



A valuation-based test of market timing [☆]

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Received 16 December 2004; received in revised form 20 November 2006; accepted 7 December 2006

Available online 30 January 2007

Abstract

We implement an earnings-based fundamental valuation model to test the impact of market timing on the firm's method of funding the financing deficit. We argue that our valuation metric provides a superior measure of equity misvaluation because it avoids multiple interpretation problems faced by the market-to-book ratio. It also eliminates the need to infer market timing based on the actions of corporate insiders or other indirect measures. We find a strong positive relation between the degree to which a firm is overvalued and the proportion of the firm's financing deficit that is funded with equity. This result is found cross-sectionally and through time and is robust to firm size, and other variables known to impact capital structure. We find evidence that overvaluation in the 1990s led to equity being increasingly preferred over debt. For a broad set of firms, market timing explains a significant portion of the variation in the type of security used to fund the financing deficit.

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JEL classification: G30; G32

Keywords: Residual income model; Capital structure; Market timing; Financing deficit

1. Introduction

Any test of the market timing theory of capital structure represents a joint test of the theory itself and the method utilized to establish whether the firm's stock is mispriced by investors.

[☆] This paper benefited from discussions with Joel Harper, John Polonchek, Ramesh Rao, Gary Simpson, Mark D. Walker, participants at the Southwest Finance Meetings, and the comments of two anonymous referees.

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Previous work has attempted to infer mispricing through a range of indirect measures, such as the trading of insiders, the level of market-to-book, and various transformations of market-to-book.

Interpretations of these studies can be hampered by the multiple and imprecise interpretations of the market timing proxies. For example, market-to-book is also commonly used as a measure of growth options. Other methods of inferring market timing, such as examinations of insider trading, rely on indirect, and noisy relationships with market timing and are unable to actually quantify the magnitude of mispricing.

The approach that we use overcomes the weaknesses of previous methods by estimating the value of the firm's stock directly, using a fundamental valuation technique. The metric, known in the accounting literature as the residual income model, capitalizes the future abnormal earnings of the firm and provides an estimate of the firm's intrinsic value. Scaling this intrinsic value by the market price generates a clean, and easily interpreted measure of mispricing.

We interact this measure with the firm's financing deficit to examine the type of security used to fund the deficit in the presence of potential equity market misvaluation. We find that firms with overvalued equity are more likely to issue equity to fund the financing deficit, while firms that are undervalued tend to issue more debt. Our results are economically significant, and in the aggregate, imply an 8% change in the amount of equity issued for a 10% deviation from fundamental value. Further, we show that the impact of market timing on the financing deficit is dependant upon the time period studied. The greater amount of equity issued in the 1990s is a function of the higher equity valuations during that period.

The paper proceeds as follows: Section 2 discusses previous literature and provides the motivation for our study, Section 3 presents the data, Section 4 presents the results and Section 5 concludes.

2. Theory and motivation

In this section we examine the previous approaches for measuring equity market timing, in particular the market-to-book ratio. We then argue that our implementation of the residual income model is a superior measure of the firm's equity valuation, compared to alternatives. Finally, we briefly discuss the literature that examines the firm's method of funding the financing deficit, and then we relate how our valuation metric can be used to test market timing in this framework.

2.1. Testing equity market timing

Baker and Wurgler's (2002) market timing theory of capital structure proposes that a firm's capital structure is the cumulative result of attempts to time the equity market. They find that the long-term average leverage ratio is significantly related to the market-to-book ratio, and conclude that low leverage firms raised capital when equity valuations (market-to-book ratios) were high and high leverage firms raised capital when equity valuations were low. Baker and Wurgler's empirical results are supported by the survey evidence of Graham and Harvey (2001) which suggests that CFOs try to time the equity market.

Two broad criticisms have been leveled at Baker and Wurgler's findings. The first criticism, voiced by Alti (2006) and Flannery and Rangan (2006), questions the longevity and overall economic significance of market timing. However, Huang and Ritter (2005), using aggregate measures of market valuation, find evidence of a long lasting market timing effect on capital structure and Leary and Roberts (2005) find that shocks to equity valuation can persist for varying lengths of time.

The second criticism, which is the focus of our paper, is proposed by Hovakimian (2006), and contends that the negative relationship between market-to-book and leverage is not indicative of market timing. Instead the relationship is argued to be due to growth opportunities, which when high (low), lead firms to use more (less) equity financing. Hovakimian also contends that the cross-sectional relationship between market-to-book and leverage dominates the temporal relationship. Indirect support comes from Liu (2005) who uses insider trading activity as a measure of misvaluation and fails to reject the null hypothesis of no misvaluation.

The use of market-to-book to test market timing is fraught with difficulties. These difficulties stem from the multiple interpretations of what the ratio captures; asymmetric information, growth options, and debt overhang problems. Disentangling these multiple interpretations then relies on creating transformations of the ratio. The multiple interpretation problem is further complicated by the relatively weak performance of market-to-book as a measure of misvaluation. For example, the premise that high market-to-book firms underperform low market-to-book firms (La Porta, 1996; Frankel and Lee, 1998) appears to be time dependent, as Kothari and Shanken (1997) find that market-to-book ratios have some predictive power over the 1926–1991 period, but that power is substantially reduced during the 1946–1991 sub-period. Lee, Myers, and Swaminathan (1999) find that market-to-book ratios predict only about 0.33% of the variation in real stock returns, and conclude that market-to-book is a weak measure of mispricing.

Finally, it is very hard to know what level of the market-to-book ratio is consistent with a firm being fairly valued. To illustrate this point, from 1971 to 2001, the average annual market-to-book in our sample ranges from 0.81 to 5.43; clearly not all of this range can be due to misvaluation.

