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The cost of equity of Internet stocks: a downside risk approach

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Beta as a measure of risk has been under fire for many years. Although practitioners still widely use the CAPM to estimate the cost of equity of companies, they are aware of its problems and are looking for alternatives. A possible alternative is to estimate the cost of equity based on the semideviation, a well-known and intuitively plausible measure of downside risk. Complementing evidence reported elsewhere about the ability of the semideviation to explain the cross-section of returns in emerging markets and that of industries in emerging markets, this article reports results showing that the semideviation also explains the cross-section of Internet stock returns.

Keywords: Internet, equity, risk, beta, downside, semideviation

1. INTRODUCTION

Much has been written on the valuation of Internet stocks over the last few years, though most of the writing has been done by practitioners and published in non-academic journals, or directly on the Web. Furthermore, although many methods of relative valuation for Internet companies have been proposed, such as for example market cap per visitor, it has been only recently that the futility of those valuation frameworks became evident.

As argued in Estrada (2000*a*, 2001*a*), the reason that several methods of relative valuation became widely popular is simply because they could be used to justify valuations that could have never been reasonably obtained with the standard DCF method. But a healthy return to DCF valuation, among several other factors, brought the valuation of many Internet companies down by more than 90% between March 2000 and March 2001.[1]

This healthy return to DCF as the standard method of valuation brings back to life two variables virtually forgotten during the frenzy of the last few years, expected cash flows and discount rates, the second of which is the focus of this article. Furthermore, because the discount rate of the most widely used version

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[1] This does not imply, of course, that the dramatic fall of Internet stocks since February 2000 was fully (or even largely) driven by risk-related factors. The meltdown in prices was obviously largely driven by a drastic reduction in expected cash flows.

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of the DCF model (the WACC model) is a company's cost of capital, and because virtually all Internet companies are fully financed by equity, the focus of this article is on the cost of equity.

More precisely, this article focuses on the semideviation as a determinant of the required return of Internet stocks. As argued below, the semideviation not only is a plausible and widely used measure of risk but also has been shown to explain the cross-section of returns in emerging markets and industries in emerging markets; see Estrada (2000*b*, 2001*b*, 2002*a*). In this regard, this article could be considered as a 'consistency check' on the ability of the semideviation to explain the required return of assets with non-normal (skewed) distributions.

Note that Internet stocks and emerging markets share several characteristics: both have a rather short history of returns; both are very volatile assets; both exhibit a rather low correlation to the market; and both exhibit relatively skewed return distributions. For this reason, a risk variable that successfully explains the cross-section of returns in emerging markets is likely to also explain the cross-section of returns of Internet stocks.

The evidence reported and discussed in this article reinforces both the plausibility of the semideviation as a measure of risk and its role as an input in an asset pricing model. Nevertheless, given the short history of most Internet stocks and the rather limited cross-section of companies, the results and implications discussed below should be regarded as tentative.

This article is organized as follows. Section 2 contains a discussion of the issue at stake, focusing on the semideviation as an appropriate measure of risk; Section 3 contains a description of the data, the results of the empirical analysis, and a discussion of the findings; and Section 4 contains some concluding remarks. An Appendix with tables and a figure concludes the article.

2. THE ISSUE AT STAKE

The DCF method is the standard framework used to assess the value of companies, and the WACC model is its most widely used version. As is well known, the WACC model consists of discounting a company's expected (unlevered) free cash flows at a rate equal to the company's cost of capital. This cost of capital, in turn, is usually thought of as the weighted average of the company's cost of debt and cost of equity, and this cost of equity is usually estimated with the CAPM.

It is not the purpose of this article to review over 30 years of academic discussion on the CAPM. It suffices for our purposes to highlight two things: first, that there are loads of evidence both supporting and rejecting the CAPM (or, perhaps more precisely, supporting and rejecting beta as an appropriate measure of risk); second, that the CAPM still is the model most widely used by practitioners.[2]

Nevertheless, the evidence against the CAPM has motivated a search for alternative measures of risk. Fama and French (1992) popularized the use of a three-factor

[2] As stated in Copeland *et al.* (2000), from McKinsey, 'It takes a better theory to kill an existing theory, and we have not seen the better theory yet. Therefore, we continue to use the CAPM (and sometimes the arbitrage pricing model), being wary of all the problems with estimating it'.

model in which the CAPM is augmented by two additional risk variables, book-to-market ratio and size. In emerging markets, where betas and mean returns are uncorrelated, several alternative models have been proposed; see, e.g. Erb *et al.* (1995, 1996*a*, *b*), Godfrey and Espinosa (1996), Lessard (1996), and Estrada (2000*b*, 2001*b*, 2002*a*), among others. For a literature review on the subject, see Pereiro (2001).

