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Market timing and the debt–equity choice

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Abstract

We test the market timing theory of capital structure using an earnings-based valuation model that allows us to separate equity mispricing from growth options and time-varying adverse selection; thus avoiding the multiple interpretations of book-to-market ratio. We find that equity market mispricing plays a significant, if not dominant, role in the security choice decision. Our results are robust to the inclusion of proxies for time-varying growth options and alternate methods of measuring misvaluation.

JEL classification: G32

Keywords: Capital structure; Market timing; Security choice; Mispricing; Earnings-based valuation; Residual income model

1. Introduction

The equity market timing theory of capital structure proposes that managers are able to identify times when equity issuance is less costly compared to other types of external financing due to the market's overvaluation of the firm's stock. Successful timing of the equity market lowers the firm's cost of equity and benefits current shareholders at the expense of new shareholders. If managers are able to time the equity market, proxies for misvaluation should be correlated with the timing of the security issuance decision.

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Some attempts have been made to document a relation between proxies for valuation and equity issuance. Loughran and Ritter (1995), for example, use post issuance returns as an indirect proxy for valuation and document greater equity issuances during periods of relatively high market values, where market values are assumed to be negatively correlated with ex post returns. More recently, Baker and Wurgler (2002) use the temporal variation in book-to-market ratios as a proxy for valuation and find that leverage is positively related to past book-to-market ratios. Baker and Wurgler argue that the past patterns of book-to-market imbed evidence of past market misvaluation.

A key drawback of using book-to-market to measure misvaluation is the multiple interpretations of the ratio. Indeed, this issue is raised by Baker and Wurgler (p. 27) who concede that while they believe their results are consistent with equity mispricing in the presence of irrational investors and/or managers, there are alternative interpretations. Their findings are also consistent with an extension of Myers' (1984) pecking order model, which includes time-varying adverse selection costs (Lucas and McDonald, 1990). Under such a setup, firms will time equity issuances relative to adverse selection costs. If book-to-market measures variations in adverse selection, equity issues are more likely when book-to-market (and adverse selection costs) is (are) low.[2] McConnell and Servaes (1995) and Stulz (1990) use book-to-market to measure growth options and find evidence that firms with many growth options issue equity to mitigate the underinvestment problem that arises from greater leverage. In both of these alternative explanations, low book-to-market is interpreted as a proxy for growth options or adverse selection costs, and firms issue equity when book-to-market is low.

In this paper we attempt to separate market timing effects (caused by irrational pricing) from the effects of growth options and adverse selection (due to asymmetric information). To examine the relative importance of growth options and mispricing, we decompose book-to-market into a growth option component and a mispricing component and then directly examine the role that each plays in the security choice decision. Our method is in the spirit of Rhodes-Kropf et al. (2005) who, in a study of equity mispricing and mergers, decompose book-to-market into two components; the ratio of (intrinsic) value to market price and the ratio of book value to (intrinsic) value. Rhodes-Kropf et al. interpret the first component (value-to-price) as a measure of mispricing and the second component (book-to-value) as a measure of growth opportunities.

Our first set of tests uses a valuation model that relies on the assumption of perfect foresight by managers. The advantage of this model is that it increases the sample size and proxies for the manager's information set at the issuance decision time. While the perfect foresight model allows for the separation of growth options and mispricing, it does not allow us to determine whether the mispricing is caused by irrationality of the market or asymmetric information between the market and managers. To tackle this issue, we repeat our tests using a valuation model in which all the inputs are publicly available at the time of the issuance (specifically, analyst earnings forecasts). This allows us to separate irrational mispricing from time varying adverse selection costs.

We conduct our perfect foresight tests on a sample of 3781 public equity and 5391 non-convertible debt issues. Consistent with the market timing theory, we find that firms with overvalued equity are more likely to issue equity, while those that are fairly valued or undervalued, are more likely to issue debt. Using the Rhodes-Kropf et al. (2005) method we are able to measure the relative importance of growth options compared to mispricing. We find that mispricing has a significant influence on the security choice decision (consistent with firms following mar-

[2] Autore and Kovacs (2005) find evidence of a relation between time varying adverse selection and equity issuances.

ket timing strategies based on irrational investors or managers), even after controlling for growth options. Previous work has been unable to measure the relative importance of growth options and mispricing because book-to-market has largely served as a single proxy for both. Our findings resolve the dual interpretation of the results of Baker and Wurgler (2002). Substituting analyst forecast earnings for ex post earnings leaves the results qualitatively unchanged. We interpret this as further evidence of market timing in general and in particular suggestive of investor irrationally. Finally we also find similar results when we use alternative valuation measures to estimate mispricing.

The paper proceeds as follows; Section 2 discusses previous research and develops the hypothesis, Section 3 presents the data and method, Section 4 presents the results and robustness checks and Section 5 concludes.

2. Literature review and hypotheses development

Until recently, the firm's capital structure choice has been modeled by two main theories. The pecking order theory, in which the firm issues the cheapest security first, usually implies that the firm prefers internal to external financing (Myers, 1984; Myers and Majluf, 1984) and the static trade off theory in which the firm makes adjustments over time toward an optimal target capital structure.

Recent studies suggest that the timing of debt and equity issues plays an important role in corporate financial policy. A survey of 392 CFOs by Graham and Harvey (2001) finds only limited support for the pecking order and static trade off theories, but reveals that CFOs claim to actively engage in market timing practices. Baker and Wurgler (2002) are the first to specifically address how market timing affects the firm's capital structure by utilizing book-to-market ratios as a proxy for firm valuation. They show that high leverage firms raised capital during periods when their book-to-market values were high and low leverage firms raised capital when their book-to-market ratios were low. They interpret these results as evidence that capital structure is the cumulative outcome of past attempts to time the equity market, and offer two possible explanations for their findings. First, if adverse selection costs vary, either across firms or across time, and are positively related to book-to-market, firms are more likely to issue equity when book-to-market and adverse selection is low.[3] This is an application of the pecking order theory to a multi-period setting in which adverse selection costs vary and firms do not revert to their capital structure because the costs of not doing so are small. Their second explanation assumes that markets are inefficient, which allows managers to time the equity market and issue equity when they perceive that investors overvalue the firm. A third explanation (not offered by Baker and Wurgler) is provided by McConnell and Servaes (1995) and Stulz (1990) who present evidence that firms with high levels of growth options will fund these growth options through equity issuances rather than debt in order to avoid debt hold up problems. Their work presents the second of the "two faces of debt" in which debt can reduce firm value by leading to underinvestment. In a more recent paper, Dittmar and Thakor (2007) develop a theory where managers and investors share the same information, but have differing priors. The degree of agreement between managers and investors about the future prospects of a new investment determines how the security issuance choice will affect the firm's post-investment stock price. In this model, a high stock price associated with equity issuance is interpreted as evidence of high agreement between managers and

[3] Lucas and McDonald (1990) and Korajczyk et al. (1991) model the timing of equity issues when adverse selection costs vary across firms. Choe et al. (1993) examine time varying adverse selection costs.

investors about the future prospects of a new investment. Important to our study, the prediction of the time varying adverse selection cost hypothesis, the growth options hypothesis, and the 'market agreement hypothesis' are broadly the same as that for the market timing hypothesis, that is; that low book-to-market firms will favor equity issuances.

The use of book-to-market as a measure of mispricing presumes that the book value of equity is a reasonable measure of fundamental value. However, as discussed earlier, a portion of the difference between market price and book value may be driven by other factors, such as growth opportunities. Rhodes-Kropf et al. (2005) recognize this problem and develop a simple decomposition of the book-to-market ratio in which book-to-market is viewed as the product of book-to-value and value-to-market, i.e.[4]:

$$\frac{B}{M} = \frac{B}{V} \times \frac{V}{M} \tag{1}$$

where B is the book value of equity, M is the market value of equity and V is the fundamental value of equity. In their setup, value-to-market (V/M) measures mispricing by the market, while book-to-value (B/V) measures growth opportunities. Previous authors have used value-to-market measures to estimate mispricing of stocks, but such measures are subject to the criticism that they may be correlated with book-to-market and may be capturing growth options rather than mispricing. By adding the book-to-value measure to our models, we are able to separate out the mispricing and growth option components of market-to-book.

