Specification of the Market-Accounting Relation

MARTIEN LUBBERINK*[1] and ROGER WILLETT[1]

[1]Victoria University of Wellington

30th November 2021

*Corresponding Author: School of Accounting and Commercial Law, Victoria University of Wellington, PO Box 600, Wellington 6140, New Zealand. W: +64 4 463 5968; M: +64 21 134 7500; F: +64 4 463 5076. Email: martien.lubberink@vuw.ac.nz.

We thank Colin Clubb, John Creedy, Peter Easton, Paul Healy, Wayne Landsman, Stuart McLeay, Jim Ohlson, Stephen Penman, Leigh Roberts, Katherine Schipper and participants at the 2016 QARN research workshop at VUW; the European Accounting Association meetings, Valencia; the AFAANZ meeting, Adelaide; the Financial Market and Corporate Governance conference, Melbourne; and the European Accounting Association meetings, Milan for useful comments.

Specification of the Market-Accounting Relation

Abstract

We argue that log-linear models, using elasticities to measure response coefficients in regression models of the market-accounting relation, are well specified and provide precise, readily interpreted and valid estimates of the relation between market and accounting values. Using this approach we show that fundamental financial statement data is sufficient, with little or no extra data, to explain firm market value. We illustrate the approach by discussing the evidence for dividend irrelevancy, the relationship of the market to book ratio with growth and its uncertainty, and the existence of abandonment options. Our method of estimating parameters in the market-accounting relation facilitates replication. We use all active Compustat firms between 1971-2020, without deletion or treatment of outliers. Our results demonstrate the utility of using log-linear models for capital market research in accounting.

Keywords: *Fundamentals, Log-Linear Models, Value Relevance*.

Data Availability: Data used are available from public sources identified in the study.

***JEL* codes:** *C10, C46, M41*.

1 Introduction

Numerous papers have examined the empirical relation between stock market values and accounting numbers to assess the 'value relevance' of the latter for the former. Value relevance studies are common, see for example Holthausen & Watts (2001); Core, Guay & Van Buskirk (2003); Oswald (2008); Song, Thomas & Yi (2010); Balachandran & Mohanram (2011); Yu (2013) and Barth, Li & McClure (2017). Despite this, they are not uncontroversial, with reservations being expressed about the validity and reliability of estimated accounting response coefficients as in, for instance, Barth, Beaver & Landsman (2001) and Holthausen & Watts (2001).

An important problem regarding value relevance studies is the functional form of the models employed to estimate the market value response coefficients of accounting variables. These models produce coefficient estimates that are hard to interpret, exhibit great volatility, and change from study to study. For example, Barth (1994) reports a value of 0.79 for the book value coefficient from a regression model of per-share market values on accounting variables. Using similar models, Francis & Schipper (1999) report an average value of 25 (6.70) for the book value (earnings) coefficient; and Zeng, Lee & Zhang (2016) report an average value of 0.0421 (5.9509) for the book value (earnings) coefficient. Aledo Martínez, García Lara, González Pérez & Grambovas (2020), in an overview of value relevance studies, show that coefficients diverge widely across model specifications. Such apparently random variation poses an obvious problem when it comes to replicating the results of previous studies and testing theoretical propositions about the nature of the market-accounting relationship.

This paper shows that a plausible statistical specification for models to validly and reliably test theories of the market-accounting relation is log-linear. The response coefficients produced by this specification are elasticities that measure the association of proportional changes in market values with proportional changes in accounting values. This way of measuring changes in variables is traditionally and widely accepted in the economics and finance literatures as an appropriate way to analyse and test theories, e.g. Cobb & Douglas (1928). It is worth considering, therefore, if the approach might benefit fundamental analysis of the market-accounting relation.

In the log-linear regression model, the constant term is a scaling parameter, closely related to the market to book ratio, as the underlying multiplicative form of the model reveals. This immunises the measurement of the response coefficients, the elasticities, from the effects of changes in scale and negates a problem that has been the subject of an ongoing debate for a number of years, see, for example (Barth & Kallapur, 1996). The elasticities reveal more clearly than the response coefficients used in most prior research, a close and consistent association between market and accounting values over time. For instance, changes in the book value of net assets on average explain in excess of 95 percent of changes in market values, in proportional terms, of Compustat firms over the 50-year sample period from 1971 to 2020. Moreover, the properties of the model imply that the elasticities on individual components of capital, earnings and dividends, sum to the overall elasticity on the book value of net assets, to a good approximation. This allows us to gauge the relative contribution of proportional changes in earnings, dividends and capital to proportional changes in market value, rather than restricting analysis to signs and the direction of change of market values compared to changes in book. By this means, for example, we find that, of the 95 percent change in market value associated with changes in the book value of net assets, changes in the value of capital contributed on average about 55 percent to changes in market values, earnings about 30 percent and dividends 10 percent.

The parameters of our model vary over time, and we measure their association with average annual market growth rates and the variance of those growth rates, the latter being interpreted as an indicator of economic uncertainty. We see that the pattern of movement in the elasticities is associated with underlying events occurring in the macroeconomy. Consequently, we apply the estimated parameters to analyse several issues central to the theoretical understanding of accounting information in equity valuation, these being the sufficiency or 'value relevance' of financial statements for market values of firms, the 'dollar-for-dollar' proposition and dividend irrelevancy, the interpretation of the market to book ratio as an indicator of growth and its uncertainty and evidence for the existence of an abandonment option in market valuation. We argue that the use of the log-linear model to estimate the parameters of the market-accounting relation brings a clarity of interpretation to fundamental analysis that is otherwise absent.

We discuss these points and others associated with them in the paper. In Section 2 we review relevant prior research and in Section 3 we describe our theoretical approach and methods relating to the way we measure the variables. Section 4 contains the main results from estimating our models and in Section 5 we discuss the implications of the estimates for the propositions that have been entertained in the literature, mentioned above. Section 6 concludes.

2 Prior research

The predominant theory in the fundamentals literature in accounting, residual income, is due to Ohlson (1995) and Penman (1998). It is founded upon discounting a form of expected future earnings, using an assumption of 'clean surplus earnings' to link the theory to the Gordon dividend model of market value (Gordon, 1962; Miller & Modigliani, 1961; Brennan, 1971). This thinking about how market values are related to information in financial statements is extended in Burgstahler & Dichev (1997) by adding a second 'abandonment option' component to the valuation model, based on an application of option theory (Berger, Ofek & Swary, 1996). Empirical research relating to fundamental analysis of the market-accounting relation in general produces mixed results, different interpretations, different methods and different focuses, e.g. Dechow, Hutton & Sloan (1999), Jiang & Lee (2005) and Bartram & Grinblatt (2018).

Tests of theories relating to fundamental analysis are usually formulated using an additive-linear regression model (e.g. Burgstahler & Dichev (1997); Barth, Beaver & Landsman (1998); Song et al. (2010); Balachandran & Mohanram (2011); Barth et al. (2017)). In a cross-section of data, this model has the form:

$$M_t \quad = \quad a_t + \textstyle\sum_i b_{i,t} A_{i,t} + \epsilon_t \qquad (1)$$

where a_t and $b_{i,t}$ are constant parameters, $A_{i,t}$ is a list of accounting and other variables and ϵ_t is a normally distributed error term. Reports of empirical tests make it difficult to interpret the parameter estimates that this model produces, especially the response coefficients (e.g. Barth & Kallapur (1996); Easton (1998); Barth & Clinch (2009)) as noted in the introduction. A commonly adopted practice to overcome this problem is to 'deflate' the model variables by the same variables on both sides of the regression equation e.g. Burgstahler & Dichev (1997). The use of opening market values as a deflator is common following (Christie, 1987). However, deflation produces many outliers, unexpected magnitudes for estimates of the response coefficients and additionally complicates statistical inferences in other ways (Easton & Sommers, 2003; Barth & Clinch, 2009; Powell, Shi, Smith & Whaley, 2009). A consequence of this is the great difficulty it engenders in attempts to replicate results out of sample, arguably an important feature of a useful theory.

The problems that result from trying to adapt Model (1) to produce parameters that make sense is illustrated by the distinction between 'levels' and 'change' or 'returns' regressions sometimes referred to in the literature (Ali & Zarowin, 1992; Easton & Harris, 1991). If (1) is a valid 'levels' description of the market-accounting relation, estimates of its response coefficients should be similar to the corresponding parameters estimated by first differencing the variables in $\Delta M_t = \sum_i b_i \Delta A_i$. This is not the case, however, see e.g. Penman & Yehuda (2009); Falta & Willett (2013).

Reported findings, particularly the 'scale' problem identified by Barth & Kallapur (1996), where parameter estimates vary widely and apparently unpredictably when the size of the independent variables change, suggest that the estimation model in (1) is statistically misspecified. This is important because, if an estimating model is misspecified, no estimation technique, regardless of how sophisticated and ingenious it may be, can cure the lack of validity and the unreliability of the estimates it produces (Davidson & MacKinnon, 1993).

The two main sources of misspecification of regression models are their functional form and residual characteristics. In particular, it is important, when using ordinary least squares and other similar forms of estimation, that the functional form assumed is either linear or capable of being made linear by some transformation of the data and that the residuals are normally distributed. Linearity in these circumstances concerns the validity of the model as a description of the underlying reality of the relationship between the variables in the regression. Normality concerns the reliability of the statistical inferences made from the sample data.

With regard to linearity there are mathematical reasons why (1) is best modelled as log-linear, not additive-linear. The argument supporting this proposition originates in the psychology literature (Luce, 1959), which in turn depends on the theory of functional equations (Cauchy (1821), Aczél (1966)). The gist of the mathematics applied to the market-accounting relation is that when variables are measured on a ratio scale, say in monetary units, as are both market and accounting variables, then, in the case of a single independent accounting variable, constants κ and β exist such that

$$M = \kappa |A|^{\beta} \tag{2}$$

The variable $|A|$ could be replaced by an arbitrarily complicated, homogeneous function $|f(kx)| = k\,|f(x)|$, including, for example, $f(x) = \sum_i x_i$ where each x_i is measured on a monetary scale. However, it is not then usually possible to relate β to individual elements of the sum unless $\beta = 1$. To surmount this problem, the single variable model (2) can be extended to more than one variable, when it has a multiplicative form:

$$M = \nu \prod_i |A|_i^{\beta_i} \tag{3}$$

where ν and the β_i are constants. In this case the response coefficients, β_i, can be identified with individual variables. Transforming the variables in (3) to logs gives the form required to apply linear statistical theory to provide valid parameter estimates.

With regard to reliability, Model (3) is equivalent in form to the Cobb-Douglas function, well known in different contexts in the economics literature (Cobb & Douglas, 1928). The extensive application of the log transformation in theoretical work in economics as well as empirical research using forms similar to the Cobb-Douglas is based on the evident reliability and stability of estimates of their parameters, and their ease of interpretation. This is particularly true of the elasticities, the βs in the above models, that measure proportional changes in the dependent variable associated with proportional changes in the independent variables. The reliability of the estimates from applying ordinary least squares and other statistical methods to the log-linear transformation of Model (2) is due to the empirical fact that the distribution of economic variables, which are invariably generated by exponential growth processes, is close to being lognormal (Aitchison & Brown, 1957).[1] Consequently, estimation based on models of the

[1]Evidence of the lognormality of the market and accounting variables used in this paper is contained in the skewness and

type shown above should provide reliable as well as valid estimates with which to test theories of market fundamentals.