2.1 The semideviation

Estrada (2000*b*) proposes to replace beta as a measure of risk by the semi-standard deviation of returns, or semideviation for short, and reported results showing that this risk variable explains the cross-section of returns in emerging markets that beta fails to explain. Furthermore, Estrada (2001*b*) reports that the semideviation also explains the cross-section of *industry* returns in emerging markets, thus strengthening the plausibility of this variable as a measure of risk.

The semideviation with respect to any benchmark B (Σ_B) can be defined as

$$\Sigma_B = \sqrt{(1/T) \cdot \sum_{t=1}^{T} \text{Min}\{(R_t - B), 0\}^2} \tag{1}$$

where R denotes returns, t indexes time, and T is the number of returns in the sample. Of all the possible benchmarks for the semideviation, this article focuses on the mean return of each stock (μ); hence, the focus is on Σ_μ.

A simple inspection of Equation 1 reveals that the semideviation gives a positive weight only to deviations *below* the benchmark; i.e. returns below B increase Σ_B, but returns above B do not. Essentially, the semideviation defines risk as volatility below the benchmark.

A downside risk approach is supported by practical considerations. Note, first, that investors do not dislike volatility; they only dislike *downside* volatility. Second, unlike some country risk indices proposed for emerging markets, the semideviation is an objective measure of risk that can be applied to markets, companies, and projects. Third, the semideviation can be articulated (as is shown below) into a very simple asset pricing model. And fourth, as is shown here and elsewhere, the semideviation is correlated to mean returns.

Interestingly, a downside risk approach is also supported by the investment community; see, e.g. Sortino and van der Meer (1991), Clash (1999), Sortino *et al.* (1999), and Sortino and Satchell (2001).

2.2 Brief review of the theory of downside risk

Besides being supported by practical considerations and by the investment community, a downside risk approach is also supported by theoretical considerations. Markowitz (1959), to start with, does consider downside risk in his seminal book and states that 'the semideviation produces efficient portfolios somewhat preferable to those of the standard deviation'. His reasons for neglecting the semideviation in his subsequent and pathbreaking analysis were simply that mean-semivariance portfolios were *back then* computationally very difficult to calculate, and that semivariance was (again, back then) a relatively unknown measure of risk. Neither objection is problematic nowadays.

Hogan and Warren (1974), Bawa and Lindenberg (1977), and Harlow and Rao (1989) all propose CAPM-like models based on downside risk measures. Hogan and Warren (1972) provide an optimization algorithm to calculate efficient portfolios based on mean and below-target semivariance,[3] and Hogan and Warren (1974) propose a below-target semivariance asset pricing framework which they call the E-S model.

Bawa and Lindenberg (1977) generalize the Hogan–Warren framework and show that, since the CAPM is a special case of their mean-lower partial moment (MLPM) model, their model is guaranteed to explain the data at least as well as the CAPM. Harlow and Rao (1989) derive an MLPM model for any arbitrary benchmark return, thus rendering the Hogan–Warren and the Bawa–Lindenberg frameworks special cases of their more general model. Their empirical tests reject the CAPM as a pricing model but cannot reject their version of the MLPM model.

On the relationship between downside risk and utility, the pioneering work is Fishburn (1977), who proposes a utility function that is concave (hence displaying risk aversion) up to a target level of wealth, and linear (hence displaying risk neutrality) from that point on. Kahneman and Tversky (1979), on the other hand, propose a utility function that is convex (hence displaying risk seeking behaviour) below the current level of wealth and concave from that point on. In these frameworks, utility is determined by gains and losses with respect to a certain level of wealth rather than by wealth itself.

More recently, Satchell (2001) derives a utility function consistent with a lower-partial moment CAPM without making any distributional assumptions, and shows that two-fund separation exists. Balzer (2001) mathematically derives a relationship between utility and downside risk measures, and her Taylor approximation to expected utility can accommodate several types of behaviour depending on the assumptions imposed on the approximation. Plantinga and de Groot (2001) contribute to this issue by determining the type of preferences that best correspond to different risk-adjusted measures.

