \frac{1-P(\theta)}{p(\theta)} C_{\theta u}(u^*(\theta),\theta)]\frac{du^*}{d\theta} + C_\theta \frac{\partial[(1-P(\theta))/p(\theta)]}{\partial \theta}. \tag{3.2.21}$$

Using the first order condition of (3.2.18), equation (3.2.21) is simplified to:

$\frac{\partial A}{\partial \theta} = C_\theta \frac{\partial[(1-P(\theta))/p(\theta)]}{\partial \theta} \geq 0$. As a result, an investor only hires a manager with $\theta \geq \theta^{'}$.

This implies that a manager with type θ lower than the cut-off type $\theta^{'}$ is not hired. As a result, there is no contractual relationship between the investor and managers with types lower than $\theta^{'}$. The investor receives nothing from the managers with types lower than $\theta^{'}$:

$$Et(\theta,x) = 0 \text{ for } \underline{\theta} \leq \theta \leq \theta^{'}. \tag{3.2.22}$$

In addition, managers with types lower than $\theta^{'}$ thus do not contribute any effort. As a result, for any $\underline{\theta} \leq \theta < \theta^{'}$: $u(\theta) = 0$; $C(0,\theta) = 0$; and $\int_{\underline{\theta}}^{\theta} C_\theta(0,\theta)d\theta = 0$.

Since the investor only cares about the expected payment $Et(\theta,x)$, the only constraint on $t(\theta,x)$ is the incentive compatibility condition [equation (3.2.6)]. Now consider if I can focus on the linear contract $t(\hat{\theta},x)$: $t(\hat{\theta}) = \beta(\hat{\theta})x + \eta(\hat{\theta})$. The manager's expected gain if he reports his true type is:

$$v_1(\theta,\theta) = u(\theta) - E[\beta(\theta)x + \eta(\theta)] - C(u(\theta),\theta) \geq 0 . \tag{3.2.23}$$

This should satisfy the incentive compatibility condition that the manager chooses optimal effort, i.e.,

$$\frac{\partial v_1(\theta,\theta)}{\partial u} = 0 \tag{3.2.24}$$

or

$$\beta(\theta) = 1 - C_u(u^*(\theta),\theta) . \tag{3.2.25}$$

This leads to a solution for $\eta(\theta)$,

$$\begin{aligned}\eta(\theta) &= u(\theta) - E[\beta(\theta)x] - C(x(\theta),\theta) - v_1(\theta,\theta) \\ &= u(\theta) - [1 - C_u(u^*(\theta),\theta)]u - C(x(\theta),\theta) - v_1(\theta,\theta) \\ &= C_u(u^*(\theta),\theta)u^*(\theta) - C(u^*(\theta),\theta) + \int_{\underline{\theta}}^{\theta} C_\theta(u^*(s),s)ds .\end{aligned} \tag{3.2.26}$$

The payment t, therefore, could be written as:

$$t(\theta,x) = (1 - C_u(u^*(\theta),\theta))x + C_u(u^*(\theta),\theta)u^*(\theta) - C(u^*(\theta),\theta) + \int_{\underline{\theta}}^{\theta} C_\theta(u^*(s),s)ds . \tag{3.2.27}$$

The appendix shows that the sufficient and necessary condition for a linear contract in (3.2.27) is

$$\frac{dC_u(u^*(\theta),\theta)}{d\theta} > 0 . \tag{3.2.28}$$

The payment contract $t(\hat{\theta}, x)$ is composed of two parts. The first part is $\eta(\hat{\theta})$, which depends on the agent's reported type only, and increases with $\hat{\theta}$.[36] $\eta(\hat{\theta})$ could be either positive or negative. Following Boyd and Smith (1996), and Boot and Thakor (1993), I interpret $\eta(\hat{\theta})$ as debt when it is positive. Let $D(\theta)$ represent the debt for type θ: $D(\theta) = \eta(\theta)$ when $\eta(\theta) > 0$. In the case where $\eta(\hat{\theta})$ is negative, it is the payment from investors to managers, and therefore could be interpreted as the fixed salary.