An econometric issue relevant to the results reported in this paper is the distinction between short and long-run 'effects', as we focus on the latter, not the former (Hendry, 1995). Long-run parameters reflect relationships between economic variables that exist in equilibrium. Short-run parameters, in contrast, reflect dis-equilibrium relationships. In the single variable multiplicative Model (5), for instance, κ represents the long-run scale factor (roughly akin to the market-book ratio) and β the long-run elasticity, showing the estimated association between proportional changes in M_t relative to those in A_t that exist in equilibrium. To measure the dis-equilibrium effects of short-run changes, lags in the variables would need to be introduced. These are necessary to make one-year ahead forecasting possible but we do not address that issue here. Instead, we focus on estimating the long-run equilibrium parameters based upon models for which there is plenty of accumulated evidence showing the strength of the relation between market and accounting values (Ball & Brown, 1968; Easton, Harris & Ohlson, 1992).

3 Theory, models and data

In this section we use measurement models based on the multiplicative principles outlined in the previous section, to estimate parameters that empirically test four propositions underlying much of the thinking about the market-accounting relation published in the literature. The first, most general of these propositions, which is relevant also to any theory of the value relevance of accounting numbers, is that the book value of net assets is insufficient for market value, in the sense that market value cannot be explained by accounting numbers without recourse to other sources of information.[2] The second, more specific proposition, often associated with the residual income framework, is that dividends reduce market value 'dollar-for-dollar'. The third proposition is that the market to book ratio is a 'proxy' for growth. The fourth proposition, on occasion used to explain the relative behaviour of the book value and earnings response coefficients over time in value relevance and other empirical studies, is the existence of an abandonment option.

In testing hypotheses relating to the propositions above, we use only variables that are directly observable, without theory dependent or other adjustments for the likes of discount rates and time series patterns of residuals, to provide ease of replication and interpretation of results. Thus, market values are obtained by simply multiplying shares outstanding and price per share at the close of business. Ac-

kurtosis statistics reported in Table 2, later in the paper.

[2]This is implicit in the theoretical specification of residual income theory given by Ohlson (1995; p669), with the assumption of a significant 'other information' variable V.

counting values are as stated in publicly accessible financial reports at the same date. In the parameter estimates we derive from the models, no outliers or unusual observations are discarded.[3]

The models based on Models (2) and (3) relate market values and, through the elasticities, the *growth* in those market values, M_t/M_{t-1}, to the fundamental accounting variables contained in the equations. We interpret the variance of the growth in market value in each year as a measure of *uncertainty* in the economic environment.

Accounting variables

In order to estimate models based on (3) we identify components of book value other than opening book value, B_t, and earnings, E_t, as follows:

$$B_t = B_{t-1} + E_t + D_t + C_t + O_t \tag{4}$$

D and C are common and preference dividends respectively, and O is an aggregate of other elements that cause changes in accounting equity. Thus the set of accounting variables in the statistical models we estimate is $A_i = \{B_{t-1}, E_t, D_t, C_t, O_t\}$, where O is a constructed variable that imparts a 'clean surplus' property to the models. D and C are invariably negative and the other variables may be so.

Main models

Consequently, the cross-section models we use to test the market-accounting relation are, for the single variable model based on closing book value:

$$M_t = \kappa_t |B|_t^{\beta_t} \omega_t \tag{5}$$

and, for the multi-variable model where closing book value is dis-aggregated according to Model (4):

$$M_t = \nu_t |B|_{t-1}^{\beta_{B,t-1}} |E|_t^{\beta_{E,t}} |D|_t^{\beta_{D,t}} |C|_t^{\beta_{C,t}} |O|_t^{\beta_{O,t}} \omega_t \tag{6}$$

The ω terms in both the above models are exogenous residuals with a lognormal distribution. Each β in (6) is an elasticity of market value with respect to the accounting variable with which it is associated, showing the proportional change in market value associated with a proportional change in the relevant variable. The β in (5) is the overall market elasticity with respect to the book value of net assets.

[3]To avoid endogeneity issues in parameter estimation we use market values three months after the date of the financial statements containing the relevant accounting data.

Given the identity in (4), if the accounting book ratios, $\frac{A_i}{B_{t-1}}$, behave almost the same as constants, it can be shown that $\sum_i \beta_i \approx \beta$.[4] This is the case with the Compustat data set we use for estimation, evidenced by the very small standard errors of these ratios.[5] A value of β_t equal to 1 therefore shows that the accounting values in (6) are 'sufficient' to explain market returns, without the need to introduce non-accounting variables in the model. In multiplicative models κ and ν act as scale factors in the relation between market and accounting values. This means a value of β_t close to 1 does not imply a market to book value ratio close to 1, as it may be so interpreted in some applications of the additive-linear model. The market to book ratio is close to κ under these circumstances.

Estimation

The parameters of Models (5) and (6) are estimated by basic ordinary least squares using a log-linear model. We do not treat the data for outliers and all data points are used for estimation. This makes replication of our results straightforward. The two models are transformed to logs as follows:

$$Ln(M_t) = Ln(\kappa_t) + \beta_t Ln(|B|_t) + \epsilon_t \tag{7}$$

and

$$Ln(M_t) = Ln(\nu_t) + \beta_{B,t-1} Ln(|B|_{t-1}) + \beta_{E,t} Ln(|E|_t|) + \beta_{D,t} Ln(|D|_t) + \beta_{C,t} Ln(|C|_t) + \beta_{O,t} Ln(|O|_t) + \epsilon_t \tag{8}$$

where $\epsilon = Ln(\omega)$ is a normally distributed residual. The strongly lognormal distribution of all the model variables and the linear form imparted to the multiplicative models by the log transformation gives the residuals in the transformed models a close to normal form. This results in parameter estimates and inferential statistics that are more reliable than those based on a linear additive model.

Absolute values

As negative values of variables have no logarithm, the estimates of the effect of changes in accounting variables on market values in the form of elasticities are based upon the absolute magnitudes of the model variables, without regard to their sign. When estimation is approached in this way, an increase in the magnitude of book value or earnings is expected to have a positive effect, i.e. a positive elasticity, with respect to market value. This is invariably the case. In contrast, an increase in the magnitude of a loss is expected to be associated with a negative magnitude of change or, at least, a much reduced and

[4]Proof of this proposition is available from the authors on request.

[5]See Table 2.

usually smaller positive magnitude of change in market value, i.e. a negative or small positive elasticity. This is usually what occurs.

When data with negative and positive values are pooled, as with data containing some observations with positive earnings and some with losses, or negative earnings, the resulting estimates of the market elasticities on earnings are a weighted average of the generally more positive elasticities on positive earnings and the more negative market elasticities on the losses. The matrix form of the weights for this averaging process is calculated by the pooling of matrices rules and is given by $(\Sigma_i X_i' X_i)^{-1} \Sigma_i X_i' X_i \beta_i$ where i denotes the partition associated with a particular combination of signs on the accounting variables. Its application to the elasticities estimated with the separate positive and negative parts of any earnings data, for example, produces exactly the same elasticity as would be obtained from estimating that elasticity for the positive and negative earnings data pooled into a single sample. Although this matrix formula is more complicated than a simple weighted average of elasticities based upon the number of positive and negative observations, that calculation typically does explain most of the averaging effect. Using absolute values, or magnitudes, of the accounting variables in Models (7) and (8) therefore allows us to take logs of the data and adopt an efficient strategy to estimation.

Hypotheses

Four hypotheses are listed that address the four propositions noted at the beginning of the section. We judge the strength of the hypotheses by the p values of the relevant parameters.

Hypothesis 1 addresses the question of whether the accounting variables in the estimation models explain the variation in market value and its growth in the long-run without the need to appeal to other information. Formally stated the hypothesis is,

Hypothesis 1. *Either the time average of β in model (7) or the time average of $\sum_i \beta_i$ for the βs in (8) over the sample period is close to 1.*

If this hypothesis is not supported we reject the proposition that accounting information is sufficient for market values.

The second hypothesis refers to the second proposition, that the declaration of dividends reduces market value, dollar for dollar. This hypothesis states that the market value of equity is inversely related to dividends, implying that,

Hypothesis 2. *H_2: The market elasticity of common dividends is negative.*

If this hypothesis is not supported, we reject the 'dollar-for-dollar' proposition regarding dividends.

For the third and fourth hypotheses we assume that investor optimism is directly related to current levels of the growth in market value and indirectly related to financial market uncertainty, measured by the variance of those growth rates. Pessimism is characterised accordingly in the converse situation.

Residual income theory implies investor optimism (pessimism) is reflected in higher (lower) earnings expectations and higher (lower) market values. The market value of equity adjusts more rapidly than book values to changing circumstances. Consequently, we reason that equities should be valued more highly relative to book value by investors in periods of greater optimism than in periods of greater pessimism. As κ approximates the market to book ratio when β is close to 1, in the long-run equilibrium context assumed in the estimation of our model parameters we hypothesise that:

Hypothesis 3a. *κ is positively correlated with the average proportional growth rate in market value and,*

Hypothesis 3b. *κ is negatively correlated with the variance of the proportional growth rate in market value.*

Hypothesis 3a reflects the accounting intuition that a high market to book ratio signals un-booked goodwill. Hypothesis 3b implies that the book to market ratio is directly related to uncertainty in market growth rates. The third hypothesis therefore relates to the question whether the market to book ratio acts a 'proxy' for growth and uncertainty. The import of empirical results relating to this question in prior research is unclear.

The last hypothesis concerns the abandonment option in equity valuation. It is split into two sub-hypotheses describing the way we expect the elasticities in Model (8) to behave if the abandonment option is present in valuing equity. We anticipate that an abandonment option is less likely to play a part in equity valuation when investors are optimistic and more likely to be valued when investors are pessimistic. Two hypotheses are therefore stated regarding the following elasticities in (8),

Hypothesis 4a. *The market elasticity of income β_E is positively correlated over the sample period with market growth rates and negatively correlated with the variance of market growth rates.*

Hypothesis 4b. *The market elasticity of opening book value $\beta_{B_{t-1}}$ is negatively correlated with market growth rates and positively correlated with the variance of market growth rates.*

Hypothesis 4a and hypothesis 4b reflect the general interpretation of the effect of an abandonment option on equity valuation envisaged in Barth et al. (1998) rather than the more specific switching effect at low levels of book value discussed in Burgstahler & Dichev (1997). If both hypothesis 4a and hypothesis 4b are supported, we do not reject this general form of the abandonment option hypothesis.

In the next section we report the results of estimating the models described in this section in the context of these hypotheses.

4 Results

Descriptive statistics

Table 2 provides summary statistics describing the data set, which comprises observations from Compustat over the period 1971 to 2020.[6] The sample firms are U.S. firms with non-zero net income, non-zero revenue, and non-zero book value.[7] Market values are from the end of the first quarter after year-end. The resulting sample contains 198,593 firm-year observations.