Finally, in a similar way to which Levy and Markowitz (1979) defend mean-variance behaviour as a good approximation to expected utility, Estrada (2002*b*) shows that mean-semivariance behaviour is a good approximation both to expected utility and to the utility of expected compound return.[4]

2.3 Skewness in stock returns

The plausibility of the semideviation as a measure of risk is tightly linked to the existence of skewed distributions of returns. If such distributions were symmetric, then the upper tail and the lower tail of any given distribution would provide the same information, the variance would be equal to twice the semivariance, and a downside risk framework would lose a good part of its appeal.

[3] More recently, De Athayde (2001) proposes a nonparametric approach to derive a mean-semivariance efficient frontier, shows the convexity of this frontier, and derives asset pricing relationships with and without a risk-free rate.

[4] For a more comprehensive review of the theory of downside risk, see Nawrocki (1999).

However, there is ample evidence that the distributions of daily returns in most markets and the distributions of returns in emerging markets (even at the monthly frequency), to name but a few, are highly non-normal; see Bekaert *et al.* (1998), Aparicio and Estrada (2001), and references therein. The importance of skewness in the assessment of risk has also been stressed by Leland (1999), Harvey and Siddique (2000), and Chen *et al.* (2001), among others.

More recently, Adcock and Shutes (2002), building on Adcock and Shutes (1998), propose a general model for skewed distributions based on the multivariate skew-normal distribution and describe its properties. Furthermore, Adcock (2002) introduces a model for skewed and leptokurtic distributions based on the multivariate skew student distribution and describes the properties of the non-linear market model that follows from it.

2.4 The cost of equity

The required return on any asset basically consists of two parts: a risk-free rate, which compensates investors for the expected loss of purchasing power, and a risk premium, which compensates investors for bearing risk. This risk premium, in turn, can be thought of as having two components, a risk premium for the market as a whole (the market risk premium) and a factor specific to each individual company. This last component, which according to the CAPM is the beta of a company, can be more generally thought of as a risk measure. Formally,

$$\mathrm{CE}_i = \mathrm{R_f} + (\mathrm{RP_M})(\mathrm{RM}_i) \tag{2}$$

where CE_i is the cost of equity (or required return), $\mathrm{R_f}$ is the risk-free rate, $\mathrm{RP_M}$ is the market risk premium, RM_i is a risk measure, and i indexes companies.

We consider below three risk measures, one based on *total* risk measured by the standard deviation ($\mathrm{RM_{TR}}$), and the other based on *downside* risk measured by the semideviation with respect to the mean ($\mathrm{RM_{DR}}$), both of which will be compared with the standard risk measure based on *systematic* risk assessed by beta ($\mathrm{RM_{SR}}$). In all three cases, we consider risk measures based on the *ratio* between each of the three risk variables (beta, the standard deviation, and the semideviation) for a given company and the same risk variable for the market. Therefore, we consider the following risk measures and implied costs of equity (required returns) for each company in the sample:

$$\mathrm{RM_{SR}} = \frac{\beta_i}{\beta_\mathrm{M}} = \beta_i \Rightarrow \mathrm{CE}_{\mathrm{SR},i} = \mathrm{R_f} + (\mathrm{RP_M})\beta_i \tag{3}$$

$$\mathrm{RM_{TR}} = \frac{\sigma_i}{\sigma_\mathrm{M}} \Rightarrow \mathrm{CE}_{\mathrm{TR},i} = \mathrm{R_f} + (\mathrm{RP_M})\left(\frac{\sigma_i}{\sigma_\mathrm{M}}\right) \tag{4}$$

$$\mathrm{RM_{DR}} = \frac{\Sigma_{\mu,i}}{\Sigma_{\mu,\mathrm{M}}} \Rightarrow \mathrm{CE}_{\mathrm{DR},i} = \mathrm{R_f} + (\mathrm{RP_M})\left(\frac{\Sigma_{\mu,i}}{\Sigma_{\mu,\mathrm{M}}}\right) \tag{5}$$

where the subscripts i and M denote the ith company and the market, respectively.

