

**The effect on investment behavior of
variations in the ratio of book value to
market value**

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Abstract

Should the ratio of book to market value affect firms' fixed investment? Will the managers take investment decisions with the ratio of book to market value in mind? This paper reviews the theories related to investment, builds up the model including the ratio of book value to market value, uses the data of Canadian companies in the past 10 years to examine whether the ratio of book to market value has explanatory power beyond that of the standard investment models.

This paper will proceed as follows: Section 1 introduces the general ideas about investment. Section 2 goes over the theories and models related to investment. Section 3 builds up the model with the ratio of book to market value as an additional explanatory variable of firms' fixed investment. Section 4 uses the data of Canadian companies in the past 10 years to examine the model. Section 5 interprets additional empirical results for the relationship between the ratio of book to market value and fixed investment. Conclusions are presented in Section 6.

1. INTRODUCTION

Investment is one of the most volatile components of aggregate demand. While smaller in magnitude than consumption, investment fluctuates more than consumption. Through the multiplier process, its fluctuations lead to fluctuations in total output and income.

Keynes argued that investment was the primary driving force in the economy. Investment fluctuates erratically because of capricious shifts in business expectations, and consumption responds to its fluctuations passively according to the consumption function. How to put the new innovation into application and develop the form of new fixed capital is the purpose of investment. That new investment may generate learning externalities or be the leading channel through which innovations stimulate growth has led to much interest in public policies

encouraging fixed capital information. In recent years, many economists have tried to make many models to describe this procedure.

1.1 Some General Ideas about Investment

In looking at the microeconomic underpinnings of investment, we shall see that Keynes's distinction between investment and consumption is not so pronounced. Because investment is a component of aggregate demand, fluctuations in the volume of investment expenditure lead to multiplied changes of output and employment. When investment rises, it may be the result, not the cause, of an increase in spending elsewhere in the economy. Moreover, while investment decisions do depend on business expectations, these expectations are based on calculated estimates of future changes in demand and prices that businesses are likely to face.

The firm's fixed investment demand function tells how much capital equipment the firm will purchase or make, given its planned level of output and the rental price of capital. If the firm has been in business for a while, it will have an existing stock of capital at the beginning of the year. After examining the planned level of output and the rental price of capital, it will decide a level of capital to use during the year. Finally, it will purchase enough new capital to make up the difference. Briefly, this is the theory of investment.

From the basic microeconomic theory, we know that the firm chooses the amount of capital it uses by equating the marginal benefit of capital to the rental price of capital. When the amount of capital is high, the marginal benefit of

further capital is low. By adjusting the amount of capital, the marginal benefit can be brought into equality with the rental price. The result of this process is the firm's desired capital stock, which is called K^* .

Now consider how the actual capital stock changes. Suppose that the firm finishes the last year with a capital stock of K_{-1} (the subscript -1 means last year) that is not equal to the desired capital stock this year, K^* . If there is no depreciation, then the level of investment will increase the capital stock by the amount of the investment. That is, investment equals to the change in the capital stock:

$$I = K - K_{-1}$$

If the firm wants its capital stock K to equal the desired capital stock K^* , then its investment demand during the year is obtained by substituting $K=K^*$, that is,

$$I = K^* - K_{-1}$$

This much investment added to its existing capital will give the firm its desired level of capital for this year. This formula is the firm's investment function. The investment function for the desired capital stock K^* can be written by assuming that $K^* = \alpha Y$ and so is strictly proportional to output:

$$I = \alpha Y - K_{-1}$$

The effect of output on investment is called the accelerator. If the firm always adjusts its capital stock each year so that it is equal to the desired stock, then investment, which is the change in the capital stock, must therefore be given by the difference between the two expressions:

$$I = \alpha Y - \alpha Y_{-1} = \alpha \Delta Y$$

In words, the level of investment depends in this simplified world on the change of output ΔY . When output accelerates, that is, its change becomes larger, investment is stimulated. A rise in output from one level to another causes a burst of investment. However, if output remains at its higher level, investment subsides. This accelerator process seems to explain a large portion of the close association between investment and GDP. Besides this accelerator model (the details are described below), there are other kinds of models describing the investment procedure and decisions. The most influential theories are neo-classical theory and q theory. Moreover, there are some other kinds of interesting theories worth our attention. We shall describe them below.

2. LITERATURE REVIEW

We shall review some theories and models relating to investment.

2.1 Accelerator Model

In the early part of this century, J.M. Clark (1917) first introduced the model of the accelerator, relating investment in fixed capital to changes in output. Later, a number of economists, particularly Koyck (1952) and Chenery (1952), modified his model. These kinds of models generally take the empirical form of a linear relation of current net investment to current and past changes in output. The basic assumption of any accelerator model is that the desired capital stock at any point in time is a constant multiple of output, Y , at that time.

$$K^* = \alpha Y \quad (1)$$

where

K^* = the capital stock that would be chosen by entrepreneurs if net additions to capital were instantaneously available at a constant price

Y = output.

In those theories that have been developed to explain the flexible accelerator model, the most satisfactory one may be an adjustment cost approach, which was first suggested by Eisner and Strotz (1963). In it, firms pay a penalty for having a capital stock different from the desired level and incur an adjustment cost, A .

The model is

$$A = f(K^* - K) + g(K^* - K_{-1}), \quad (2)$$

$$f(0) = g(0) = 0;$$

where

$f(\cdot)$ = cost of having a capital stock different from K^* , the static optimum for the output of the current period,

$g(\cdot)$ = cost of adjusting the capital stock.

The actual net investment undertaken is the one that minimizes costs in the trade-off between f (having too much or too little capital) and g (incurring costs of adjustment). In principle, installation costs, rising supply prices for capital goods, and production lags could all be included in an adjustment-cost framework.

However, these kinds of discussion of the flexible accelerator have an unwarranted assumption: expected future output is equal to the current level. But firms expect future output to be greater in a number of ways, and plan long-range production strategy ten or more years in advance.

Modern interpretation of the accelerator models are based on the following assumptions:

(1) Past levels of output are the most important determinants of expectations about future output.

(2) Other variables that might have been included in the model either have little impact on expectations or are observed with such large errors. Therefore, they are best omitted altogether in empirical work.

Therefore, the discussion so far has focused on net additions to the capital stock, and has ignored replacement investment. If it can be assumed that depreciation is approximately exponential and that the replacement of depreciated capital responds linearly to lagged output, then gross investment, I , can be represented as a distributed lag on output, plus a constant multiplied by the capital stock of the last period:

$$I = \alpha \sum_{s=0}^{\infty} \beta_s \Delta Y_{-s} + dK_{t-1} \quad (3)$$

where

I = investment

K_{-1} = capital stock of last period

$\Delta Y = Y - Y_{-1}$, where Y is private non-residential business output.