[Table 2 about here]

The second column of Table 2 shows how these observations are distributed among the positive, zero and negative values of each accounting variable. There are 6,946 negative book value observations constituting 3.5 percent of the total. There are 55,791 loss observations being 28 percent of the total. There are more positive other income observations (130,690, 66 percent of the non-zero observations) than negative observations (60,428; 33 percent). Dividends were paid in just under one-half of the cases (92,129; 46 percent) and not paid in the remaining 106,464. The arithmetic mean ratios are shown in the third column of the bottom rows of Table 2. For instance, the market to book ratio is 6.24. The mean values of the logged ratios in column eight, e.g. m, $r_{0..5}$ are exponentiated for comparison with the unlogged ratio. The standard errors of these ratios are close to zero. When the latter are calculated for each year, there is little variation over the years, showing that they behave close to being constant. There is a reduction in skewness and kurtosis in the logged data, indicating an attenuation to the Gaussian distribution.

Parameter estimates

Table 3 shows parameter estimates for the long-run relation between the market and accounting values from Model (8) for each year and pooled. Those for the single variable model in closing book value (i.e. $M = \kappa|B|^{\beta}$) are shown in columns 2 to 4. The corresponding estimates for the multivariable model (i.e. $M = \nu \prod_i |A_i|^{\beta_i}$) are shown in columns 5 to 11, where column 11 sums the coefficients on logged absolute values of $B_{t-1}, E_t, D_t, C_t, O_t$.

[Table 3 about here]

The rows of the upper section of Table 3 show estimates for each year of the sample period. The bottom section of the table shows estimates based on pooled data and average values for the cross-sections. The significance of nearly all the parameters is very high, with some exceptions where a parameter estimate is close to zero. The t-statistics are therefore not shown. This means that the individual yearly parameter estimates are very precise and that differences in these over time reliably reflect changes in those

[6] A listing of the variables used in modelling with their sources is given in Table 1.

[7] Variables are defined in Table 1.

parameters.

Figure 1 summarizes the evolution in the parameter estimates from the log-linear model.

[Figure 1 about here]

With Table 3, this figure shows that, on average over the sample period, 93 percent of long-run market returns are explained by changes in closing book value. The R^2 shows that closing book value explains on average 81 percent of the variation in market value. This demonstrates a very close long-run relationship between market and book values and is consistent with previous findings (Easton & Harris, 1991; Easton et al., 1992).

Columns 3 and 11 of Table 3 respectively show that β and the sum of the β coefficients is consistently close to 1. The average of the yearly βs is 93 percent and β has a pooled value of 96 percent. The average of the sum of the βs is 96 percent with a pooled value of 99 percent. The correlation between β and $\sum_i \beta_i$ is 79 percent, indicating again that the ratio condition for their equality is usually satisfied to a good approximation, as explained in Section 3 and illustrated by the statistics in Table 2. However, the standard errors for the βs are typically very small, even across the annual data, and the apparently quite small differences lead to rejection of the sufficiency hypotheses H_1a and H_1b at the usual levels of statistical significance. There may, therefore, be some value in adding non-financial statement information to explanatory models of the long-run market-accounting relation. It is not clear from the figures shown, however, if the benefit of obtaining such additional information would exceed its cost in non-forecasting applications.

It is shown in Table 3 that common dividends have statistically significant positive elasticities in each year of the sample period, whereas preference dividends are typically negative. When zero dividend observations are excluded, the elasticity on common dividends almost doubles to higher positive values. This shows the declaration of common dividends does not reduce market value, possibly because of a signalling role that positively affects market returns. The evidence therefore does not support H_2 and we reject the dollar-for-dollar hypothesis.

The close association of the scale factors in the multiplicative models, κ and ν, with the market to book ratio, is shown in the panels in Figure 2. Table 4 displays the correlations between κ and selected model parameters over the sample period. κ, in the top row of the table, has positive correlations with market returns (26 percent with a p value of 0.04) and their variance (23 percent with a p value of 0.06) shown in the final two columns. Therefore there is some support for H_3a of a direct association of κ and the market to book ratio with market growth rates but none for H_3b of a negative association of κ with uncertainty measured by the variance of market growth rates. In fact, the direction of association with the uncertainty metric appears to be in the opposite, positive, direction. We investigate this point further in the following Section.

[Figure 2 and Table 4 about here]

A strong inverse relationship between the elasticity of book values and earnings is evident from the time sequences shown in Table 3 columns 6 and 7 and displayed in Figure 1. From Table 4, column 3, row 3, the negative correlation between these two parameters is 85 percent and highly significant.[8] The same Table shows that the market elasticity on opening book value has a negative correlation of 30 percent with the market growth rate and a p probability of 0.02, as shown in column 7, rows 3 and 4 respectively. It also has a positive correlation of 51 percent with the variance of the growth rate, with a highly significant p value, as shown in the same rows of the subsequent adjacent column. The market elasticity of net income has, in comparison, a positive correlation of 23 percent with the growth rate and a p value of 0.06 (column 7, rows 5 and 6) and a highly significant negative correlation of 61 percent with the variance of the growth rate (column 8, rows 5 and 6). We therefore do not reject either of hypotheses H_4a and H_4b and conclude that the relative time sequence patterns of the elasticities on opening book value and earnings support the proposition that an abandonment option plays a part in the market valuation of equity.

We checked the correlations relevant to the third and fourth hypotheses against a variety of different ways of calculating market growth. In every case, although the correlations were not always as strong as shown here, the pattern of signs described above was repeated, indicating that these results are robust to different measures of the growth in market values.

The strength of the results reported above, the correspondence of the evolution of the various model coefficients with macro-economic events, their relation to to the underlying accounting concepts of income and capital, their import for our understanding of the value relevance of dividends and the way they reflect financial market growth and uncertainty are discussed in the next Section.

5 Discussion

Our criteria for assessing the strength of the test results reported in Section 4 is whether they are likely to be replicated using similar data from different time periods. We relate the discussion to the basic economic concepts of capital and income by estimating the following model,

$$Ln(M_t) = Ln(\eta_t) + \beta_{I,t} Ln(|I|_t) + \beta_{F,t} Ln(|F|_t) + \epsilon_t \tag{9}$$

where I is investment, being the change in capital, or the stock of net assets available to the firm; and F_t is comprehensive income in period t. $I_t = B_t - B_{t-1} - F_t$. B_t and B_{t-1} are as previously defined. The variables in this model are thus related to those in Model (8) in that I_t includes opening book value, common

[8] The column numbers referenced for Table 4 begin with the first column of correlation statistics

dividends, preference dividends and other transactions with owners after excluding other comprehensive income.

5.1 Sufficiency (Hypothesis 1)

Estimates of the parameters in Model (9) are shown in Table 5, their sequence plots in Figure 3 and correlations of the parameters with growth rates and the variance of growth rates in Table 6.

[Table 5, Figure 3 and Table 6 about here]

As with the sequence plots in Figure 1, the sequence plots in Figure 3 display a clear relationship to macroeconomic events taking place over the sample period, especially the two major financial upheavals that occurred at the end of the millennium and in the global financial crisis. The average sum of the β_is is now 99.96 percent (column 4, in the row labelled 'Pooled'). The sum has a standard error of 0.0061 but is still significantly different from 1 at the 5 percent level, leaving the formal conclusion stated in Section 4, regarding H_1, unaltered. However, the point concerning whether it is worth worrying about other information that may fill this gap holds with even more force than before. On the basis of this evidence, we conclude that the information contained in the financial statements of Compustat firms over the period 1971-2020 is sufficient to *explain* the long-run or fundamental market value of equity in those firms, without recourse to information not contained in the financial statements.[9]

The evidence in Table 3 and Table 5 supports the contention that, if market value relevant information in non-accounting data is contained in the fundamental value of equity, then, in the case of Compustat firms over the period from 1971 to 2020, it is also nearly all contained in contemporaneous accounting data. The parameter estimates, their relation to each other in the model and the inferential statistics, change little when the model is re-estimated for large samples of Compustat firms over periods ending each year from 2009 to 2020. Consequently, given the variable definitions in the models and the inclusion of all firms data without consideration of industry type or outliers, we believe that the ability to replicate these models is high in large cross sections of firms. For all practical purposes, therefore, financial statements represent a sufficient repository of relevant information for valuing shares in the long run.

5.2 Dividend irrelevance (Hypothesis 2)

Our rejection of the 'dollar-for-dollar' proposition in H_2 is based on the elasticity of dividends being positive. As already noted with reference to Table 3 in the previous section, this is true of every year in the sample data. This point is further reinforced by the dividend elasticities shown in Table 7. Here

[9]The sufficiency of accounting information for *forecasting* as opposed to explaining market values is not considered in this paper and is an entirely different matter. Forecasting market value using accounting data requires forecasting the latter and, by definition, that in turn requires information from outside the financial statements.

we use the partitioning principles outlined in Section 3 to show the elasticity on common dividends and preference dividends, pooled for the entire sample from 1971 to 2020, under different circumstances. For example, the top row labelled 'Partition 1' shows β_D and β_C, being the market value elasticities with respect to common dividends and preference dividends, respectively, as having values of 0.22 and −0.03. These values are calculated for observations in which all the model variables except 'transactions with owners' are positive, as indicated by the signs in columns 2-6. In Partition 13 when both earnings and transactions with owners are negative, these elasticities change to 0.31 and −0.02, respectively. Looking down those two columns (7 and 8) it can be seen again that the elasticity on common dividends is always positive, whereas the elasticity on preference dividends is sometimes negative. It is noticeable also that the elasticity on preference dividends is only greater than positive ten percent when common dividends are not paid (Partitions 19 and 21).

[Table 7 about here]

The rejection of the dollar-for-dollar proposition does not necessarily negate the insight provided by the Miller-Modigliani dividend irrelevancy principle. Table 4 shows that the correlation between the market elasticity on opening book value, $\beta_{B_{t-1}}$, and the elasticity on common dividends, β_D, is positive, while the correlation between β_D and the market elasticity on earnings, β_E, is negative, which suggests the market reaction to proportional changes in dividends is more similar to the reaction of the market to capital movements than to changes in earnings.

This point about dividend irrelevancy is illustrated in Figure 4. The figure displays the market elasticities of capital and income from Figure 3 compared to those of opening book value, earnings and dividends shown in Figure 1. Merging the definitions of the accounting variables in the way indicated in the formulation of Model (9) means that the estimation of the elasticities by ordinary least squares attributes the variance in market value explained by dividends to the remaining variables in the model, capital and income. This makes the estimates of both the capital and income variables biased from a strictly statistical viewpoint but, in this case, it shows the variation in market value explained by dividends in (8) being attributed to the elasticity on capital rather than the elasticity on income in (9). The result is that the elasticity on capital displays a time series pattern in Figure 3 similar to that of the elasticity on closing book value in Figure 1. Futhermore, the profile of the elasticity on capital has shifted upward in distance similar to the elasticity on dividends, whereas the elasticity on comprehensive income is virtually unchanged from the elasticity on earnings.