2.2. Measuring misvaluation directly

As an alternative valuation measure, Lee, Myers, and Swaminathan (1999) find that the residual income valuation model predicts over 20% of the variation in real stock returns.¹ They attribute this performance to the use of time varying interest rates in the model, a component that is absent from market-to-book (and other simple valuation ratios). The residual income model has been studied extensively in the accounting literature, and substantial empirical and theoretical support exists for its performance as a valuation metric.² The model is a transformation of the dividend discount model that assumes clean surplus accounting and uses future earnings and a time varying discount rate.³ Other researchers, such as D'Mello and Schroff (2000), Dong, Hirshleifer, Richardson, Teoh (2006) and Elliott, Koëter, and Warr (2006), use the residual income model to measure the effect of the misvaluation of equity on corporate finance decisions. We present a full discussion of the implementation of the model in Section 3.2.

We create a value-to-market ratio by scaling the residual income model valuation by the firm's market price. This ratio captures misvaluation without contamination by growth options and follows Rhodes-Kropf, Robinson and Viswanathan (2005), who decompose book-to-market into a measure of growth options and a measure of valuation. They argue that value-to-market measures mispricing by the market, while book-to-value measures growth opportunities.

¹ Ours, and other recent implementations of the model are based on the work of Ohlson (1991, 1995).

² Frankel and Lee (1998) find that the residual income model has predictive power in the cross-section of stock returns in domestic and international markets. Penman and Sougiannis (1998) also find support for the valuation performance of the model.

³ Clean surplus accounting is the requirement that the change in retained earnings equals net income less dividends paid (see Feltham and Ohlson, 1995).

2.3. The financing deficit and market timing

The firm's method of funding the financing deficit is explored in Shyam-Sunder and Myers (1999) who suggest that if the pecking order theory of Myers (1984) and Myers and Majluf (1984) holds, a one-to-one relationship should be observed between the net change in debt and the financing deficit. The financing deficit is defined as the difference between asset growth and the sum of current liabilities growth and retained earnings growth. They estimate the coefficient on DEF, in Eq. (1):

$$\Delta D_{it} = a_0 + b_1 \text{DEF}_{it} + e_{it} \quad (1)$$

where ΔD_{it} is the net change in debt, DEF_{it} is the financing deficit, and b_1 is the slope coefficient on DEF_{it} . For a firm following the pecking order, $a_0=0$ and $b_1=1$. Using a sample of firms with continuous data over a 19 year period, Shyam-Sunder and Myers estimate b_1 to be about 0.75, which they interpret as strong support for the pecking order theory.⁴

Frank and Goyal (2003) reexamine the Shyam-Sunder and Myers (1999) approach and find that net equity issues, rather than debt issues, more closely track the financing deficit. Including all firms with at least 1 year of data, Frank and Goyal obtain a b_1 coefficient of only 0.20 and argue that this provides evidence against the pecking order theory. Lemmon and Zender (2004) control for debt capacity constraints and find that firms not at their debt capacity generally follow the pecking order. They demonstrate that in contrast to Frank and Goyal and Fama and French (2002), larger firms actually face higher levels of asymmetric information than smaller firms.⁵

If firms follow the market timing theory of capital structure, the deficit coefficient, b_1 , (from Eq. (1)) will vary with the level of misvaluation of the firm's stock. When firms are overvalued, the deficit coefficient should be lower than when they are undervalued. This possibility is examined by Kayhan and Titman (2007) who compute two variables based on the market-to-book ratio: a long run average market-to-book interacted with the long run average of the firm's financing deficit, as a measure of valuation relative to other firms; and a short-term measure (defined as the covariance between market-to-book and the financing deficit) to determine whether a firm uses external capital when its price is high. They find that the former measure accounts for the negative relationship between market-to-book and leverage, while the short term measure provides only weak evidence of market timing.

We follow an approach similar to Kayhan and Titman, in that we interact our residual income model based measure of valuation with Shyam-Sunder and Myers' financing deficit variable. However, our measure is able to more precisely measure mispricing regardless of its magnitude or duration. We expect firms that are fairly valued or undervalued to fund a greater proportion of the deficit with debt, while those that are overvalued are more likely to issue equity to fund the deficit.

⁴ While the coefficient is not equal to unity, Shyam-Sunder and Myers point to the fact that some firms may have reached their debt capacity, as discussed in Chirinko and Singha (2000) and are therefore forced to issue some equity.

⁵ Furthermore, they find that smaller, high growth firms have lower debt capacity and are forced to raise capital through equity issues, thus providing the apparent violation of the pecking order documented by Frank and Goyal.

3. Data and method

3.1. Sample selection

Our initial sample attempts to replicate that of Frank and Goyal (2003) and comprises all firms on Compustat during the period 1971–2001.⁶ We exclude financial firms and utilities (SIC's 4900–4999 and 6900–6999), firms with invalid Compustat format codes (data item 318: 4, 5 or 6), firms engaged in major mergers (footnote code: AA or AB), and firms with negative or missing book value of equity or assets. Following Frank and Goyal, we drop extreme Compustat observations to minimize the contamination of our data by miscoded observations.⁷ We do not require that firms be continuously listed in the data set, but our valuation model does impose some additional restrictions on the data that are not included in Frank and Goyal's sample. Calculation of the misvaluation metric imposes a minimum four-year survival bias on the firms in our sample. Table 1 shows the number of firms in our valuation sample for each year. The number ranges from a low of 1329 in 1971 to a maximum of 2601 in 2000. The model and its data requirements are discussed in the next section.

