Decomposing the Book-to-Price Effect: Leverage and Stock Returns

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ABSTRACT

The starting point for this thesis is a decomposition of book-to-price (B/P) into an enterprise-book-to-price component (that pertains to the firms operations and supposedly reflects operating risk) and a leverage component (assumed to capture financial risk), laid out by Penman et al (2007). Using Swedish data, we show that the leverage component of B/P is *negatively* associated with future stock returns, conditional upon enterprise-book-to-price. This result is in line with the findings of Penman et al (2007) and contradicts the basic finance tenet of a return premium to leverage. With the hypothesis that the puzzling results could be explained by omitted operating risk factors negatively correlated with leverage, we include unlevered beta and variability in return on net operating assets as alternative operating risk proxies. This does not alter the negative relationship, but our results imply that the B/P constituents fail to adequately explain operating and financial risk factors in returns. We propose an alternative model of expected return, and our results point at a *twofold leverage effect* that explains the puzzling irregularity and needs to be taken into consideration when examining the association between leverage and stock returns.

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1 Introduction

The notion of a positive relation between leverage and expected return to equity is widely accepted in finance theory and supported by numerous influential theoretical frameworks. Miller and Modigliani (1958) propose that expected return to a firm's equity is increasing in leverage, given an expected unlevered return higher than its cost of borrowing. The most widespread model describing the relationship between risk and expected return, the Capital Asset Pricing Model, introduced by Sharpe (1964), Lintner (1965) and Black (1972), states that expected return to equity is positively associated with beta. Beta is in turn increasing in leverage, implying a positive relation between expected return and leverage. Fama and French (1992, 1993, 1996) specify a three factor asset pricing model which, besides beta, includes additional risk proxies that are based on empirical observations. One of them is the book-to-price equity (or book-to-market or HML) measure, which the authors claim subsumes the positive leverage effect in returns. This further supports the fundamental principle of leverage as a risk factor that is being rewarded. Despite the large theoretical literature on this question, the available empirical evidence is, to our knowledge, quite limited. Bhandari (1988) examines whether firms' debt/equity ratios are positively related to stock returns in the years 1948-1979, controlling for beta and size, and finds that this is the case. Fama and French (1992) investigates the relationship between leverage – measured as book value of assets to market value of equity – and returns over the years 1963-1990, and confirms the positive association. Research from Johnson (2004), however, points to the contrary and reports a weak inverse relationship between leverage and future returns, conditional upon the volatility of the underlying assets.

Penman, Richardson and Tuna (2007) examines how the Fama and French book-to-price equity measure (B/P) absorbs leverage more precisely. They accept the B/P ratio as a risk factor positively correlated with expected return to equity and separate B/P into an operating and a leverage component pertaining to the firm's operating and financial risk, respectively. The authors find that the operating component is positively related to subsequent stock returns, in accordance with extant risk explanations. Leverage is, however, conditional upon the operating component *negatively* associated with future stock returns. This is a remarkable result, clearly inconsistent with the basic finance tenet that financial risk should be rewarded.

With the perverse finding of Penman et al (2007) as a starting point, the first part of this thesis examines if the contradictory result holds when the study is replicated using Swedish instead of U.S. data. By regressing future returns on the components in cross-section, we find that – conditional upon supposed operating risk – a distinct negative relation indeed is observed also in the Swedish case. Our result strengthens the case of Penman et al and at the same time adds to the mystery of the anomaly.

The leverage component of the B/P ratio is measured as the market value of net debt to the market value of equity and captures financial risk, consistent with conventional theory. A credible measure of operating risk that is theoretically established and empirically supported is still to be identified. As a result, the operating component, measured as net operating assets to the market value of net operating assets (enterprise book-to-price) is arbitrarily assumed to capture operating risk. If the operating component fails to capture and isolate the risk pertaining to the firm's operations, the anomalous finding could be a result of an improper decomposition of B/P into one component that reflects only operating risk and one that reflects only financial risk. The second part of this thesis investigates whether the inclusion of alternative operating risk proxies alters the negative relation between leverage and subsequent returns. Incorporating two additional operating risk proxies in the analyses – unlevered beta and variability in return on net operating assets – does not amend the negative relationship between leverage and returns, but imply that the perverse relationship could be a function of improper proxies for operating and financial risk.

The results obtained in the second part of the thesis suggest that enterprise book-to-price incorporates not only operating, but financial risk factors as well. If this is the case, enterprise book-to-price fails to isolate operating risk, and at the same time implies that the leverage component (ND/P) does not incorporate all aspects of financial risk. In the last part of this thesis, we propose an alternative model of expected return based on the notions of Miller and Modigliani (1958), to examine whether the anomalous negative relationship between leverage and returns could be due to inadequate as well as omitted risk proxies. We elaborate on a twofold leverage effect that has not been identified in the analyses thus far; a positive effect related to the compounding impact that leverage has on operating risk and a negative effect attributable to interest costs. Our regression results confirm that leverage does not affect returns in one direction only and the perverse negative relation between leverage and returns, found by Penman et al (2007) and confirmed by our analyses in the first two parts of the thesis, could hence be a result of a failure to develop the interaction between operating and financial risk factors.

The remainder of the paper proceeds as follows. Section 2 provides background on the book-to-price effect and section 3 describes how B/P can be decomposed into an operating and a leverage component. Section 4 includes a description of our sample and definitions of variables. In section 5, results from our replicating study are presented. Section 6 discusses alternative operating risk proxies and how they affect our results when incorporated in the analysis. In section 7, we examine the relationship between leverage and returns using an alternative expected return model. Section 8 ends the paper with a discussion and concluding remarks.

2 B/P and Stock Returns

If assets and liabilities were carried at market value on the balance sheet, the book value of equity would equal the market value of equity and the B/P ratio would be unity for all levels of risk. A prerequisite for B/P to be an indicator of cross-sectional variations in risk is hence dependant on the accounting for assets and liabilities not being marked to market. With historical cost accounting today being the predominant accounting application in nonfinancial firms, this requirement is fulfilled and non-monetary assets are carried at amortized historical cost. The market value reflects the value of future prospects and is usually higher than the historical cost, which in turn generates B/P ratios lower than unity.

The association between B/P and average stock returns is most prominently announced by Fama and French (1992). Based on comprehensive regressions, they find a strong cross-sectional relation between the B/P ratio and average stock returns. According to the authors, the B/P ratio is a proxy for (unobservable) risk factors in returns, with a high B/P ratio indicating higher fundamental risk than would a low ratio. Fundamental to this explanation is that B/P is an indicator of the relative prospects of firms. High B/P firms are expected to generate persistently low returns on assets relative to low B/P firms, implying higher fundamental risk and accordingly higher expected returns. Moreover, the authors find a close link between B/P and leverage and hypothesize that the B/P effect absorbs financial distress risk – imposed by leverage – that should be positively associated to returns.