3. DATA AND RESULTS

The data used in this article consist of the monthly returns for 215 Internet companies compiled from different indices (such as the *Fortune e-50*) and lists [such as those provided by Perkins and Perkins (1999) and Hand (2000)] of Internet companies. Monthly returns are compiled from the later of the company's inception or January 1995 and through to December 2000. The market returns are those of the S&P500 index.

In order to check the consistency of the results for individual companies, results are also reported for 43 portfolios of five companies each. Furthermore, given the highly unusual drop in most stocks over the last 9 months of the year 2000, results are reported for both the full sample period January 95 to December 00, as well as for the shorter sample period January 95 to February 00.

Table 1 reports average summary statistics for the 215 companies and the 43 portfolios, for both sample periods. As can be seen in the table, over the longer January 95 to December 00 sample period the average Internet company delivered a *negative* mean monthly return of almost 1%, displayed a huge monthly volatility of 34% (118% in annual terms) and downside volatility of 20%, and had a low correlation (0.3) and high beta (2.6), both with respect to the market.

Internet stocks, however, delivered a positive and very high mean monthly return over the shorter January 95–February 00 period, with virtually the same volatility, downside volatility, relative volatility (beta), and correlation to the market as in the longer sample period. The portfolios of internet stocks, just like the individual stocks, also delivered much higher mean returns in the shorter sample period, and also with virtually the same volatility, downside volatility, relative volatility (beta), and correlation to the market as in the longer sample period. In other words, the mean returns of companies and portfolios are very different across the two sample periods, but the risk variables relevant for the computation of required returns are not.

Finally, though not reported in the table, the coefficients of standardized skewness indicate that 93 (68) companies and 16 (17) portfolios exhibit a significantly skewed distribution of returns in the longer (shorter) sample period.[5] In addition,

Table 1. Summary statistics (monthly dollar returns)

	Sample period	μ	σ	ρ	β	$\sum_\mu$
Companies	Through Dec/00	−0.99	34.07	0.33	2.57	20.32
Companies	Through Feb/00	10.33	33.69	0.29	2.55	20.17
Portfolios	Through Dec/00	3.52	25.37	0.46	2.65	15.39
Portfolios	Through Feb/00	8.55	25.01	0.43	2.57	14.89
S&P500	Through Dec/00	1.57	4.28	1.00	1.00	3.34
S&P500	Through Feb/00	1.86	4.09	1.00	1.00	3.27

μ: Arithmetic mean (%); σ: standard deviation (%); ρ: correlation with respect to the S&P500; β: beta with respect to the S&P500; $\sum_\mu$: semideviation with respect to the mean (%).

[5] Throughout the article, all hypotheses are tested at the 5% significance level.

Jarque-Bera tests reject the normality of the return distributions of 123 (105) companies and 20 (21) portfolios in the longer (shorter) sample period. In other words, even at the monthly frequency, many of the return distributions under consideration exhibit significant departures from normality in general and skewness in particular.

3.1 Companies

The first step of the analysis consists of computing, over the whole sample period available for each company, one statistic that summarizes the average (return) performance of each company, and another statistic that summarizes its risk under each of the three definitions considered. Returns are thus summarized by mean monthly arithmetic returns, and risk is assessed in three different ways: *systematic* risk (SR) measured by beta, *total* risk (TR) measured by the standard deviation of returns, and *downside* risk (DR) measured by the semideviation of returns with respect to the mean.

Table 2 shows the cross-sectional correlations between mean returns and each of the three risk variables considered and simply previews some of the results analyzed in more detail below. As the exhibit shows, all three correlations are rather low, although statistically significant. In the shorter sample period, which does not include the free fall of the last nine months of the year 2000, the correlations between mean returns and each of the three risk variables are much higher. Furthermore, in this shorter period, the semideviation exhibits the highest correlation to mean returns of all three risk variables.

More detailed results about the relationship between risk and return can be obtained from regression analysis, first by running a cross-sectional simple linear regression model relating mean returns to each of the three risk variables considered. More precisely,

$$\mathrm{MR}_i = \gamma_0 + \gamma_1 \mathrm{RV}_i + u_i \tag{6}$$

where MR_i and RV_i stand for mean return and risk variable, respectively, γ_0 and γ_1 are coefficients to be estimated, u_i is an error term, and i indexes companies. The results of these regressions are reported in Table 3.