3.2. The residual income model

We measure misvaluation with the ratio of intrinsic value, measured with the residual income model, to current market price (see D'Mello and Shroff, 2000, for a more detailed review of this method). Intrinsic value estimates are based on future realized abnormal earnings, as described by Eqs. (2) and (3).

$$V_0 = B_0 + \sum_{i=1}^T (1+r)^{-i} E_0[X_{i-r} \times B_{i-1}] + \frac{(1+r)^{-T}}{r} \text{TV} \quad (2)$$

The terminal value, TV, is calculated as

$$\text{TV} = E_0[(X_{T-r} \times B_{T-1}) + (X_{T+1-r} \times B_T)]/2 \quad (3)$$

V_0 is the value of the firm's equity at time zero, B_0 is the book value of equity at time zero, r is the cost of equity, and $E_0(X_i)$ are the expected earnings for period i , at time zero. Time zero is the previous fiscal year end and T equals 2 years. The residual income model equates firm value to book value plus the present value of future abnormal earnings (which are similar to Economic Value Added). By assuming the clean surplus relation (i.e. changes in retained earnings are equal to net income less dividends) this model can be shown to be equivalent to the dividend discount model. We use 3 years of future earnings, which might appear to be too short a period to capture all the future growth opportunities of a firm. However, the residual income model does not

⁶ Frank and Goyal deflate all numbers to 1982 values. We do not do this as the variables that we use from the Frank and Goyal paper are all ratios and deflating a ratio has no effect.

⁷ We drop values of Net debt and Deficit that are outside the top and bottom 0.5% and 99.5% of all values. This results in the loss of about 1.6% of all observations.

Table 1
Observations and inflation adjusted market values per year

Year	Number	Average market value (\$ Millions, 1980 dollars)	Median market value (\$ Millions, 1980 dollars)
1971	1329	776.77	73.54
1972	1851	689.24	68.63
1973	2068	535.27	39.44
1974	2227	312.55	22.98
1975	2141	402.52	27.48
1976	1994	455.01	33.93
1977	1864	396.04	37.05
1978	1891	373.35	37.62
1979	2077	323.42	31.22
1980	2065	380.09	34.61
1981	2270	294.77	26.47
1982	2127	321.85	23.65
1983	2053	408.10	38.38
1984	2113	381.02	29.79
1985	2111	461.34	33.78
1986	2188	492.31	35.15
1987	2334	485.94	33.26
1988	2385	537.57	34.18
1989	2386	616.12	39.81
1990	2412	600.98	31.14
1991	2457	717.81	42.05
1992	2445	737.47	49.35
1993	2484	793.37	60.37
1994	2449	767.79	55.83
1995	2416	955.64	57.69
1996	2464	967.22	59.11
1997	2441	1057.33	65.09
1998	2233	1248.75	60.04
1999	2444	1514.75	98.36
2000	2601	1924.90	79.44
2001	2500	1691.14	89.02
Total observations	68,920		

This table presents the annual number of firms for which the residual income valuation model was estimated each year, together with the average and median inflation adjusted market value of equity for each year. All market values are deflated by the CPI (1980=100).

capitalize raw earnings, rather it employs abnormal earnings (as in EVA) which tend to revert to zero, i.e.:

$$\text{Abnormal Earnings} = X_i - r \times B_{i-1} = \left[\frac{X_i}{B_{i-1}} - r \right] B_{i-1} \quad (4)$$

Abnormal earnings in Eq. (4) are equivalent to the difference between return on equity and the required return on equity, multiplied by the book value of equity. By treating the terminal value, TV, as a nominal perpetuity we are implicitly assuming mean reversion of the abnormal earnings over time.

Our primary tests use a perfect foresight version of the Residual Income Model (D'Mello and Shroff, 2000). In this implementation, B_0 is Compustat item d60 (book equity), and X_i is item d18 (income before extraordinary items). The use of the ex-post realization of earnings maximizes our

sample size but is not without some problems, the most significant of which is the issue of endogeneity. However, this endogeneity should bias our tests against finding evidence of misvaluation, as debt issues reduce future realized earnings through higher interest costs. Therefore, VP ratios for debt issuers will be biased downward, implying overvaluation, counter to our hypothesis. However, to check the robustness of our model, we re-estimate a subset of our tests using the analyst earnings forecast (obtained from FirstCall) made at the beginning of the fiscal year.⁸

We use Fama and French's (1997) three factor model to calculate the industry cost of equity, r , with the short-term T-bill as a proxy for the risk-free rate of interest.⁹ Lee, Myers and Swaminathan (1999) report that both the short-term T-Bill rates and the long-term Treasury bonds rates are useful proxies, however estimates of the intrinsic value V_0 , based on the short-term Treasury Bill outperform those based on the long-term Treasury Bond because they have a lower standard deviation and a faster rate of mean reversion. TV is calculated as the average of the last 2 years of the finite series and is restricted to be non-negative, as a negative TV implies that the firm would continue to invest in negative NPV projects in perpetuity.

By using future realized earnings and assuming perfect (and unbiased) foresight by managers, we proxy for the manager's, presumably more informed rational expectations. The use of realized earnings can be justified because we are not attempting to create a trading rule surrounding security issuance; we are merely measuring the deviation of market price from fundamental value.¹⁰ The estimated intrinsic value of the stock (V_0) is compared to the market value of the stock to determine the valuation error. Estimated misvaluation is measured as:

$$VP_0 = \frac{E(V_0)}{P_0} \quad (5)$$

Where VP_0 is the misvaluation at time zero, P_0 is the market price of the stock at time zero, and V_0 is the intrinsic value of the stock at time zero. If no misvaluation is present, VP should equal 1. A VP less (greater) than one implies over (under)-valuation.¹¹ Because the valuation model requires earnings through year $t+3$, we implicitly impose a four-year survival bias in our sample.

3.3. The financing deficit

We expand the model used by Shyam-Sunder and Myers (1999) with a direct measure of valuation. The original model regresses the change in net debt issued by the firm in each year on that firm's financing deficit, as in Eq. (1). The financing deficit for firm i in year t , DEF_{it} , is defined as:

$$DEF_{it} = DIV_{it} + I_{it} + \Delta W_{it} - C_{it} = \Delta D_{it} + \Delta E_{it} \quad (6)$$

⁸ D'Mello and Shroff (2000), Lee, Myers and Swaminathan (1999), and Dong, Hirshleifer, Richardson, Teoh (2006) also use analyst forecast data as a robustness check.