[Figure 4 about here]

This suggests that market participants react to changes in dividends in a way that is similar to the way they react to changes in capital. In this respect the time series behaviour of the elasticities in the figure imply a form of dividend irrelevancy property for income, in that the impact of changes in dividends on market value is more similar to the impact of changes in capital than to changes in earnings and income, as reflected in the negative correlations between earnings and dividends in Table 4. Although our results do not support the dollar-for-dollar property, therefore, they are consistent with a principle akin to that implied by dividend irrelevancy.

5.3 Market to Book ratio (Hypothesis 3)

The tests of H_3 and H_4 reported in Section 4 depend upon the correlation of κ and the elasticities on the investment and income variables with market growth rates and their variance. These are based upon much smaller sample sizes than are the tests of H_1 and H_2. For the tests to be reliable indicators of the hypothetical relationships, the correlations need to be stable over time, so that the outcome of the tests are not dependent on the sample period in which the tests are applied and would be replicated if the sample period was changed. To assess if this is the case with our data, we construct a stability index for each test. The index is constructed using principles similar to the bootstrap, with 5, 10, 15 and 20 year rolling windows for samples of the data, measuring the relative frequency of positive and negative correlations in each window length and aggregating the results across the windows. The index is then applied to measure the relative frequency with which the entire sample of data returns a consistent sign on the correlation between the variables of interest. For example, a 100 percent score on the index indicates all the different time period windows return a correlation coefficients with a sign that accords with the hypothesised correlation between the variables concerned.

Calculating the stability index in the way described, produces a score for H_3a of 87 percent. This is based on the correlations between κ and market returns being positive in 131 samples out of a total of 150 samples. The index provides a measure of the level of confidence we have in our earlier non-rejection of H_3a, that κ and, by implication, the market to book ratio, are positively associated with the growth rate of market values.

By contrast, the same stability index calculation returns a value of only 33 percent when applied to to the test results for H_3b. This hypothesis, which asserts a negative correlation between κ and the variance of market returns, was earlier rejected. Consequently the stability score indicates a low level of confidence, or lack of confidence perhaps, in the rejection of H_3b.

The underlying reason for the differing levels of confidence in the test results relating to H_3a and H_3b can be seen in Figure 5. This shows comparative plots of the correlations between κ and market growth rates on the one hand and between κ and the variance of those growth rates on the other, based on the 20-year rolling windows between 1971 and 2020. There are 30 of these and they provide information similar to moving averages.

[Figure 5 about here]

In the case of H_3a the rolling twenty-year windows show correlations from 1972-1991 through to 2001 - 2020 that are nearly all positive, corresponding to the correlation between κ and market returns over the entire sample period from 1972 to 2020. This fact is reflected in the relatively high stability score noted above. In contrast, with regard to H_3b, the correlations between κ and the variance of growth rates are not consistently in accord with the overall positive correlation shown for the complete sample period in Table 4. Up to 1999 the correlations between κ and the variance of growth rates are positive and then are noticeably negative, becoming less so in the final two years of observations in 2019 and 2020. Moreover, when the length of the windows for calculating correlations is reduced, a more erratic profile of the correlation coefficient emerges. It is this mixture of correlations that produces the low score on the stability index noted above and hence the low confidence in the results from testing H_3b.

On the basis of the visual evidence in Figure 5 and the stability score for H_3a it is reasonable to conclude that the predominant direction of association between κ and the growth rate is positive in the sample period, implying that the market to book ratio could be seen as a proxy for growth, confirming the results of Goranova, Dharwadkar & Brandes (2010); Lenox, Rockart & Lewin (2010). This proxy becomes stronger in the last forty years of the sample period, since 1981. By comparison, the increasing strength of a positive association between κ and growth corresponds to κ exhibiting an increasingly negative correlation with the variance in the growth rate, which we are characterising as an indicator of economic uncertainty. If H_3b is tested on 20 year windows of sample data over the last 40 years it is not rejected. Hence, in the later part of the sample period, there is evidence that κ is negatively related to uncertainty, implying that the book to market ratio during this period might also be seen as a proxy for uncertainty.

5.4 Abandonment option (Hypothesis 4)

H_4 focuses on testing the proposition that an abandonment option is present in the market valuation of equity.[10] As with H_3, for H_4 the test results can be assessed in terms of the stability index defined above, to give an indication of our level of confidence that results can be replicated in different time windows. In this case we have a joint condition, in that, to support the abandonment proposition, neither H_4a nor H_4b should be rejected, which is a stronger criterion. We therefore approach the construction of the index in two ways. First, we adopt the same approach described above with H_3. We refer to this approach as 'independent' since it takes each hypothetical relation between the different elasticities and the market variables separately, then aggregates them to give an overall index of replication. In the second, which we refer to as 'joint', we require the pattern on the signs of the correlations to be the same as that shown

[10] The results of testing the two hypotheses remain the same if the income and capital variables in Model (9) are substituted for earnings and opening book value, as can be seen from Table 6.

in Table 6. In this case, for each sample, the correlations must exhibit the signs between the variables shown in Table 8.

[Table 8 about here]

The scores on the stability index are also shown in the upper part of Table 8. The independence score is 84 percent, which is the relative frequency across all four windows of 5, 10, 15 and 20 years that the individual correlations between the model variables are in accord with the relevant hypothesis. The joint scores show the relative frequency with which correlations concur to the patterns shown in Table 8. In windows containing 5 years of data, the expected pattern occurs with a relative frequency of only 51 percent, barely different from chance. However, this rises monotonically as the window increases in length to a relative frequency for the 20-year moving window of 93 percent.

This demonstrates the increased consistency in the test results that are produced as the size of the sample period increases. As with H_3, the evolution of the time series of the correlations referred to in H_4 are displayed in Figure 6. It can be seen from these sequence plots that the pattern of signs on the correlation coefficients are almost always in the direction predicted. We take these results therefore, as providing a reasonable level of confidence in the stability of the tests of H_4 reported in Section 4 to conclude that, in our large sample of Compustat firms, over extended periods of time, the evidence is consistent with an abandonment option playing a part in market valuation.

[Figure 6 about here]

In formulating H_4 to reflect observations indicating the presence of abandonment options thinking in the behaviour of market values over time, we made assumptions consistent with the discounting of expected future earnings and residual income theory. This is therefore a very general characterisation of the effects of abandonment options on valuation. It is consistent with the implications of extensions to residual income theory that include the effects of abandonment options.

6 Conclusions

The log-linear model used to estimate the regression parameters in this paper are argued to be more valid and reliable than those produced by alternative specifications of the market-accounting relation. The validity of the specification is based upon the theory of functional equations and the reliability of estimates derived from it are due to the strongly lognormal behaviour of the variables. The resulting estimates consequently display stability between samples over time and are readily interpreted in terms of their economic significance and relationship to the broader economic environment.

The estimated models demonstrate, on the basis of cross-sections of annual data, that the information in financial statements is sufficient to explain nearly all of market value and changes in market value in the long-run. They allow us to deconstruct book value into the main financial aggregates of capital and income and see how the equity markets react to changes in those individual components over time.

Study of those patterns leads to a number of insights regarding different aspects of the market-accounting relation. It produces evidence that is inconsistent with the proposition that dividend payments reduce market value dollar-for-dollar. Instead we find a different kind of dividend irrelevancy effect in that the market response to proposed dividends, while invariably positive in their effect on market values, is similar to the market response to changes in capital, rather than to the market response to changes in earnings. We also find that the market to book value is generally positively associated with financial market growth but that its association with uncertainty in financial markets is sensitive to the period in which the association is measured. This may help to explain why it is difficult to interpret this ratio, or the book to market ratio, as a 'proxy for risk'. Our results do, however, show general support for the existence of an abandonment option in the valuation of market equity.

The estimation models described in this paper are straightforward to replicate. There are no theory dependent definitions of variables to complicate estimation or interpretation. The validity and reliability of the models with respect to their statistical properties, together with the large sample size, produces accurate estimates. All data is used in estimation without discarding outliers or subjecting them to special treatment.

The main provisos concerning our conclusions pertain to their scope and generality. With respect to scope, when we use the term 'sufficiency' we refer to sufficiency of accounting information in *explaining* market value, not in forecasting future market values. Forecasting future market values with accounting variables involves forecasting future accounting values and that comes from outside financial statements. With respect to generality, our results pertain to the association of accounting numbers with the relatively accessible variables of growth in market values and uncertainty in those growth rates. The results do not directly relate to net market returns, whereby market growth rates are linked to investor wealth and the associated concept of financial market risk. Consequently, we do not comment on the implications of our results in the context of the CAPM and arbitrage pricing theory.

References

Aczél, J. (1966). 'Lectures on Functional Equations and Their Applications'. In 'Mathematics in Science and Engineering', (Academic Press, New York London).

Aitchison, J. & Brown, J. A. C. (1957). *The Lognormal Distribution with Special Reference to Its Uses in Economics* (Cambridge University Press, London, UK).

Aledo Martínez, J., García Lara, J. M., González Pérez, M. T. & Grambovas, C. A. (2020). 'An empirical assessment of proposed solutions for resolving scale problems in value relevance accounting research'. *Accounting & Finance*, vol. 60, no. 4, pp. 3905–3933.

Ali, A. & Zarowin, P. (1992). 'Permanent versus transitory components of annual earnings and estimation error in earnings response coefficients'. *Journal of Accounting and Economics*, vol. 15, no. 2–3, pp. 249–264.

Balachandran, S. & Mohanram, P. (2011). 'Is the decline in the value relevance of accounting driven by increased conservatism?' *Review of Accounting Studies*, vol. 16, no. 2, pp. 272–301.

Ball, R. & Brown, P. (1968). 'An Empirical Evaluation of Accounting Income Numbers'. *Journal of Accounting Research*, vol. 6, no. Autumn, pp. 159–178.

Barth, M. E. (1994). 'Fair value accounting: Evidence from investment securities and the market valuation of banks'. *The Accounting Review*, vol. 69, pp. 1–25.

Barth, M. E., Beaver, W. H. & Landsman, W. R. (1998). 'Relative valuation roles of equity book value and net income as a function of financial health'. *Journal of Accounting and Economics*, vol. 25, no. 1, pp. 1–34.

——— (2001). 'The relevance of the value relevance literature for financial accounting standard setting: Another view'. *Journal of Accounting and Economics*, vol. 31, pp. 77–104.

Barth, M. E. & Clinch, G. (2009). 'Scale effects in capital markets-based accounting research'. *Journal of Business Finance & Accounting*, vol. 36, no. 3-4, pp. 253–288.

Barth, M. E. & Kallapur, S. (1996). 'The valuation roles of equity book value and net income as a function of financial health'. *Contemporary Accounting Research*, vol. 13, pp. 527–567.

Barth, M. E., Li, K. & McClure, C. G. (2017). 'Evolution in Value Relevance of Accounting Information'. *SSRN Electronic Journal*. *https://ssrn.com/abstract=2933197*.

Bartram, S. M. & Grinblatt, M. (2018). 'Agnostic fundamental analysis works'. *Journal of Financial Economics*, vol. 128, no. 1, pp. 125–147.

Berger, P., Ofek, E. & Swary, I. (1996). 'Investor valuation of the abandonment option'. *Journal of Financial Economics*, vol. 42, no. 42, pp. 1–31.

Brennan, M. (1971). 'A Note on Dividend Irrelevance and the Gordon Valuation Model'. *The Journal of Finance*, vol. 26, no. 5, pp. 1115–1121.