2.2 q Theory:

It might be argued that Keynes (1936) first introduced q theory of investment and then William Brainard and James Tobin (1968) revitalized and elaborated it. Tobin (1969, 1978) developed the q theory of investment, using information in financial markets to find the relationship between $E_t\{\Lambda\}$ ¹ and observed variables. In this theory, the rate of investment is a function of q, which is the ratio of the market value of new additional investment goods to their replacement cost. There are some kinds of adjustment costs which lie behind the theory. If a firm can freely change its capital stock, then it will continue to increase or decrease its capital stock until q is equal to unity. The relation between these intuitive concepts and formal models has been developed in a series of papers. Andrew Abel (1980), Lucas and Edward Prescott (1971) and Michael Mussa (1977) demonstrate that adjustment costs, technology, and optimizing behaviour lead to a relation between investment and marginal q. However, the role of the production function is not clear in Tobin's exposition since marginal q is unobservable. Therefore, empirical researchers have utilised average q, which is observable. The formal conditions under which this substitution is appropriate have been established by Fumio Hayashi (1982, 1985). He formalizes the idea that investment is a function of marginal q and that this idea is equivalent to the firm's optimal capital accumulation problem with adjustment cost. He also derives the optimal rate of investment as a function of

¹ $E\{\Lambda\}$: the expectation of shadow price of capital

marginal q adjusted for tax parameters and derives an exact relationship between marginal q and average q .

The main assumptions are:

1. The firm is a price-taker.
2. The firm faces the constant returns to scale in both production of goods and installation of capital.
3. The market value of the firm corresponds to its fundamental value.

The model is:

$$\text{Max}_{\{I, N\}} V_0 = \int_0^{\infty} e^{-rt} (P^f f(K, N) - P^G g(K, I) - \omega N - P^I I) dt \quad (4)$$

$$\text{subject to:} \quad K_t = I_t - \delta K_{t-1} \quad (5)$$

where

V_0 = the present value of the firm

$f(\cdot)$ = production function, which is determined by the labour and capital input

$g(\cdot)$ = adjustment function,

P^f : price of firm's output

P^G : price of adjustment inputs

P^I : price of investment goods

K : capital input

I : investment input

ω : wage rate

N : labour input

δ : rate of physical depreciation.

The main contribution of Hayashi is to derive the investment function when firms face convex adjustment costs, as the investment is linked to the market value of the firm. In general, it has been found that the q model's empirical performance has been unsatisfactory. This will be reviewed in terms of the statistical significance of q and the fit of the equation.

In some earlier research, the empirical evidence tended to support the q hypothesis. Yehuda Grunfeld (1960) presented analyses with financial value, finding that his approximate q variable "explains a larger proportion of investment behaviour than either lagged or current profits"(p.233). In models with distributed lags of q , John Ciccolo (1975) and Engle and Foley (1975) show that, with a capacity utilisation variable, q plays a significant role in the investment equation.

However, in most recent work, these initially encouraging results with aggregate data have not been confirmed. In equations with capacity utilization, capital stock, and taxes, Von Furstenberg (1977) concludes that including a distributed lag of q_t in quarterly regressions "must be regarded as optional" (p. 288). The research results of Summers (1981), Blanchard and Wyplosz (1981), and Hayashi (1982) show that the coefficients of multiple determination are rather low and that there is substantial serial correlation in the residuals.

Moreover, there have been three persistent discrepancies discussed in the literature.

First, the assumption of dynamics appears to be inadequate for the sequential problems. This model requires that all assumptions enter prior to the

characterization of the optimal investment policy. However, the lagged I_t/K_t and q_t are frequently justified by the assumption of delivery lags, multi-period adjustment costs or other dynamic elements in technology.

Second, the model implies that only q_t has a systematic relation to investment and other variables should be omitted. However, quantity variables---such as liquidity and output---are frequently statistically significant. Chirinco and Schaller (1995) study 212 Canadian firms for the period 1973 to 1986 to show the relationship between liquidity and investment.

The third and perhaps the most important criticism of the q model is that the estimated adjustment costs are generally so high that they seem economically implausible. For example, the results of the Summers study imply that the adjustment process is much slower than is usually assumed, with half-life of more than a decade. Twenty years after an unexpected change in the economic environment, the capital stock would have moved only three-fourths of the way to its ultimate steady-state value.

However, Schaller (1990) tested two main explanations for the empirical weakness of the theory---aggregation and imperfect competition. By using the data from 188 individual firms, it is possible to address directly aggregation problems, which turn out to be of considerable importance.

The degree of serial correlation is much smaller in his sample than in previous studies using aggregate time-series, where the serial correlation is roughly twice as large as at the firm level.

Without allowing for heterogeneity, the econometrics is not very plausible, as they suggest upward-sloping demand curves and decreasing marginal adjustment costs as the rate of investment increases. Taking account of heterogeneity among firms, the results suggest that imperfect competition may be of some importance. For the broad measure of investment, which includes inventory investment, allowing for both firm heterogeneity and imperfect competition also moves the estimated adjustment cost parameters in a more economically plausible direction. Specifically, the estimated marginal adjustment cost parameter drops by about one-third compared to its estimate when not allowing for imperfect competition.

Moreover, financial factors affect investment. Two main explanations have been suggested. One is that firms have finance constraints, which creates a wedge between the costs of internal and external finance. As a result, investment may be higher for firms in a position to draw upon relatively inexpensive internal funds. An alternative explanation is that liquidity serves as a proxy for omitted variables and other specific problems.

Finance constraints can arise from two sources: asymmetric information or transaction costs. If asymmetric information problems loom large, reducing disclosure requirements and instituting other streamlining procedures for new share issues may not be especially helpful in easing finance constraints.

2.3 Neoclassical Model

In the Neoclassical explanation of investment behavior, the specification of the desired capital stock is derived from the technique of maximizing (minimizing) an objective function subject to a constraint. Like intertemporal utility maximization, where consumption decisions were made subject to multi-period budget constraints, the Neoclassical model of optimal capital accumulation is derived from the microeconomic theory of the firm that seeks to maximize profits (minimize costs) subject to a production function.

Jorgenson and a number of colleagues pioneered the most frequently used Neoclassical model (Jorgenson 1971).

The assumptions are:

- (1). The firm maximizes the discounted flow of profits over an infinite horizon.
- (2). Delivery lags, adjustment costs and vintage effects are absent.
- (3). Capital depreciates at a geometric rate.

The firm can achieve any K^* instantaneously and it does not need to consider the future problem. Therefore, the multi-period optimization problem becomes essentially static.

If the output is produced under competitive conditions and technology can adequately be described by a Cobb-Douglas production function, the desired capital stock at each point in time should be a linear function of output

$$K_t^* = \alpha Y_t C_t^{-\sigma} \quad (6)$$

where

α = distribution parameter

Y_t = output

C_t = user cost (rental price) of capital

σ = elasticity of substitution between capital and variable inputs

$$C_t = P_t^I (r_t + \delta) (1 - m_t - z_t) / (1 - \tau_t) \quad (7)$$

where

P_t^I = purchase price of new capital

r_t = the real financial cost of capital net of tax

δ = geometric rate of the capital depreciation

m_t = the rate of the investment tax credit

z_t = discounted value of tax depreciation allowance

τ_t = the rate of business income taxation.

Now, we divide total investment into net investment and replacement investment, relaxing the assumption of instantaneous adjustment.

Net investment (I_t^n) is decided by lag on new orders.

$$I_t^n = \sum_{j=0}^{\tau} \beta_j \Delta K_{t-j}^* \quad (8)$$

where

β = the delivery lag distribution extending for $\tau+1$ periods.