⁹ We also use a fixed risk premium approach as in Lee, Myers and Swaminathan (1999) and a simple one factor market model and generate similar results.

¹⁰ D'Mello and Shroff (2000) use a matching sample of stocks in order to measure relative misvaluation; however, this is not possible in our study because we are using the entire Compustat universe.

¹¹ During our sample the average VP is actually close to 1 (0.9764 to be exact). However, there is substantial variation within the sample. For example, in the pre-1990 period the average is 1.10, implying relative undervaluation, and 0.81 in the post-1990 period, implying relative overvaluation. Our results are robust to sub-period tests.

where DIV_{it} is cash dividends, I_{it} is net investments, ΔW_{it} is change in working capital, C_{it} is cash flow after interest and taxes, ΔD_{it} is net debt issued in year t (long-term debt issuance minus long-term debt reduction), and ΔE_{it} is net equity issued in year t (sale of common stock minus stock repurchases).¹²

We interact the financing deficit variable (DEF in Eq. (1)) with the misvaluation measure (VP in Eq. (5)). We then regress net debt issued on the financing deficit and our interacted VP-financing deficit variable. In later regressions, we control for the effects of conventional leverage variables (tangibles, growth options, size and profitability). Our basic model is:

$$\Delta D_{it} = a + b_1 \text{DEF}_{it} + b_2 (\text{DEF}_{it} \times \text{VP}_{it}) + e_{it} \quad (7)$$

where $(\text{DEF}_{it} \times \text{VP}_{it})$ is the financing deficit interacted with the measure of misvaluation. If firms follow the pecking order theory to fund their financing deficit, then b_1 should be close to unity. Further, if firms attempt to time the market, we expect b_2 to be significantly greater than zero. If there is no evidence of market timing we expect b_2 to be not statistically different from zero. When the interaction term is included in the model, the total impact of the deficit variable for the average VP firm is the sum of b_1 and b_2 .

4. Results

4.1. Valuation interacted with the financing deficit

Table 2 presents the results of estimating the model specified in Eqs. (1) and (7). Model 1 presents the regression of ΔD (change in net debt) on the financing deficit.¹³ The coefficient on the deficit variable is 0.243, implying that about 24% of the deficit is funded with debt, and is lower than that found by Shyam-Sunder and Myers' estimate of about 0.75, but higher than that found by Frank and Goyal. Given our 4 year data requirement, it is not surprising that the coefficient on the deficit variable is between the other two studies, but much closer to the latter.

In Model 2 of Table 2 we present the regression results of Eq. (7), where the second variable is an interaction between the financing deficit and the valuation measure (overvalued firms have a $\text{VP} < 1$ and undervalued firms have a $\text{VP} > 1$). The coefficient on this variable is a positive and significant 0.254, indicating that as firms become more overvalued (i.e. $\text{VP} < 1$), b_2 times $(\text{DEF} \times \text{VP})$ becomes smaller and overvalued firms use more equity to fund their financing deficit. The result is also economically significant; the coefficient 0.254, implies that a firm with the average financing deficit (0.049), a 10% decrease in VP (i.e. a 10% overvaluation of equity), will result in a 9.0% decrease in the amount of debt used to fund the financing deficit.¹⁴

Models 3 and 4 repeat the analysis for large firms (assets greater than the median assets in a given year) and Models 5 and 6 do the same for small firms (assets less than the median in a given

¹² We use the approach documented in more detail by Frank and Goyal (2003). A detailed list of the specific Compustat variables is available upon request, or can be found in the Frank and Goyal paper on page 229.

¹³ In all our regressions we control for firm fixed effects, use year dummies, and report p values based on Roger's standard errors (see Rogers, 1993) which are White standard errors (White, 1980) that include a correction for within-group correlation. This correction is necessary over and above the use of firm fixed effects as discussed in Petersen (2005). Our results are robust to using White standard errors, although the White standard errors are generally smaller.

¹⁴ We estimate Eq. (7) using the coefficient estimates from Table 2, Model 2, at the sample mean for both DEF and VP. For the average sample firm, plugging $\text{DEF} = 0.049$ and $\text{VP} = 1$ into Model 2 of Table 2 implies that debt amounting to 0.013983 (1.40%) of assets is issued to fund the deficit. Changing VP to 0.9, implying 10% overvaluation shifts this proportion of debt to 0.012728 (1.3%), which is a 9% change, i.e. $(0.013983/0.012728) - 1$.

Table 2
Deficit regressions with the interaction of misvaluation

	All firms		Assets > Median assets		Assets ≤ Median assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept [a_0]	-0.005** [0.02]	-0.005*** [0.01]	-0.005** [0.02]	-0.004** [0.02]	-0.009*** [0.01]	-0.008*** [0.01]
Deficit [b_1]	0.243** [<0.01]	0.126*** [<0.01]	0.525*** [<0.01]	0.391*** [<0.01]	0.155*** [<0.01]	0.071*** [<0.01]
Deficit VP [b_2]	-	0.254*** [<0.01]	-	0.179*** [<0.01]	-	0.229*** [<0.01]
N	68,920	68,920	34,451	34,451	34,469	34,469
Adjusted R^2	0.2678	0.3636	0.5116	0.5348	0.1911	0.2968

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

The dependant variable is net debt issued divided by total assets. Financial firms and utilities are excluded. Deficit is the financing deficit which is the sum of dividends, investments, and change in working capital, minus the cash flow after interest and taxes, all divided by total assets. VP is the value to price ratio where V is computed using the residual income model. Columns 1–2 represent the entire sample, while 3–4 and 5–6 represent firms with above and below median assets (in a given year) respectively. Rogers (1993) corrected p -values are in parentheses. Regressions control for firm fixed effects, and include unreported year dummies.

year). The pattern found for the full sample persists in the sub-samples, and the coefficient of the interacted variable is positive and significant in both cases. Consistent with previous literature, the small firm sample clearly shows a preference for equity and the large firm results move closer to those of Shyam-Sunder and Myers (1999).