There is, however, no general agreement as to how the B/P effect should be interpreted. It can, alternatively to consider the B/P ratio as an indicator of risk, be explained as abnormal returns to mispricing due to market inefficiency. Lakonishok, Shleifer and Vishny (1994) and Haugen (1999), among others, present mispricing explanations based on investors' overreaction to past performance. Overreaction supposedly leads to high B/P firms, with a recent historical track record of poor performance, being underpriced. Given long term market efficiency, investor overreaction tends to be corrected and high B/P firms will thus generate subsequent abnormal returns. This makes the B/P measure a predictor of differences in returns, not because of any additional risk, but because of the systematic undervaluation (and following correction) of poor performing companies. Research from Daniel and Titman (1997) also challenges the Fama and French interpretation of the B/P effect. Their results indicate that the return premium do not arise because of the co-movement between stocks and B/P, but because stocks with similar B/P ratios have similar firm characteristics and co-vary with one another.

Although consensus has not been reached regarding the theoretical explanation of the B/P effect, there is no disagreement that the B/P ratio empirically explains subsequent returns. As a working principle, we will view B/P as a risk factor, consistent with Penman et al (2007).

3 Decomposing B/P

The decomposition of the B/P ratio into an operating and a leverage component, laid out by Penman et al (2007), requires an understanding of basic balance sheet relationships. The standard balance sheet, equating total assets to total liabilities and equity, can be reformulated to distinguish operating and financing activities:

Standard Balance Sheet			
Assets		**Liabilities & Equity**	
Operating Assets	OA	Operating Liabilities	OL
Financial Assets	FA	Financial Liabilities	FL
		Common Equity	B
Total Assets	OA+FA	Total Liabilities & Equity	OL+FL+B

Reformulated Balance Sheet			
Operations		**Financing**	
Operating Assets	OA	Financial Liabilities	FL
Operating Liabilities	OL	Financial Assets	FA
		Net Debt (FL-FA)	ND
		Common Equity	B
Net Operating Assets	OA-OL	Financing Activities	ND+B

Operating assets and liabilities are involved in the operations of a business, in the selling of goods and services. Examples of assets and liabilities typically classified as operating include inventories, property, plant and equipment, accounts payable and wages payable. Financing activities consist of financing assets and liabilities that deal with the funding of operations and disbursement of excess cash generated by the operations. Common examples are short and long term financial liabilities (debt) and cash invested in short-term securities.

According to the reformulated balance sheet, net operating assets (NOA) is the difference between operating assets and operating liabilities, also referred to as the book value of the enterprise/firm. The net operating assets are employed in the operations and are financed by net debt (ND) and equity (B). Net debt is the difference between financial liabilities and financial assets. Common shareholders' equity is the residual claim on the firm's net operating assets after subtracting net creditors' claims. The B/P ratio thus applies a valuation multiple to common shareholders' equity that pertains to both the operating and the financing activities of the balance sheet.

Under the assumption that the B/P effect is a market efficient pricing of risk, Penman et al (2007) decompose the ratio into an operating and a leverage component. The starting point for the B/P ratio breakdown is the balance sheet equation, which equates common shareholders' equity to the difference between net operating assets and net debt:

$$\text{Common Shareholders' Equity (B)} = \text{Net Operating Assets (NOA)} - \text{Net Debt (ND)}$$

The market value equivalent to the balance sheet equation is:

$$P = P^{NOA} - P^{ND}$$

P is the market value of shareholders' equity, also referred to as market capitalization. P^{NOA} is the market value of net operating assets (value of the enterprise/firm), and P^{ND} is the market value of net debt.

Empirical research commonly relies on the assumption that book value of debt adequately approximates market value of debt. This assumption generally holds, but may be violated if fixed-rate debt is subject to large interest rate swings, if the issuer of debt is in financial distress or if the price of credit risk changes. Theoretical frameworks are virtually always built upon market values, which makes the accuracy of the debt approximation of great importance. Sweeney, Warga and Winters (1997) examine firms' book- versus market-based capital structure for the period 1978-1991, and find differences in the time-series behavior of the two measures, with substantial and persistent divergences in some years and almost no divergences in others. However, monthly cross-sectional correlations between book and market-based capital structure are always very high (above 95%), leading the authors to conclude that cross-sectional studies are likely to be insensitive to the use of book values of debt as a proxy for market values. The assumption that net debt is carried on the balance sheet at market value is maintained by Penman et al (2007). To prevent potential mismeasurement of net debt from affecting the robustness of their results, the authors control for both changes in credit quality and interest rate risk, yet still find a negative correlation between market leverage and future returns. Hence, assuming that the book value of net debt equals the market value of net debt appears to be safe, and the above relationship can be stated as:

$$P = P^{NOA} - ND$$

In order to get the B/P ratio on the left hand side, the balance sheet equation is divided by P:

$$\frac{B}{P} = \frac{NOA}{P} - \frac{ND}{P}$$

By extending with P^{NOA}, the above equation can be expressed as:

$$\frac{B}{P} = \frac{P^{NOA}}{P} * \frac{NOA}{P^{NOA}} - \frac{ND}{P}$$

Dividing both sides of the market value equivalent to the balance sheet equation ($P = P^{NOA} - ND$) with P and rearranging:

$$\frac{P^{NOA}}{P} = 1 + \frac{ND}{P}$$

Given this equality, P^{NOA}/P in the above expression of B/P can be substituted:

$$\frac{B}{P} = \left(1 + \frac{ND}{P}\right)\frac{NOA}{P^{NOA}} - \frac{ND}{P}$$

Rearranging:

$$\frac{B}{P} = \frac{NOA}{P^{NOA}} + \frac{ND}{P}\left(\frac{NOA}{P^{NOA}} - 1\right) \qquad (1)$$

Equation (1) expresses the B/P ratio as a leveraging equation, where the enterprise book-to-price ratio (NOA/P^{NOA}) and leverage (ND/P) are the determinants. Returns related to the B/P effect should, accordingly, be rewards for operating risk, captured by enterprise book-to-price, and financial risk, determined by leverage. If enterprise book-to-price measures operating risk, its relationship with subsequent returns should be positive and, given a level of enterprise book-to-price, leverage should add to expected return conditioned on a market efficient pricing of operating and financial risk. Empirical tests of these theoretical predictions are made in section 5.