Table 3 shows that all three risk variables in both sample periods are clearly significant. Beta is related to the mean returns of Internet stocks, but so are both the standard deviation and the semideviation. This last variable, in particular, explains a whopping 56% of the variability in returns in the shorter sample

Table 2. Correlations to mean returns: companies

Sample period	SR	TR	DR
Through Dec/00	0.32	0.32	0.30
Through Feb/00	0.50	0.62	0.75

SR: Systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). All numbers in the table show correlations to mean returns.

Table 3. OLS regressions: companies

RV	$MR_i = \gamma_0 + \gamma_1 RV_i + u_i$					
	γ_0	t-ratio	γ_1	t-ratio	R^2	Adj-R^2
Through Dec/00						
SR	−4.92	−5.08	1.53	4.89	0.10	0.10
TR	−8.54	−5.32	0.22	4.99	0.10	0.10
DR	−9.78	−4.90	0.43	4.57	0.09	0.09
Through Feb/00						
SR	4.97	5.00	2.10	8.51	0.25	0.25
TR	−7.74	−4.55	0.54	11.64	0.39	0.39
DR	−14.23	−8.82	1.22	16.37	0.56	0.56

MR: Mean return; RV: risk variable; SR: systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). Critical value for a two-sided test at the 5% significance level: 1.97.

period (compared to only 25% in the case of beta). Because four of these six regressions are heteroscedastic, Table A-1 in the Appendix reports the results of regressions in which significance is based on White's heteroscedasticity-consistent covariance matrix. As can be seen in that table, the qualitative results and conclusions remain the same.

Finally, Table A-2 in the Appendix reports the results of multiple regressions in which returns are jointly related to two risk variables. Perhaps the more interesting result to highlight is that, when jointly considered, both beta and the semideviation come out significant, thus indicating that each explains part of the variability in mean returns not explained by the other.

3.2 Portfolios

In order to check the consistency of the results reported for individual companies, and also to control for the errors-in-variables problem that arises when estimating the beta of individual companies (see Blume, 1971), cross-sectional correlations and regressions were also run for 43 equally weighted portfolios of five companies each. The overall results by and large confirm those reported above for companies.

Table 4 reports the cross-sectional correlations between the mean returns of the portfolios and the three risk variables considered. As the table shows, and consistent with the results reported above for companies, the correlations between mean returns and each of the three risk variables are rather low over the longer sample period, and much higher over the shorter sample period. Furthermore, as was the case for companies, in the shorter sample period the correlation between mean returns and the semideviation is the highest of the three. However, unlike the case for companies, in the longer sample period the correlation between mean returns and the semideviation is also the highest of the three. In other words, in *both* sample periods the semideviation is more correlated to the mean returns of portfolios of Internet stocks than beta.

Table 4. Correlations to mean returns: portfolios

Sample period	SR	TR	DR
Through Dec/00	0.22	0.22	0.33
Through Feb/00	0.58	0.50	0.69

SR: Systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). All numbers in the table show correlations to mean returns.

As before, more detailed results can be obtained from regression analysis. Table 5 shows that, in the longer sample period, only the semideviation is significantly related to mean returns; beta and the standard deviation are not. In the shorter sample period, on the other hand, all three risk measures are significantly related to returns, although it is the semideviation the one that exhibits the highest statistic al significance and explanatory power.

Although the regressions for the full sample period do not display heteroscedasticity, those for the shorter sample period do. Table A-3 in the Appendix thus reports the results of regressions in which significance is based on White's heteroscedasticity-consistent covariance matrix. As can be seen in that table, the main qualitative relevant results do not change: in the longer sample period, the semideviation is significantly related to mean returns but beta is not; in the shorter sample period, both risk variables are related to mean returns but the semideviation displays a higher statistical significance and explanatory power.

Finally, Table A-4 in the Appendix reports the results of multiple regression analysis. As can be seen in that exhibit, when beta and the semideviation are jointly considered in the shorter sample period, it is the semideviation the one variable that comes out significant.