Since capital depreciates at geometric rate, replacement investment (I_t^r) is proportional to the capital stock available at the beginning of the period.

$$I_t^r = \delta K_{t-1} \quad (9)$$

Combining (7), (8), and (9), we can obtain the Neoclassical model of investment:

$$I_t = I_t^r + I_t^n = \delta K_{t-1} + \alpha \sum_{j=0}^{\infty} \beta_j \Delta(Y_{t-j} C_{t-j}^\sigma) + u_t \quad (10)$$

When $\sigma=0$, (10) reduces to the flexible accelerator (Hollis Chenery 1952). In this case, fiscal and monetary policies have no direct effect on investment, but have indirect effects through Y .

There are some deficiencies of the model.

First, the optimal capital stock (6) was determined under the assumption that there is no delivery lag, but the net investment equation (8) was based on a lag distribution. Therefore, the investment path generated by the Neoclassical Model may not be optimal---see John Gould (1969) and Marc Nerlove (1972).

Second, the characteristics of technology are very important. Vintage effects may not be absent. It may even influence the relation between past investments and the capital stock entering the production function.

Third, this model assumes that capital depreciates at a geometric rate, but in reality, numerous empirical investigations provide mixed support for this assumption.

Fourth, in the Neoclassical model, static or extrapolative expectations are very important. However, capital accumulation has the nature of being fundamentally forward looking. They are at odds. And this is related to the famous "Lucas Critique"(1978, Lucas and Sargent).

The most important idea of the Neoclassical model is that, after simplifications, the dominant determinant of investment is output.

Further extensions to previously cited models

Effective-Tax-Rate Model

Martin Feldstein's (1982) Effective-Tax-Rate Model finds the relationship between a quantity variable, a price variable and net investment. He reports that the fundamental determinant of investment expenditures should be the real net-of-tax rate of return on that investment. Feldstein's model provides an alternative way of examining the effects of taxes on investment.

The assumption is that output accounts for the trend component in the investment and it places all variables in the same units.

The model is:

$$I_t^n/Y_t = \alpha_0 + \alpha_1 RN_{t-1} + \alpha_2 UCAP_{t-1} + u_t \quad (11)$$

where

RN = the price variable, which is the net return to capital, defined as the average yield to shareholders and equity holders net of depreciation and effective taxes.

UCAP = an index of capacity utilization

I_t^n/Y_t = ratio of real investment to real GNP

u_t = random disturbance

Here, if expectations are assumed to be static, then the Y 's represents only the technology. If expectations are extrapolative, then (11) represents a combination of expectation and technology parameters.

The Effective-Tax-Return model is different from the Neoclassical model in two aspects:

First, in the Neoclassical model, the price variable (C_t) is determined as a marginal concept. While in the Effective-Tax-Return model, RN is based on average.

Second, in the Neoclassical model, it is the two-stage procedure. But in the Effective-Tax-Return model, net investment relates directly to the quantity and price variable. Therefore, it makes “the combined behavior of firms and households as a ‘black box’ that links net investment to the net-of-tax profit of investment” (Feldstein 1987a, p.391)

Return-Over-Cost Model

Feldstein’s second new model contrasts the maximum potential net return (MPNR), that firms can afford on a standard investment project, with the cost of funds, COF.

The assumption is

$$(1). \text{MPNR}=\text{COF}$$

Whenever the benefits (MPNR) exceed the costs (COF), firms begin to acquire capital in order to make $\text{MPNR}=\text{COF}$.

$$(2). \text{The fluctuations in demand positively affect net investment.}$$

The Model is:

$$I_t^n/Y_t = \alpha_0 + \alpha_1 \text{UCAP}_{t-1} + \alpha_2 (\text{MPNR}_{t-1} - \text{COF}_{t-1}) + u_t \quad (12)$$

As we mentioned before, the estimated coefficients may represent both technology and expectation parameters.

Feldstein estimates the equation above and a variety of related specifications by least squares with a first-order autocorrelation correction. The test shows that the first-order autocorrelation correction is not inferior to a more general first-order ARMA process. He uses the data of 1955-1977 to estimate the basic parameter. The results “indicate the yield differential has a powerful effect and the variation in capacity utilization is also important.” (Feldstein 1982, p.849)

Vector Autoregressive Models.

Autonomous shocks are very important in assessing the determinants of investment. The reported empirical results could be affected seriously by a simultaneous equation problem induced by autonomous shocks contained in u . For example, the technology shocks affecting seriously the firm's decisions or the linkage between aggregate saving and investment may occur. Therefore, in the Neoclassical model, both ΔY and ΔC could be correlated with the shocks. The finding of significant output effects and insignificant user cost effects (which has a substantial negative impact on investment) may be explained by the resulting bias. Even this kind of problem could be solved by using instrumental variables, but obtaining valid instruments is a difficult task.

There are other problems about variables. Even variables which have no direct impact on the investment might still have significant effects on the relevant expectations. Therefore, it is difficult to identify the structural parameters. For

example, in the Neoclassical model, one of the assumptions is that capital depreciates at a geometric rate. However, this rate may be changed or determined by interest rates and the level of or change in output. Therefore, it is very difficult to identify the coefficient on ΔY solely with delivery lag technology—equation (10).

In response to this case, Christopher Sims (1980) suggests a nonstructural approach. He reports that it is not good to attempt to identify the econometric structure. So he treats each variable in the system as endogenous and regresses current values on their own lags and those of all other variables in the system.

A few authors have applied this method to investment spending. Robert Gordon and John Veitch (1986) report that ΔY , ΔC and q are not important determinants compared with the real money shock. However, W. Douglas McMillin (1985) for the United States and Michael Funke (1989) for West Germany report that q has important effects on investment and that money and government debt affect investment only through q .

The empirical tests by Chirinco (1987) find that none of these three models supports Feldstein's view that taxes have an important effect on business net investment between the mid 1960s and the late 1970s.

3. General Methods

In recent years, there has been a lively debate on whether stock market prices are always equal to the expected present value of future dividends. However, empirical studies have provided evidence that equity prices may vary

too much relative to dividends. This means that investors may overreact. That is, there may be fads in stock market prices, and that there may be a tendency to be overly optimistic about the future performance of stocks that have done well in the recent years. It is widely understood that business fixed investment is relatively volatile and may play an important role in economic fluctuations.

Higher stock prices provide firms with a potential cheap source of finance, so we might expect firms to react by issuing equity. Economic theory, however, leaves open the question of whether firm's fixed investment will react to the over- or under- valuation of the stock market. On the one hand, firms may use the earnings-price ratio as a measure of the cost of capital so that a stock price bubble will lower the discount rate applied to future cash flows and stimulate investment. It might be an "active financing mechanism". On the other hand, firms might view stock prices as unreasonably high and issue new shares but put the proceeds into securities, rather than fixed investment. This would be an "inactive financing mechanism". Therefore, there may be some relationship between firm's fixed investment and the market price of its shares. Since the market price will be indirectly reflected on the ratio of book value to market value, we do the research on the relationship between the ratio of book value to market value and fixed investment.