The equation further tells us that leverage induces a nonlinear relationship between (levered) B/P and enterprise book-to-price. If enterprise book-to-price is greater than 1, B/P increases in leverage and is higher than enterprise book-to-price if leverage is positive, but lower if leverage is negative. Conversely, B/P decreases in leverage if enterprise book-to-price is less than 1, and is lower than enterprise book-to-price if leverage is positive, but higher if leverage is negative. Cases where enterprise book-to-price equals 1 imply a mark to market accounting of assets and liabilities. B/P would in these instances also equal 1 and not be predictive of differences in future returns. The nonlinear relationship between B/P and enterprise book-to-price suggests that a B/P ratio higher than 1 can be composed of relatively high enterprise book-to-price and positive leverage, or relatively low enterprise book-to-price and negative leverage. A B/P ratio lower than 1 can be composed of relatively low enterprise book-to-price and positive leverage, or relatively high enterprise book-to-price and negative leverage. Although it can be said that B/P absorbs leverage, we will examine to what extent the B/P effect is explained by enterprise book-to-price, and to what extent it is a leverage effect.

4 Data and Variables

Our primary source of data is Thomson Datastream, from which both financial statement data and stock returns are obtained. The sample includes annual data from Swedish nonfinancial firms listed on the OMX Nordic Exchange Stockholm and classified as Large Cap firms. Firms belonging to the financial industry: finance, insurance and real estate companies, are excluded since they are usually highly leveraged without necessarily being in financial distress, as would more likely be the case for nonfinancial firms.[1] The industrial classification follows the Global Industry Classification Standard. Large Cap firms listed on the OMX Nordic Exchange Stockholm have a market capitalization exceeding 1 billion euros and the sample has been delimited to these firms to ensure that share prices are efficient with regard to liquidity risk. The turnover of Large Cap firms' shares is, hence, assumed to be high enough to rule out any liquidity discounts. For firms with multiple

[1] The method of excluding the financial services industry is in accordance with Fama and French (1992) and Penman et al (2007).

share classes, the one with the highest turnover is selected. Firms included in the final, refined, sample are presented in Appendix C.

The following data is extracted for a firm-year: book value of common equity (Thomson Datastream Code WC03501), market capitalization (WC08001), long term debt (WC03251), short term debt and current portion of long term debt (WC03051), cash and short term investments (WC02001), operating income (WC01250), stock returns (Return Index, RI) and beta[2]. Definitions of the variables retrieved from Datastream are displayed in Appendix B. Missing data items are, to the highest possible extent, retrieved from annual reports published on the firms' home pages. Financial statement data is measured at the end of the fiscal year and collected for the 21-year period between 1986 and 2006.

The calculation of variables follows Penman et al (2007). The B/P ratio is calculated as book value of common equity (B) to market capitalization (P). Net operating assets (NOA) are the sum of common equity and book value of net debt (ND). ND, in turn, is equal to financial liabilities (= long term debt + short term debt and current portion of long term debt) minus financial assets (= cash and short term investments)[3]. The market value of net operating assets (P^{NOA}) is the sum of P and ND, where ND is assumed to equal the market value of net debt. The enterprise book-to-price ratio (NOA/P^{NOA}) is calculated as NOA to P^{NOA} and financial leverage is measured as ND/P. To minimize the influence of outliers and to avoid misleading results from potentially erroneous data, extreme values (that lie more than 10 standard deviations from the time-series mean) are excluded for the following variables: B/P, NOA/P^{NOA}, ND/P and B/P - NOA/P^{NOA}. Firm-years with negative values for NOA and/or P^{NOA} are included in the portfolio and correlation analysis, but excluded from the regression analysis. In total, this gives 548 firm-year observations for the portfolio and correlation analysis and 546 firm-year observations for the regression analysis.

To ensure that financial statement data is known before the subsequent returns they are predicted to explain, the 12-month return period for each firm starts four months after the fiscal year-end. We assume that annual report information is publically available within four months after the fiscal year-

[2] Betas for individual companies are estimated from a linear regression model using weekly firm and market return data for the fiscal year for which B/P and its components are measured. The market return in the beta calculation is based on the market capitalization weighted MSCI World Index.

[3] A part of cash should be defined as an operating asset since a certain amount of cash is usually required to run the operations of a firm. Operating and financing cash is, however, usually not reported separately, which makes a distinction problematic, especially since the amount of cash needed in the firm's operations varies across industries. As many firms store cash in interest bearing accounts and since this item typically is small, assuming that all cash and cash equivalents are financial assets should be safe.

end, as firms listed on the OMX Nordic Exchange Stockholm, according to the listing rules, are required to announce a communiqué containing essential annual account information at the latest two months after the fiscal year-end. Two additional months are added since the listing rules may occasionally be broken by some firms and, further, the actual annual report is usually announced three to four months subsequent to the fiscal year-end.[4]

Additional comments regarding the sample and the methods applied will be given throughout the paper in connection to portfolio, correlation and regression analyses.

5 Operating and Leverage Effects in Stock Returns

The first part of this section encompasses basic unconditional relationships between B/P, its components and future returns. The second part provides a correlation analysis between B/P, its components, future returns and other risk characteristics. In the last part, we present the results of a regression analysis where the incremental return related to B/P, its components and other risk characteristics is estimated.

5.1 Basic Relationships

Table 1 displays buy-and-hold returns for four portfolios formed on B/P (panel A), enterprise book-to-price (panel B), leverage (panel C) and the difference between B/P and enterprise book-to-price (panel D). The difference between B/P and enterprise book-to-price, hereinafter also referred to as the financial component of the B/P ratio (note that ND/P is referred to as the leverage component), expresses the amount by which B/P differs from enterprise book-to-price because of leverage. Returns are raw returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. In order to remove the potential size-effect[5], i.e. the historically observed tendency for small firms to have higher returns than large firms, the analysis is replicated using size-adjusted returns (in accordance with Penman et al [2007]). Qualitatively similar results are obtained and presented in table 1 in Appendix A.

[4] A return window starting four months after the fiscal year-end is used by Penman et al (2007) and also in numerous prior studies examining stock price responses on accounting data. See, for example, Sloan (1996) and Beneish and Vargus (2002). Penman et al (2007) replicate their analysis using a more conservative six month gap between the fiscal year-end and the start of the return period (in accordance with Fama and French [1992]), but find virtually identical results.

[5] See, for example, Banz (1981).

TABLE 1

Mean Annual Raw Returns for Portfolios Formed on Book-to-price (B/P) and its Components

This table reports mean raw returns over the subsequent 12 months for portfolios formed on B/P, enterprise book-to-price, market leverage and the difference between B/P and enterprise book-to-price (the financial component), for the period 1986-2006.