Decomposition of book-to-market only addresses one part of the multiple interpretations problem, in that we separate growth options from mispricing. However, it does not directly tackle the issue of asymmetric information. Under the pecking order model, asymmetric information leads firms to avoid external equity financing. Firms do not issue equity because the market will rationally re-price the stock immediately after the issue because of the potential lemons problem. Fama and French (2002) argue that the fact that many firms do issue equity (and do so in large amounts) is inconsistent with asymmetric information being a significant issue. Therefore, in order for asymmetric information to play a role in the security issuance decision we must assume that the firm's managers believe that they have superior information about the future prospects of the firm *and* that the market will under react when the firm acts on this information asymmetry. This version of the asymmetric information story relies on investor irrationality after the issuance, as the firm may be correctly priced based on the market's unconditional information set. Distinguishing between pure irrational mispricing and mispricing due to differing information sets depends upon the method of computing V, the fundamental value of the stock.

We use the residual income model as a measure of fundamental value. We explicitly incorporate the growth opportunities into the measure (in the form of future abnormal earnings), time-varying market interest rates, and avoid, to some degree the potential that accounting conventions may not accurately reflect fundamental value.[5] Lee et al. (1999) find that the residual income model has significant predictive ability (over 20% of the variation in the real return of the Dow 30) and therefore performs well as a measure of valuation. They also find that book-to-market ratios alone explain only about one third of one percent of the variation in the real

[4] These authors actually use market-to-book rather than book-to-market, but we have restated their decomposition to be consistent with our setup.

[5] The residual income model is computed as the book value of equity plus the present value of future earnings in excess of the required rate of return (very similar to Economic Value Added). The specific properties of the model and its ability to capture growth opportunities are discussed in Section 3.2.

return in the Dow 30 stocks over a one to eighteen month time horizon, and conclude that book-to-market ratios provide little economic predictability of stock returns. This result is broadly consistent with Kothari and Shanken (1997) who show that while book-to-market ratios have some predictive power over returns during the 1926–1991 time period, their predictive ability is substantially reduced in the 1946–1991 sub-period.

We compute a firm's fundamental value with two different inputs. The first is a perfect foresight model that uses ex post realizations of future earnings and represents our proxy for the manager's opinion of value at the time of issuance. The second version of the model uses analyst's earnings forecasts and thus contains only information available to the market at the time of issuance. There are three potential explanations for the perfect foresight model producing a valuation different from the current stock price. First, we cannot rule out the possibility of a misspecified model, and that the model merely produces a noisy estimate of the market price. If this were the case we would expect no predictable relation between the mispricing measure and firm behavior. Second, the model may capture pure misvaluation, where the market has irrationally failed to value the stock correctly. Finally, if the perfect foresight model accurately proxies for the manager's information set, and does yield a different value than the stock price, it is possible that asymmetric information between the firm and investors is driving the valuation wedge and causing the mispricing. To tackle the third possibility, we use the analyst forecast model which is free of asymmetric information between the firm and investors because it uses only publicly available information. Confirmation of the perfect foresight results by the analyst forecast model implies that the security issuance decision is not driven by asymmetric information, instead, and perhaps more troubling; the mispricing is driven by investors irrationally misvaluing stocks.

With the two measures of intrinsic value, relative to market price, we examine the choice of securities in light of the market timing hypothesis, while controlling for extant theories of capital structure. We seek to determine what, if any, mispricing of equity exists across different types of security issuances, at the time of issue. We study debt and public equity issuances.[6] Consistent with the market timing hypothesis we expect firms to issue equity when equity is most overvalued, and when equity is undervalued we expect the firm to issue debt. We model the security issuance decision as a function of mispricing and proxies for factors that previous researchers have documented as important determinants of leverage.

3. Data and method

3.1. Sample selection

The initial sample consists of all non-financial, US firms that issued public seasoned equity, and all non-convertible debt (both public and private), during the period 1980–1999. We exclude financial companies due to the highly regulated environment in which they operate. Filing and issue dates and issue specific variables are obtained from Securities Data Company's (SDC) Global New Issues database. We require that all firms have relevant data available on CRSP and COMPUSTAT. In the case of multiple debt issues that occur within 10 days, we combine the proceeds of the issues, use the first filing date, and treat them as one offering.

The valuation model requires one year of accounting data prior to, and at least three years of accounting data after the announcement date. The initial sample contains 9172 security issuances

[6] Due to a very limited sample size of companies issuing private equity, we omit these from our analysis.

Table 1
Security issues by year

Year	Total number of issues	Public equity	Debt
1980	339	180	159
1981	423	207	216
1982	600	410	190
1983	277	111	166
1984	393	153	240
1985	496	150	346
1986	410	124	286
1987	335	64	271
1988	366	99	267
1989	376	78	298
1990	557	217	340
1991	551	206	345
1992	678	275	403
1993	439	206	233
1994	518	239	279
1995	585	300	285
1996	586	277	309
1997	531	185	346
1998	414	164	250
1999	298	136	162
Total	9172	3781	5391

Notes. This table presents the distribution of the total sample of all US non-financial firms with data available on CRSP, COMPUSTAT and SDC issuing public equity, public non-convertible debt or private non-convertible debt between January 1980 and December 1999 for which we are able to compute the valuation metric. Issues done by the same company in the subsequent 10 days after the issue date are combined into one issue.

which are divided into 3781 public equity issues and 5391 debt issues.[7] Table 1 presents the number of issues for each type of security for each year of the sample. Total issues vary from a high of 678 in 1992 to a low of 277 in 1983.

3.2. Variables to measure potential market timing

The key variable required to test the market timing theory is a measure of value relative to price at the time of security issuance. Other studies that have examined market timing have relied on post issue returns, market activity, issuance returns or book-to-market ratios as proxies for mispricing. Broadly following Rhodes-Kropf et al. (2005), we decompose book-to-market into two components, book-to-value and value-to-market. We use the residual income model to estimate a firm's intrinsic value, allowing us to more directly measure mispricing. The residual income model is also used in a similar context by D'Mello and Shroff (2000), Jindra (2000), and Dong et al. (2002). Lee et al. (1999) show that value-to-price ratios, where value is based on a

[7] Our initial listing of issues from SDC totals 40,307 of which 17,329 are private debt, 14,237 are public debt and 8065 are public equity. The combination of finding data in Compustat, and the restrictions imposed by the valuation model substantially reduce the sample to that reported.

residual income valuation model, have greater predictive power in forecasting future returns than book-to-market ratios, earnings-to-price ratios, and dividend yields. The intrinsic value is then scaled by market price to yield a ratio that, in theory, should equal unity when the firm is fairly valued and is greater (less) than one if it is undervalued (overvalued). We implement the model assuming perfect foresight. This assumption allows us to estimate the model for a large sample, but as discussed above, does not preclude an asymmetric information based misvaluation story. In robustness tests, we use also analyst earnings forecasts, and obtain similar results, consistent with asymmetric information not being a driver of our main results.

Use of the value-to-price ratio has several advantages. First, we do not rely on a market model and thus avoid the issues related to the use of daily stock returns in event studies.[8] Second, the security issuance literature has not only documented abnormal performance in the short run, but also in the long-run. The residual income model allows us to capture both, short-run and long-run effects. Third, by assuming perfect foresight by managers (through the use of ex post data) we are able to include a proxy for manager's private information about the future earnings of the company.