3.1 Informal Evidence

If its shares are overvalued, a firm may have an incentive to issue new shares to take advantage of the "arbitrage" opportunity and may increase the fixed

investment. Thus, one sign of overvaluation would be a dramatic increase in total fixed investment. Fixed investment increased steadily during the latter part of the 1980s and peaked at 1988-1989 in Canada (119.1 billion USD in 1989²) at a level more than twice as high as the mean over the sample period. Moreover, if firms suspect that there are investors with overly optimistic beliefs about their shares, it makes sense for them to take advantage of the situation by applying for loans from the bank and thereby increasing their fixed investment. From the data of the recent aggregates, we can find surprising correlation of the peak of stock market and fixed investment ($r^2=0.888891$ by linear regression model). (See Table1, Table 2, and Figure 1).

Table1. TORONTO STOCK MARKET STATISTICS / COMPOSITE (300)

CLOSE³

TORONTO STOCK EXCHANGE, STOCK PRICE INDEX, 1975=1000,
MONTHLY.

Year	Index
1980	2125.62
1981	2158.42
1982	1640.20
1983	2340.70
1984	2366.75
1985	2712.53
1986	3010.59

² The data are from Cansim D31710.

³ The data are from Cansim B4237.

1987	3567.78
1988	3302.73
1989	3801.53
1990	3421.10
1991	3469.48
1992	3402.92
1993	3904.22
1994	4284.06
1995	4433.88
1996	5268.01

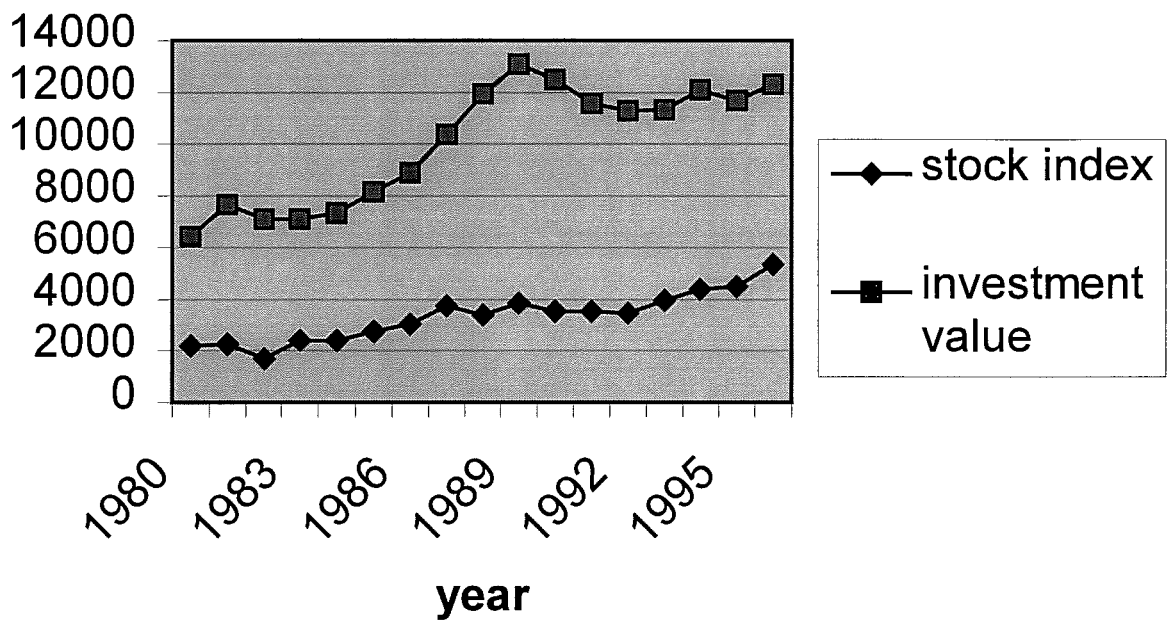
Table 2 EXPENDITURE CANADA PROVINCIAL / BUSINESS
INVESTMENT : FIXED CAPITAL⁴

Year	Investment
1980	6406.5
1981	7667.2
1982	7080.8
1983	7083.2
1984	7330.9
1985	8131.2
1986	8899.3
1987	10383.1

⁴ The data are from Cansim D31710 and their units are 10 million dollars

1988	11910.0
1989	13081.2
1990	12476.6
1991	11557.0
1992	11275.9
1993	11306.8
1994	12105.1
1995	11655.3

Figure 1. Investment and Stock Index



Model Construction

From the review of the above data, we can see some relations between the fixed investment and stock index. However, the research in macroeconomics has emphasized the importance of linking the financial and real output sectors and working with optimizing models.

This paper will test whether the ratio of book value to market value helps explain fixed investment. In view of the long-standing debates in the literature over the appropriate specification of the model's demand side, we examine two broad empirical specifications that encompass the most common approaches.

First, we shall try to use the ratio of book value to market value instead of q and insert this variable into demand models based on q . The q model emphasizes market valuations of the firm's assets as the determinant of investment. The most extensive tests of alternative specifications and estimation techniques are presented for the q model. These tests lead to similar conclusions for the other models.

Second, we shall begin with sales accelerator models in which fluctuations in sales or output motivate changes in capital spending.

The general form of the reduced-form investment equations that we examine is

$$(I/K)_{it} = f(X/K)_{it-1} + g(B/M)_{it-n} + u_{it}$$

where

I_{it} = investment in plant and equipment for firm i during period t ;

X = vectors of variables, possibly including lagged values, that have been

emphasized as determinants of investment from a variety of theoretical perspectives;

B/M = the ratio of book value to market value, which may involve more than 1 period and

u = an error term.

The function g depends on the ratio of book value to market value. It represents the potential sensitivity of investment to fluctuations in available ratio of book value to market value after investment opportunities are controlled

through the variables in X . All variables are divided by the beginning-of-period value of capital stock K .⁵

3.2 Simple q theory

Tobin's q investment theory appears to provide a framework which satisfies the two criteria. The introduction of Tobin's q -ratio in the literature has prompted noteworthy advances in economic model-building and empirical analysis. Therefore, this paper will build the model on the basis of Tobin's q theory and the successive works.

It is reasonable to assume that investment depends on the ratio of market value of existing capital to its replacement cost. The firm should decide to invest only when an investment of one dollar increases the firm's market value by more than one dollar. As the value of q rises, firms increase their investment until they are just indifferent between installing an extra unit of capital and paying out its cost in the form of higher dividends. Most of the theoretical and empirical works did analysis on this basis. However, there are two important empirical test result qualifications, which affect the development of q theory:

First, the R^2 s are rather low;

Second, there are substantial serial correlations in residuals.

The first problem shows that there might be substantial unexplained aspects. There may be some important things that we omit. Therefore, let's suppose that one of these possible unexplained aspects is the ratio of book value to market

⁵ This is done because we want to scale down the size of firms, making the results to be not dominated by large sized firms.

value, which also links the financial and real sectors while working with optimizing models. Moreover, the ratio of book value to market value is also very important to the return of the stocks. It contains information about future returns that is not captured by other variables, such as interest yield spreads and dividend yields (J. Pontiff and L.D. Schall, 1998).

Therefore, this paper suggests using the ratio of book value to market value instead of q to test the relationship between the stock market and fixed investment.