Panel A: Future returns for B/P portfolios

			Mean Value for Each Portfolio			
Portfolio	N	Mean B/P	Future Returns	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}
1	138	0,202	0,161	0,233	0,105	-0,031
2	130	0,369	0,236	0,417	0,182	-0,048
3	131	0,586	0,229	0,636	0,295	-0,050
4	149	0,987	0,290	0,940	0,644	0,047

Panel B: Future returns for enterprise book-to-price (NOA/P^{NOA}) portfolios

			Mean Value for Each Portfolio			
Portfolio	N	Mean NOA/P^{NOA}	Future Returns	B/P	ND/P	B/P - NOA/P^{NOA}
Negative	2	---	0,126	0,461	-0,547	---
1	138	0,197	0,181	0,225	-0,024	0,027
2	131	0,434	0,216	0,369	0,189	-0,065
3	130	0,651	0,232	0,573	0,395	-0,079
4	147	0,961	0,289	0,985	0,687	0,024

Panel C: Future returns for market leverage (ND/P) portfolios

			Mean Value for Each Portfolio			
Portfolio	N	Mean ND/P	Future Returns	B/P	NOA/P^{NOA}	B/P - NOA/P^{NOA}
1	137	-0,111	0,241	0,375	0,309	0,066
2	131	0,085	0,211	0,454	0,480	-0,027
3	131	0,294	0,210	0,527	0,606	-0,080
4	149	0,928	0,255	0,804	0,839	-0,035

Panel D: Future returns for portfolios formed on B/P - NOA/P^{NOA}

			Mean Value for Each Portfolio			
Portfolio	N	Mean B/P - NOA/P^{NOA}	Future Returns	B/P	NOA/P^{NOA}	ND/P
1	138	-0,163	0,242	0,432	0,595	0,488
2	131	-0,063	0,191	0,511	0,574	0,255
3	131	-0,004	0,210	0,593	0,597	0,216
4	148	0,142	0,272	0,644	0,502	0,294

The portfolios are constructed by ranking all firm observations each calendar year on B/P and its components. The observations are partitioned into four portfolios based on the value of the measure ranking each portfolio, displayed at the head of each panel. The values range from the lowest, in portfolio 1, to the highest, in portfolio 4. If the number of annual observations is uneven, thus preventing an equal partitioning into the four portfolios, the outermost observations are, in a consistent

(Continued)

TABLE 1 – *Continued*

manner, primarily placed in portfolio 4 and secondarily (if two or three uneven observations) in portfolio 4 and 1. As a consequence, these portfolios contain more observations than do portfolio 2 and 3. In panel B, negative values for NOA/P^{NOA} are placed into a separate portfolio. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded (3 observations). The total number of firm-years used in the analysis is 548.

B/P is measured as the book value of equity (B) to the market value of equity (P). Enterprise book-to-price (NOA/P^{NOA}) is the book value of net operating assets (NOA) relative to the market value of net operating assets (P^{NOA}), where P^{NOA} is the sum of P and net debt (ND). Net debt equals the book value of financial liabilities minus financial assets (assumed to equal the market value of net debt), and ND/P is market leverage. All ratios are calculated at fiscal year-end.

Returns are raw returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. Both variable and return numbers reported in the table are portfolio means.

Panel A of table 1 reports a positive relation between B/P and future returns, confirming the B/P effect. The relation is not entirely unequivocal, with portfolio 2 and 3 having similar returns, but the difference in returns between portfolio 1 and 4 is substantial. The mean B/P ratio for portfolio 4 is considerably higher than the one for portfolio 3, since portfolio 4, despite the reduction of extreme values, still contains observations with relatively high values on B/P. However, excluding observations that deviate more than 100 percent from the mean B/P of portfolio 4 – and hence narrowing the delimitation of outliers further – yields almost identical results with regard to future return. Panel A also provides insight into the interdependence between variables. The enterprise book-to-price ratio follows the same pattern as the B/P ranking, implying a high correlation between the two variables. Indeed, leverage also follows the same pattern as B/P, with high B/P firms having higher leverage, considerably so for firms with the highest B/P. Recall from equation (1) that leverage has an increasing effect on the B/P ratio for firms with enterprise book-to-price higher than 1. This effect is elucidated by the positive difference between B/P and enterprise book-to-price for portfolio 4 (in the right hand column), as opposed to negative differences for the other portfolios. Portfolio 4 contains firms with high enterprise book-to-price that are generally highly levered, meaning that when buying a high B/P firm, the investor is typically buying a combination of high enterprise book-to-price and leverage risk.

Panel B documents a distinct positive relation between enterprise book-to-price and subsequent returns, in line with the book-to-price effect and the previous discussion regarding operating risk and returns. Moreover, there is a positive correlation between enterprise book-to-price and leverage, which induces a clear pattern between leverage and returns.

Panel C reports returns related to different levels of leverage. Returns are expected to increase in leverage, but the observed results do not really comply with the predictions. Portfolio 4, containing highly levered firms, has the highest return, as anticipated. Portfolio 1, on the other hand, has the lowest leverage (negative), but still higher return than both portfolio 2 and 3. This result is surprising considering that portfolio 1 is constituted by firms with relatively low enterprise book-to-price and the lowest leverage, supposedly having relatively low operating risk and the lowest financial risk.

Returns associated with the difference between B/P and enterprise book-to-price, or the financial component of the B/P ratio, are reported in panel D. The financial component is a measure of the amount by which B/P differs from enterprise book-to-price because of leverage and should thus be highly correlated with leverage. Indeed, the returns in panel D rank in a similar pattern as the returns for the portfolio formed on leverage. Further, the difference between B/P and enterprise book-to-price is largest for the portfolios with highest leverage (1 and 4).

To conclude, the observed unconditional relationship between B/P and subsequent returns, as well as between enterprise book-to-price and returns, are in line with the previously stated predictions based on theory. The association between leverage and returns does, on the other hand, not fully align with expectations. These results are, in general, qualitatively similar to the ones obtained by Penman et al (2007).

5.2 Correlations

As the panels of table 1 illustrate, different components of equation (1) correlate in a more or less strong manner. To clarify the subtleties of the relationship between components and to support the analysis in the next part of this section, a more thorough correlation analysis is required.

Table 2 provides Pearson (lower diagonal) and Spearman (upper diagonal) correlation coefficients[6] between B/P, enterprise book-to-price, leverage and the difference between B/P and enterprise book-to-price. In addition, (levered) beta, size (measured as the natural logarithm of market capitalization and denoted as ln [size]), raw returns and size-adjusted returns are included in the analysis. Reported correlation coefficients are computed by pooling all firm-year observations, since the relationship between variables is assumed to be constant over the sample period. The analysis is repeated with average

[6] Pearson's correlation coefficient is the most widely used measure when calculating correlations. It characterizes the degree of linear dependence between variables, and is, since it is a parametric correlation coefficient, not stable to outliers or variables that are not normally distributed. Spearman's rank correlation coefficient, on the other hand, is non-parametric and calculated using variable ranks instead of their values. This makes the coefficient less sensitive to outliers and the relation between variables can be calculated independently of their distribution.

correlation coefficients, estimated annually, across the years in the sample. This method is in accordance with Penman et al (2007) and the qualitatively similar results are presented in table 2 in Appendix A, confirming the assumption of a constant relation between variables over time.[7]

Table 2 includes two panels: panel A, reporting correlations for observations where enterprise book-to-price is higher than or equal to 1 (66 observations) and panel B, where enterprise book-to-price is lower than 1 (482 observations). The dichotomy is motivated by equation (1), which prescribe that the sign of the correlation between variables in some cases depends on whether enterprise book-to-price is higher or lower than 1.