Table 5. OLS regressions: portfolios

	$MR_i = \gamma_0 + \gamma_1 RV_i + u_i$					
RV	γ_0	t-ratio	γ_1	t-ratio	R^2	Adj-R^2
Through Dec/00						
SR	1.63	1.18	0.71	1.46	0.05	0.03
TR	1.67	1.22	0.07	1.44	0.05	0.02
DR	−0.91	−0.45	0.29	2.25	0.11	0.09
Through Feb/00						
SR	3.07	2.31	2.13	4.52	0.33	0.32
TR	3.66	2.55	0.20	3.73	0.25	0.23
DR	−0.96	−0.58	0.64	6.06	0.47	0.46

MR: Mean return; RV: risk variable; SR: systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). Critical value for a two-sided test at the 5% significance level: 2.02.

3.3 Required returns

A brief recap is in order at this point. The results reported so far establish that, in the case of companies (1) all three risk variables when considered individually are significantly related to mean returns in both sample periods; and (2) the semideviation exhibits the highest individual explanatory power (56%) in the shorter sample period. In the case of portfolios; (3) all three risk variables when considered individually are significantly related to mean returns in the shorter sample period; (4) only the semideviation is significantly related to mean returns in the longer sample period; (5) the semideviation exhibits the highest individual explanatory power (46%) in the shorter sample period; and (6) when the semideviation and beta are jointly considered, in the shorter sample period, only the semideviation is significantly related to mean returns. Essentially, the evidence reported suggests that the semideviation is a risk variable at least as good as (and likely better than) beta to assess the risk of Internet stocks.

Our final step is then to estimate required returns based on the semideviation and compare them to those based on beta (and on the standard deviation for the sake of completeness). To that purpose, panel A of Table 6 reports, for both sample periods, the average costs of equity of companies and portfolios generated by Equations 3–5, a risk-free rate of 5.11%, and a market risk premium of 5.5%.[6] Figure A-1 in the Appendix provides a graphical representation of these average costs of equity. Panel B of Table 6 reports the cost of equity of a few selected companies.

Table 6 reports at least two interesting findings. First, the relevant risk variables are, as discussed above, rather constant across the two sample periods, which implies that, for any given risk variable, the estimated costs of equity are not very different *across the two sample periods*. For companies, the differences are under two percentage points for all three risk variables, and for portfolios the differences are a bit larger though all of them are under three percentage points.

Second, for any given sample period, the estimated required returns are very different *across risk measures*. For companies and for the whole sample period, the required returns based on systematic risk (19.2%) are almost exactly half as large as those based on downside risk (38.6%). For portfolios, and again for the whole sample period, the required returns based on systematic risk (19.7%) are about one-third lower than those based on downside risk (30.5%). In both cases, the required returns based on total risk are much higher than those based on systematic risk or downside risk.

Needless to mention, the differences in the required return for companies based on beta (19.2%) and on the semideviation (38.6%) are very significant from an economic point of view. The difference of almost 20 percentage points can make or break a huge number of investment projects and have a very significant impact on valuation. Much the same can be said about the difference of almost 11 percentage points in the case of portfolios. Put simply, the differences in the estimated costs

[6] The 5.11% risk-free rate is based on the yield of 10year US Treasury Notes at the end of the year 2000. The 5.5% world market risk premium is similar to that used by Stulz (1995).

Table 6. Risk variables, risk measures, and costs of equity

	Through	β	σ	$\sum_\mu$	RM_{SR}	RM_{TR}	RM_{DR}	CE_{SR}	CE_{TR}	CE_{DR}
Panel A: Averages										
Companies	Dec/00	2.6	118.0	70.4	2.6	8.0	6.1	19.2	48.9	38.6
Companies	Feb/00	2.6	116.7	69.9	2.6	8.2	6.2	20.4	51.7	40.3
Portfolios	Dec/00	2.7	87.9	53.3	2.7	5.9	4.6	19.7	37.7	30.5
Portfolios	Feb/00	2.6	86.6	51.6	2.6	6.1	4.5	20.6	40.1	31.4
S&P500	Dec/00	1.0	14.8	11.6						
S&P500	Feb/00	1.0	14.2	11.3						
Panel B: Selected companies										
Amazon		3.5	112.4	64.0	3.5	7.6	5.5	24.4	46.8	35.6
Ariba		4.0	143.0	86.4	4.0	9.6	7.5	27.1	58.1	46.2
Cisco		1.5	39.7	29.5	1.5	2.7	2.6	13.6	19.8	19.1
eBay		3.9	127.8	70.4	3.9	8.6	6.1	26.8	52.5	38.6
Oracle		1.6	61.9	38.1	1.6	4.2	3.3	14.1	28.1	23.2
Priceline.com		4.7	126.4	75.7	4.7	8.5	6.5	31.0	52.0	41.1
Real Networks		3.7	133.4	78.7	3.7	9.0	6.8	25.4	54.6	42.5
Yahoo!		4.0	104.0	58.8	4.0	7.0	5.1	26.9	43.7	33.1