Since q is the ratio of replacement cost to the market value, it is very possible that there is collinearity between q and the ratio of book value to market value. Therefore, this paper uses the ratio of book value to market value instead of q .

We employ an empirical specification derived from an adjustment cost technology. Although Lawrence Summers specifies a variable cost of adjustment per unit of investment relative to capital, we assume the cost of adjustment is constant here. Since it takes time to reflect the effect of the stock market on the fixed investment, we use two lagged ratios of book value to market value as independent variables.

Since the t-test shows that the significance of one variable of the ratio of book value to market value is so large, we use the two variables to test the result of the relationship of investment and the ratio of book value to market value. These are the only explanatory variables for these regressions.

The model is:

$$(I/K)_{it} = \alpha_0 + \alpha_1 (B/M)_{it-1} + \alpha_2 (B/M)_{it-2} + u_{it}$$

where

I = Investment

K = Total Capital, here we use total assets (as measured from the balance sheets)
as the value of total capital

B/M = The ratio of book value to market value.

3.3 Accelerator Model

We will continue with the basic investment theory. The reason that this model is chosen is that: from a theoretical standpoint, the q investment demand model has many attractive features; however, in practice, other approaches have performed better empirically. Some of the most successful empirical investment models are based on the traditional acceleration principle, which links the demand for capital goods to the level or change in a firm's output or sales. Below we test whether the ratio of book value to market value effects across retention classes holds up in models that include sales changes. Certainly, we can see that a possible explanation for the effect of the ratio of book value to market value variable in all the retention classes is that the ratio of book value to market value is correlated with sales.

The model is:

$$I_t/K_t = \alpha \sum_{s=0}^{+\infty} \beta_s \Delta Y/K_{t-s} + \gamma (B/M)_{t-1}$$

where

I = investment

$\Delta Y = Y - Y_{-1}$, where Y is private nonresidential business output

B/M = the ratio of book value to market value.

4. Empirical Test and Analysis

In this section, by testing the hypothesis concerning the proposed relationship between investment and the ratio of book value to market value, we attempt to determine elements of investment.

4.1 Data Sources

The data below were obtained from the Financial Post and are annual data series available from the FP Corporate Analyzer. The main resource is the section entitled "The Fundamental Data". The Fundamental Data facility is designed to provide more refined (i.e., less aggregated) data and access to a broader range of financial data. This database, which is similar to the Compustat in the United States, is derived from firms' financial statements.

This paper retrieves and reviews the full range of corporate data items available in FP Analyzer. Using this facility, we select a number of companies and compare their performance on a single criterion. These are not aggregate data, but the data of specific firms.

The time period is from 1989 to 1998. The companies are selected from TSE 300 companies. Since the firms in TSE 300 are all publicly traded, they are likely to face information problems, both because lenders will tend to know more about firms that have been visible for an extended period of time and because TSE 300 firms can credibly enter into a repeated relationship with lenders.

Second, we sorted these firms by the industries in the way that the FP Analyzer did since different industries have different investment characteristics. Third, we sorted these firms by dividend growth rate. We define the firms with growth rate larger than 10% as "high growth dividend firms".

This paper uses the reciprocal of the ratio of average price to book value⁶ as the ratio of book value to market value, capital expenditure as investment, total assets as the capital, and total revenue as the output (since we have to do the analysis with different industries). Because the number of companies is different in the each industry, we have to cut off some companies in some items if the data are not available in other items⁷. However, we still have more than 200 companies as observations. We pay more attention to the results of the five most recent years.

The structure of the Value Line data permits an interesting test of this possibility. A firm is not added to the database until it is "of interest to subscribers and the financial community". Once a firm is added, however, observations on items from its income statements and balance sheets are collected for the last 10 years prior to the date it is added to the Value Line database. Most class firms were not recognized until near the end of the sample period even though our data for these firms extend back to 1989. Therefore, the strongest case for the ratio of book value to market value for specific firms can be made for the shorter time period, 1993-1998 and particularly 1997 and 1998.

⁶ Since the average price is obtained from the market value.

⁷ For example, we got rid of the firms whose asset value are available while the ratios of book

4.2 Simple q Model

In this model we consider two lagged ratios of book value to market value of companies in the TSE 300 as independent variables, whereas the investments of those firms are treated as dependent variables. The simple q investment model was tested using the data from 1993 to 1998. The data of 1992, 1991, 1990 and 1989 were not used since the number of sampled companies for this period was

Table3: Effects of the Ratio of Book Value to Market Value on Investment

Independent variable and summary statistic	1998	1997	1996	1995	1994	1993
α_0	0.160672	0.174163	0.260591	0.318579	0.142518	0.182243
S.E.	7.622040	0.023667	0.100151	0.159669	0.015378	0.032673
B/M_{t-1}	-0.022062	-0.020457	-0.029021	-0.034647	-0.014284	-0.026962
S.E	-2.166465	0.020869	0.103063	0.136575	0.017011	0.023316
B/M_{t-2}	-0.125122	-0.006689	-0.015419	-0.022175	-0.004460	-0.000342
S.E	-1.563010	0.018057	0.018057	0.121974	0.015552	0.022835
R^2	0.032177	0.028957	0.005102	0.003520	0.059386	0.033120
Prob(F-statistic)	0.032252	0.041243	0.584436	0.710345	0.005329	0.066449
Sample Number	213	220	213	181	174	164

1. Dependent variable is the investment-capital ratio $(I/K)_{it}$
2. Sample number is from the firms in TSE300.

value to market value are not available.

not sufficiently large. It was expected that the correlation between the ratio of book value to market value and investment would be stronger in later years.

There are two reasons for this expectation. First, the economic growth rates are relatively stable during the last two sample years, and most firms were no longer using up all their internal funds. Second, as firms become mature, more observations of the projects are realized and balance sheets are collected, and asymmetric information problems should become less severe. We can draw this conclusion from the notes of the Financial Post.

The results of the model fitting are presented in Table 3. It is observed that the estimates of the regression coefficients for the two independent variables for all six years are negative. This indicates that, as the ratio of book value to market value increases, the investment decreases, and the vice versa. It means that highly evaluated firms (low ratio of book value to market value) will have more investment.

As expected, the ratio of book value to market value coefficient is generally larger in the latest period (B/M_{t-1} , Line 2 in Table 3). However, the results in table 3 show that the coefficients are still not large enough. The second largest absolute value is just 0.034674 for 1995 when most of these firms had yet to be recognized by the Value Line. The coefficient is the smallest for 1994 (0.014284). Furthermore, as the results show, the values of the latest coefficients are not very different between sample years. They have become approximately stable over time.

However, the coefficients in earlier years differ greatly among the sample years (B/M_{t-2} , Line 4 in Table 3). We can still find much difference: from ---- -0.000342 to -0.125122. The absolute values of these coefficients for these firms decline almost monotonically.

The coefficients of multiple determination are very small. It means that the explanatory power of the ratio of book value to market value is limited.