As indicated by the previously observed unconditional relationships, the correlation between B/P and enterprise book-to-price is strong across both panels of table 2. Equation (1) stipulates a positive relation between B/P and leverage if enterprise book-to-price is equal to or higher than 1 and leverage is positive. This relation is confirmed by the positive correlation coefficients for B/P and leverage in panel A (0,457 Pearson and 0,169 Spearman). Leverage is negatively correlated to enterprise book-to-price in panel A, which weakens the positive association between B/P and leverage, since B/P increases in enterprise book-to-price when leverage is positive.

If enterprise book-to-price is lower than 1, equation (1) suggests a negative relationship between B/P and leverage, given that the latter is positive. The correlations found in panel B are on the contrary positive (0,366 Pearson and 0,384 Spearman). The explanation to this contradictive result is the strong positive correlation between enterprise book-to-price and leverage in panel B (0,609 Pearson and 0,689 Spearman). Leverage may actually be negatively correlated with B/P when enterprise book-to-price is lower than 1 and leverage is positive, but its strong positive correlation with enterprise book-to-price has an offsetting effect on the potentially negative relationship.

5.3 Regression Analysis

In this section, we estimate the incremental return related to each component of equation (1). As B/P explains differences in returns, we previously predicted that its component parts should explain differences in returns as well. More precisely, enterprise book-to-price is assumed to be an operating risk characteristic and expected to be positively associated with

[7] The correlation coefficients in table 2 in Appendix A should, due to the low number of observations, especially in panel A, be interpreted with caution.

TABLE 2

Correlations between B/P, Its components, Size, Beta and Returns

This table reports cross-sectional correlations for the period 1986-2006. Spearman correlation coefficients are displayed in the upper diagonal, and Pearson correlation coefficients in the lower diagonal.

Panel A: Correlations ($NOA/P^{NOA} \geq 1$)

	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	Size	Beta	Size-adj. Returns	Raw Returns
B/P	---	0,922	0,169	0,779	-0,249	-0,029	0,011	0,022
NOA/P^{NOA}	0,617	---	-0,175	0,527	-0,200	-0,007	0,051	0,045
ND/P	0,457	-0,189	---	0,621	-0,192	-0,011	-0,024	0,035
B/P - NOA/P^{NOA}	0,842	0,095	0,708	---	-0,147	0,038	-0,009	0,014
Size	-0,187	-0,311	-0,183	-0,024	---	0,202	-0,079	-0,183
Beta	0,006	-0,165	0,049	0,121	0,241	---	0,211	0,193
Size-adj. returns	0,020	0,107	-0,047	-0,048	-0,128	0,176	---	0,987
Raw returns	0,026	0,109	-0,012	-0,042	-0,208	0,144	0,995	---

Panel B: Correlations ($NOA/P^{NOA} < 1$)

	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	Size	Beta	Size-adj. Returns	Raw Returns
B/P	---	0,907	0,384	-0,086	-0,142	-0,003	0,105	0,105
NOA/P^{NOA}	0,909	---	0,689	-0,447	-0,122	0,007	0,049	0,041
ND/P	0,366	0,609	---	-0,884	-0,057	0,015	-0,076	-0,088
B/P - NOA/P^{NOA}	-0,024	-0,439	-0,672	---	0,008	-0,011	0,057	0,076
Size	-0,167	-0,168	-0,215	0,043	---	0,294	0,029	-0,101
Beta	-0,027	-0,029	-0,025	0,011	0,232	---	-0,024	-0,056
Size-adj. returns	0,065	0,035	-0,115	0,056	0,002	0,042	---	0,982
Raw returns	0,060	0,028	-0,101	0,061	-0,127	0,018	0,987	---

Correlations coefficients utilize a total number of 66 firm-year observations in panel A and 482 firm-year observations in panel B. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for the following variables: B/P, NOA/P^{NOA}, ND/P and B/P - NOA/P^{NOA} (3 observations). The definitions of these variables can be found in the notes to table 1. Size is the natural logarithm of market capitalization, ln (P), measured at fiscal year-end. Beta is estimated from a linear regression model using weekly firm and market return data for the fiscal year for which B/P and its components are measured. The market return in the beta calculation is based on the market capitalization weighted MSCI World Index. Size-adjusted returns are calculated by ranking all firm-year observations on market capitalization, measured at the fiscal year-end preceding the 12-month return period, and assigning them into four portfolios. The equal-weighted return for the respective size portfolio is then subtracted from the raw return in order to compute the size-adjusted return.

returns. Leverage captures financial risk and is also expected to be positively related to subsequent returns. To examine these predictions and to what extent the returns to the components are sensitive to returns associated with other standard risk characteristics – that serves as controls for potentially unidentified risk – future raw returns are cross-sectionally regressed on B/P, its components, (levered) beta and ln (size). The following regression equation is specified:

$$R_{t+1} = \alpha + \lambda_1 \frac{NOA_t}{P_t^{NOA}} + \lambda_2 \frac{ND_t}{P_t} + \cdots + \varepsilon_t \tag{2}$$

Returns are measured for the 12-month period beginning four months after the fiscal year-end, i.e. four months after the time of the variable measurement. Alpha (α) is a constant representing the regression line intercept. The ellipsis (ε) indicates potentially omitted, unidentified operating risk characteristics. Leverage is assumed to be a credible measure of financial risk, whereas enterprise book-to price is a tentative proxy for operating risk. Unidentified risk should consequently pertain to the operations of the firm.

Table 3 reports regression coefficients estimated by pooling all firm-year observations. *T*-statistics are reported in parentheses below each coefficient. The table consists of three panels: panel A reports results for the full sample of firm-years (546 observations), panel B for firm-year observations where enterprise book-to-price is equal to or higher than 1 (66 observations) and panel C for firm-years where enterprise book-to-price is lower than 1 (480 observations). The analysis is also repeated using the same methodology as Penman et al (2007), with average regression coefficients, estimated each year, across the years in the sample. The results, presented in table 3 in Appendix A, generally correspond to the results in table 3, although less pronounced.[8] The qualitatively similar results corroborates with our assumption of no temporal variations in the relationship between variables over time.