β: Beta; σ: standard deviation; $\sum_\mu$: semideviation with respect to the mean; RM: risk measure; CE: cost of equity. SR, TR, and DR indicate systematic risk, total risk, and downside risk, respectively. RMs and CEs follow from expressions (3)–(5). Costs of equity based on a risk-free rate of 5.11% and a world market risk premium of 5.5%. Data on panel B through Dec/00. 'Companies' represents an average over 215 companies; 'Portfolios' represents an average over 43 portfolios. All numbers other than beta and RMs expressed in %. Annual figures.

of equity across different risk measures are simply too large for practitioners to ignore.

A subjective assessment does not necessarily help: is a 19.2% required return for the average Internet stock 'too low'? Is a 38.6% required return 'too high'? Hard to say. But the evidence presented here does provide more support to the semideviation than to beta as an appropriate measure of risk for Internet stocks.

4. CONCLUDING REMARKS

A widely accepted definition of risk, critical for the purposes of project evaluation and company valuation, has eluded academics and practitioners for decades. Practitioners, puzzled by a wealth of evidence on the poor explanatory power of beta, have been considering alternatives to the CAPM for a long time.

The semideviation is a plausible measure of risk for it captures the downside volatility that investors want to avoid, and gives no weight to the upside volatility to which investors want to be exposed. It also explains (as the results reported above show) the cross-section of Internet stock returns better than beta, and can be built into a model that companies and investors can use to estimate discount rates just as easily as they use the CAPM.

The empirical evidence reported elsewhere suggests that the semideviation explains the cross-section of returns where beta fails (such as in emerging markets), as well as where beta does not fail (such as industries in emerging markets). The evidence reported in this article provides overall stronger support to the semideviation than to beta as an appropriate measure of risk for Internet stocks.

The numerical differences between the costs of equity based on beta and those based on the semideviation are, as the results above show, substantial. This is particularly important for the purposes of project evaluation (and company valuation), for use of one discount rate or the other may lead to substantially different decisions regarding whether or not carry on an investment project (or to substantially different company valuations). As argued above, these differences are just too large for practitioners to ignore. And when deciding which model to use to estimate the cost of equity of Internet stocks, perhaps the evidence reported and discussed in this article may lead practitioners to lean in favour of the semideviation as the proper measure of risk of this (and similar) type of assets.

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APPENDIX

Table A-1. Heteroscedasticity-consistent simple regressions: companies

	$MR_i = \gamma_0 + \gamma_1 RV_i + u_i$					
RV	γ_0	t-ratio	γ_1	t-ratio	R^2	Adj-R^2
Through Dec/00						
SR	−4.92	−4.87	1.53	4.86	0.10	0.10
TR	−8.54	−5.15	0.22	5.13	0.10	0.10
DR	−9.78	−4.69	0.43	4.52	0.09	0.09
Through Feb/00						
SR	4.97	4.23	2.10	6.16	0.25	0.25
TR	−7.74	−3.75	0.54	8.04	0.39	0.39
DR	−14.23	−7.53	1.22	12.62	0.56	0.56

MR: Mean return; RV: risk variable; SR: systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). Significance based on White's heteroscedasticity-consistent covariance matrix. Critical value for a two-sided test at the 5% significance level: 1.97.

Table A-2. Heteroscedasticity-consistent multiple regressions: companies

	$MR_i = \gamma_0 + \gamma_1 RV_{1i} + \gamma_2 RV_{2i} + v_i$						
RV_1/RV_2	γ_0	t-ratio	γ_1	t-ratio	γ_2	t-ratio	R^2
Through Dec/00							
SR/TR	−8.83	−5.35	1.02	2.76	0.15	2.72	0.14
SR/DR	−9.01	−4.18	1.06	2.60	0.26	1.99	0.12
TR/DR	−9.23	−4.39	0.18	2.77	0.11	0.71	0.11
Through Feb/00							
SR/TR	−7.00	−3.84	1.15	3.83	0.43	6.60	0.45
SR/DR	−13.21	−6.97	0.62	2.31	1.09	9.74	0.57
TR/DR	−14.24	−7.64	−0.14	−2.03	1.45	8.48	0.56

MR: Mean return; RV: risk variable; SR: systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). Significance based on White's heteroscedasticity-consistent covariance matrix. Critical value for a two-sided test at the 5% significance level: 1.97.