In addition to the cross-sectional time-series regressions presented in Table 2, we estimate the deficit regressions using a Fama and Macbeth (1973) framework. We estimate cross-sectional regressions annually (for each of the 31 years covered by our sample) and then test the average of the slope coefficients. The average coefficient on DEF is 0.210 and the average coefficient on (DEF × VP) is 0.239; both are significantly different from zero at the 1% level. The size sub-sample results are qualitatively similar.

4.2. Inclusion of other capital structure determinants

As a robustness test, we add tangibility of assets, R and D expenditures, capital expenses, sales, and profitability as control variables to the Table 2 regressions.¹⁵ Each variable is interacted with the financing deficit variable, in order to capture each variable's contribution to the deficit coefficient. Tangible assets (Compustat data items: Net PPE [d8]/Total Assets [d6]) are associated with greater leverage, because the firm may use these assets as collateral, and firms with fewer tangible assets may be more opaque to the debt market. Growth options are proxied for by R and D expenditures (data items R and D Expense [d46]/Total Assets [d6]) and capital expenditures (data items: [d128]/[d6]). Increased profitability (data items: EBITDA [d13]/Total Assets [d6]) may result in lower leverage as greater retained earnings reduces the need for external

¹⁵ These variables have been used by various other researchers (for example: Rajan and Zingales, 1995; Hovakimian et al., 2001; Fama and French, 2002; Hovakimian, 2006; Flannery and Rangan, 2006) to control for firm specific attributes in the capital structure decision. Frank and Goyal (2003) also use these variables.

debt, or conversely increased profitability may increase leverage as the firm will have higher debt capacity. Sales growth, (as measured by $\ln(\text{Total Sales})$ data item [d12]) proxies for change in size of the firm. The full specification of the regression is as follows:

$$\begin{aligned} \Delta D_{it} = & a_0 + b_1 \text{DEF}_{it} + b_2 (\text{DEF}_{it} \times \text{VP}_{it}) + b_3 (\Delta T_{it} \times \text{DEF}_{it}) + b_4 (\Delta \text{RD}_{it} \\ & \times \text{DEF}_{it}) + b_5 (\Delta C_{it} \times \text{DEF}_{it}) + b_6 (\Delta \ln S_{it} \times \text{DEF}_{it}) \\ & + b_7 (\Delta P_{it} \times \text{DEF}_{it}) + \varepsilon_{it} \end{aligned} \quad (8)$$

where ΔT is change in tangible assets divided by total assets, ΔRD is change in research and development expenditures, ΔC is change in capital expenditures, $\Delta \ln S$ is change in the natural log of net sales, and ΔP is change in profitability (operating income over total assets). We adjust for firm fixed effects (similar to Frank and Goyal (2003)), include year dummies, and report Rogers (1993) standard errors to control for within group correlations.

Model 1, of Table 3, presents the results of estimating Eq. (8), excluding $\text{DEF} \times \text{VP}$. We find that firms with more tangible assets and capital expenditures use more debt to fund the deficit — possibly because fixed assets are more likely to be financed with secured debt. Increased R and D expense also increases the proportion of the deficit funded with debt, consistent with growth firms

Table 3
Deficit regressions with conventional leverage variables, and the interaction of misvaluation

	All firms		Assets > Median assets		Assets ≤ Median assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept [a_0]	-0.006*** [<0.01]	-0.005*** [<0.01]	0.013*** [<0.01]	0.013*** [<0.01]	-0.010*** [<0.01]	-0.007** [0.02]
Deficit [b_1]	0.374*** [<0.01]	0.236*** [<0.01]	0.691*** [<0.01]	0.580*** [<0.01]	0.266*** [<0.01]	0.157*** [<0.01]
Deficit × VP [b_2]	–	0.231*** [<0.01]	–	0.126*** [<0.01]	–	0.219*** [<0.01]
Δ Tangibility × Deficit [b_3]	0.647*** [<0.01]	0.510*** [<0.01]	0.447*** [<0.01]	0.397*** [0.01]	0.582*** [<0.01]	0.463*** [<0.01]
Δ R and D × Deficit [b_4]	0.346*** [<0.01]	0.258*** [<0.01]	2.369*** [<0.01]	2.086*** [<0.01]	0.219*** [<0.01]	0.161*** [<0.01]
Δ Capital Exp × Deficit [b_5]	0.066*** [<0.01]	0.064*** [<0.01]	0.036*** [<0.01]	0.037*** [<0.01]	0.083*** [<0.01]	0.081*** [<0.01]
Δ lnSales × Deficit [b_6]	-0.049*** [<0.01]	-0.037*** [<0.01]	-0.228*** [<0.01]	-0.200*** [<0.01]	-0.030*** [<0.01]	-0.022*** [<0.01]
Δ Profitability × Deficit [b_7]	0.136*** [<0.01]	0.115*** [<0.01]	0.537*** [<0.01]	0.468*** [<0.01]	0.090*** [<0.01]	0.081*** [<0.01]
N	57,756	57,756	28,872	28,872	28,884	28,884
Adjusted R^2	0.3889	0.4583	0.6219	0.6324	0.3118	0.3959

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

The dependant variable is net debt issued divided by total assets. Financial firms and utilities are excluded. Deficit is the financing deficit which is the sum of dividends, investments, and change in working capital, minus the cash flow after interest and taxes, all divided by total assets. VP is the value to price ratio where V is computed using the residual income model. Δ Tangibility is the change in tangible assets divided by total assets, Δ Research and Development is the change in Research and Development expense divided by total assets, Δ Capital expenditures is the change in capital expenditures divided by total assets, Δ Log sales is the change in the natural log of net sales, and Δ Profitability is the change in profitability defined as operating income over total assets. Columns 1–2 represent the entire sample, while 3–4 and 5–6 represent firms with above and below median assets (in a given year) respectively. Rogers (1993) corrected p -values are in parentheses. Regressions control for firm fixed effects, and include unreported year dummies.