In addition to the asymmetric information issue, we also acknowledge that use of ex post data does not exempt us from the possibility that management may manipulate accounting data and therefore bias the results. We ameliorate this problem by scaling the valuation ratio by the average valuation ratio for the subject firm from the two years prior to the issue. This approach captures the temporal misvaluation of the firm. There is also a possibility that the results from the ex-post earnings-based residual income model (RIM) are driven by the choice of security and therefore may be endogenous. The analyst forecast earnings-based RIM model ameliorates this problem.

Ohlson (1990, 1995) demonstrates that the residual income model is theoretically identical to the dividend discount model in determining the value of equity. We provide a proof of this equivalence in Appendix A. However, the use of accounting numbers in the residual income model makes the model easier for practical implementation than the dividend discount model. In the residual income model, equity value estimates are based on future abnormal earnings. The basic model determines the intrinsic value by adding to book value the discounted expected earnings in excess of normal return on book value:

$$E(V_0) = B_0 + \sum_{i=1}^{T} (1+r)^{-i} E_0[X_i - r^* B_{i-1}] + \frac{(1+r)^{-T}}{r} TV \tag{2}$$

where TV is calculated as:

$$TV = E_0\big[(X_T - r^* B_{T-1}) + (X_{T+1} - r^* B_T)\big]/2. \tag{3}$$

$E(V_0)$ is the value of the firm's equity at time zero, B_0 is the book value at time zero (Compustat item 60), r is the cost of equity, and $E_0(X_i)$ are the expected future earnings for year i at time zero (Compustat item 18). Time zero is the time at the end of the fiscal year immediately preceding the file date, and T equals two years. All variables are scaled by shares outstanding (Compustat item 25).

The residual income model, calculated as the sum of book value, the present value of two years of abnormal earnings, and a terminal value, captures the long run growth opportunities in

[8] See Brown and Warner (1980, 1985), Corrado and Zivney (1992), and MacKinlay (1997) for a detailed discussion on the use of daily stock returns in event studies.

a way that may not be immediately obvious. First, future contributions to value are expressed as abnormal earnings (similar to the concept of economic value added). For the market in aggregate the mean abnormal earnings should be around zero. Firms with non-zero abnormal earnings will see their abnormal earnings revert to zero over time, as competitive pressures reduce their ability to earn abnormal profits.[9]

The terminal value treats the last year's abnormal earnings as a level, nominal perpetuity, which is equivalent to projecting the absolute value of these abnormal earnings declining in real terms. Firms with growth opportunities should have positive abnormal earnings and the model will capture these beyond the two years of the explicit earnings used in the model. It is conceivable that the model may undervalue firms with no growth opportunities in the short run, but substantial growth opportunities in the long term, so in unreported results we also estimate the valuation model using four and five years of data following the issue date and generate qualitatively similar results.

The cost of equity, r, is estimated using a single factor model on a firm by firm basis. We also estimate the cost of equity using the Fama–French three factor model, and generate similar results, but find that the estimates using this approach are far noisier than those from the single factor model. The equity risk premium is estimated as the geometric difference between the return on the S&P 500 and the risk free rate from 1926 to 2004 and is 6%. Our results are substantively unchanged if we use a rolling risk premium based on the geometric difference between the S&P 500 returns and the risk free rate over the 60 months prior to the issuance. We use the short-term T-Bill rate as a proxy for the risk-free rate of interest. Lee et al. (1999) report that both the short-term T-Bill rates and the long-term Treasury bond rates are useful proxies for the risk free rate. However, estimates of V_0 based on the short-term T-Bill rate outperform those using the long-term T-bond rates because they have a lower standard deviation and a faster rate of mean reversion. The estimated intrinsic value of the stock at the time of issue announcement is then scaled by the market value of the stock. Mispricing is measured as the value to price ratio:

$$VP_0 = \frac{E(V_0)}{P_0} \tag{4}$$

where VP_0 represents the estimated absolute mispricing at time zero, P_0 represents the market price of the stock one month prior to the security issue, and V_0 represents the intrinsic value of the stock at time zero.[10] We also measure mispricing relative to the previous years as shown in Eq. (5), where VP_{-1} and VP_{-2} are the value to price ratios for the two years prior to the issue:

$$VPts = \frac{VP_0}{(VP_{-1} + VP_{-2})/2}. \tag{5}$$

If no mispricing is present, VPts should equal 1. A VPts less than 1, indicates that the firm is overvalued at time $t = 0$ relative to the previous years. A VPts greater than one indicates that the firm is undervalued.

In addition to the perfect foresight valuation model, we also compute the residual income model using analyst forecasts of future earnings from FirstCall. We use the last average forecast made prior to the issue date for the fiscal year-end immediately following the security issuance

[9] Conversely firms with negative abnormal earnings will, over time, see these earnings revert positively as management (or new management) takes steps to correct operational deficiencies.

[10] As a robustness check we use the prior year end stock price and generate qualitatively similar results, albeit a little less significant.

Table 2
Correlations between misvaluation metrics and other key variables

	VP	VPts	FVP	FVPts	BTM	MVts
VP	1					
VPts	0.7528***	1				
FVP	0.2094***	0.0445**	1			
FVPts	0.0201	0.0375	0.4859***	1		
BTM	0.3809***	0.0526***	0.6462***	0.2160***	1	
MVts	−0.0406	−0.0712***	−0.3103***	−0.4421***	−0.0806***	1
Cost of Capital	−0.1383***	−0.0294**	−0.3158***	−0.2394***	−0.1049***	0.1160***

Notes. VP is the value to price measure computed using the perfect foresight residual income model and using the stock price for the month end prior to the issue. FVP is the value to price ratio using consensus analyst forecasts in residual income model. VPts and FVPts are the VP and FVP ratios in the issue year, scaled by the average of the ratios in the two prior years. BTM is the book-to-market ratio in the issue year. MVts is the market value of equity in the month prior to the issue scaled by the average of the market value of equity in the two prior years. Cost of Capital is estimated using a beta from a single factor model on a firm by firm basis, a risk premium of 6% (the difference between the average return on the S&P500 and the risk free rate), and a risk free rate using the current T-Bill rate.

** Significant at the 5% level.

*** Idem, 1%.

as well as the year-end following this forecast period. Future book values are estimated using the accounting ‘clean surplus’ relation, which states that book value equals prior book value plus net income less dividends (as in Lee et al., 1999). All other elements of the model are implemented in the same way as before. We refer to the value-to-price ratio estimated using analyst forecasts as FVP. The time series valuation metric estimated in this manner is called FVPts.

3.3. A comparison of valuation models

As discussed earlier, we argue that the value-to-price measure, computed using the residual income model, is a more accurate measure of mispricing compared to the book-to-market ratio. However, these two variables are potentially correlated as they share the same denominator. In Table 2 we present pair-wise correlations of the various mispricing measures and book-to-market. The correlation between VP and book-to-market (BTM) is a positive, and significant, 0.3809. The correlation between VPts and book-to-market is lower, but significant at 0.0526. The correlation between the time series perfect foresight model (VPts) and the analyst forecast model (FVPts) is positive, as we would expect, but fairly small in magnitude, at 0.0375. Recall that the only difference between these two metrics is the data source of the earnings. This correlation implies that assumptions about the use of earnings can have a significant impact on the valuation model.