According to Boyd and Smith (1996) and Boot and Thakor (1993), the payment that is contingent on the firm's output is interpreted as equity. This implies that the firm's total equity is output x. The firm's equity is divided into two parts. One part is $(1 - C_u(u^*(\hat{\theta}), \hat{\theta}))x$, which is paid to the investor. This part is interpreted as outside equity.[37] The other part is $C_u(u^*(\hat{\theta}), \hat{\theta})x$, which is kept by the manager. This is interpreted as inside equity.

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[36] Differentiating $\eta(\theta)$ we obtain $\frac{\partial \eta(\theta)}{\partial \theta} = [C_{uu} \frac{\partial u^*}{\partial \theta} + C_{\theta u}] u^*(\theta) = \frac{dC_u(u^*(\theta), \theta)}{d\theta} u^*(\theta) > 0$

The inequality comes from the condition posed in (3.2.28).

[37] Equation (3.2.26) shows that $1 > C_u(u^*(\hat{\theta}), \hat{\theta}) > 0$.

3.2.2 Case II: The Manager's participation constraint is positive

Now assume that the manager's outside opportunity is some $w > 0$. The manager's individual rationality condition (3.2.8) then changes to:

$$v_1(\theta,\theta) = u - Et(\theta,x) - C(u(\theta),\theta) \geq w. \tag{3.2.29}$$

Assume that the manager reports his true type. The investor's expected payment is:

$$Et(\theta,x) = u(\theta) - C(u(\theta),\theta) - v_1(\theta). \tag{3.2.30}$$

Replacing $v_1(\theta)$ with equation (3.2.11), $Et(\theta,x)$ could be rewritten as:

$$Et(\theta,x) = u(\theta) - C(u(\theta),\theta) - v_1(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} C_\theta(u(\theta),\theta)d\theta \tag{3.2.31}$$

and

$$v_0 = \int_{\underline{\theta}}^{\bar{\theta}} [u(\theta) - C(u(\theta),\theta) - v_1(\underline{\theta}) + \frac{1-P(\theta)}{p(\theta)} C_\theta(u(\theta),\theta) - RK]p(\theta)d\theta. \tag{3.2.32}$$

The principal's optimization problem therefore becomes:

$$\max_{u(\theta),t(\theta,x)} v_0 = \int_{\underline{\theta}}^{\bar{\theta}} [u(\theta) - C(u(\theta),\theta) - v_1(\underline{\theta}) + \frac{1-P(\theta)}{p(\theta)} C_\theta(u(\theta),\theta) - RK]p(\theta)d\theta$$

(3.2.33)

subject to conditions (3.2.5) and (3.2.6), and two individual rationality conditions:

$$v_0 \geq 0 \tag{3.2.34}$$

$$v_1(\theta,\theta) \geq w. \tag{3.2.35}$$

The investor hires a manager with type θ if and only if this action produces non-negative expected gains for the investor, i.e.,

$$A(\theta) \geq 0. \tag{3.2.36}$$

The lowest type always receives the expected gain of w. If he is hired by the investor, the investor pays him w, which is just sufficient to make him indifferent between being a manager and a worker. Otherwise, he earns wage w from the labor market:

$$v_1(\underline{\theta}) = w. \tag{3.2.37}$$

If type θ is hired, he chooses an optimal u^* according to the first-order condition:

$$1 - C_u(u^*(\theta),\theta) + \frac{1-P(\theta)}{p(\theta)} C_{\theta u}(u^*(\theta),\theta) = 0. \tag{3.2.38}$$

The manager's positive participation constraint does not change his optimal effort $u^*(\theta)$, if he is hired. The first-order condition under the positive participation constraint (3.2.38) is the same as when the manager's opportunity cost is normalized to be zero [equation (3.2.18)].

The positive participation constraint, $w > 0$, does, however, affect the expected gain for the lowest type and the investor's decision on the types he would hire. The manager with the lowest type, if hired, receives expected gain of w, which is just enough to make him indifferent between being a manager and a worker.