Table 4
Sub-period deficit regressions with the interaction of misvaluation

	Sub-period		Full sample
	(1971–1989)	(1990–2001)	(1971–2001)
	(1)	(2)	(3)
Intercept [a_0]	-0.012*** [<0.01]	-0.008*** [<0.01]	-0.063*** [<0.01]
Deficit [b_1]	0.187*** [<0.01]	0.091*** [<0.01]	0.158*** [<0.01]
Deficit \times VP [b_2]	0.264*** [<0.01]	0.212*** [<0.01]	0.269*** [<0.01]
Deficit \times NINETIES [b_3]	–	–	-0.058*** [<0.01]
Deficit \times VP \times NINETIES [b_4]	–	–	-0.053** [0.04]
N	39,474	29,446	68,920
Adjusted R^2	0.4586	0.2918	0.3697

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

The dependant variable is net debt issued divided by total assets. Financial firms and utilities are excluded. Deficit is the financing deficit which is the sum of dividends, investments, and change in working capital, minus the cash flow after interest and taxes, all divided by total assets. VP is the value to price ratio where V is computed using the residual income model. All variables are scaled by assets. NINETIES is a dummy variable that takes the value of 1 if the observation is after 1989 and zero otherwise. Columns 1–2 represent the sub-samples, while column 3 represents the entire time period. Rogers (1993) corrected p -values are in parentheses. Regressions control for firm fixed effects, and include unreported year dummies.

having higher asymmetric information. Increased sales has a negative effect on the magnitude of the deficit coefficient, consistent with firms experiencing growth (or perhaps having more growth options) using equity to protect those options. Finally, increased profitability contributes to a higher coefficient on the deficit variable, consistent with firms seeing their debt capacity increase as their coverage ratio improves.

We now turn our attention to the interaction between the financing deficit and VP. In Model 2 we include the DEF \times VP interaction; the coefficient is a highly significant 0.231; very close to the coefficient in Model 1 of Table 2, providing evidence that the VP measure is not proxying for another determinant of capital structure. The adjusted R^2 of Model 2 is larger than that of Model 1 (0.4583 and 0.3889, respectively), indicating that the financing deficit adds explanatory power to the model.¹⁶ Models 3 and 4, and Models 5 and 6, present coefficient estimates for large and small firms, respectively, and in all cases the results are broadly in line with those reported in Table 2. The coefficient on the financing deficit in the large firm sample (Model 4), is nearly 0.6, a figure considerably closer to that found by Shyam-Sunder and Myers, while including a substantially larger number of firms.

4.3. The impact of valuation over time

During the 1990's, Frank and Goyal (2003) find that firms are less likely to use debt when funding their financing deficit. They, and Lemmon and Zender (2004), argue that this is most likely due to an

¹⁶ In unreported regressions, we obtain similar results when we use the change in market net debt (i.e. debt/(market value of equity+debt) issued as the dependent variable.

increased number of small, high-growth firms that face more severe constraints on debt issuance. However, during this decade, market valuations also reached levels not previously experienced, and if firms issue equity when they are overvalued, we expect to see lower financing deficit coefficients during this period. In Table 4, we estimate the deficit regression with $DEF \times VP$ for pre- and post-1990 separately. We also estimate a full sample model that includes an interaction term for the 1990s. Models 1 and 2 suggest that the coefficient on the deficit variable during the 1990s is smaller than during the earlier period, similar to Frank and Goyal's finding. However, the valuation effect is significant across both periods, although ΔD appears to be less sensitive to misvaluation during the later period. In Model 3 we use the entire sample period and include interacted variables for both misvaluation and time period. The regression specification is as follows:

$$\Delta D_{it} = a_0 + b_1 DEF_{it} + b_2 (DEF_{it} \times VP_{it}) + b_3 (DEF_{it} \times NINETIES) + b_4 (DEF_{it} \times VP_{it} \times NINETIES) + \varepsilon_{it} \quad (9)$$

where NINETIES is a binary variable that has a value of 1 after 1989 and zero otherwise.

The results echo those found in the time-period sub-samples from Models 1 and 2. The negative and significant coefficient of $(DEF \times NINETIES)$ implies that less of the financing deficit was financed with debt during the 1990s. The negative coefficient on $(DEF \times VP \times NINETIES)$ is significant ($t = -2.02$), suggesting that the impact of misvaluation in the 1990s on the deficit coefficient was slightly smaller than during the early time period.