Regression I in panel A, displaying results for future returns regressed on B/P alone, significantly confirms the B/P effect. The estimated coefficient in regression I is positive also across panels B and C, although with less significance. Regression II reports a positive incremental return related to enterprise book-to-price, in line with the ratio being an operating risk characteristic. Regression III includes leverage alone and yields a slightly

[8] The results in table 3 in Appendix A should be interpreted with caution, since the relatively few observations in some years could potentially bias the estimated coefficients and *t*-statistics.

TABLE 3

Regression Analysis for B/P Decomposition

This table reports coefficients and t-statistics (in italics in parentheses) estimated from cross-sectional regressions of raw stock returns on B/P, B/P components, size and beta, for the period 1986-2006.

Panel A: Full sample (sample size is 546 firm-year observations)

	I	II	III	IV	V	VI	VII
Intercept	0,130	0,124	0,227	0,236	0,109	0,136	1,163
	(3,43)	*(2,89)*	*(8,85)*	*(10,36)*	*(2,47)*	*(3,12)*	*(4,06)*
B/P	0,184						
	(3,30)						
NOA/P^{NOA}		0,187			0,251	0,175	0,199
		(2,90)			*(3,26)*	*(2,69)*	*(2,57)*
ND/P			0,012		-0,067		-0,093
			(0,33)		*(-1,51)*		*(-2,10)*
$B/P - NOA/P^{NOA}$				0,265		0,219	
				(1,92)		*(1,59)*	
Size							-0,065
							(-3,85)
Beta							0,059
							(1,75)
Adj. R^2	0,018	0,013	-0,002	0,005	0,019	0,016	0,040

Panel B: $NOA/P^{NOA} \geq 1$ (sample size is 66 firm-year observations)

	I	II	III	IV	V	VI	VII
Intercept	0,376	0,034	0,444	0,450	0,022	0,034	2,044
	(1,26)	*(0,07)*	*(3,56)*	*(4,57)*	*(0,04)*	*(0,07)*	*(1,50)*
B/P	0,044						
	(0,21)						
NOA/P^{NOA}		0,337			0,342	0,353	0,168
		(0,88)			*(0,87)*	*(0,91)*	*(0,41)*
ND/P			-0,007		0,006		-0,037
			(-0,10)		*(0,07)*		*(-0,46)*
$B/P - NOA/P^{NOA}$				-0,088		-0,111	
				(-0,33)		*(-0,42)*	
Size							-0,133
							(-1,87)
Beta							0,297
							(1,71)
Adj. R^2	-0,015	-0,004	-0,015	0,002	-0,019	-0,017	0,031

(Continued)

TABLE 3 – *Continued*

Panel C: $NOA/P^{NOA} < 1$ (sample size is 480 firm-year observations)	I	II	III	IV	V	VI	VII
Intercept	0,150	0,178	0,230	0,218	0,128	0,164	1,072
	(3,23)	*(3,80)*	*(8,99)*	*(8,81)*	*(2,62)*	*(3,48)*	*(3,79)*
B/P	0,121						
	(1,31)						
NOA/P^{NOA}		0,051			0,260	0,126	0,243
		(0,60)			*(2,47)*	*(1,36)*	*(2,34)*
ND/P			-0,134		-0,243		-0,280
			(-2,26)		*(-3,31)*		*(-3,81)*
$B/P - NOA/P^{NOA}$				0,344		0,480	
				(1,55)		*(1,97)*	
Size							-0,058
							(-3,46)
Beta							0,038
							(1,16)
Adj. R^2	0,001	-0,001	0,009	0,003	0,019	0,005	0,039

Reported coefficients are estimated from cross-sectional regressions for the period 1986-2006. T-statistics are the coefficient divided by its standard error. Returns are raw returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. Definitions of the variables can be found in the notes to tables 1 and 2. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for the following variables: B/P, NOA/P^{NOA}, ND/P and $B/P - NOA/P^{NOA}$ (3 observations). Firm-years with negative values for NOA and/or P^{NOA} are also excluded (2 observations). The total number of firm-years used in the regression analysis is 546.

positive, but insignificant, estimated coefficient in panel A. This is surprising given that higher financial risk should add to returns in a more distinguished manner. This not being the case may, however, be due to a negative correlation between leverage and operating risk – a relationship that could also explain the slightly negative and insignificant coefficient on leverage in panel B, when enterprise book-to-price is higher than 1. Indeed, in panel A of table 2, leverage and enterprise book-to-price are negatively correlated. Finally, panel C reports a strongly negative and significant estimated coefficient on leverage when enterprise book-to-price is lower than 1. This contradictive result cannot be explained by the interaction between leverage and enterprise book-to-price, since the variables have a strong positive correlation when enterprise book-to-price is lower than 1 (reported in panel B of table 2).

Regression V comprises both enterprise book-to-price and leverage. The inclusion of enterprise book-to-price controls for supposed operating risk and isolates the relationship between leverage and returns. Although this relationship is expected to be positive, the estimated coefficients in regression V points to the contrary. In panel A, the coefficient on leverage is negative, implying a return discount rather than a premium. Panel B reports a close to zero and insignificant coefficient on leverage, also inconsistent with financial risk being rewarded. Finally, panel C, covering the main part of the sample

(88%), reports a highly significant and strongly negative coefficient on leverage.

The financial component of B/P yields an almost significantly positive coefficient in panel A, both before and after controlling for supposed operating risk in regressions IV and VI, implying a reward to leverage. However, the results displayed in panel B and C points to the contrary. Equation (1) suggests a positive relation between the financial component of B/P and leverage when enterprise book-to-price is higher than 1, which is confirmed by the strong positive correlation between the components in panel A of table 2. Accordingly, if leverage is rewarded with returns, the coefficients in regressions IV and VI in panel B should be positive, but are in contrast negative. Further, an inverse relationship between leverage and the financial component is prescribed when enterprise book-to-price is lower than 1, confirmed by the strong negative correlation between the variables in panel B of table 2. Thus, for leverage to be positively related to returns, the coefficients on the difference between B/P and enterprise book-to-price should be negative. The estimated coefficients in regression IV and VI in panel C are however strongly positive, strengthening the anomalous relation between leverage and returns.

In the last regression of table 3, ln (size) and beta are controlled for, since a negative correlation between leverage and these risk characteristics could explain the negative relation between leverage and returns. Indeed, table 2 reports a negative correlation between leverage and size, but an ambiguous correlation between leverage and beta. However, when these factors are included in regression VII, the coefficient on leverage is negative across all panels, and even more so compared to regression V, with higher levels of significance. Similar to Penman et al (2007), adjusted coefficients of determination (adjusted R^2) are surprisingly low across all regressions in table 3, indicating that only a small fraction of variations in returns are explained by the components of B/P. Section 7 contains a more thorough discussion on the coefficients of determination.