When we compared with the ratio of book value to market value coefficient in the latest period (B/M_{t-1}) with that of the more distant period (B/M_{t-2}), we may infer that when companies make investment decisions, they will not only consider the ratio of book value to market value of the more recent year, but also of the years before. Of course, the latest ratio of book value to market value will have a much bigger impact on the investment decision relative to these of other years. Moreover, outside investors will also consider the previous periods when providing financial resources. On the other hand, the fact that the differences remain substantial for so long a period indicates that the phenomenon is quite persistent.

The standard errors (SE) associated with the coefficient estimates for the ratio of book value to market value coefficient in the latest period (B/M_{t-1}) and with the earlier coefficient (B/M_{t-2}) are relatively large. This implies we cannot reject the hypothesis that the coefficients on these two variables are not different from zero at the 5% significance level. However, the F tests show that the two variables made a meaningful contribution in explaining the variation in our dependent variable (98-0.032252, 97-0.041243, 96-0.584436, 95-0.710345, 94-

0.005329, and 93-0.066449). Thus we have a statistically significant effect (at the 10 percent level) in three regressions out of five.

4.3 Accelerator Model

In the next step, we examine the accelerator model. In this model, investment is treated as the dependent variable and the change in sales (normalized by the value of the capital stock) and the lagged ratio of book value to market value are used as predictors. The data used for model fitting correspond to the period from 1989 to 1998. The results of the analysis are presented in Table 4.

As can be seen, the sign of the regression coefficient on the ratio of the book value to market value is negative for all years. This indicates that the greater is the ratio of book value to market value, the smaller is the investment. That is, a highly evaluated market value (lower ratio of book value to market value) will cause more investment. More importantly, the standard errors (SE) associated with the coefficient estimations are much smaller. Therefore, we can reject the hypothesis that the coefficients on the variables are not different from zero at the 5% confidence level.

Moreover, some of the effects of the ratio of book value to market value in the accelerator model can indeed be explained by the correlation between the ratio of book value to market value and sales. The coefficient for ratio of book

value to market value declines in all samples when the sales variables are added to the equation. Since the value of R squares are big enough (all nine are larger

Table 4 The investment Function with output change

Independent variable and summary statistic	1998	1997	1996	1995	1994	1993	1992	1991	1990
α_0	0.129561	0.138026	0.141943	0.100595	0.116678	0.134717	0.118526	0.136938	0.062060
S.E.	0.019131	0.0143054	0.014242	0.011504	0.015114	0.019275	0.023036	0.014579	0.081767
$\Delta Y / K_t$	0.0703940	0.016110	0.0196392	0.165452	0.102890	0.110620	0.422753	0.357357	2.952391
S.E.	0.061341	0.045739	0.0196251	0.016251	0.019159	0.006092	0.016101	0.005650	0.117436
$(B/M)_{t-1}$	-0.01733	-0.017835	-0.014355	-0.144476	-0.14272	-0.10550	-0.010550	-0.018740	-0.071641
S.E.	0.007151	0.005588	0.005296	0.04537	0.005137	0.006210	0.007487	0.004208	0.027987
R^2	0.255353	0.624574	0.624574	0.390749	0.202048	0.696512	0.823259	0.967459	0.829278
Prob(F-statistic)	0.099145	0.062457	0.005296	less than 0.01	less than 0.01	less than 0.01	less than 0.01	less than 0.01	less than 0.01
Sample Number	183	203	203	194	186	176	159	151	142

1. Dependent variable is the investment-capital ratio $(I/K)_t$
2. Sample number is from the firms in TSE300.

than 0.200, and the largest is 0.967), it means that these variables have strong explanatory power. The results in Table 4 also show that from 1990 to 1993, R squared coefficients are much larger in earlier years than in later years.

The results of the analysis of the regression model also provide an interesting perspective on a point often raised in the investment literature. It is typical to find significant effects of sales. Sales may be proportional to the investment (as we have found in Table 4).

Including the ratio of book value to market value effect in the estimated equation helps to explain this equation. Since the ratio of book value to market value is based on asset prices determined in forward-looking markets, it should capture the prospective profitability of investment better than lag effects in all the dividend-payout classes. To the extent that the ratio of book value to market value captures the effect of future profitability in the demand for investment, this result supports the interpretation that the ratio of book value to market value effect is significant in the publicly traded firms.

5. Additional Analysis

5.1 Investment equations at the industry level

Another dimension of firm heterogeneity that may be important for investment behaviour is a difference across industry categories. Table 5 provides estimates of the simple q model augmented with the ratio of book value by retention to market value using the average number of firms. Here we chose six sub groups of TSE 300 companies. They are Metals & Minerals, Gold & Precious Minerals, Oil & Gas, Paper & Forest, Consumer Products and Industry Products. Since we use the average number of the ratio of book value to market value and capital, the model is changed into

$$(I/K)_{avg,t} = \alpha_0 + \alpha_1 (B/M)_{avg,t-1}$$

where⁸

⁸ Annual average value of each firm.

I =Investment

K=Total Capital, here we use total asset

B/M= The ratio of book value to market value.

We chose these six subgroups since they are important to the whole economy.

Table 5 The ratio of Book value to market value on Investment, Various industries, 1989-1998

Industry	B/M	Std. Error	r-squared	D-W test	Sample number
Metals & Minerals	-0.042157	0.015717	0.238259	1.132652	27
Gold & Precious Minerals	-0.018631	0.040684	0.020540	1.213604	12
Oil & Gas	-0.021387	0.055531	0.016213	1.083252	11
Paper & Forest	-0.204396	0.139493	0.112134	1.083252	19
Consumer Products	-0.150226	0.079652	0.307784	1.614410	10
Industry Products	-0.137383	0.039386	0.708738	1.946170	7

There is still the negative correlation between investment and ratio of book value to market value. The results reported are robust when compared with the alternative investment demand specifications reviewed before. The coefficients of observations are small in the first three separate industry categories. Metals & Minerals is 0.042157, Gold & Precious Minerals is 0.018631 and Oil & Gas is 0.021387.

In three out of the six cases, the ratio of book value to market value coefficients are larger for the high retention classes, such as the firms in Paper & Forest, Consumer Products and Industry Products.

With industry effects held constant, it casts further doubt on a productivity shock interpretation of the effects due to the consideration of the ratio of book value to market value only. These results indicate that a greater sensitivity of investment to the ratio of book value to market value in good prospect firms is a kind of phenomenon restricted to particular industries. The investment in the particular industries that are more related to the final goals of the economy (consumer spending and investments in other industries) will be more affected by the ratio of book value to market value. More important, the standard errors (SE) associated with the estimated coefficients are much smaller. Therefore, we can reject the hypothesis that the coefficient on the variables is not different from zero at 5% significance level.

5.2 The Ratio of book value to market value and Investment in

High-payout firms

In some specifications of the investment models presented here, the estimated coefficient on the ratio of book value to market value is very possibly both statistically significant and economically important for the high-payout firms. This finding was quite robust. We tried further splits of those firms based on the level of payout rates over the samples. We also divided those firms into groups based on dividend growth⁹, rather than level, to test the hypothesis that the investment of firms that increase their dividends would be less sensitive to the

⁹ We define the firms with growth rate larger than 10% as "high growth dividend firms".

ratio of book value to market value coefficients. For these subgroups, the estimated coefficients were roughly the same as those from the full sample.