Table A-3. Heteroscedasticity-consistent simple regressions: portfolios

	$MR_i = \gamma_0 + \gamma_1 RV_i + u_i$					
RV	γ_0	t-ratio	γ_1	t-ratio	R^2	Adj-R^2
Through Dec/00						
SR	1.63	1.61	0.71	1.89	0.05	0.03
TR	1.67	2.34	0.07	2.68	0.05	0.02
DR	−0.91	−0.76	0.29	3.84	0.11	0.09
Through Feb/00						
SR	3.07	3.20	2.13	4.55	0.33	0.32
TR	3.66	3.73	0.20	4.02	0.25	0.23
DR	−0.96	−0.59	0.64	5.17	0.47	0.46

MR: Mean return; RV: risk variable; SR: systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). Significance based on White's heteroscedasticity-consistent covariance matrix. Critical value for a two-sided test at the 5% significance level: 2.02.

Table A-4. Heteroscedasticity-consistent multiple regressions: portfolios

	$MR_i = \gamma_0 + \gamma_1 RV_{1i} + \gamma_2 RV_{2i} + v_i$						
RV/RV_2	γ_0	t-ratio	γ_1	t-ratio	γ_2	t-ratio	R^2
Through Dec/00							
SR/TR	1.32	1.43	0.43	0.79	0.04	1.04	0.06
SR/DR	−1.09	−0.68	−0.30	−0.30	0.35	1.39	0.11
TR/DR	−2.02	−1.06	−0.11	−0.91	0.54	1.77	0.13
Through Feb/00							
SR/TR	2.27	2.17	1.59	3.63	0.09	2.15	0.36
SR/DR	−0.84	−0.55	0.54	0.64	0.54	2.41	0.48
TR/DR	−2.18	−1.24	−0.19	−1.57	1.04	3.91	0.52

MR: Mean return; RV: risk variable; SR: systematic risk (beta); TR: total risk (standard deviation); DR: downside risk (semideviation). Significance based on White's heteroscedasticity-consistent covariance matrix. Critical value for a two-sided test at the 5% significance level: 2.02.

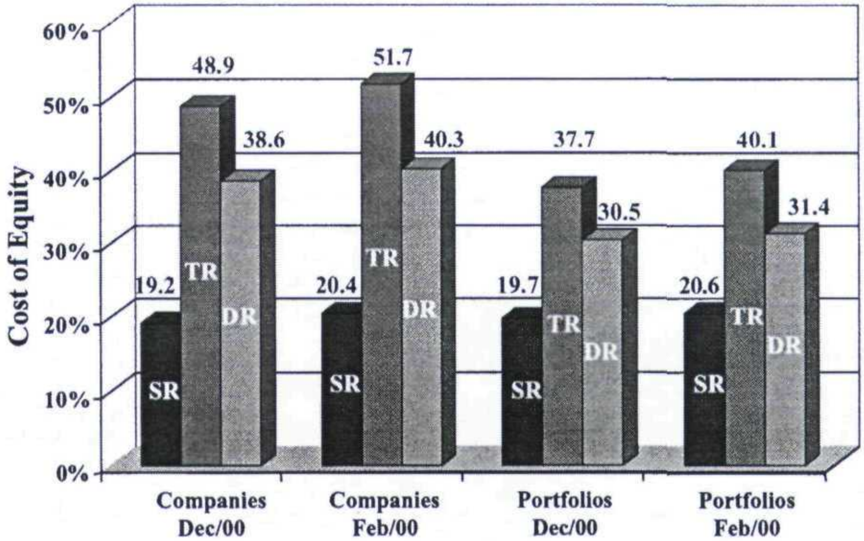

Fig. A-1. Costs of equity (averages). SR: Systematic risk (beta), TR: total risk (standard deviation); DR: Downside risk.

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