Given that the manager reports his true type and chooses effort level according to equation (3.2.18), the expected transfer payment to the principal is, contingent on type θ being hired:

$$Et(\theta, x) = u^*(\theta) - C(u^*(\theta),\theta) - w + \int_{\underline{\theta}}^{\theta} C_\theta(u^*(\theta),\theta)d\theta. \tag{3.2.39}$$

As discussed in the previous section, the risk-neutral investor cares only about the expected payment, not the specific form of payment $t(\theta, x)$. In addition, the opportunity wage enters the expected transfer payment $Et(\theta, x)$ through the individual rationality condition for the lowest type, if he is hired.

The cut-off point $\underline{\theta}'$ is affected by the opportunity wage. Replace $v_1(\underline{\theta})$ with w and rewrite equation (3.2.15):

$$A(\underline{\theta}') = u(\underline{\theta}') - C(u(\underline{\theta}'), \underline{\theta}') - w + \frac{1 - P(\underline{\theta}')}{p(\underline{\theta}')} C_\theta(u(\underline{\theta}'), \underline{\theta}') - RK = 0. \qquad (3.2.40)$$

The investor does not hire a manager with type lower than $\underline{\theta}'$. Consequently, contracts between the investor and manager of types lower than $\underline{\theta}'$ are never made. As a result, the investor receives nothing from managers with types $\underline{\theta} \le \theta \le \theta'$, i.e.,

$$Et(\theta, x) = 0 \text{ for } \underline{\theta} \le \theta < \theta'. \qquad (3.2.41)$$

For types lower than $\underline{\theta}'$, they do not devote effort to the project. Consequently, for any $\underline{\theta} \le \theta \le \theta'$, I find that $u(\theta) = 0$; $C(0, \theta) = 0$; and $\int_{\underline{\theta}}^{\theta} C_\theta(0, \theta) d\theta = 0$. For managers with types $\theta > \underline{\theta}'$, the optimal contract is characterized by equations (3.2.37) to (3.2.39).

I focus again on the linear contract $t(\hat{\theta},x)=\beta(\hat{\theta})x+\eta(\hat{\theta})$. The incentive compatibility condition (3.2.6) provides a solution for $\beta(\theta)x$, given that the manager reports his true type:

$$\beta(\theta)=1-C_u(u^*(\theta),\theta). \tag{3.2.42}$$

This leads to the solution for the fixed payment $\eta(\theta)$

$$\begin{aligned}\eta(\theta)&=u(\theta)-E[\beta(\theta)x]-C(x(\theta),\theta)-v_1(\theta,\theta)\\&=u(\theta)-[1-C_u(u^*(\theta),\theta)]u-C(x(\theta),\theta)-v_1(\theta,\theta)\\&=C_u(u^*(\theta),\theta)u^*(\theta)-C(u^*(\theta),\theta)-w+\int_{\underline{\theta}}^{\theta}C_\theta(u^*(s),s)ds.\end{aligned} \tag{3.2.43}$$

Thus, the manager's outside opportunity wage, w, only affects the fixed portion of the payment $\eta(\theta)$. The payment contract $t(\theta,x)$, contingent on that type θ being hired, is:

$$t(\theta,x)=[1-C_u(u^*(\theta),\theta)]x+C_u(u^*(\theta),\theta)u^*(\hat{\theta})-C(u^*(\theta),\theta)-w+\int_{\underline{\theta}}^{\theta}C_\theta(u^*(s),s)ds. \tag{3.2.44}$$

3.2.3 Case III: Multiple Managers and Investors with a Positive Participation Constraint

This section examines a third case in which there are many investors and managers, with one investor hiring one manager. The managers are assumed to be drawn independently from the distribution $P(\theta)$. I focus on determining whether the comparative statistics result with respect to the opportunity wage is sensitive to the change in assumptions about the numbers of managers and investors.[38]

As shown in case II, the opportunity wage affects the cut-off point $\underline{\theta}'$ through the individual rationality constraints. An agent's participation constraint requires that his expected gain from the contract is no less than the opportunity wage. Assuming other things being equal, agents with lower types drop out of the managerial group as the opportunity wage rises, since their expected gain from the contract is less than what they can earn in the competitive labor market. As a result, the group of managers shrinks and only those agents with the highest types work as managers. This is Theorem 3.1 and the proof follows.

Theorem 3.1 Other things being equal, a higher wage leads to a smaller group of managers. The group of managers is composed of those at the higher end of the distribution.