4. Results

4.1. Univariate evidence of mispricing

Table 3 presents summary statistics for the two security issue types. A lower (higher) VP (value-to-price) ratio implies equity overvaluation (undervaluation). In theory, one would expect the VP ratio to have a mean of 1, however, this is not the case for the sample as a whole, and neither is it necessarily the case for the universe of stocks. The mean of VP is dependent on the choice of the equity risk premium used in the cost of capital computation. We use a fixed

Table 3
Summary statistics by issue type

Variable	Debt ($n = 5391$)			Equity ($n = 3781$)		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
VP	0.874	0.715	0.823	0.674	0.414	1.350
VPts	1.075	0.940	0.846	0.923	0.691	3.640
FVP	0.681	0.579	0.475	0.397	0.288	0.382
FVPts	1.208	1.027	0.657	0.802	0.704	0.502
Proceeds	147.76	98.80	233.26	93.62	39.00	319.57
Sales	5923.58	2070.60	10,657.56	961.47	155.64	3050.64
CapEx	0.090	0.075	0.072	0.098	0.069	0.103
Tangibility	0.501	0.492	0.250	0.375	0.309	0.264
MV	5725.10	1569.63	15,007.04	1028.97	248.36	6508.66
MTB	1.520	1.270	0.787	3.361	1.978	12.540
Profitability	0.150	0.140	0.067	0.151	0.145	0.108
Depreciation	0.046	0.042	0.025	0.044	0.036	0.034
R&D	0.013	0.000	0.028	0.030	0.000	0.063
Leverage	0.635	0.641	0.158	0.533	0.547	0.232
Tax Rate	0.368	0.350	0.062	0.359	0.350	0.086
Ind_Leverage	0.560	0.564	0.100	0.522	0.515	0.107

Notes. The summary statistics are computed using annual data from 1980 to 1999. VP is defined as the intrinsic value of the stock divided by price using the 3-year perfect foresight residual income model to calculate the intrinsic value. VPts is VP scaled by the average of the previous two years VP. Proceeds are the dollar aggregate proceeds raised. FVPts and FVP are the value to price ratios computed in the same manner as the VP based ratios except using analyst earnings forecasts. The sample size for these observations is 1751 for debt issues and 1950 for equity issues. Sales (Compustat item 12) are the annual sales for the issuing firm. CapEx is capital expenditures divided by total assets (items: 128/6). Tangibility is the ratio of fixed assets to total assets or item 8/6. MV is market value of equity in the month prior to the issue. MTB is the market-to-book ratio in the issue year. Profitability is EBITDA/Assets or items 13/6. Depreciation is the ratio of depreciation expense to total assets or items 14/6. R&D is the ratio of research and development expense to total assets or items 46/6. Leverage is the ratio of all liabilities to assets or items (6-60)/6. Tax Rate is the marginal tax rate of the firm based on the marginal tax rates generously provided by John Graham and developed for his paper Graham (1996). Industry Leverage is the annual average leverage of all firms in each of the 48 Fama–French (1997) industry groups for all firms on Compustat.

risk premium (the long-run difference between the return on the S&P 500 and T-Bills); however during most of the time period under examination, the risk premium implied by prices was lower, and declining. Thus in a bull market, it is likely that the risk premium is overstated. As we are examining the changes in the VP ratio, the level of the risk premium is not particularly important, and by assuming a stable risk premium, we are reducing the effect of market wide misvaluation. Other researchers have encountered this issue, for example, Lee et al. (1999) find a similar result in their implementation of the residual income model and note that they could scale the risk premium to a value that would equate to a VP ratio equal to 1 at the start of their sample, but this would have no effect on the overall results.

In Table 3, we observe that the mean and median VP ratios for the equity issuers (0.674 and 0.414, respectively) are lower than those for the debt issuers (0.874 and 0.715, respectively), consistent with more overvalued firms preferring to issue equity rather than debt. This finding holds for the time series measure of relative misvaluation, VPts, although to a lesser degree. Overall, we find that debt issuers are on average larger than equity issuers, and have more tangible assets. We find similar, if not more pronounced results for the analyst forecast measures, FVPts

Table 4
Percentage of mispricing and sub-sample comparison

Sign Rank Test	Debt	Equity	Difference
	Panel A: VPts		
VPts < 1 (overvalued)	56.14%	75.53%	
VPts > 1 (undervalued)	43.86%	24.47%	
Z-statistic	−8.300***	−23.890***	
N	4569	2190	
Difference tests			
Mean VPts	1.075	0.923	0.152*
Median VPts	0.940	0.691	0.249***
	Panel B: VP		
VP < 1 (overvalued)	72.36%	82.62%	
VP > 1 (undervalued)	27.64%	17.38%	
Z-statistic	−32.837***	−40.120***	
N	5391	3781	
Difference tests			
Mean VP	0.874	0.674	0.199***
Median VP	0.715	0.414	0.301***

Notes. This table presents Wilcoxon signed rank tests of the proportion of the debt and equity samples that are overvalued (VP < 1) and undervalued (VP > 1). The means tests are unpaired t-tests assuming unequal variances. The median tests are two-sample Wilcoxon rank-sum tests. Panel A reports tests for the time series mispricing measure, VPts. Panel B reports the tests for the absolute VP measure. VPts is the ratio of the issue year V/P ratio scaled by the average V/P ratio for the prior two years. V is the intrinsic value computed using the residual income model. P is the price in the month prior to the issue. Firms overvalued relative to their prior years have a VPts < 1, while relatively undervalued firms have a VPts > 1. Firms that are overvalued in absolute terms have a VP < 1 and those that are overvalued have a VP > 1.

* Significant at the 10% level.

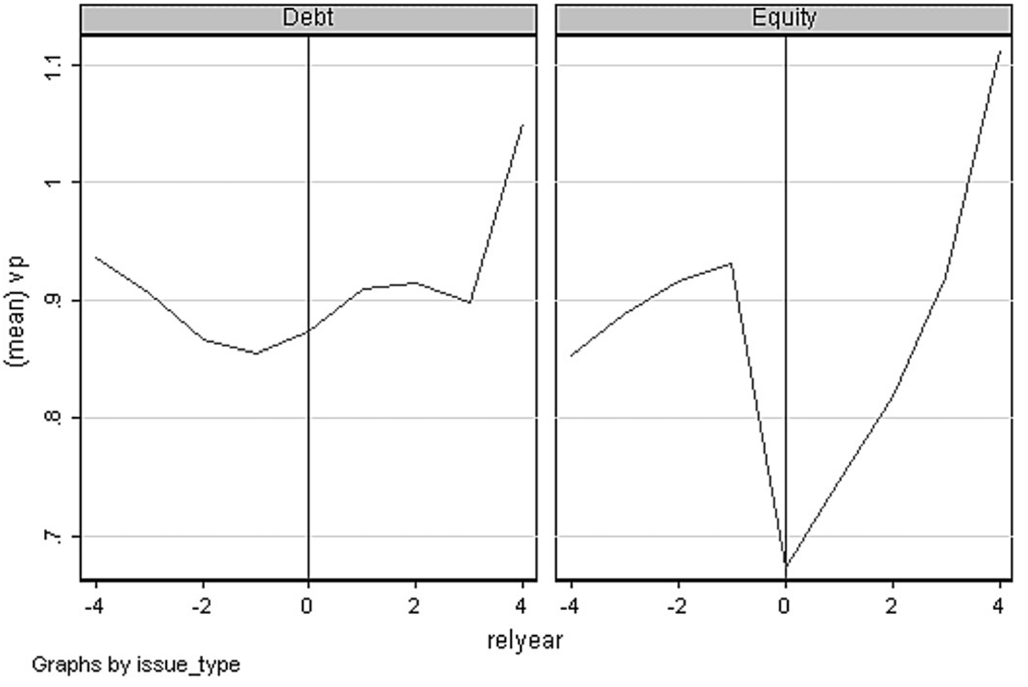
*** Idem, 1%.

and FVP. However, as the observations for these metrics are concentrated in the latter part of the sample due to data availability, they are coincident with the bull market of the 1990s.

In Table 4 we present tests of the percentage of overvalued and undervalued firms in each issue type, as well as cross issue comparisons of mispricing. Panel A presents Wilcoxon sign rank tests of the proportion of firms with VPts < 1 (relatively overvalued) and VPts > 1 (relatively undervalued). For both issue types, there are a greater proportion of firms overvalued relative to their prior years, although as we discussed earlier, this is most likely an artifact of a declining expected risk premium. There are, however, cross sectional differences between issue types. For example, 75.53% of equity issues are relatively overvalued, whereas only 56.14% of debt issues are relatively overvalued. At the bottom of Panel A, these non-parametric results are confirmed by testing the difference of the means and medians between debt and equity issues (statistically significant in both cases).