Burgstahler, D. & Dichev, I. (1997). 'Earnings, Adaptions and Equity Value'. *The Accounting Review*, vol. 72, no. 2, pp. 187–215.

Cauchy, A.-L. (1821). *Cours d'analyse de l'École royale polytechnique*, vol. 19 (École polytechnique France).

Christie, A. A. (1987). 'On Cross-sectional Analysis in Accounting Research'. *Journal of Accounting and Economics*, vol. 9, no. 3, pp. 231–258.

Cobb, C. W. & Douglas, P. H. (1928). 'A Theory of Production'. *American Economic Review*, vol. 18, no. 1, pp. 139–165.

Core, J. E., Guay, W. R. & Van Buskirk, A. (2003). 'Market valuations in the New Economy: An investigation of what has changed'. *Journal of Accounting and Economics*, vol. 34, no. 1-3, pp. 43–67.

Davidson, R. & MacKinnon, J. G. (1993). *Estimation and Inference in Econometrics* (Oxford University Press).

Dechow, P. M., Hutton, A. P. & Sloan, R. G. (1999). 'An Empirical Assessment of the Residual Income Valuation Model'. *Journal of Accounting and Economics*, vol. 26, no. 1–3, pp. 1–34.

Easton, P. D. (1998). 'Discussion of revalued financial, tangible, and intangible assets: association with share prices and non-market-based value estimates.' *Journal of Accounting Research*, vol. 36, no. Supplement, pp. 235–247.

Easton, P. D. & Harris, T. S. (1991). 'Earnings as an Explanatory Variable for Returns'. *Journal of Accounting Research*, vol. 29, no. 1, pp. 19–36.

Easton, P. D., Harris, T. S. & Ohlson, J. A. (1992). 'Aggregate Accounting Earnings can Explain most Security Returns'. *Journal of Accounting and Economics*, vol. 15, no. 2–3, pp. 119–142.

Easton, P. D. & Sommers, G. A. (2003). 'Scale and the Scale Effect in Market-Based Accounting'. *Journal of Business Finance & Accounting*, vol. 30, no. 1–2, pp. 25–55.

Falta, M. & Willett, R. (2013). 'The Impact of Exponential Growth Variables on Regression Models of the Market–Accounting Relation'. *Journal of Accounting, Auditing & Finance*, vol. 28, no. 3, pp. 243–272.

Francis, J. & Schipper, K. (1999). 'Have Financial Statements Lost Their Relevance?' *Journal of Accounting Research*, vol. 37, no. 2, pp. 319–352.

Goranova, M., Dharwadkar, R. & Brandes, P. (2010). 'Owners on both sides of the deal: mergers and acquisitions and overlapping institutional ownership'. *Strategic Management Journal*, vol. 31, no. 10, pp. 1114–1135.

Gordon, M. J. (1962). *The investment, financing, and valuation of the corporation* (Irwin).

Hendry, D. F. (1995). *Dynamic econometrics* (Oxford University Press).

Holthausen, B. & Watts, R. (2001). 'The Relevance of Value Relevance Literature of Financial Accounting Standard Setting'. *Journal of Accounting and Economics*, vol. 31, no. 1–3, pp. 3–75.

Jiang, X. & Lee, B. S. (2005). 'An Empirical Test of the Accounting-Based Residual Income Model and the Traditional Dividend Discount Model'. *Journal of Business*, vol. 78, no. 4, pp. 1465–1504.

Lenox, M. J., Rockart, S. F. & Lewin, A. Y. (2010). 'Does interdependency affect firm and industry profitability? an empirical test'. *Strategic Management Journal*, vol. 31, no. 2, pp. 121–139.

Luce, R. D. (1959). *Individual Choice Behavior: A Theoretical Analysis* (Dover Publications).

Miller, M. H. & Modigliani, F. (1961). 'Dividend Policy Growth and the Valuation of Shares'. *Journal of Business*, vol. 34, pp. 411–433.

Ohlson, J. A. (1995). 'Earnings Book Values and Dividends in Security Valuation'. *Contemporary Accounting Research*, vol. 11, no. 2, pp. 661–687.

Oswald, D. R. (2008). 'The determinants and value relevance of the choice of accounting for research and development expenditures in the United Kingdom'. *Journal of Business Finance & Accounting*, vol. 35, no. 1-2, pp. 1–24.

Penman, S. H. (1998). 'Combining Earnings and Book Value in Equity Valuation'. *Contemporary Accounting Research*, vol. 15, no. 3, pp. 291–324.

Penman, S. H. & Yehuda, N. (2009). 'The pricing of earnings and cash flows and an affirmation of accrual accounting'. *Review of Accounting Studies*, vol. 14, no. 4, pp. 453–479.

Powell, J., Shi, J., Smith, T. & Whaley, R. (2009). 'Common Divisors, Payout Persistence, and Return Predictability'. *International Review of Finance*, vol. 9, no. 4, pp. 335–357.

Song, C. J., Thomas, W. B. & Yi, H. (2010). 'Value relevance of FAS No. 157 Fair Value hierarchy information and the impact of corporate governance mechanisms'. *The Accounting Review*, vol. 85, no. 4, pp. 1375–1410.

Yu, K. (2013). 'Does recognition versus disclosure affect value relevance? Evidence from pension accounting'. *The Accounting Review*, vol. 88, no. 3, pp. 1095–1127.

Zeng, Y., Lee, E. & Zhang, J. (2016). 'Value relevance of alleged corporate bribery expenditures implied by accounting information'. *Journal of Accounting and Public Policy*, vol. 35, no. 6, pp. 592–608.

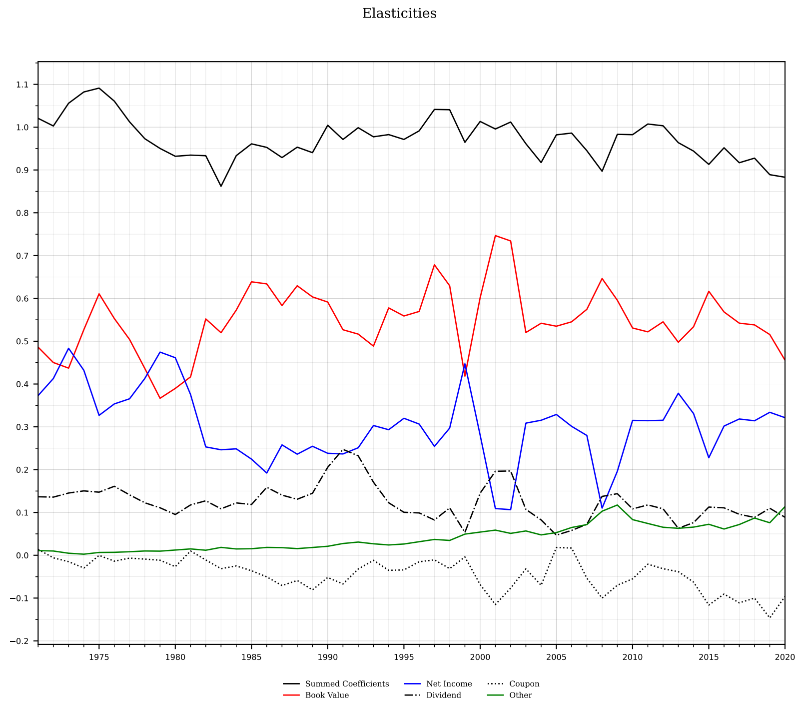
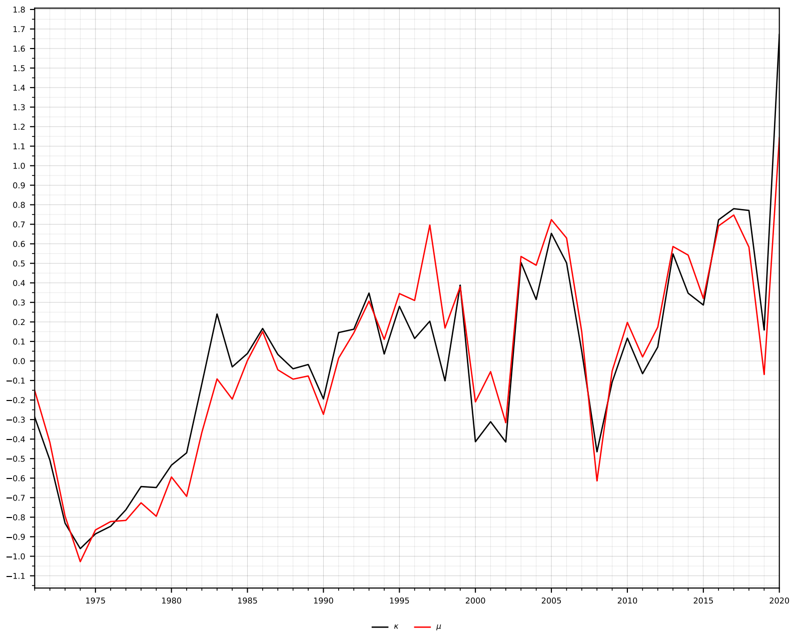
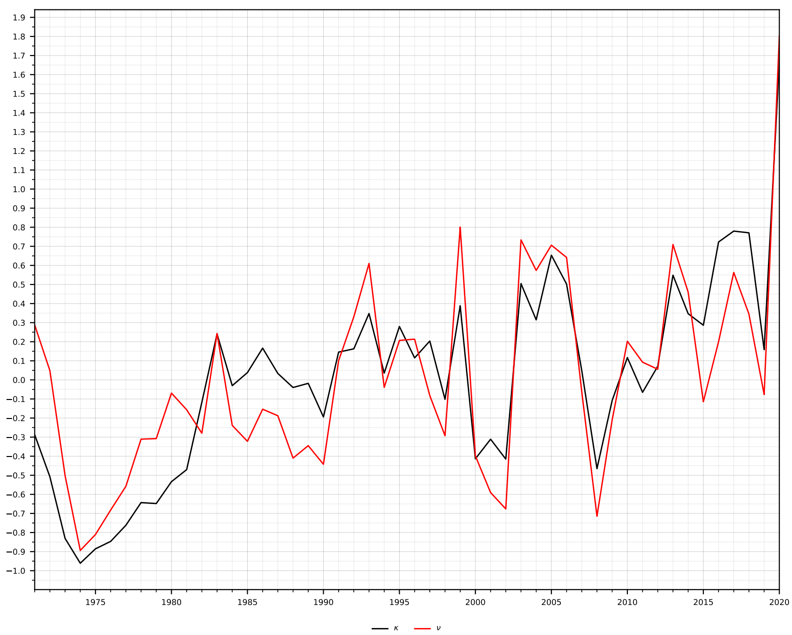


Figure 1: Empirically estimated elasticities using $M = \nu \prod_i |A_i|^{\beta_i}$. See Columns 6 to 11 of Table 3. Summed coefficients in black, book value in red, net income in blue, dividends in black dash-dotted line, coupons in black dotted line, and other items in green.