Proof: According to equation (3.2.40), an investor's cut-off point $\underline{\theta}'$ is solved by:

$$A(\underline{\theta}') = u(\underline{\theta}') - C(u(\underline{\theta}'),\underline{\theta}') - w - \frac{1-P(\underline{\theta}')}{p(\underline{\theta}')} C_{\theta}(u(\underline{\theta}'),\underline{\theta}') - RK = 0. \qquad (3.2.40)$$

Totally differentiate equation (3.2.40) with regard to w and $\underline{\theta}'$, and rearrange:

$$\frac{d\underline{\theta}'}{dw} = \{[1 - C_u(u^*(\underline{\theta}'),\underline{\theta}') + \frac{1-P(\underline{\theta}')}{p(\underline{\theta}')} C_{\theta u}(u^*(\underline{\theta}'),\underline{\theta}')]\frac{du^*}{d\underline{\theta}'} + C_{\theta}\frac{\partial[(1-P(\underline{\theta}'))/p(\underline{\theta}')]}{\partial \underline{\theta}'}\}^{-1}$$

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[38] As a result, competition among agents as well as problems stemming from common agency are ignored in this analysis.

which, by the first-order condition (3.2.38), simplifies to:

$$\frac{d\underline{\theta}'}{dw} = \{C_\theta \frac{\partial[(1-P(\underline{\theta}'))/p(\underline{\theta}')]}{\partial\underline{\theta}'}\}^{-1} \geq 0. \text{ Q.E.D.}$$

The rise in the wage affects the *average* percentage of inside equity through its effect on the cut-off type $\underline{\theta}'$. As discussed in Case I, the percentage of inside equity held by each manager, if he is hired, equals his marginal cost of effort $C_u(u^*(\theta),\theta)$. Equation (3.2.28) then implies that both increase with type θ. In addition, the analysis in Case II points out that lower types drop from the managerial group as the opportunity wage rises. The managerial group is composed of the managers at the higher end of the distribution. As a result, the average percentage of inside equity, which averages over the managerial group, increases as wage rises. Let $\bar{\beta}$ represent the average percentage of the inside equity:

$$\bar{\beta} = \frac{\int_{\underline{\theta}'}^{\bar{\theta}} C_u(u^*(\theta),\theta)p(\theta)d\theta}{(1-P(\underline{\theta}'))}. \tag{3.2.45}$$

Take the derivative on w and apply Leibniz's rule:

$$\frac{d\bar{\beta}}{dw} = \frac{d\bar{\beta}}{d\underline{\theta}'}\frac{d\underline{\theta}'}{dw} = \frac{p(\underline{\theta}')\frac{d\underline{\theta}'}{dw}[C_u(u^*(\bar{\theta}),\bar{\theta}) - C_u(u^*(\underline{\theta}'),\underline{\theta}') - \int_{\underline{\theta}'}^{\bar{\theta}} C_{\theta u}(u^*(\theta),\theta)P(\theta)d\theta]}{[1-P(\underline{\theta}')]^2} > 0$$

. (3.2.46)

Theorem 3.2 The average percentage of inside equity increases with the opportunity wage.

The positive relationship between the aggregate percentage of inside equity and the opportunity wage in this model is consistent with the findings of Holderness et al. (1999). Measured by the percentage of common stock held by a firm's officers and directors as a group, the managerial ownership of publicly traded U.S. firms was higher in 1995 than that in 1935: the median managerial ownership doubled from 7 percent to 14 percent, and its mean increased from 13 percent in 1935 to 21 percent in 1995.

In addition to affecting the average percentage of inside equity $\bar{\beta}$, w could also change the *average* debt-equity ratio through three channels. The first is through its effect on the cut-off point $\underline{\theta}'$, the lowest type that a principal wants to hire. *Ceteris paribus*, the higher wage leads to a smaller group of managers, which in turn affects the aggregate equity. The second is through its effect on debt. A higher opportunity wage leads to a smaller fixed payment, i.e., lower debt when the fixed payment $\eta(\hat{\theta}) > 0$.