In Panel B of Table 4, we examine the difference between VP for all debt issuers and VP for equity issuers. We find that the equity issuers are significantly overvalued, relative to debt issuers, and again this finding is confirmed in the difference of the means test at the bottom of the panel. This result also holds when we examine the medians using a sign rank test.

In addition to the tests presented in Table 4, we present mean VP valuation ratios graphically in Fig. 1 for the nine years around the security issuance. Firms issuing equity are clearly overvalued during the issue year, and the overvaluation decreases during the subsequent two years. This result is consistent with empirical evidence that stocks underperform following the issuance of



Notes. This figure presents the annual VP ratio for debt issuers and equity issuers relative to the issue year which is coded as year 0. VP is the ratio of V; the intrinsic value estimated using the residual income model to P, the price of the stock in the month prior to the issue. For years before and after the issue, the price on the 1 year anniversary of the month before the issue is used.

Fig. 1. Time series of V/P ratios by issue type.

new equity. There is a less clear pattern surrounding the debt issues, and there does not appear to be any systematic decrease in VP associated with the debt issue at year zero.

4.2. Multivariate tests of the security issuance decision

In a multivariate setting we test how well the mispricing measure predicts the likelihood that the firm will issue a particular type of security. Our general approach is to use a binary variable to code issue type, and then examine the impact of our mispricing metric on the issuance decision, in a framework that controls for other well documented determinants of security choice. Table 5 presents the coefficient estimates from the following logit regression model[11]:

$$IssueType_j = \Phi\big[\beta_0 + \beta_1[valuation\ measure] + \gamma[controls]\big] \quad (6)$$

where $IssueType_j$, takes the value of 1 for debt and the a value of 0 for equity, and the valuation measure is either the absolute measure (i.e. VP or FVP) or the time series relative measure (i.e. VPts or FVPts).[12] The control variables are described in the following sub-section.

[11] Using a normal cumulative density function (i.e., probit) yields qualitatively similar results.

[12] We log all the VP measures because they are highly skewed. A Shapiro–Francia W-test data rejects the null of normality for VP at the 1% level.

4.2.1. Control variables

In this section we discuss the variables that we employ to control for alternative interpretations of our misvaluation measure, as well as for known determinants of capital structure. We rely heavily on the work of Flannery and Rangan (2006) who in turn build upon the work of Rajan and Zingales (1995), Hovakimian (2003), Hovakimian et al. (2001), and Fama and French (2002). These variables are chosen to control for the various factors that may influence the firm's choice of security.

Size

Larger firms tend to have more debt, are more transparent, have lower asset volatility and sell enough debt so that the fixed cost of debt is low. For any given issue, larger firms will more likely issue debt. We expect a positive coefficient on the size variable. We use the natural log of sales (Compustat item 12) as a proxy for size.

Growth options

Often, book-to-market has been used as a proxy for growth options. However, book-to-market can have other interpretations, such as misvaluation. In an attempt to ameliorate the problem associated with book-to-market, we use several alternative measures of growth options. The ratio of capital expenditures scaled by total assets is computed using Compustat item 128 divided by item 6. Research and Development expense is also scaled by total assets and is computed as R&D expense (item 46) divided by total assets (item 6). Higher levels of both ratios, presumably lead to more growth options. Firms with more growth options may attempt to protect this anticipated growth by limiting leverage, and therefore R&D and CapEx are expected to have a negative coefficient.

We also measure growth options using the book-to-value ratio (BV), where value is computed using the residual income model and book is the book value of the firm's equity. This approach follows the method set out in Rhodes-Kropf et al. (2005). To capture the time series variation in this ratio we scale each year's observation by the average of the two previous year's ratios in a manner identical to that used to estimate VPts in Eq. (5). This variable is called BVts and is computed as:

$$BVts_0 = \frac{BV_0}{(BV_{-1} + BV_{-2})/2}. \tag{7}$$

We expect to find a positive coefficient on the growth option proxy.

Profitability

Higher profits will increase retained earnings, which mechanically reduces leverage, however, higher profits increases the firms debt capacity and in turn, may result in higher leverage. Therefore, in our model, the coefficient on profitability is indeterminate. We measure profitability as EBITDA (item 13) divided by total assets (item 6).

Tangibility

Firms with more intangible assets will tend to prefer equity, as it is difficult to use such assets to collateralize debt. Asset tangibility is measured as the ratio of fixed assets (item 8) to total assets (item 6). A positive coefficient in our model will be consistent with our expectations.

Depreciation

Firms with more depreciation have less need for debt tax shields and will be more likely to issue equity. We expect a negative relationship between depreciation and the probability the firm issues debt. Depreciation is measured as depreciation expense (Compustat item 14) divided by Total Assets.

Target leverage

If firms move their leverage to a long-run target, firms below the target are more likely to issue debt. We capture target leverage through two variables. Leverage is computed as;

$$Leverage = (Total\ Assets\text{–}Book\ Equity)/Total\ Assets. \tag{8}$$

We also include the industry median leverage for the firm's Fama and French (1997) industry classification computed in the same manner as above. This variable is called IndLeverage. We expect the sign on leverage to be negative and the sign on IndLeverage to be positive if firms with leverage below the industry average issue debt to move towards an industry target.

Credit quality

Firms with rated debt have access to greater quantities of debt at lower costs, and tend to be more levered. Therefore, we expect a positive coefficient in our model. We include a variable "Rated" which takes the value 1 if the firm has rated debt under Compustat item 280, and zero otherwise.

Tax benefits

Firms in a higher corporate tax bracket benefit more from the deductibility of interest payments, and therefore are more likely to prefer debt to equity. We expect a positive coefficient on tax rate in our model. The marginal tax rates were generously provided by John Graham (and used in Graham, 1996 and other subsequent work) as proxies for the firm's marginal tax rate.[13]

Interest rates

Firms may respond to changes in the level of interest rates in their security issuance decision. For example, a reduction in the cost of debt may induce firms to issue more debt relative to equity. We proxy for the change in the level of interest rates by including a variable "Rate Change" which measures the change in the AAA Corporate debt rate over the last year. We obtain this data from the FRED II database at the Federal Reserve Bank of St. Louis.[14]

In addition to the controls discussed, we also include year dummies (unreported) in our regressions to control for time factors such as time varying equity risk premium.

4.3. Regression results

Table 5 presents logit models for the choice between debt and equity. Model 1 presents the simplest model, in which ln VPts is used as the valuation measure. In this model, the coefficient for ln VPts is positive (0.9242) and significant at the one-percent level, indicating that firms that are relatively more overvalued, are more likely to issue equity. Logit coefficients can be

[13] http://faculty.fuqua.duke.edu/~jgraham/taxform.html.

[14] http://research.stlouisfed.org/fred2/.