(a) Scaling factor (κ) in black, and the the market to book ratio (μ) in red



(b) Scaling factor (κ) in black, and the scaling factor in the multivariable model (ν) in red

Figure 2: Comparison of the scaling factor, κ, in the single variable book value model (5) with the market to book ratio, μ, in Panel (a), and with ν, the scaling factor in the multivariable model (6), in Panel (b).

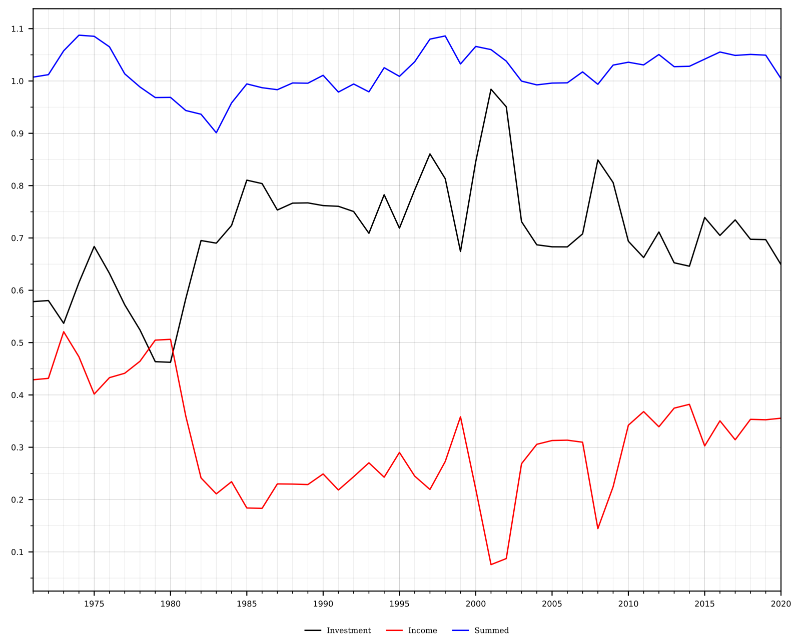


Figure 3: Empirical elasticities from Model (9) using the estimates shown in Table 5. Summed coefficients in blue, capital (investment) in black, comprehensive income in red.

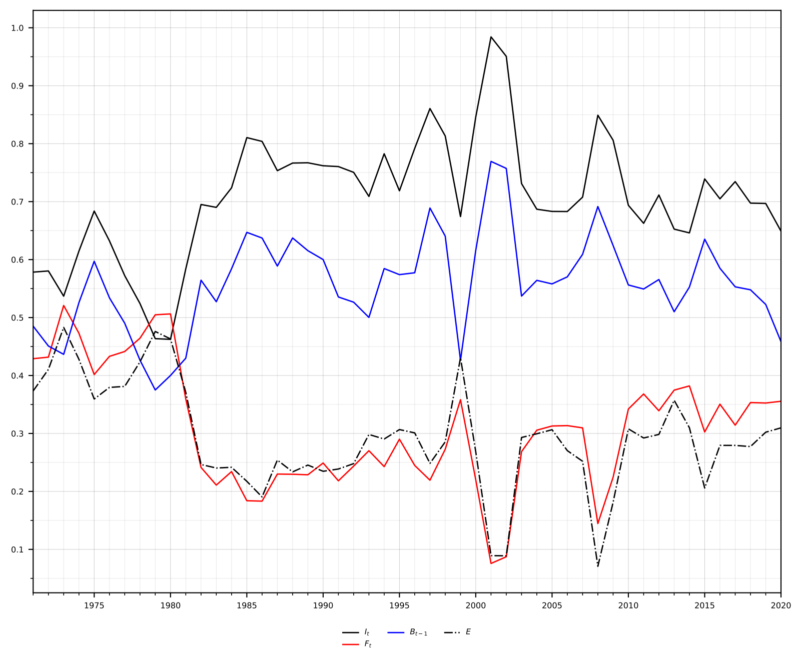


Figure 4: Comparison of the elasticity on earnings derived from Model (8) and Table 3 shown in Figure 1 with the elasticities on income and investment derived from Model (9) and Table 5 shown in Figure 3. Capital (investment) in black, book value in blue, net income in dotted black, comprehensive income in red.

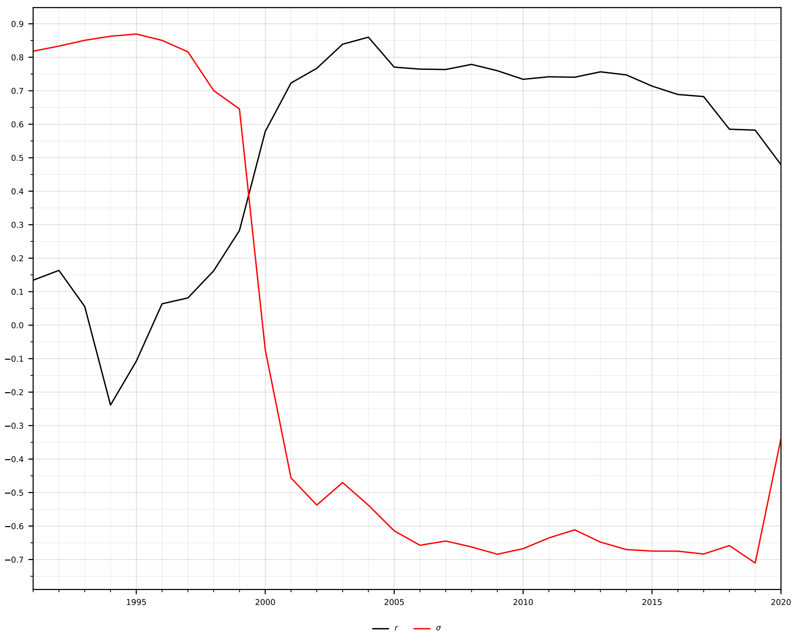
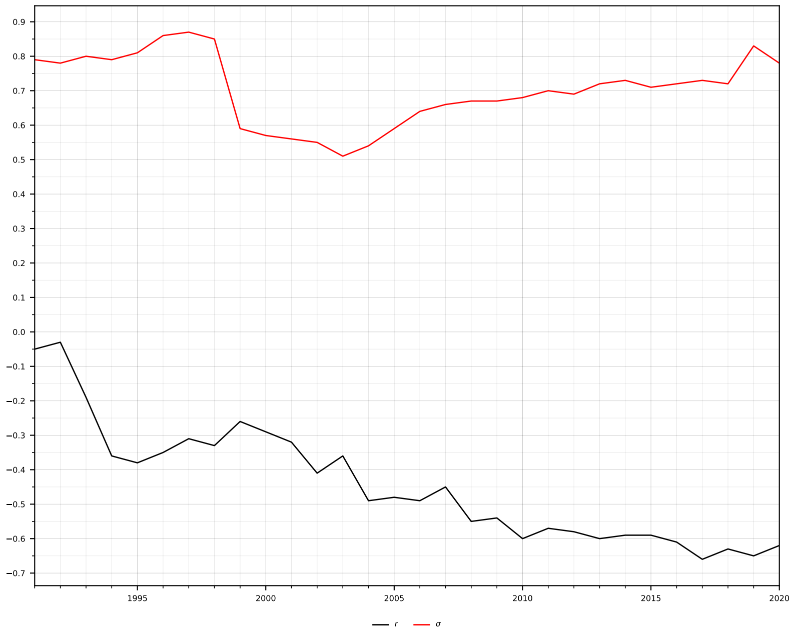
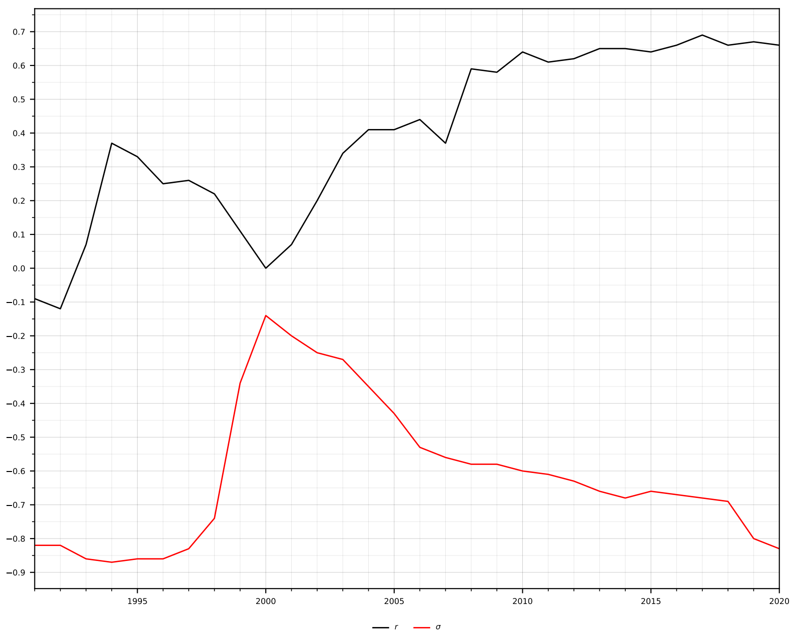


Figure 5: Correlations between κ in Model (7) and market growth, g, as defined in Table 1 (black) and between κ and the variance of returns, σ^2, also defined in Table 1 (red): 20-year rolling windows



(a) Correlations between the investment elasticity, β_I, in Model (9) and the growth rate, g, (black) and between the investment elasticity and σ^2 (red).



(b) Correlations between the income elasticity, β_F, in Model (9) and the growth rate, g, (black) and between the income elasticity and σ^2 (red).

Figure 6: Correlations between the income, β_F, and investment, β_I, elasticities in Model (9) as shown in Table 5 with the growth rate, g, and the variance of the growth rate, σ^2, as defined in Table 1.