Finally, a higher opportunity wage also affects the group of managers who would like to pay debt to their principals. Let θ_d be such that $D(\theta_d) = 0$. It can be shown that $\frac{\partial \theta_d}{\partial w} > 0$.[39] The group of managers who prefer debt transfers to their

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[39] $D(\theta_d) = C_u(u^*(\theta_d), z_d)u^*(\theta_d) - C(u^*(\theta_d), \theta_d) + \int_{\underline{\theta}'}^{\theta_d} C_\theta(u^*(s), s)ds - w$. This indicates that

$$\frac{\partial \theta_d}{\partial w} = [C_{uu} \frac{\partial u^*}{\partial \theta} + C_{\theta u}]u^*(\theta_d) = \frac{dC_u(u^*(\theta), \theta)}{d\theta} u^*(\theta_d) > 0.$$

investors also shrinks as the opportunity wage rises. The average debt-equity ratio therefore depends on the relationship between θ_d and θ' and on which one decreases faster, the aggregate debt or the aggregate equity as a result of increases in the wage.

The cut-off type $\underline{\theta}'$ above which an investor is willing to hire a manager is larger than the type from which all managers are willing to pay debt, i.e., $\underline{\theta}' \leq \theta_d$. This can be seen from the fact that $\dfrac{\partial \eta(\theta)}{\partial \theta} > 0$ and $\eta(\underline{\theta}')$ might be negative.[40] The opportunity wage affects the average debt-equity ratio through its effect on the two cut-off points $\underline{\theta}'$ and θ_d, and on debt payment $D(\theta)$. One possible situation is that $\underline{\theta}' < \theta_d$ when the wage is low and the cut-off point $\underline{\theta}'$ increases faster than θ_d as the outside wage rises. It is then possible that beyond a certain wage level, $\eta(\theta) > 0$ and $\underline{\theta}' = \theta_d$ (Figure 3.2). Denote the average debt-equity ratio by γ. It is then solved by

[40] By equation (3.2.43), the fixed payment to the cut-off type $\underline{\theta}'$ is:

$$\eta(\underline{\theta}') = C_u(u^*(\underline{\theta}'),\underline{\theta}')u^*(\underline{\theta}') - C(u^*(\underline{\theta}'),\underline{\theta}') - w + \int_{\underline{\theta}}^{\theta'} C_\theta(u^*(s),s)ds$$

Replacing $C(u(\underline{\theta}'),\underline{\theta}')$ by equation (3.2.4) obtains:

$$\eta(\underline{\theta}') = C_u(u^*(\underline{\theta}'),\underline{\theta}')u^*(\underline{\theta}') - u(\underline{\theta}') + \frac{1-P(\underline{\theta}')}{p(\underline{\theta}')}C_\theta(u(\underline{\theta}'),\underline{\theta}') + \int_{\underline{\theta}}^{\theta'} C_\theta(u^*(s),s)ds + RK$$

$$= (C_u(u^*(\underline{\theta}'),\underline{\theta}') - 1)u^*(\underline{\theta}') + \frac{1-P(\underline{\theta}')}{p(\underline{\theta}')}C_\theta(u(\underline{\theta}'),\underline{\theta}') + RK\,.$$

The first two items are negative and the third term is positive. The sign of $\eta(\underline{\theta}')$ therefore is indeterminate.

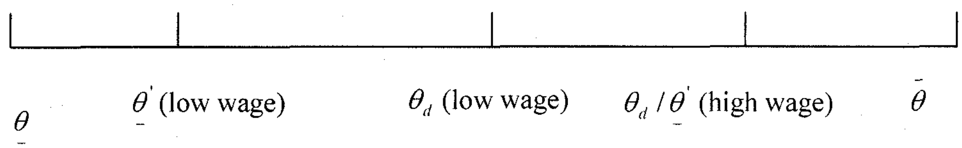
$$\gamma = \frac{\int_{\theta_d(w)}^{\bar{\theta}} D(\theta, w) p(\theta) d\theta}{\int_{\underline{\theta}'(w)}^{\bar{\theta}} u^*(\theta) p(\theta) d\theta} \tag{3.2.47}$$

when $\underline{\theta}' < \theta_d$ and

$$\frac{\partial(\gamma)}{\partial w} = -\frac{u^*(\underline{\theta}')p(\underline{\theta}')\frac{\partial \underline{\theta}'}{\partial w}\int_{\theta_d}^{\bar{\theta}} D(\theta)p(\theta)d\theta - [1 - P(\theta_d)]\int_{\underline{\theta}'}^{\bar{\theta}} u^*(\theta)p(\theta)d\theta}{[\int_{\underline{\theta}'}^{\bar{\theta}} u^*(\theta)p(\theta)d\theta]^2}. \tag{3.2.48}$$