Table 5
The debt–equity choice and equity misvaluation

Model	1	2	3	4
Intercept	−3.9671***	−3.8213***	−4.6563***	−4.6884***
	(−8.21)	(−7.88)	(−10.56)	(−10.46)
ln VPts	0.9242***	1.5022***	–	–
	(11.76)	(15.61)		
ln VP	–	–	0.4343***	0.7382***
			(8.90)	(10.26)
ln BVts	–	1.0305***	–	–
		(9.25)		
ln BV	–	–	–	0.6492***
				(7.68)
CapEx	−0.8097	−1.2701*	0.5459	0.8843**
	(−1.31)	(−1.94)	(1.37)	(2.15)
R&D	−3.1383***	−2.1361*	−3.0918***	−1.8599**
	(−2.82)	(−1.95)	(−3.41)	(−2.05)
ln Sales	0.5648***	0.5499***	0.5353***	0.5173***
	(16.81)	(16.38)	(20.56)	(19.45)
Tangibility	0.8381***	0.8088***	0.6851***	0.5816***
	(3.63)	(3.46)	(3.62)	(3.04)
Profitability	1.7530***	0.9464	−0.5094	1.7580***
	(3.10)	(1.57)	(−1.34)	(3.35)
Depreciation	−2.2151	−0.3474	0.1959	−2.0767
	(−1.20)	(−0.19)	(0.14)	(−1.47)
Leverage	−0.0579	0.2654	−0.2111	0.0565
	(−0.23)	(0.99)	(−1.22)	(0.27)
Rated	0.8359***	0.8463***	1.0142***	1.0845***
	(7.47)	(7.49)	(10.77)	(11.42)
Ind. Leverage	0.4125	0.2894	0.1078	−0.0482
	(0.78)	(0.55)	(0.24)	(−0.11)
Tax Rate	1.9580**	1.6445**	1.9900***	1.8012***
	(2.40)	(2.02)	(3.23)	(2.84)
Rate Change	0.0894	0.0571	0.1621***	0.1517***
	(1.56)	(0.99)	(3.33)	(3.21)
Pseudo-R^2	0.3339	0.3485	0.3334	0.3438
N	6759	6759	9172	9172
Odds ratio for a 10% shift in:				
ln VPts or ln VP	1.0968	1.1621	1.0444	1.0766

Notes. This table provides the estimates from logistic regressions. The dependent variable equals 1 when the security issued is debt and 0 if equity. Coefficients are reported with Z score in parentheses. ln VP is the log of VP, where VP is defined as the intrinsic value of the stock divided by price using the 3-year perfect foresight residual income model to calculate the intrinsic value. ln VPts is the log of VP scaled by the average of the previous two years VP. ln BV is the log of the ratio of the book value of equity to V. ln BVts is the log of BV scaled by the average of the two previous years BV. Rated takes the value 1 if the firm is rated under Compustat item 280, 0 otherwise. Rate Change is the annual change in the AAA bond rate. The rest of variables are defined in Notes, Table 3. All regressions contain unreported year dummies and robust standard errors clustered at the firm level.

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

interpreted in two ways. First, exponentiating the coefficient yields the odds ratio; a measure of the change in the odds of a debt issuance for a unit increase in the independent variable. Frequently, in applications such as ours, researchers will standardize this ratio to measure the change in odds for a one standard deviation shift in the independent variable of interest. In our case, the standard deviation of VPts is quite large and may not present a realistic shift in valuation for a particular firm. Instead we examine the odds ratio for a 10% shift in the valuation measure i.e. an increase from a mean of 1 to 1.1, representing 10% undervaluation. In this case the change in $\ln$ VPTS is $\ln(1.1) = 0.09531$. The odds ratio for this magnitude change is therefore $e^{0.9242*0.09531} = 1.0921$. Therefore a 10% decline in valuation will increase the likelihood of a debt issuance by about 9%. A similar magnitude change will occur for 10% overvaluation.[15]

A second approach for interpreting the economic significance of logit coefficients is the marginal change in the probability of a debt issuance. In this case, we are measuring the change in probability from the conditional probability (i.e., that set at the mean values of all the independent variables). This can be computed as[16]:

$$\frac{\partial E[y/x]}{\partial x} = \frac{e^{\beta x}}{1+e^{\beta x}}\left[1 - \frac{e^{\beta x}}{1+e^{\beta x}}\right]\beta \tag{9}$$

where y is the dependent variable, x is the independent variable and β is the coefficient. For Model 1, when using the mean of $\ln$ VPts (which equates to a mean VPts of 0.8295), this equation evaluates to 0.2306, implying that a 0.1 increase in $\ln$ VPts (about a 10% change in VPts) will result in a 2.3% increase in the probability of a debt issuance.

Model 1 includes two growth options proxies, CapEx and R&D. The coefficient on CapEx is insignificant while R&D is significantly negative; suggesting that firms that have more growth options will favor equity over debt. Several of the control variables are also significant. For example, the positive coefficient on ln(Sales) indicates that larger firms are more likely to issue debt, as are firms with more tangible assets, greater profitability, rated deb and higher marginal tax rate. The signs on the control variables are largely as expected and have been well documented by previous authors such as Hovakimian et al. (2001), Fama and French (2002), Korajczyk and Levy (2003), Kayhan and Titman (2007) and Flannery and Rangan (2006). The significance of $\ln$ VPts, even after inclusion of the control variables, indicates the importance of market valuation as a factor in the debt–equity decision.

In Model 2 we include $\ln$ BVts, which measures changes in growth opportunities. With the addition of $\ln$ BVts, the coefficient on the mispricing measure, $\ln$ VPts, is a highly significant 1.5022. In this case a 10% increase in VPts translates into a 15% increase in the likelihood of a debt issuance (i.e. $e^{1.5022*0.09531}$), or a 3.682% increase in the probability of a debt issuance. Again, a roughly symmetric pattern exists for a decrease in VPts. The growth options proxy, $\ln$ BVts, has a positive and significant coefficient of 1.0305, which implies that a 10% increase in this variable will translate into approximately a 10% increase in the likelihood that the firm will issue debt.

We do not directly include book-to-market in the regression with VPts or VP for the simple reason that, by construction, BMts and BM are highly correlated with VPts and VP, respectively. Inclusion of highly correlated covariates in a regression results in the usual symptoms of multicollinearity, most notably larger standard errors for the correlated variables.[17] Since VP is a

[15] A 20% and 40% increase in VPts translates to a 17% and 31% increase respectively in the likelihood of debt issuance.

[16] See Greene (2002) for a complete discussion.

[17] Indeed, inclusion of book-to-market in our regressions greatly reduces the significance of VPts or VP.

component of book-to-market and the collinear component is excluded from the regression, the interpretation of VP is altered. This gets at the basic motivation behind the Rhodes-Kropf et al. method—namely to separate out valuation effects and growth options.

4.3.1. Absolute misvaluation

In Models 3 and 4 we repeat the analysis of Models 1 and 2, but instead of measuring relative valuation using VPts, we measure misvaluation with the absolute valuation metric, VP. The absolute valuation metric compares the intrinsic value V with the stock price P, but does not scale the measure by the previous two-year's V/P ratios. The absolute measure is a more direct measure of misvaluation in that it compares price to intrinsic value, but it assumes that in equilibrium V should equal P. If there are biases in the model (perhaps in the risk premium used), then it could be the case that for many firms, V never actually equals P, but these firms are not necessarily mispriced.

The results for the absolute measure are qualitatively similar to those of Models 1 and 2, although the significance of the coefficients is a little lower. Using Eq. (9) to evaluate the economic significance of V/P in Model 3, we find that for a mean V/P of 0.5668, a 10% change in V/P results in a roughly 1.1% increase in the probability of a debt issuance. For Model 4, which incorporates the $\ln B/V$ growth option variable, a 10% change in V/P results in a 1.8% increase in the probability of a debt issuance.

4.3.2. Residual income model using analyst's earnings forecasts

The residual income model that we have implemented so far assumes perfect foresight, in which future realized earnings are unbiased current period forecasts of future expected earnings. We justify this approach (which has been used by other researchers) on the grounds that we are attempting to measure intrinsic value using the information set available to the managers of the firm.[18] However, this approach is subject to two criticisms. First, to the extent that future earnings may depend on the capital structure decisions made today, we may be inducing an element of endogeneity into our research method. Specifically, firms that issue equity rather than debt will post higher future net income, due to lower interest costs. However, this endogeneity will bias against finding that equity issuers are overvalued as higher future earnings implies a higher V. The second criticism is that if managers do indeed have private information, the valuation wedge present in the perfect foresight model may be driven by asymmetric information and not irrational mispricing.