Here, we use the simple q model. In this model, we use two lagged ratios of book value to market value of companies in TSE 300 as independent variables, whereas the investment of those firms is treated as dependent variable.

The result of the model fitting is presented in Table 6. As can be seen, the coefficient estimates on the two independent variables for all six years are negative. This indicates that the greater the ratio of book value to market value, the smaller the investment. It means that highly evaluated firms (high ratio of book value to market value) will have more investment.

However, the standard errors (SE) associated with the coefficient estimates for the ratio of book value to market value coefficient in the latest period $(B/M)_{t-1}$ and the further coefficient $(B/M)_{t-2}$ are relatively large. This implies that we can not reject the hypothesis that the coefficients on these two variables are not different from zero at 5% confidence level. Moreover, the F tests show that the two variables made a meaningless contribution in explaining the variation in our outcome variable.

Because firms pay substantial dividends, such findings may seem inconsistent with our emphasis on the prospect forecasting. Why would these firms not cut dividends rather than investment when the ratio of book value to market value rises? One explanation is that agency costs of internal finance (that is, potential "managerial waste" on less productive investments) accounts for this

link between the ratio of book value to market value and investment in mature firms. While these agency problems may be important, they do not seem to explain the entire ratio of book value to market value effect for high dividend

Table 6: Effects of the ratio of Book Value to Market Value on Investment for high payout firms

Independent variable and summary statistic	1998	1997	1996	1995	1994	1993
α_0	0.072567	0.098231	0.085675	0.121942	0.079692	0.062736
S.E.	0.013994	0.024772	0.018935	0.023971	0.012101	0.016671
B/M_{t-1}	-0.008793	-0.033240	-0.007094	-0.017440	-0.013678	-0.001255
S.E	0.032465	0.030991	0.013912	0.028012	0.018487	0.016572
B/M_{t-2}	-0.006149	-0.017978	-0.002121	-0.001488	-0.003418	-0.001560
S.E	0.026236	0.021437	0.016919	0.021769	0.014705	0.009555
R^2	0.001813	0.030005	0.023450	0.054717	0.033234	0.001900
Prob(F-statistic)	0.960000	0.543735	0.539585	0.259109	0.375247	0.981158
Sample Number	48	43	55	51	61	23

1. Dependent variable is the investment-capital ratio $(I/K)_{it}$
2. Sample number is from the firms in TSE300.

firms. In those firms, the coefficient of the ratio of book value to market value effect is small when using the simple q model. It suggests that there is no strong correlation between the ratio of book value to market value and investment in high dividend firms. This may be due to the result that these firms chose to increase dividends instead of to increase investment. Nor is there any measured effect for the beginning-of-period stocks of liquidity on investment in these firms.

Furthermore, the evidence of R squared coefficients suggests that, in the presence of even a big ratio of book value to market value, investment may still not be sensitive to it for the high payout firms. If these firms are reluctant to cut dividends when the ratio of book value to market value rises, maybe for signaling reasons, they might reduce investment somewhat rather than seek more intensively external finance. This kind of behavior would, of course, magnify the importance of financial constraints for macroeconomic fluctuations in investment, a possibility that should be considered in more depth in future research.

5.3 Stock price, investment, and economic fluctuations

Changes in stock market prices will be reflected in the ratio of book value to market value. Moreover, stock prices in capital markets can magnify the macroeconomic effect of shocks to liquidity that reduce some firms' access to low-cost finance and worsen their balance sheet positions. Therefore, we might use the ratio of book value to market value as a symbol of stock market prices. To examine this issue more closely, we consider the extent to which the effects on investment of the ratio of book value to market value can account for the variability in aggregate investments. Since 1980, nonresidential gross investment has fluctuated in the same pattern as the stock market. The peak of fixed investments coincides with the peak of the stock market, as we have seen in Figure 1.

How much of the variance in investments can be explained by our estimated effect of the ratio of book value to market value of the capital stock?

To answer this question, we perform a regression analysis on the effects on investment of the lagged values of sales and the lagged ratio of book value to market value. It is different from initial accelerator model since we divide those firms into different classes according to the ratio of book value to market value. We want to test whether the value of the ratio of book to market value has non-linear, differential impact on fixed investment. The model was fitted on data from 1989 to 1998. The results of the analysis are summarised in Table 7.

As can be seen, the sign of the coefficient of the ratio of the book value to market value is negative for all years in classes 1 and 2. This indicates that the greater the ratio of book value to market value, the smaller the investment. That is, overestimation of market value (low ratio of book value to market value) will cause more investment. More importantly, the t ratios associated with the coefficient estimates are much larger in class 2 than in class 1. Therefore, we can have more confidence in rejecting the hypothesis that the coefficients on the variables are not different from zero in class 2 than in class 1.

From the estimated investment model (Table 7), using lagged ratio of book value to market value and lags of sales and inventories as independent variables, the ratio of book value to market value coefficients for the class 1 and 2 are -0.00401 and -0.17241 , respectively, on average. In fact, we observe each year that the coefficient of firms with high¹⁰ ratio of book value to market value (class 1) is much smaller numerically than the coefficients of firms with low ratio

¹⁰ We consider ratio of book value to market value greater than 2 as high.

of book value to market value¹¹ (class 2). In particular, the coefficients of the firms for classes 2 are 43 times greater than those for class 1, on average. We make the conservative assumption that the effect of the ratio of book value to market value for the mature, high perspective firms in class 2 is appreciably greater than that for firms in class 1. We found in the simple q model that the results are not as good as for the accelerator model. This result may suggest an

Table 7 The Investment and the Ratio of book value to market value of the different classes

Year	class 1 (the ratio of book value to market value)		class 2 (the ratio of book value to market value)	
	Coefficients	SE	Coefficients	SE
1998	-0.001508	0.003458	-0.014780	0.075521
1997	-0.000573	0.003024	-0.122889	0.046782
1996	-0.002274	0.002780	-0.088500	0.050137
1995	-0.008374	0.005041	-0.115778	0.047559
1994	-0.005742	0.003465	-0.264980	0.062008
1993	-0.001586	0.003985	-0.296829	0.092612
1992	-0.004327	0.002511	-0.204455	0.057735
1991	-0.004300	0.002045	-0.164206	0.060234
1990	-0.007429	0.005189	-0.279304	0.243830

1. Class 1 is the ratio of book value to market value bigger than or equal to 2
2. Class 2 is the ratio of book value to market value less than or equal to 1

explanation of this phenomenon for all companies. In general, investment may be decided first by the output. People will consider using the stock market more often in the case of companies deemed to have better economic prospects, compared with companies deemed to have poorer prospects. Those firms with

¹¹ We consider the ratio of book value to market value less than 1 as low.

low ratio of book value to market value are easier to get loans whether from public or from banks since they have good prospects in the stock market.

The aggregate investment-capital ratio can be expressed as a weighted average of the ratio for each class, with weights equal to the proportion of the aggregate capital stock in each class. To predict the effect of the ratio of book value to market value changes for firms like those in classes 1 and 2 for aggregate investment fluctuations, therefore, one needs to estimate the proportion of aggregate capital stock in the various categories of firms. We begin very conservatively by assuming that the aggregate proportions are the same as our Value Line sample proportions.