The sign of $\frac{\partial(\bar{d}/s)}{\partial w}$ is therefore indeterminate. It depends on whether aggregate equity or aggregate debt decreases faster.

Figure 3.2. The Relationship between Two Cut-off Points



It is possible that $\underline{\theta}'$ rises faster than θ_d as the opportunity wage increases. Starting from a certain level of wage, $\underline{\theta}'$ is equal to θ_d. The average debt-equity ratio therefore becomes

$$\gamma = \frac{\int_{\underline{\theta}'(w)}^{\bar{\theta}} D(\theta, w) p(\theta) d\theta}{\int_{\underline{\theta}'(w)}^{\bar{\theta}} u^*(\theta) p(\theta) d\theta} \tag{3.2.49}$$

with

$$\frac{\partial(\gamma)}{\partial w} = -\frac{D(\underline{\theta}')}{u(\underline{\theta}')} \frac{\partial \underline{\theta}'}{\partial w} - \int_{\underline{\theta}'}^{\bar{\theta}} \frac{1}{u^*(\theta)} < 0 . \tag{3.2.50}$$

The aggregate debt-equity ratio in the economy therefore could decrease as opportunity wages in a rich country increase.

3.3 Conclusion

Using an optimal contract framework, this chapter develops a theoretical model where economic development affects both corporate financial and ownership structures. It begins by showing that the optimal contract provides for a payment from the manager to the investor that is linear in output. The fixed payment that is independent of the firm's actual performance is interpreted as debt; the payment that is contingent on the firm's output is interpreted as outside equity. The manager receives inside equity, with the share equal to his marginal cost of effort.

Economic development affects the average debt-equity ratio and the average percentage of inside equity through the manager's participation constraint conditions.

Other things being equal, higher income leads to a smaller managerial group. The lower type managers continue to drop out of the managerial group due to the higher opportunity wage. The agents who stay in the managerial group are the higher types. Since the percentage of inside equity increases with the manager type, an increase in the opportunity wage leads to a larger average percentage of inside equity. This is consistent with the pioneering but preliminary findings of Holderness et al. (1999). Their findings are based on the comparison of the mean percentage of common stocks held by firms' officers and directors between 1995 and 1935. It is possible that the managerial ownership in 1995 is especially high due to the stock market booming during the 1990s. During this period, managers may have been more willing to accept compensation packages in which they share firm profits. Further studies on the secular pattern of managerial ownership as a group are needed for us to understand this issue better.

The percentage of equity held by each manager, however, does not change with income in this model. It is equal to the manager's marginal cost of effort, given that the manager reports his true type and his optimal effort, which depends on his type only.

The long-term pattern of average debt-equity ratio in this model is indeterminate. The opportunity wage affects the average debt-equity ratio through three channels. The first is a higher wage decreases the fixed payment to the investor since now he has to pay his manager the opportunity wage plus an informational rent. Second, a higher wage increases the cut-off type where managers are willing to pay debt to investors. These two effects result in a decrease in aggregate debt. Third, a higher opportunity wage affects the cut-off type where agents are willing to work as managers rather than workers. The Higher wage increases the opportunity cost of being a manager so that lower types drop from the managerial group, other things being equal. This leads to the decreases in total equity. The average debt-equity ratio, defined as the ratio of total debt to total equity, depends on which one decreases faster.

The pattern of the debt-equity ratio in this model, however, might ignore other factors affecting the debt-equity ratio. In this model, debt comes from a simple contractual relationship between the investor and manager. An example is a venture capitalist and his firm. The fixed payment by the manager may not be the only source of debt. Debt might be the result of a more complicated contractual relationship. One example is that the investor does not have the resources to finance his project. He has to seek external funds and, at the same time, hire a manager to work for him. Future research could examine the contractual relationship among three parties: an investor, an entrepreneur and a manager.