One way to test the robustness of our results to these criticisms is to employ analyst forecasts of earnings instead of actual realized earnings. To this end, we re-estimate the residual income model using earnings forecasts obtained from FirstCall (our approach follows that of Lee et al., 1999). We use the last consensus forecast made before the security issuance for each of the 1, 2 and 3 future year-ends. Where the year 3 year-end forecast is unavailable we estimate the growth rate between the 1 and 2 year forecast and then we use this growth rate to estimate the 3-year

[18] It is possible that manager's estimates are biased. The impact on the results would depend on whether managers are optimistic or pessimistic about future earnings realizations. Assuming they are overoptimistic (as this seems most likely), then their expectation of V, call it V^m will be higher than the V that we estimate based on realized EPS. Therefore $V^m/P > V/P$, so managers will think that their stock is less overvalued than our model estimates. In this case, market timing managers would be less likely to issue equity. This bias would then go against the predictions of our model and serve to weaken our results. Further, when using the VPts measure, any managerial bias (so long as the manager's bias remains static over time) will be negated, as the measure is scaled by prior year's V/P ratios.

forecast. FirstCall data is available beginning in 1990, so our tests in this section cover a subset of the full sample. Furthermore, we only compute our forecast residual income model for the firm years in which we were able to compute the perfect foresight model—thus avoiding any bias due to selective coverage of the analyst forecast data.

Table 6 presents the results from re-running the models specified in Table 5, but using analyst forecasts earnings to compute the valuation model. In Models 1 and 2 we measure misvaluation in relative terms using FVPts, while in Models 3 and 4 we measure misvaluation as FVP. Again as with the results from Table 5 we find the mispricing metric is positive and significant in all the models. It could be argued that in an efficient market, one would not find any mispricing when analyst forecasts are used in lieu of the ex post earnings. However, others (Lee et al., 1999) have found similar results. We interpret these findings as evidence that the mispricing in the larger sample is not due to information asymmetry between the firm's managers and investors, but due to market irrationality.

4.3.3. Alternative valuation measures

If managers are responding to market valuation of their firm's equity when they make the decision to sell securities, we should observe that misvaluation captured by other valuation metrics is also correlated with the security issuance decision.[19] In Table 7 we explore this issue further by using price-to-earnings ratios, price-to-sales ratios and the stock price run up as proxies for overvaluation signals that might be received by managers. We express both the price-to-earnings and price-to-sales ratios in absolute terms and in relative terms in the same manner as employed for VP. The price-to-earnings ratio is the price in the month before the issue divided by the most recent year end earnings per share before extraordinary items (Compustat item d18).

The first model in Table 7 uses the time series P/E ratio, PEts which is computed as

$$PEts_0 = \frac{PE_0}{(PE_{-1} + PE_{-2})/2} \tag{10}$$

where PE_0 is the price to earnings ratio in the issue year. As with the other misvaluation measures, we log all the valuation ratios, as they are heavily skewed. Logging the PE ratio does result in the loss of some observations for which earnings are negative, however the interpretation of negative price-to-earnings ratio is not clear. In Model 1 the coefficient on PEts is significant and negative implying that an increase in the firm's PE ratio relative to previous years means that the firm is more likely to issue equity. A similar result is found when we examine Model 2 which uses the time series price to sales ratio PSts. In Models 3 & 4 we replace the time series measures of relative misvaluation with the contemporaneous price-to-earnings and price-to-sales ratios and again find that higher absolute measures of these ratios make an equity issuance more likely.

Finally in Model 5 we examine a run-up in the stock price (we actually use market value to control for stock splits and changes in shares outstanding). The price run up is computed as:

$$MVts_0 = \frac{MV_0}{(MV_{-1} + MV_{-2})/2} \tag{11}$$

where MV_0 is the market value of the firm in year t. A run up in the value of the firm's equity over the previous two years is again more likely to lead the firm to issue equity, consistent with the managers interpreting this run-up as a signal that the firm's equity is now overvalued.[20]

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[19] We would like to thank the referee for suggesting this extension.

[20] We do not include ln MVts in our Table 5 regressions as a control variable because ln MVts is highly correlated with ln VPts (rho = −0.6329). Inclusion of ln MVts leads to multicollinearity and increases the standard error of ln VPts. In

Table 6
The debt–equity choice and equity misvaluation using analyst earnings forecasts

Model	1	2	3	4
Intercept	−3.7459**	−3.6852***	−3.9999***	−3.4932***
	(−4.40)	(−4.28)	(−6.27)	(−4.96)
ln FVPts	1.5105***	1.9759***	–	–
	(9.87)	(9.72)		
ln FVP	–	–	1.0918***	1.2352***
			(13.48)	(12.26)
ln BFVts	–	1.1410***	–	–
		(4.21)		
ln BFV	–	–	–	0.3503***
				(2.74)
ln CapEx	−3.5431***	−3.9021***	0.4403	0.5555
	(−3.04)	(−3.24)	(0.60)	(0.72)
R&D	−1.2063	−0.6507	−0.6488	−0.3406
	(−0.60)	(−0.32)	(−0.44)	(−0.23)
ln Sales	0.7104***	0.7091***	0.7139***	0.7217***
	(10.55)	(10.33)	(15.38)	(15.37)
Tangibility	1.2936***	1.1462***	0.8196***	0.8068***
	(3.05)	(2.67)	(2.77)	(2.70)
Profitability	−1.7368	−1.1320	1.3678*	2.2985***
	(−1.62)	(−0.97)	(1.74)	(2.61)
Depreciation	5.4293	7.0486*	0.2234	−0.6041
	(1.51)	(1.870)	(0.11)	(−0.29)
Leverage	−0.8897*	−0.5268	−1.2973***	−1.1418***
	(−1.91)	(−1.02)	(−4.41)	(−3.73)
Rated	0.6773***	0.6755***	1.0581***	1.0549***
	(3.72)	(3.67)	(7.63)	(7.59)
Ind. Leverage	−0.5522	−0.4038	−0.8240	−1.0067*
	(−0.66)	(−0.47)	(−1.37)	(−1.67)
Tax Rate	1.9509	0.6981	3.2871***	2.9667***
	(1.30)	(0.47)	(2.98)	(2.68)
Rate Change	−0.3520	−0.3430	−0.1602	−0.1749
	(−1.46)	(−1.41)	(−0.91)	(−1.00)
Pseudo-R^2	0.3516	0.3668	0.4153	0.4173
N	1548	1548	3489	3489
Odds ratio for a 10% shift in:				
ln FVPts or ln FVP	1.1631	1.2185	1.1154	1.1315

Notes. This table provides the estimates from logistic regressions. The dependent variable equals 1 when the security issued is debt and 0 if equity. Coefficients are reported with Z score in parenthesis. ln FVP is the log of FVP, where FVP is defined as the intrinsic value of the stock divided by price using the 3-year analyst forecast residual income model to calculate the intrinsic value. Analyst earnings forecasts are from FirstCall. ln FVPts is the log of FVP scaled by the average of the previous two years FVP. The rest of variables are defined in Notes, Tables 3 and 5. All regressions contain unreported year dummies and robust standard errors clustered at the firm level.

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

unreported regressions, when this variable is added to Model 2 of Table 5, the coefficient on ln VPts falls to 0.3478, but remains statistically significant at the 1% level.