Table 1: Variables used in models

Symbol	Compustat Xpressfeed (Legacy code)	Definition
M	PRCC (A24) × CSHO (A25)	Market value: Price Close - Annual × Common Shares Outstanding measured at the end of the first quarter after year-end.
B	CEQ (A60)	Book value of of equity: Common/Ordinary Equity
B_{t-1}		Lagged book value
E	NI (A172)	Earnings, Net Income.
D	DVC (A21)	Dividends Common or Ordinary.
C	DVP (A19)	Preferred/Preference Dividends, or Coupons
O		Other items: $\Delta B - E + D + C$
F		Comprehensive income: $E - C$
I		Investment, being the change in capital, or the stock of net assets, available to the firm: $B_t - B_{t-1} - F_t$
A		An accounting number $A = \{B_{t-1}, E_t, D_t, C_t, O_t\}$
κ		Intercept term in the single-variable log-linear model, exponentiated
ν		Intercept in the multi-variable, multiplicative (log-linear) model (8) exponentiated
η		Intercept in the multi-variable, multiplicative (log-linear) model (9), exponentiated
β		Response coefficient (elasticity) in the single-variable log-linear model
β_i		Response coefficients (elasticities) in the multi-variable multiplicative (log-linear) model
a		Intercept in the multi-variable additive-linear model (1)
b_i		Response coefficients in the multi-variable additive-linear model (1)
r_i		Ratio of accounting variable A_i to B_t
g		Growth rate of market value, $\frac{M_t}{M_{t-1}}$
σ^2		Variance of growth rate of market value, *Var(g)*
μ		Geometric average of market to book ratio, $\frac{M_t}{\lvert B_t \rvert}$
ρ		Correlation coefficient between two variables, x and y, $\rho(x, y)$
n or Obs		Number of observations

Table 2: Summary statistics

	Unlogged data					Logged data				
Variable	Obs	Mean	Std. Err.	Skewness	Kurtosis	Obs	Mean	Std.Err.	Skewness	Kurtosis
M	198,593	2,467.50	39.12	38.08	2,874	198,587	5.08	0.01	0.20	-0.19
B	198,593	911.17	13.30	25.18	971	198,593	4.48	0.00	0.01	0.10
B^+	191,647	955.19	13.74	24.99	947	191,647	4.53	0.00	0.06	0.06
B^-	6,946	-303.49	25.79	-30.57	1,152	6,946	3.06	0.03	-0.10	-0.33
E	198,593	103.77	2.36	4.32	1,745	198,593	2.52	0.00	0.05	0.16
E^+	142,802	177.59	2.85	23.15	873	142,802	2.70	0.01	0.01	0.16
E^-	55,791	-85.17	4.08	-63.04	5,314	55,791	2.07	0.01	0.08	0.23
D	198,593	47.53	0.80	24.17	1,062	92,129	2.24	0.01	0.01	0.15
D^+	92,129	102.44	1.71	16.66	505	92,129	2.24	0.01	0.01	0.15
C	198,593	2.11	0.09	113.13	19,454	33,645	0.13	0.01	-0.19	-0.34
C^+	33,645	12.46	0.52	47.23	3,367	33,645	0.13	0.01	-0.19	-0.34
O	198,593	0.78	2.13	9.34	1,989	197,118	-0.45	0.02	-3.48	12.28
O^+	130,690	80.54	2.41	44.21	2,791	130,690	-0.12	0.02	-3.93	16.69
O^-	66,428	-156.12	4.17	-27.08	1,195	66,428	-1.09	0.04	-2.85	7.37
$m, (\frac{M}{B_0})$	198,593	6.24	1.71	409.91	175,899	198,587	2.31	0.00	4.06	26.80
$r_0, (\frac{B_t}{B_0})$	198,593	1.16	0.04	171.79	58,749	198,593	1.02	0.00	-2.64	71.29
$r_1, (\frac{E}{B_0})$	198,593	-0.05	0.11	-418.52	182,919	198,593	0.06	0.01	-0.81	6.26
$r_2, (\frac{D}{B_0})$	198,593	0.12	0.02	241.20	73,556	92,129	0.05	0.00	4.43	43.51
$r_3, (\frac{C}{B_0})$	198,593	0.01	0.00	174.26	52,837	33,645	0.01	0.01	1.63	7.06
$r_4, (\frac{O}{B_0})$	198,593	0.34	0.14	413.80	179,652	197,118	0.02	0.02	0.33	10.80

The table shows pooled data average values of variables from Compustat over the years 1971-2020. Superscripts on the variables indicate whether they are positive (+) or negative (-). m is the market to book ratio; r_0 is the growth rate of book value, r_1 is the ratio of earnings to book value, r_2 is the ratio of dividends to book value, r_3 is the ratio of preferred dividend to book value, and r_4 is the ratio of other items to book value. These variables are further defined in Table 1. All variables are represented by their pooled averages. When the data is unlogged the averages are arithmetic. When the data is logged, the averages are geometric. The mean values of the logged ratios, e.g. m, $r_{0..4}$ are exponentiated for comparison with the unlogged ratio.

Table 3: Parameter estimates for the main models

Period	κ	β_{B_t}	$\bar{R}^2$	ν	$\beta_{B_{t-1}}$	β_E	β_D	β_C	β_O	$\Sigma_i \beta_i$	$\bar{R}^2$	Obs
1971	1.91	0.96	0.82	6.80	0.49	0.37	0.14	0.01	0.01	1.02	0.86	1,669
1972	1.45	0.99	0.83	5.84	0.45	0.41	0.14	-0.01	0.01	1.00	0.85	1,908
1973	0.77	1.05	0.85	3.54	0.44	0.48	0.15	-0.01	0.00	1.06	0.88	2,222
1974	0.49	1.08	0.86	1.91	0.53	0.43	0.15	-0.03	0.00	1.08	0.88	2,300
1975	0.65	1.07	0.87	2.24	0.61	0.33	0.15	0.00	0.01	1.09	0.87	2,191
1976	0.74	1.05	0.89	2.70	0.55	0.35	0.16	-0.01	0.01	1.06	0.91	2,359
1977	0.92	1.00	0.89	3.23	0.50	0.37	0.14	-0.01	0.01	1.01	0.91	2,405
1978	1.15	0.97	0.87	4.25	0.44	0.41	0.12	-0.01	0.01	0.97	0.90	2,369
1979	1.18	0.95	0.85	4.47	0.37	0.47	0.11	-0.01	0.01	0.95	0.88	2,334
1980	1.44	0.95	0.83	5.53	0.39	0.46	0.10	-0.03	0.01	0.93	0.85	2,164
1981	1.55	0.91	0.85	5.16	0.42	0.38	0.12	0.01	0.01	0.93	0.86	2,789
1982	2.28	0.86	0.81	4.59	0.55	0.25	0.13	-0.01	0.01	0.93	0.82	3,882
1983	3.03	0.84	0.82	6.69	0.52	0.25	0.11	-0.03	0.02	0.86	0.82	3,987
1984	2.46	0.88	0.85	4.76	0.57	0.25	0.12	-0.02	0.01	0.93	0.85	4,128
1985	2.59	0.90	0.83	4.35	0.64	0.22	0.12	-0.04	0.02	0.96	0.83	4,259
1986	2.87	0.89	0.83	5.01	0.63	0.19	0.16	-0.05	0.02	0.95	0.82	4,184
1987	2.57	0.89	0.83	4.87	0.58	0.26	0.14	-0.07	0.02	0.93	0.83	4,359
1988	2.43	0.90	0.83	3.98	0.63	0.24	0.13	-0.06	0.02	0.95	0.83	4,555
1989	2.46	0.90	0.81	4.24	0.60	0.25	0.14	-0.08	0.02	0.94	0.81	4,489
1990	2.08	0.91	0.79	3.80	0.59	0.24	0.21	-0.05	0.02	1.00	0.80	4,462
1991	2.78	0.88	0.77	6.07	0.53	0.24	0.25	-0.07	0.03	0.97	0.78	4,445
1992	2.87	0.90	0.78	7.02	0.52	0.25	0.23	-0.03	0.03	1.00	0.81	4,545
1993	3.22	0.89	0.81	8.26	0.49	0.30	0.17	-0.01	0.03	0.98	0.82	4,751
1994	2.60	0.92	0.82	5.49	0.58	0.29	0.12	-0.04	0.02	0.98	0.83	5,620
1995	3.11	0.91	0.80	6.63	0.56	0.32	0.10	-0.03	0.03	0.97	0.81	5,874
1996	2.81	0.94	0.82	6.61	0.57	0.31	0.10	-0.02	0.03	0.99	0.82	6,082
1997	3.03	0.96	0.82	5.43	0.68	0.25	0.08	-0.01	0.04	1.04	0.82	6,311
1998	2.40	0.96	0.78	4.47	0.63	0.30	0.11	-0.03	0.03	1.04	0.79	6,161
1999	3.42	0.90	0.69	8.84	0.42	0.45	0.05	0.00	0.05	0.96	0.72	5,816
2000	1.71	0.98	0.75	4.08	0.60	0.28	0.15	-0.07	0.05	1.01	0.72	5,686
2001	1.93	0.98	0.77	3.34	0.75	0.11	0.20	-0.12	0.06	1.00	0.75	5,425
2002	1.73	0.97	0.79	3.00	0.73	0.11	0.20	-0.08	0.05	1.01	0.77	5,080
2003	3.78	0.91	0.80	9.02	0.52	0.31	0.11	-0.03	0.06	0.96	0.82	4,755
2004	3.42	0.93	0.84	8.53	0.54	0.32	0.08	-0.07	0.05	0.92	0.85	4,579
2005	4.11	0.91	0.82	9.08	0.54	0.33	0.05	0.02	0.05	0.98	0.85	4,489
2006	3.86	0.92	0.82	8.86	0.55	0.30	0.06	0.02	0.06	0.99	0.84	4,369
2007	3.01	0.93	0.79	6.07	0.57	0.28	0.07	-0.05	0.07	0.95	0.81	4,250
2008	1.74	0.92	0.71	3.02	0.65	0.11	0.14	-0.10	0.10	0.90	0.69	4,150
2009	2.52	0.94	0.78	5.26	0.60	0.20	0.14	-0.07	0.12	0.98	0.79	3,973
2010	3.01	0.93	0.78	7.16	0.53	0.32	0.11	-0.06	0.08	0.98	0.82	3,802
2011	2.61	0.94	0.77	6.62	0.52	0.31	0.12	-0.02	0.07	1.01	0.82	3,689
2012	2.91	0.94	0.78	6.36	0.55	0.32	0.11	-0.03	0.07	1.00	0.82	3,616
2013	3.85	0.92	0.79	8.73	0.50	0.38	0.06	-0.04	0.06	0.96	0.82	3,566
2014	3.49	0.94	0.76	7.82	0.53	0.33	0.08	-0.06	0.07	0.94	0.81	3,622
2015	3.24	0.93	0.75	5.37	0.62	0.23	0.11	-0.12	0.07	0.91	0.78	3,656
2016	4.16	0.91	0.76	6.68	0.57	0.30	0.11	-0.09	0.06	0.95	0.81	3,570
2017	4.30	0.91	0.76	7.87	0.54	0.32	0.10	-0.11	0.07	0.92	0.80	3,468
2018	4.28	0.90	0.74	7.08	0.54	0.31	0.09	-0.10	0.09	0.93	0.79	3,441
2019	2.99	0.90	0.69	5.11	0.52	0.33	0.11	-0.15	0.08	0.89	0.73	3,406
2020	6.36	0.87	0.70	13.02	0.46	0.32	0.09	-0.10	0.11	0.88	0.74	3,381
	κ	β_{B_t}	$\bar{R}^2$	ν	$\beta_{B_{t-1}}$	β_E	β_D	β_C	β_O	$\Sigma_i \beta_i$	$\bar{R}^2$	Obs
Pooled	2.24	0.96	0.81	5.04	0.59	0.30	0.10	-0.03	0.03	0.99	0.82	198,593
Average	2.61	0.93	0.80	5.78	0.55	0.30	0.12	-0.04	0.04	0.97	0.82	
Std	1.13	0.05	0.05	2.16	0.08	0.09	0.04	0.04	0.03	0.05	0.05	
SE	0.16	0.01	0.01	0.31	0.01	0.01	0.01	0.01	0.00	0.01	0.01	
LCL	2.29	0.92	0.79	5.17	0.53	0.28	0.11	-0.05	0.03	0.96	0.80	
UCL	2.92	0.95	0.81	6.38	0.57	0.33	0.14	-0.03	0.05	0.99	0.83	

The table shows coefficient estimates of the models below, using Compustat data from 1971-2020, where the coefficients represent elasticities on variables $\{B, B_{t-1}, E_t, D_t, C_t, O_t\}$:

$$\ln(M) = \ln(\kappa) + \beta \ln|B| + \varepsilon \quad \text{(Model (7))}$$
$$\ln(M) = \ln(\nu) + \sum_i \beta_i \ln|A_i| + \varepsilon \quad \text{(Model (8))},$$

$\Sigma_i \beta_i$ is the sum of β_i. These variables are further defined in Table 1. All models are estimated by taking logs and using OLS.