The regression analysis convincingly points at a negative relationship between leverage and future returns, conditioned on supposed operating risk, thereby implying a violation against the basic finance notion of a reward to leverage. The negative association further survives, and is even more distinguished, after controlling for standard risk characteristics. The perverse relationship that Penman et al (2007) find is thus confirmed when performing a replicating study on Swedish data. In the following section, we investigate whether an inclusion of alternative operating risk proxies, other than enterprise book-to-price, alters the negative relationship between leverage and returns.

6 Alternative Operating Risk Proxies

The nomination of the enterprise book-to-price ratio as a characteristic that captures and isolates the operating risk in stock returns is, according to Penman et al (2007), tentative. Although we previously derived and theoretically showed that the ratio should constitute the operating component of the B/P measure, an inclusion of enterprise book-to-price is speculative in the absence of a widely accepted measure of operating risk. If all operating risk factors are not identified and included in the analysis, the observed negative relation between leverage and returns may be a function of leverage being negatively associated with unidentified operating risk. In this instance leverage would, besides being a proxy for financial risk, indicate differences in operating risk. Conversely, the negative relation could be a result of enterprise book-to-price encompassing not only operating risk factors, but financial risk factors as well. We attempt to control for these potential inaccuracies by including two additional operating risk proxies: unlevered beta and variability in return on net operating assets, in the analysis.

6.1 Unlevered Beta

Whereas appointing enterprise book-to-price as an operating risk factor is speculative, including leverage as a financial risk factor is theoretically justified and can formally be motivated by the following leverage formula:

$$r_E = r_U + \frac{ND}{P}\,(r_U - r_{ND}) \tag{3}$$

Leverage equation (3) states that expected return to equity (r_E) is increasing in expected return to unlevered equity (r_U) as well as in leverage (ND/P), given an expected unlevered return higher than the expected return to net debt. It expresses the Miller and Modigliani (1958) notions that are prevailing still.

When a firm is financed solely by equity, r_E equals r_U, and hence the term unlevered return to equity. If a firm has no leverage, its net operating assets equal its equity. The unlevered return to equity is accordingly equivalent to the return to the firm's net operating assets, and should be determined by and isolate operating risk. The expected unlevered return to equity can be estimated using the Capital Asset Pricing Model (CAPM)[9]:

$$r_U = r_F + \beta_U\,(r_M - r_F) \tag{4}$$

[9] For a deeper discussion on the CAPM and potential empirical shortcomings of the model, see, for example, Black (1993), Jagannathan and McGrattan (1995) and Fama and French (2004).

According to the model, the expected unlevered return to equity is a linear function of the unlevered beta. The risk-free rate of return (r_F) and the market risk premium (r_M-r_F) are similar across assets, whereas unlevered beta is the differentiating factor determining the expected unlevered return of a specific asset. The risk-free rate of return compensates investors for the time value of money and the product of unlevered beta and the market risk premium is a compensation for risk. Unlevered beta is obtained by stripping levered beta (β_E), that measures the extent to which return on a stock co-varies with the market return, from financial risk. This should leave a risk measure pertaining only to the operating risk of a firm:

$$\beta_U = \frac{\beta_E}{\left(1 + \frac{ND}{P}\right)} \tag{5}$$

The CAPM has a strong theoretical foundation, based on the portfolio management teachings of Markowitz (1952), and beta is widely acknowledged as a fundamental risk proxy. As discussed before, the nomination of B/P as a systematic risk factor is primarily based on empirical evidence and mispricing cannot be ruled out as an explanation to the B/P effect. The positive relation between enterprise book-to-price and returns, recognized in the analysis of unconditional relationships as well as in both the correlation and regression analysis, is consistent with a risk explanation, but also with a mispricing story. The uncertainties surrounding the enterprise book-to-price ratio could possibly be circumvented by using unlevered beta as a proxy for operating risk.

6.2 Variability in Return on Net Operating Assets

The relationship, in book value terms, between return on net operating assets[10] (R_{NOA}), return on equity (ROE) and leverage (ND/B) is explained by the following leverage formula:

$$ROE = R_{NOA} + \frac{ND}{B}\,(R_{NOA} - NBC)$$

ROE is a function of R_{NOA}, compounded by the product of leverage and the operating spread (the difference between R_{NOA} and the net borrowing cost [NBC]). According to the equation, leverage turns unfavorable if the return on

[10] Return on net operating assets is calculated as operating income (Thomson Datastream Code WC01250) divided by net operating assets (defined under the section Data and Variables), with both items being measured at the end of the fiscal year.

net operating assets is insufficient. The impact of leverage on return on equity is thus a function of both leverage, pertaining to the financing activities of the firm, and $R_{NOA,}$ pertaining to the operating activities of the firm. Consequently, if a firm has high variability in R_{NOA}, it may choose to carry lower leverage. Conversely, if a firm is highly levered, it may try to reduce the variability in return on net operating assets.

In summation, the unlevered beta is expected to capture and isolate the operating risk factor in cross-sectional stock returns. Adding leverage, given a level of the unlevered beta, should increase risk and expected return. Variability in return on net operating assets is also presumed to be an operating risk proxy. Moreover, it is expected to control for the supposed negative relation between operating and financial risk. We test if these predictions hold, by including the two variables in an analysis of unconditional relationships, a correlation analysis and finally a regression analysis.

6.3 Basic Relationships

Table 4 reports buy-and-hold returns for four portfolios formed on unlevered beta (panel A) and variability in return on net operating assets (panel B). Where nothing else is stated, the methodology applied when computing table 4 is analogous with the one in table 1. To control for the potential size-effect, the analysis is repeated using size-adjusted returns, displayed in table 4 in Appendix A. (Levered) betas are estimated using the same methodology as in section 5. All variables in equation (5) are measured at the end of the fiscal year.

As panel A illustrates, there is not a distinguishable positive unconditional relation between unlevered beta and future returns, but Portfolio 4, containing firms with the highest unlevered betas, has the noticeably highest return. However, when adjusting returns for the potential size-effect, the unconditional relationship between unlevered beta and return becomes clearly positive, implying that size and unlevered beta are positively correlated. By construction of equation (5), a ranking on unlevered beta should concurrently be an inverse ranking on leverage, given levered beta. This negative relation is confirmed in panel A. Further, variability in return on net operating assets follows a similar pattern as unlevered beta, in line with the expectation that both measures proxy for operating risk.

Variability in return on net operating assets is calculated as the standard deviation of return on net operating assets for the prior five years, which

TABLE 4

Mean Annual Raw Returns for Portfolios Formed on Unlevered Beta and Variability in Return on Net Operating Assets

This table reports mean raw returns over the subsequent 12 months for portfolios formed on unlevered beta and variability in return on net operating assets (σ R_{NOA}), for the period 1986-2006.