Table 7
The debt–equity choice using alternative valuation ratios

Model	1	2	3	4	5
Intercept	−4.8834***	−3.8373***	−0.5965	−4.8246***	−2.7361
	(*−8.93*)	(*−8.33*)	(*−1.14*)	(*−10.68*)	(*−6.82*)
ln PEts	−0.2890***	–	–	–	–
	(*−6.38*)				
ln PSts	–	−1.1815***	–	–	–
		(*−13.75*)			
ln PE	–	–	−0.5239***	–	–
			(*−9.35*)		
ln PS	–	–	–	−0.3243***	–
				(*−6.74*)	
ln MVts	–	–	–	–	−1.0673***
					(*−18.05*)
CapEx	−0.5121	−1.0867*	−0.0352	0.0836	0.5697
	(*−0.84*)	(*−1.87*)	(*−0.08*)	(*0.20*)	(*1.35*)
R&D	−2.0821**	−3.0958***	−2.3740**	−2.0660**	−4.0335***
	(*−2.02*)	(*−3.21*)	(*−2.37*)	(*−2.27*)	(*−4.40*)
ln Sales	0.5640***	0.5405***	0.5308***	0.5085***	0.4776***
	(*18.58*)	(*18.73*)	(*18.74*)	(*18.92*)	(*18.32*)
Tangibility	0.9362***	0.8492***	0.7705***	1.3214***	0.5269***
	(*4.09*)	(*4.00*)	(*3.70*)	(*6.60*)	(*2.79*)
Profitability	−0.4447	0.9665*	−2.8006***	−0.2056	0.2538
	(*−0.80*)	(*1.86*)	(*−5.55*)	(*−0.51*)	(*0.64*)
Depreciation	0.6279	−0.7023	3.8813***	−1.6077	−1.5626
	(*0.34*)	(*−0.42*)	(*2.40*)	(*−1.09*)	(*−1.09*)
Leverage	−0.2664	−0.0837	−0.4557**	−0.6449***	0.0365
	(*−1.10*)	(*−0.36*)	(*−2.38*)	(*−3.37*)	(*0.21*)
Rated	0.9757***	0.9328***	1.1457***	1.1169***	0.8260***
	(*8.51*)	(*8.88*)	(*11.01*)	(*11.56*)	(*8.71*)
Ind. Leverage	0.3287	0.3930	−0.1377	0.2077	0.5739
	(*0.63*)	(*0.81*)	(*−0.29*)	(*0.43*)	(*1.30*)
Tax Rate	1.7406**	2.2526***	0.1611	1.8064***	1.6927***
	(*2.03*)	(*3.28*)	(*0.21*)	(*2.92*)	(*2.69*)
Rate Change	0.1032**	0.0840	0.1420***	0.1590***	0.1320***
	(*2.02*)	(*1.73*)	(*2.86*)	(*3.34*)	(*2.82*)
Pseudo-R^2	0.2945	0.3256	0.3414	0.3306	0.3588
N	6739	7633	8296	9172	9172
Odds ratio for a 10% shift in:					
ln PEts or ln PE	0.9715		0.9490		
ln PSts or ln PS		0.8886		0.9681	
ln MVts					0.8988

Notes. This table provides the estimates from logistic regressions. The dependent variable equals 1 when the security issued is debt and 0 if equity. Coefficients are reported with Z score in parenthesis. PE is the price earnings ratio, PS is the price to sales ratio. PEts and PSts and the current year's ratios scaled by the average of the previous 2 years. ln MVts is the log of the current years market value scaled by the average of the previous 2 years. The rest of variables are defined in Notes, Tables 3, 5 and 6. All regressions contain unreported year dummies and robust standard errors clustered at the firm level.

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

While the results of our tests using alternative valuation ratios confirm the results using the residual income model valuation ratios, there are other reasons that rationally explain an increase in all of these alternative measures. For example, an increase in PE ratios could be due to a reduction in the firm's systematic risk, an increase in expected growth or an increase in the operating efficiency of the firm. Price to sales ratios, while popular among equity analysts, suffer the significant draw back that they can vary with leverage. The advantage of the residual income model approach is that it provides an explicit point estimate of the firm's value, rather than a comparison with just a single dimension of the firm (such as earnings).

5. Conclusion

We test the market timing theory of capital structure in a framework that avoids the dual interpretation problem of book-to-market, in which book-to-market measures growth options, asymmetric information or irrational equity mispricing. We employ an earnings based valuation model (the residual income model) to directly measure the firm's intrinsic value. Using a sample of 9172 security issuances we find that firms whose equity is overvalued (i.e. the market value exceeds the intrinsic value generated by the residual income model) are significantly more likely to issue equity.

In order to differentiate between the impact of mispricing and growth options in the security issuance decision, we decompose book-to-market into two components; mispricing (value-to-price) and growth options (book-to-value). After controlling for growth options, we find that mispricing has significant incremental explanatory power. To control for asymmetric information that may be present in the perfect foresight model, we use a valuation model based on analyst forecasts and find our results are remain robust to this alternative specification.

Finally, our results are robust to alternative valuation measures such as price-to-earnings ratios, price-to-sales ratios and a measure of the stock price run-up. We conclude that mispricing of equity plays a major, if not dominant role, in the security choice decision.

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Appendix A. Proof of the equivalence of the dividend discount model and the residual income model

The dividend discount model

$$V_0 = \sum_{t=1}^{N} \frac{D_t}{(1+r)^t} + \frac{R_N}{(1+r)^N} \tag{A.1}$$

where V_0 is the value of equity at $t = 0$, D_t is the expected dividend at t, r is the discount rate, and R_N is the terminal value at $t = N$.

The clean surplus relation states that

$$D_t = X_t - B_t + B_{t-1} \tag{A.2}$$

where X_t is the expected earnings for the period ending at t, and B_t is the book value of equity at t. Substituting (A.2) into (A.1) and doing some algebra,

$$\begin{aligned}
V_0 &= \sum_{t=1}^{N}\left[\frac{X_t + B_{t-1} - B_t}{(1+r)^t}\right] + \frac{R_N}{(1+r)^N} \\
&= \sum_{t=1}^{N}\left[\frac{X_t}{(1+r)^t} + \frac{B_{t-1}}{(1+r)^t} - \frac{B_t}{(1+r)^t}\right] + \frac{R_N}{(1+r)^N} \\
&= \sum_{t=1}^{N}\left[\frac{X_t}{(1+r)^t}\right] + \sum_{t=1}^{N}\left[\frac{B_{t-1}}{(1+r)^t}\right] - \sum_{t=0}^{N-1}\left[\frac{B_t}{(1+r)^t}\right] + B_0 - \frac{B_N}{(1+r)^N} + \frac{R_N}{(1+r)^N} \\
&= \sum_{t=1}^{N}\left[\frac{X_t}{(1+r)^t}\right] + \sum_{t=1}^{N}\left[\frac{B_{t-1}}{(1+r)^t}\right] - \sum_{t=1}^{N}\left[\frac{B_{t-1}}{(1+r)^{t-1}}\right] + B_0 - \frac{B_N}{(1+r)^N} + \frac{R_N}{(1+r)^N} \\
&= \sum_{t=1}^{N}\left[\frac{X_t}{(1+r)^t}\right] + \sum_{t=1}^{N}\left[\frac{1}{(1+r)^t} - \frac{1}{(1+r)^{t-1}}\right]B_{t-1} + B_0 - \frac{B_N}{(1+r)^N} + \frac{R_N}{(1+r)^N}.
\end{aligned}$$

Since $\frac{1}{(1+r)^t} - \frac{1}{(1+r)^{t-1}} = \frac{-r}{(1+r)^t}$,

$$V_0 = \sum_{t=1}^{N}\left[\frac{X_t}{(1+r)^t} - \frac{rB_{t-1}}{(1+r)^t}\right] + B_0 - \frac{B_N}{(1+r)^N} + \frac{R_N}{(1+r)^N}$$

as $N \to \infty$ assuming earnings are growing into perpetuity at a rate less than the cost of equity, implies that the terminal value and book value at $N = \infty$ will be zero:

$$V_0 = \sum_{t=1}^{\infty}\left[\frac{X_t}{(1+r)^t} - \frac{rB_{t-1}}{(1+r)^t}\right] + B_0.$$

This is the residual income model as commonly implemented.

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