Table 4: Correlations of the main model parameters

	κ	$\beta_{B_{t-1}}$	β_E	β_D	β_C	β_O	g	σ^2
κ	1.00	0.01	-0.17	-0.46	-0.33	0.63	0.26	0.23
p-value		0.49	0.12	0.00	0.01	0.00	0.04	0.06
$\beta_{B_{t-1}}$		1.00	-0.85	0.28	-0.39	0.17	-0.30	0.51
p-value			0.00	0.02	0.00	0.12	0.02	0.00
β_E			1.00	-0.40	0.47	-0.32	0.23	-0.61
p-value				0.00	0.00	0.01	0.06	0.00
β_D				1.00	-0.16	-0.31	-0.20	0.28
p-value					0.14	0.01	0.08	0.03
β_C					1.00	-0.56	0.25	-0.40
p-value						0.00	0.04	0.00
β_O						1.00	-0.10	0.37
p-value							0.25	0.00
g							1.00	-0.32
p-value								0.01
σ^2								1.00

The table shows Pearson correlations between the parameters in Model (8), the market growth rate, g, and its variance, σ^2 using Compustat data from 1971-2020. The p-values are the probabilities associated with the correlations. The variables are defined in Table 1.

Table 5: Parameter estimates for the Capital and Income Model

Period	η	β_I	β_F	$\Sigma\beta_i$	$\bar{R}^2$	Obs
1971	4.69	0.58	0.43	1.01	0.85	1,658
1972	3.71	0.58	0.43	1.01	0.85	1,887
1973	2.55	0.54	0.52	1.06	0.88	2,193
1974	1.47	0.61	0.47	1.09	0.88	2,268
1975	1.65	0.68	0.40	1.09	0.88	2,159
1976	1.93	0.63	0.43	1.07	0.91	2,327
1977	2.38	0.57	0.44	1.01	0.90	2,358
1978	2.98	0.52	0.46	0.99	0.90	2,313
1979	3.14	0.46	0.50	0.97	0.88	2,277
1980	3.98	0.46	0.51	0.97	0.85	2,108
1981	2.95	0.58	0.36	0.94	0.86	2,707
1982	2.97	0.70	0.24	0.94	0.83	3,784
1983	3.82	0.69	0.21	0.90	0.83	3,889
1984	2.96	0.72	0.23	0.96	0.86	4,024
1985	2.59	0.81	0.18	0.99	0.84	4,140
1986	2.88	0.80	0.18	0.99	0.83	4,055
1987	2.88	0.75	0.23	0.98	0.84	4,186
1988	2.63	0.77	0.23	1.00	0.84	4,348
1989	2.64	0.77	0.23	1.00	0.83	4,277
1990	2.25	0.76	0.25	1.01	0.81	4,245
1991	2.95	0.76	0.22	0.98	0.79	4,234
1992	3.21	0.75	0.24	0.99	0.82	4,319
1993	3.96	0.71	0.27	0.98	0.83	4,532
1994	2.81	0.78	0.24	1.03	0.84	5,367
1995	3.76	0.72	0.29	1.01	0.82	5,589
1996	2.98	0.79	0.24	1.04	0.84	5,805
1997	2.72	0.86	0.22	1.08	0.83	6,050
1998	2.26	0.81	0.27	1.09	0.80	5,896
1999	3.81	0.67	0.36	1.03	0.76	5,545
2000	1.70	0.85	0.22	1.07	0.73	5,423
2001	1.37	0.98	0.08	1.06	0.75	5,185
2002	1.32	0.95	0.09	1.04	0.76	4,836
2003	4.08	0.73	0.27	1.00	0.83	4,520
2004	4.72	0.69	0.31	0.99	0.84	4,346
2005	5.08	0.68	0.31	1.00	0.85	4,236
2006	4.93	0.68	0.31	1.00	0.84	4,119
2007	3.42	0.71	0.31	1.02	0.82	3,994
2008	1.42	0.85	0.14	0.99	0.68	3,893
2009	2.26	0.81	0.22	1.03	0.78	3,719
2010	3.50	0.69	0.34	1.04	0.82	3,546
2011	3.42	0.66	0.37	1.03	0.81	3,418
2012	3.05	0.71	0.34	1.05	0.83	3,321
2013	4.66	0.65	0.37	1.03	0.84	3,234
2014	4.55	0.65	0.38	1.03	0.79	3,242
2015	2.94	0.74	0.30	1.04	0.76	3,261
2016	3.57	0.70	0.35	1.06	0.80	3,163
2017	3.59	0.73	0.31	1.05	0.80	3,069
2018	3.47	0.70	0.35	1.05	0.78	3,056
2019	2.39	0.70	0.35	1.05	0.72	3,040
2020	5.50	0.65	0.36	1.00	0.74	3,026
	η	β_I	β_F	$\Sigma_i\beta_i$	$\bar{R}^2$	Obs
Pooled	2.18	0.60	0.30	1.00	0.82	188,187
Average	3.13	0.71	0.31	1.02	0.82	
Std	1.01	0.11	0.10	0.04	0.05	
SE	0.14	0.02	0.01	0.01	0.01	
LCL	2.85	0.68	0.28	1.00	0.81	
UCL	3.41	0.74	0.34	1.03	0.83	

The table shows coefficient estimates of the model below, using data Compustat data from 1971-2020. All models are estimated by taking logs and using OLS.

$$\ln(M) \quad = \quad \ln(\eta) + \sum_i \beta_i \ln|A_i| \quad + \quad \varepsilon,$$

where $A_i = \{I_t, F_t\}$ and $I_t = B_t - B_{t-1} - F_t$. The variables are further defined in Table 1.

Table 6: Correlations of the Capital and Income model parameters.

	κ	β_{I_t}	β_{F_t}	g	σ^2
κ	1.00	0.19	-0.25	0.26	0.23
p-value		0.10	0.04	0.04	0.06
β_{I_t}		1.00	-0.91	-0.29	0.76
p-value			0.00	0.02	0.00
β_{F_t}			1.00	0.20	-0.74
p-value				0.08	0.00
g				1.00	-0.32
p-value					0.01
σ^2					1.00

The table shows Pearson correlations of the Capital and Income Model parameters shown in the table above with the market growth rate, g, and its variance, σ^2, using Compustat data from 1971-2020. The variables are further defined in Table 1.

Table 7: Parameter estimates derived from the main model with partitions of the sample data.

Partition	B_{t-1}	E	D	C	O	v	$\beta_{B_{t-1}}$	β_E	β_D	β_C	β_O	$\Sigma_i\beta_i$	$\bar{R}^2$	Obs
1	+	+	+	+	-	1.45	0.43	0.43	0.22	-0.03	0.01	1.05	0.95	5,436
3	+	+	+	+	+	0.96	0.60	0.40	0.08	-0.07	0.02	1.03	0.91	11,021
4	+	+	+	0	-	1.84	0.41	0.46	0.20	0.00	0.01	1.08	0.94	27,189
5	+	+	+	0	0	2.39	0.15	0.58	0.28	0.00	0.00	1.01	0.90	131
6	+	+	+	0	+	1.90	0.46	0.45	0.10	0.00	0.02	1.03	0.91	32,221
7	+	+	0	+	-	1.40	0.56	0.38	0.00	0.05	0.01	1.00	0.85	1,616
9	+	+	0	+	+	2.27	0.46	0.36	0.00	0.03	0.05	0.89	0.79	3,869
10	+	+	0	0	-	1.31	0.63	0.43	0.00	0.00	0.01	1.07	0.91	16,474
11	+	+	0	0	0	1.81	0.32	0.65	0.00	0.00	0.00	0.96	0.68	320
12	+	+	0	0	+	2.12	0.55	0.39	0.00	0.00	0.03	0.98	0.84	34,010
13	+	-	+	+	-	0.40	0.81	-0.09	0.31	-0.02	0.01	1.02	0.89	505
15	+	-	+	+	+	1.27	0.66	-0.02	0.26	0.00	0.05	0.96	0.82	940
16	+	-	+	0	-	0.50	0.83	-0.09	0.27	0.00	0.01	1.03	0.87	2,277
18	+	-	+	0	+	0.99	0.78	-0.01	0.20	0.00	0.03	1.00	0.84	2,971
19	+	-	0	+	-	0.93	0.75	-0.07	0.00	0.15	0.02	0.85	0.68	924
21	+	-	0	+	+	2.20	0.44	0.10	0.00	0.10	0.09	0.73	0.51	5,048
22	+	-	0	0	-	-0.02	0.98	-0.07	0.00	0.00	0.01	0.92	0.76	7,775
23	+	-	0	0	0	0.30	0.63	0.03	0.00	0.00	0.00	0.67	0.42	739
24	+	-	0	0	+	1.63	0.64	0.13	0.00	0.00	0.06	0.83	0.63	29,578
B^-						2.37	0.28	0.43	0.36	-0.07	0.07	1.07	0.62	5,115
Averages						1.40	0.57	0.24	0.11	0.01	0.02	0.96	0.79	188,159
Estimates weighted by observations						1.66	0.55	0.33	0.07	0.00	0.03	0.98	0.83	
Pooled data parameter estimates						1.58	0.30	0.03	0.09	-0.03	0.03	1.00	0.82	188,187

The table shows coefficient estimated from the main model (8) using Compustat data during the period 1971-2020. $\Sigma_i\beta_i$ is the sum of β_i. The symbols in columns 2 through 6 indicate whether the variable in that column is positive (+), zero (0), or negative (-). Some partitions are not reported because of a lack of observations, i.e. partitions 2, 8, 14, 20. The row labelled partition B^- shows coefficient estimates using pooled data for the entire period when opening book value is negative. The vector of pooled estimates in the bottom row of the Table relies on observations of the entire data set. β_p can also be recovered precisely by weighting the row vector estimates, β_j, in each partition j by $\beta_p = [\sum_i \mathbf{X_j'X_j}]^{-1}[\sum_i \mathbf{X_j'X_j}\beta_\mathbf{j}]$. All models are estimated by taking logs and using OLS.

Table 8: Stability Index for Hypotheses 3 and 4

	Independent Test	Joint Tests			
Rolling windows		5 Years	10 Years	15 Year	20 Year
Correct Sign	505	23	27	28	28
Total	600	45	40	35	30
Percent	0.84	0.51	0.68	0.80	0.93

H4: Predicted signs on correlations

Market variables	g	σ
Elasticities		
β_I	-	+
β_F	+	-

β_I and β_F are the market value elasticities on Investment and Income, respectively. The growth rate is g and the variance of the growth rate is σ. The signs on the correlation relate to the predicted correlations between variables in the same row and column of the Table. Thus the sign on $\rho(\beta_I, g)$ is negative and that on $\rho(\beta_I, \sigma)$ is positive.