The analysis of the effect of increasing opportunity wages on the corporate financial structure and ownership provides a strong link to overall economic development. Of course, economic development could affect these contracts via other unmodelled channels. For example, economic development may lead to increases in the education chosen by managers; these choices would clearly affect the distribution of types of managers. As a result, the average debt-equity ratio and the average percentage of inside equity could change accordingly. I leave the study of such linkages to future research.

APPENDIX

The proof of the sufficient and necessary condition for the linear contract defined by equation (3.2.27) follows McAfee and McMillan (1988). I need to show that truth-telling is the best strategy when the manager is given the linear contract defined by equation (3.2.27) under the condition $\frac{dC_u(u^*(\theta),\theta)}{d\theta} > 0$. If a manager's reported type is $\hat{\theta}$, the contract $t(\hat{\theta},x)$ is:

$$t(\hat{\theta},x) = [1 - C_u(u^*(\hat{\theta}),\hat{\theta})]x + C_u(u^*(\hat{\theta}),\hat{\theta})u^*(\hat{\theta}) - C(u^*(\hat{\theta}),\hat{\theta}) + \int_{\underline{\theta}}^{\theta} C_\theta(u^*(s),s)ds\,.$$

The manager's expected gain from reporting $\hat{\theta}$ with true type θ is:

$$v_1 = C_u(u^*(\hat{\theta}),\hat{\theta})(u - u^*(\hat{\theta})) + C(u^*(\hat{\theta}),\hat{\theta}) - C(\theta,u) - \int_{\underline{\theta}}^{\theta} C_\theta(u^*(s),s)ds\,. \qquad (3.2.51)$$

The manager's optimal effort $\hat{u}$ given his reported type $\hat{\theta}$ and true type θ is obtained from the first-order condition:

$$\frac{\partial v_1}{\partial u} = 0 \Rightarrow C_u(\hat{u},\theta) = C_u(u^*(\hat{\theta}),\hat{\theta})$$

with

$$\frac{d\hat{u}}{d\hat{\theta}} = -\frac{dC_u(\hat{u}(\hat{\theta}),\hat{\theta})}{d\hat{\theta}\, C_{uu}(\hat{u},\theta)} \geq 0$$

and

$$\frac{d\hat{u}}{d\theta} = -\frac{C_{u\theta}(\hat{u},\theta)}{C_{uu}(\hat{u},\theta)} \geq 0 . \tag{3.2.52}$$

Replacing $u = \hat{u}$ in equation (3.2.51),

$$v_1\big|_{u=\hat{u}} = C_u(u^*(\hat{\theta}),\hat{\theta})(\hat{u}-u^*(\hat{\theta})) + C(u^*(\hat{\theta}),\hat{\theta}) - C(\hat{u},\theta) - \int_{\underline{\theta}}^{\theta} C_\theta(u^*(s),s)ds .$$

Differentiate $v_1\big|_{u=\hat{u}}$ with respect to $\hat{\theta}$:

$$\frac{\partial v_1}{\partial \hat{\theta}}\bigg|_{u=\hat{u}} = \frac{dC_u(u^*(\hat{\theta}),\hat{\theta})}{d\hat{\theta}}(\hat{u}-u^*(\hat{\theta})) + C_u(u^*(\hat{\theta}),\hat{\theta})(\frac{\partial \hat{u}}{\partial \hat{\theta}} - \frac{\partial u^*(\hat{\theta})}{\partial \hat{\theta}}) + C_u(u^*(\hat{\theta}),\hat{\theta})\frac{\partial u^*(\hat{\theta})}{\partial \hat{\theta}}$$

$$+ C_\theta(u^*(\hat{\theta}),\hat{\theta}) - C_u(\hat{u},\theta)\frac{\partial \hat{u}}{\partial \hat{\theta}} - C_\theta(u^*(\hat{\theta}),\hat{\theta})$$

which simplifies to

$$\frac{\partial v_1}{\partial \hat{\theta}}\bigg|_{u=\hat{u}} = \frac{dC_u(u^*(\hat{\theta}),\hat{\theta})}{\partial \hat{\theta}}(\hat{u}-u^*(\hat{\theta})) .$$

This implies that $(\hat{u} = u^*(\hat{\theta}))$ with the first-order condition $C_u(\hat{u},\theta) = C_u(u^*(\hat{\theta}),\hat{\theta})$.