The raw coefficient estimates tell only part of the story however. A richer interpretation can be made when one considers the level of VP across time. To examine directly the temporal impact of VP on the financing deficit, we estimate Model 1 from Table 2 for each year from 1971 to 2001 (similar to that of the Fama–MacBeth regressions reported earlier) and capture the annual coefficient on the financing deficit. Fig. 1 presents the annual deficit coefficient obtained from each of the annual regressions and the annual average VP ratio, plotted against time. The correlation between these two series is a highly significant 0.90. Based on this analysis, it seems reasonable to

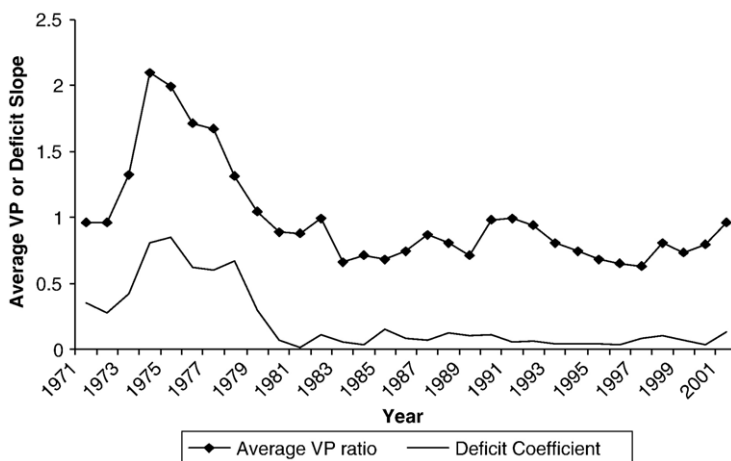


Fig. 1. Average VP ratio and deficit coefficient by year. The VP ratio is the average Value to Price ratio for each year in the sample, where V is computed using the residual income model. The Average Deficit Coefficient is estimated from the following regression which is run annually; $\Delta D_{it} = a + bDEF_{it} + e_{it}$.

conclude that a substantial amount of the variation in the financing deficit coefficient is due to changes in misvaluation.

So far, our analysis has established that the degree of relative misvaluation is an important determinant of the method of funding the financing deficit, and significantly reduces the hypothesized one-to-one relationship between it and the net change in debt. In the following section we address whether our use of the perfect foresight valuation model biases our results.

4.4. Valuation using analyst forecasts

The prior analysis assumes managers have perfect foresight, which is subject to the criticism that it may not be a realistic proxy for ex-ante valuation. To test the robustness of our results we re-estimate the valuation model using FirstCall mean analyst earnings forecasts. For each of the 3 years of future expected earnings we use the consensus forecast that is closest to the beginning of the fiscal year being valued, but after the year end when B_0 , book equity is reported. In the cases where the third year forecast is missing we project the second year forecast using the implied growth rate from the year one forecast to the year two forecast. The FirstCall data imposes some restrictions on our sample size, as it is only available from 1991 onwards, and only a subset of our sample is in the FirstCall database. Even though analyst forecast data is publicly available, Lee, Myers and Swaminathan (1999) and others show that the residual income model using this data has predictive ability.

When the basic deficit regressions from Table 2 (i.e. Models 1 and 2) are re-estimated using the analyst forecast valuation, the deficit coefficient is 0.184 in Model 1 which is lower than the overall sample coefficient from Model 1 of Table 2 (0.243), but close to the results for the 1990 sub-period (0.186). When we add $(DEF \times VP)$ to the regression in the same way as in Model 2 of Table 2, except that VP is computed using analyst earnings forecasts, the coefficient on DEF is 0.102 and on $DEF \times VP$ it is 0.150. Both coefficients are significant at the 1% level and indicate that undervalued firms tend to issue more debt to fund the deficit while over valued firms favor equity.¹⁷ Therefore, it seems reasonable to conclude that our results are not due to endogeneity in the perfect foresight model.

4.5. Asymmetric valuation effect

If the cost of debt is constant and the cost of equity is inversely related to over-valuation, then we should observe a different slope on the deficit coefficient depending on whether firms are overvalued or undervalued, and whether the firm has a financing deficit or a financing surplus (i.e. a negative deficit).¹⁸ We examine these subsamples using a spline regression framework and present the results in Table 5, and graphically in Fig. 2. We estimate the following piecewise (or spline) regression:

$$\Delta D_{it} = a + b_1 DEF_{it} + b_2 (DEF_{it} \times VP_{it}) + b_3 [DEF_{it} \times VP_{it} - DEF_{it} \times VP_{it}^*] \times OVER_{it} + e_{it} \quad (10)$$

¹⁷ The regressions both have 14,518 firm years of observations. We include fixed effects and year dummies and Rogers (1993) standard errors. The adjusted R^2 is 0.2333 for Model 1 and 0.2600 for Model 2.

¹⁸ We assume that managers use the lowest cost type of financing and the cost of debt is constant. At some point, as equity becomes more over-valued, the cost of outside equity financing will become less than the cost of other sources of financing.

Table 5
Asymmetric effects of misvaluation using a spline regression

	Deficit > 0	Deficit < 0
Intercept [a_0]	0.013*** [<0.01]	0.005** [0.001]
Deficit [b_1]	0.248** [0.01]	0.672*** [<0.001]
Deficit × VP [b_2]	0.063*** [<0.01]	0.037** [0.043]
(Deficit × VP – Deficit) × OVER [b_3]	0.216*** [<0.001]	0.032 [0.579]
Deficit mean	0.1263	–0.0390
N	36,785	31,658
Adjusted R^2	0.2737	0.6453

***, **, and* indicate significance at the 1%, 5% and 10% levels, respectively. The regression model is a spline model with the node fixed at $VP=1$.

The dependant variable is net debt issued divided by total assets. Financial firms and utilities are excluded. Deficit is the financing deficit which is the sum of dividends, investments, and change in working capital, minus the cash flow after interest and taxes, all divided by total assets. VP is the value to price ratio where V is computed using the residual income model. OVER is a dummy variable that takes the value of 1 if $VP < 1$ and 0 otherwise and represents overvaluation. All variables are scaled by assets. Rogers (1993) corrected p -values are in parentheses. Regressions control for firm fixed effects, and include unreported year dummies.

where $OVER=1$ if $VP < 1$ and zero otherwise, and $DEF \times VP^*$ is the location on the horizontal axis where the spline node is to occur, which in our case is when $VP^*=1$.¹⁹ When $VP^*=1$, Eq. (10) reduces to:

$$\Delta D_{it} = a_0 + b_1 DEF_{it} + b_2 (DEF_{it} \times VP_{it}) + b_3 [DEF_{it} \times VP_{it} - DEF_{it}] \times OVER_{it} + e_{it} \quad (11)$$

For undervalued stocks (i.e. $VP \geq 1$) the slope coefficient on DEF is b_1 and the interaction between DEF and VP is simply b_2 , however for overvalued stocks (i.e. $VP < 1$ and $OVER=1$) the slope coefficient on DEF is $(b_1 - b_3)$ and the coefficient on $(DEF \times VP)$ is $(b_2 + b_3)$.