This result, however, almost certainly underestimates the true effect because large, mature firms constitute a greater proportion of our Value Line sample than they do for the aggregate economy. Indeed, data for our sample period from 1994 to 1998 indicate that approximately 10 percent of aggregate assets are held by firms with total assets less than \$100 million. The median capital stock figure for our Value Line firms in class 1, certainly less than their total assets, was \$1705.2 million in 1998. Class 2 firms had a median capital stock of \$889.2 million. These statistics imply that the aggregate importance of firms as small as or smaller than those in class 1 and class 2 is much greater than our sample proportions would indicate, and the 10 percent figure derived above may well be a loose lower bound. The aggregate retention data also suggest that low-dividend firms are much more numerous and account for a much greater fraction of investment and capital in the economy as a whole than they do in our Value Line

sample. Therefore, the portion of a representative aggregate shock to investment that could be explained by the kind of financial effects estimated here could be substantial, and financial constraints could account for a large proportion of the aggregate variability of investment. Such results provide further support to current research that suggests that aggregate economic fluctuations could be linked to problems in financial markets.

5.4 Further extensions and links to related current research

The link between financial influence on investment and ratio of book value to market value suggests that research on "prospect forecasting" through financial intermediation is important for understanding the investment process. Good prospects can resolve the financial constraints on fixed investment. One channel through which forecasting prospects can have an effect is that financial institutions specialize in long-term borrower relationships and in the evaluation of status in stock market. These institutions can figure prominently in the financing of smaller firms lacking cost-effective access to commercial paper, bond, and equity markets. Also, venture capitalists can be viewed as specialists in judgement of the investment prospects of growing enterprises. However, the existence of a lemon premium in equity issues does not imply that large arbitrage profits exist, where any cash-rich firm or individual could buy a constrained firm. Rather, "profits" arises from the costly activity of investigating and overcoming information asymmetries.

The existence of the influence of the ratio of book value to market value has implications for research in industrial organization because the prospects of firms will affect their financial condition through the borrowing institutions. As we mentioned before, financial institutions specialize in long-term borrower relationships and in the evaluation of status in the stock market. These institutions can figure prominently in the finance of smaller firms lacking cost-effective access to commercial paper, bond, and equity markets. Also, venture capitalists can be viewed as specialists in judgement of the investment prospects in growing enterprises. As Mandelbrot (1966) and Samuelson (1965) show, successive price changes are consistent with an efficient market. It is useful to assume that security markets are efficient, so the announcement-period stock price movement represents the market's unbiased opinions of mergers. Kenneth Judd and Petersen (1986) argue, for example, that the large differentials in the cost of internal and external financing can rationalize predatory and limit-pricing strategies. In addition, evidence provided by Ravenscraft and Scherer (1987) supports the view that many mergers appear to match different corporations that face different marginal capital costs. So the opportunity of getting loans would permit reallocation of capital that bypasses capital markets. This possibility suggests other research questions, some which have been addressed by Ravenscraft and Scherer (1987). Do mergers of companies in related activities perform better than purely conglomerate mergers, and if so, what are the effects on their ratios of book value to market value, and what are the effects on the forecasting of their prospects? How do young firms with high ratio of book value to market value

perform relative to those acquired by more mature companies? Similarly, how do start-up ventures of cash-rich companies perform relative to independent start-up ventures?

Our empirical results on firm investment suggest that models should address links between net worth and credit allocation and the possibility of precautionary retention by many firms. Theoretical research is proceeding along this line.

Future research should consider the role of the ratio of book value to market value in investment decisions in other countries, examining differences in tax policies, the structure of capital markets, and organization of firms.

A particularly interesting research topic would be the analysis of differences in the sensitivity of investment to the ratio of book value to market value according to the extent to which lenders participate in corporate decision making. Research in these areas is just beginning.

Also, output is clearly the primary determinant of nonresidential fixed investment. Among the equipment equations, the simple accelerator model has a lower estimated forecast error--- associated hypothesis tests are confirmed by a superior performance in the statistical model. While the simple q model (with two lagged ratios of book value to market value) also provides significant F test, it does so at the expense of the associated individual t tests.

The accelerator model suggests that output typically is strongly correlated with investment. Both the accelerator model and the simple q model

could generate the frequently observed empirical result that the ratio of book value to market value has a negative effect on investment.

These results are also relevant to debates over the source of aggregate fluctuations. The importance of firm heterogeneity in stock markets, especially the high coefficients of the firms with low ratio of book value to market value, suggests that representative agent, real business-cycle models, in which financial factors are irrelevant and productivity shocks drive macroeconomic movements, are unlikely to be good descriptions of cyclical fluctuations. On a formal level, models should consider channels through which exogenous shocks are magnified by forecasting prospects in capital markets.

6. Conclusion

This paper has presented a brief overview of the effect on investment behavior of variations in the ratio of book value to market value. By using data from TSE 300 individual firms, it is possible to address aggregation problems directly. These turn out to be of considerable importance. It appears that in both the q model and accelerator model, there are negative relationships between investment and the lagged ratio of book value to market value. The result of estimating and comparing the results of these two models can be summarized by answering the questions raised at the beginning of the paper. It satisfies the assumption that the lower the ratio of book value to market value, (which means good prospects in the stock market), the higher the investment.

However, the statistical significance of the coefficients of the ratio of book value to market value is quite low in both models. It means that the explanatory power of ratio of book value to market value is still limited in all the companies. However, we found that, in the case of accelerator model in which companies are divided through the value of the ratio of book value to market value, agents will consider investing in those companies listed on the stock market which appear to have more promising prospects. Since firms with a low ratio of book value to market value are in better position to negotiate loans, whether from public resources (equity, bonds), or from banks, they will have better prospects in the stock market.

At the industry level, the results indicate that a greater sensitivity of investment to the ratio of book value to market value in good prospect firms is a kind of phenomenon restricted to particular industries. The investment in the particular industries that are more related to the final goals of the economy (consumer spending and investments in other industries) is affected more by the ratio of book value to market value.

Output is clearly the primary determinant of non-residential fixed investment. Among the equipment equations, the simple accelerator has the lowest estimated forecast error; this status is confirmed by a superior performance in our empirical study.

We admit that the correspondence between the empirical literature and the empirical content of our model is not always precise. For instance, our model, in

some respects, ignores imitation and other sources of innovation and quality changes.

Moreover, the conclusion is based on samples with small numbers, which include only TSE 300 companies. Even if there exists some relationship between the ratio of book value to market value and fixed investment, further research is needed in order to investigate a large number of companies. There are thousands of companies in Canada. One should attempt to obtain larger samples to test the validity of our conclusions.

As mentioned before, research on "prospect forecasting" through financial intermediation is important for understanding the investment process, as is research on the relationship between mergers and investment.

The primary implication of these results for economic policy is that there is no quick and easy way to channel aggregate demand toward non-residential fixed investment. The response of investment to direct incentives is just as Bischoff (1971) mentioned, "If real output grows significantly as a result of strength in other sectors, substantial gains in real investment are likely to follow."(p.51) In the short run, at least, the best way to keep investment spending up is to keep high productivity or demand.

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