The necessary and sufficient condition for $\frac{\partial v_1}{\partial \hat{\theta}}\bigg|_{u=\hat{u}} = 0$ is $\hat{\theta} = \theta$.

The second order-condition must be negative,

$$\frac{\partial^2 v_1}{\partial \hat{\theta}^2} = -\frac{\partial^2 v_1}{\partial \hat{\theta}\partial\theta} < 0 .$$

This is equivalent to $\frac{\partial^2 v_1}{\partial \hat{\theta} \partial \theta} = \frac{dC_u(u^*(\hat{\theta}), \hat{\theta})}{d\hat{\theta}} \frac{\partial \hat{u}}{\partial \theta}\Big|_{\hat{\theta}=\theta} > 0$. Since $\frac{\partial \hat{u}}{\partial \theta} > 0$ by (3.2.52),

the necessary and sufficient condition for $\frac{\partial^2 v_1}{\partial \hat{\theta} \partial \theta} > 0$ is:

$$\frac{\partial C_u(u^*(\hat{\theta}), \hat{\theta})}{\partial \hat{\theta}} > 0.$$

As a consequence,

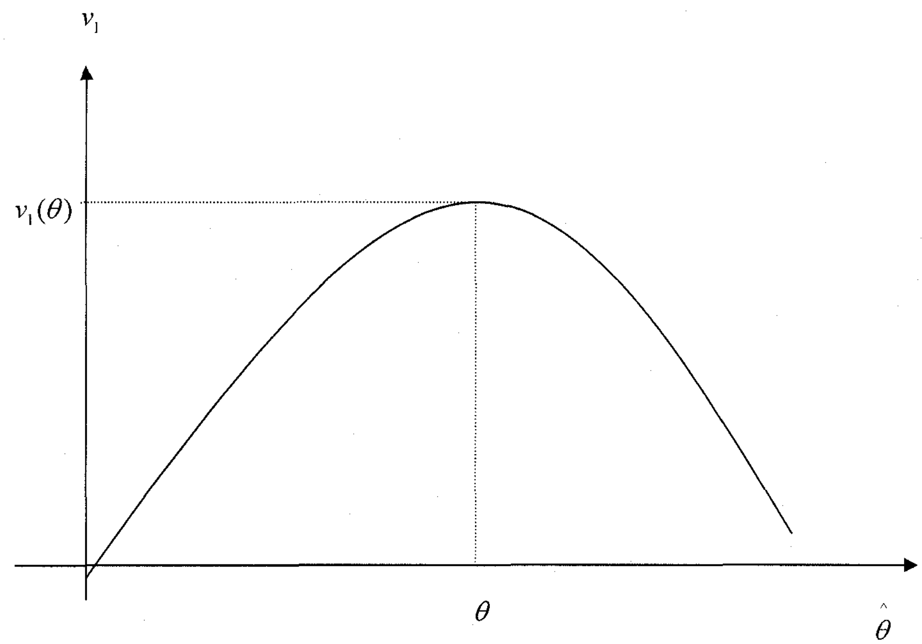
$$\frac{\partial v_1}{\partial \hat{\theta}} >=< 0 \text{ when } \hat{\theta} <=> \theta.$$

This indicates that agents receive their maximum expected profit when $\hat{\theta} = \theta$ (see Figure 3.3).

Since by the optimal contract, $\mu = u^*(\theta)$ and $\hat{\theta} = \theta$, a manager's expected profit from equation (3.2.51) is:

$$v_1 = -\int_{\underline{\theta}}^{\theta} C_\theta(u^*(s), s) d\theta >=< 0 \text{ when } \theta >=< \theta'.$$

Figure 3.3. The Relationship between a Manager's Expected Gain and His Reported Type



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