Firms with a financing deficit ($DEF > 0$) must raise external capital to cover the financing shortfall, however, valuation should only effect the equity issuance decision when they are overvalued, therefore we expect to find a zero slope on the interacted $DEF \times VP$ variable when $VP \geq 1$, and a non-zero slope for $DEF \times VP$ when $VP < 1$ when market timing should matter. In Model 1 of Table 5, when the firm is undervalued ($VP > 1$) the coefficient, b_2 measures the full interaction of the Deficit and VP (as $OVER=0$ in this case). The value of b_2 is 0.063, which while positive and significant is small compared to the coefficients estimated in Table 2, Model 2. When the firm is overvalued ($VP < 1$) the interaction coefficient b_3 captures the additional slope of this section of the line. In this case, b_3 is a highly significant 0.216, indicating that valuation has an important effect on the proportion of debt used to fund the deficit, and that this proportion will decline as the firm becomes more overvalued.

Model 2 presents the estimates for the spline regression when firms have a negative deficit (a financing surplus). The key result here is that b_3 is small and not statistically different from

¹⁹ In the spline model we assume that the breakpoint between outside equity and debt is at the ‘fair-valuation’ of equity, however in reality it is probably in some region above $VP=1$ (i.e. undervalued).

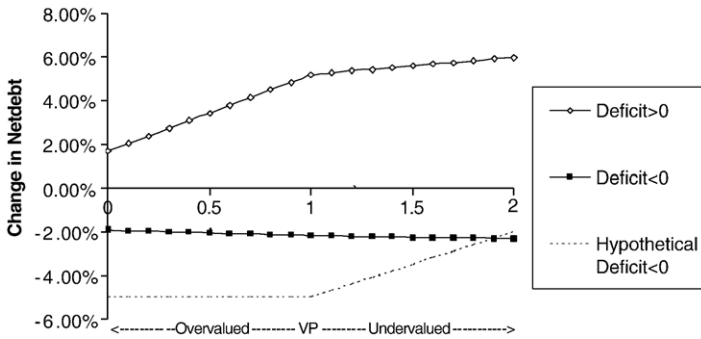


Fig. 2. Deficit spline regression. This graph presents the fitted values of the change in Net Debt issued for a reasonable range of VP based on the spline regressions estimated in Table 5.

zero, implying that market timing does not have a differential effect on the firms repurchasing decision when the firm has a financing surplus. Furthermore, the small magnitude of b_2 implies that overall valuation does not matter much to firms with a surplus. For these firms with surplus funds, it appears as though most of their surplus is used to repurchase debt (as the coefficient b_1 is quite high), and that the amount repurchased is largely invariant to the misvaluation.

The fitted values of ΔD for Models 1 and 2 of Table 5 are plotted against a range of VP ratios (using the sample mean values of DEF) in Fig. 2. Fig. 2 clearly demonstrates the relative importance of VP in determining (through the interaction) the slope of the deficit variable when the firm has a positive deficit. When a firm is overvalued, the slope is steeper and positive implying that changes in valuation level have a significant impact on the amount of debt issued. When the firm is undervalued, the slope is less, indicating that for correctly or undervalued firms, the level of valuation does not matter as much. For firms that have a negative deficit (i.e. financing surplus) the line is essentially horizontal, a result contrary to the market timing theory. To aid the reader we have plotted the shape of the hypothetical line (the dotted line on the figure) that would be expected if the firm were to engage in market timing and had a negative deficit. This line indicates that it is only when the firm is undervalued that market timing would matter and in this case the firm would repurchase more stock (and less debt).

The negative deficit (financing surplus) results are puzzling and not consistent with the theory of market timing, but we are not the first to document this issue. Kayhan and Titman (2007) also fail to find cross-sectional variation among the negative deficit firms and postulate that this may be due to the lack of variation in their sample.²⁰ We suspect that the cause may be related to managerial incentives surrounding the decision to repurchase equity. If managers favor greater financial slack (and less discipline from the debt market), they will be more likely to pay off debt before they repurchase equity, regardless of valuation. We find weak support for this idea, when, in unreported regressions, we examine the Table 2, Model 2 regression with an interaction for firms with times interest earned ratios greater than the sample mean (i.e. plenty of financial slack). For these firms, we find that the coefficient for the $DEF \times VP$ variable becomes negative (although small in magnitude), consistent with these firms repurchasing stock when undervalued. We

²⁰ See Kayhan and Titman (2007) page 16, footnote 30.

consider a full investigation of this issue is beyond the scope of the current paper, and we leave it open as a topic for future research.

5. Conclusion

We use the residual income model to directly measure the fundamental value of a firm's equity and examine the impact of market timing on the firm's method of funding the financing deficit. The use of this earnings-based valuation metric allows us to disentangle the multiple interpretations associated with market-to-book. We find that firms whose equity is overvalued by the market are more likely to issue equity to fund the deficit than undervalued firms. Our findings are robust to other factors that have been found to significantly impact the firm's method of funding the deficit. In addition, our results hold when we estimate our valuation metric using different proxies for future earnings. We interpret our results as providing evidence for Baker and Wurgler's (2002) market timing theory of capital structure. We find that the impact of the valuation effect varies over time, and that the level of misvaluation is highly correlated with the proportion of the financing deficit that is funded by equity.

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