Panel A: Future returns for Unlevered Beta portfolios

			Mean Value for Each Portfolio					
Portfolio	N	Mean Unlevered Beta	Future Returns	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	σ R_{NOA}
1	137	0,214	0,224	0,558	0,589	0,522	-0,031	0,098
2	131	0,573	0,218	0,657	0,673	0,449	-0,016	0,079
3	131	0,878	0,207	0,545	0,585	0,258	-0,040	0,136
4	149	1,505	0,267	0,440	0,430	0,057	0,010	0,257

Panel B: Future returns for σ R_{NOA} portfolios

			Mean Value for Each Portfolio					
Portfolio	N	Mean σ R_{NOA}	Future Returns	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	Unlevered Beta
1	92	0,029	0,170	0,653	0,717	0,513	-0,064	0,701
2	87	0,053	0,202	0,554	0,613	0,320	-0,058	0,779
3	87	0,088	0,207	0,467	0,494	0,138	-0,027	0,945
4	100	0,390	0,285	0,380	0,344	0,017	0,037	1,119

The portfolios are constructed by ranking all firm observations each calendar year on unlevered beta and variability in return on net operating assets, following the same methodology as in table 1. Extreme values that lie more than 10 standard deviations from the time-series mean are excluded (3 observations). The total number of firm-years used in the analysis is 548 in panel A and 366 in panel B.

Unlevered beta is calculated as levered beta divided by (1 + ND/P). Variability in return on net operating assets is measured as the standard deviation of the return on net operating assets for the prior five years. This requires six years of continuous data and reduces the sample in panel B.

Returns are raw returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. Both variable and return numbers reported in the table are portfolio means.

requires six years of continuous data and reduces the number of observations to 366 in panel B, as opposed to 548 in panel A. The measurement point in time is the end of the fiscal year.

Panel B reports a positive relation between variability in return on net operating assets and future returns, in accordance with expectations. Interestingly, leverage ranks inversely to variability in return, consistent with the previous discussion of a negative relationship between operating and financial risk. Moreover, return variability is negatively related to enterprise book-to-price, although both measures are supposed to reflect operating risk. This could imply that one, or indeed both, of the measures are inadequate proxies, or that they capture different dimensions of operating risk.

6.4 Correlations

Table 5 presents a complete set of Pearson and Spearman correlation coefficients between unlevered beta and variability in return on net operating assets, in addition to the variables previously presented in table 2. The methods used and assumptions made when computing table 2 applies to table 5 as well. The table includes two panels: panel A contains observations where enterprise book-to-price is higher than or equal to 1 and panel B contains observations where enterprise book-to-price is lower than 1. Panel A includes 66 observations and panel B 482, except for correlations encompassing variability in return on net operating assets, which include 36 observations in panel A and 330 observations in panel B.

The negative relation between unlevered beta and leverage, dictated by equation (5), is confirmed by the negative correlation coefficients between the two variables across both panels. According to panel A, unlevered beta and enterprise book-to-price do not seem to be correlated, and panel B, covering the main part of the sample (88%), even reports a negative correlation between the two variables. Since both measures are predicted to reflect operating risk, this could mean either that enterprise book-to-price alone does not represent all operating risk factors in stock returns, that the ratio fails to isolate these factors, or that unlevered beta is an inadequate proxy for operating risk. Unlevered beta and variability in return on net operating assets are positively correlated across both panels, which is expectable if both measures capture operating risk. Panel B reports a rather strong negative correlation between return variability and leverage, supporting the notion of a negative relationship between operating and financial risk. It further opens for the possibility that the previously observed negative relation between leverage and returns might be due to leverage being negatively correlated to operating risk factors not included in the analysis.

TABLE 5

Correlations between B/P, Its components, Size, Beta, Returns, Unlevered Beta and Variability in Return on Net Operating Assets

This table reports cross-sectional correlations for the period 1986-2006. Spearman correlation coefficients are displayed in the upper diagonal, and Pearson correlation coefficients in the lower diagonal.

Panel A: Correlations ($NOA/P^{NOA} \geq 1$)

	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	Size	Beta	Size-adj. Returns	Raw Returns	Unlevered Beta	σ R_{NOA}
B/P	---	0,922	0,169	0,779	-0,249	-0,029	0,011	0,022	-0,169	-0,085
NOA/P^{NOA}	0,617	---	-0,175	0,527	-0,200	-0,007	0,051	0,045	0,005	-0,089
ND/P	0,457	-0,189	---	0,621	-0,192	-0,011	-0,024	0,035	-0,509	0,054
B/P - NOA/P^{NOA}	0,842	0,095	0,708	---	-0,147	0,038	-0,009	0,014	-0,260	-0,210
Size	-0,187	-0,311	-0,183	-0,024	---	0,202	-0,079	-0,183	0,423	0,063
Beta	0,006	-0,165	0,049	0,121	0,241	---	0,211	0,193	0,790	0,294
Size-adj. returns	0,020	0,107	-0,047	-0,048	-0,128	0,176	---	0,987	0,166	0,145
Raw returns	0,026	0,109	-0,012	-0,042	-0,208	0,144	0,995	---	0,109	0,138
Unlevered Beta	-0,192	-0,042	-0,459	-0,213	0,312	0,762	0,183	0,132	---	0,155
σ R_{NOA}	0,145	0,132	0,120	0,124	-0,193	0,103	0,346	0,344	0,175	---

Panel B: Correlations ($NOA/P^{NOA} < 1$)

	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	Size	Beta	Size-adj. Returns	Raw Returns	Unlevered Beta	σ R_{NOA}
B/P	---	0,907	0,384	-0,086	-0,142	-0,003	0,105	0,105	-0,123	-0,296
NOA/P^{NOA}	0,909	---	0,689	-0,447	-0,122	0,007	0,049	0,041	-0,205	-0,461
ND/P	0,366	0,609	---	-0,884	-0,057	0,015	-0,076	-0,088	-0,279	-0,623
B/P - NOA/P^{NOA}	-0,024	-0,439	-0,672	---	0,008	-0,011	0,057	0,076	0,229	0,613
Size	-0,167	-0,168	-0,215	0,043	---	0,294	0,029	-0,101	0,303	-0,091
Beta	-0,027	-0,029	-0,025	0,011	0,232	---	-0,024	-0,056	0,931	0,048
Size-adj. returns	0,065	0,035	-0,115	0,056	0,002	0,042	---	0,982	0,017	-0,064
Raw returns	0,060	0,028	-0,101	0,061	-0,127	0,018	0,987	---	-0,012	-0,044
Unlevered Beta	-0,124	-0,213	-0,271	0,243	0,245	0,935	0,067	0,046	---	0,213
σ R_{NOA}	-0,154	-0,245	-0,225	0,322	-0,049	0,050	0,017	0,019	0,137	---

Correlation coefficients utilize a total number of 66 firm-year observations in panel A and 482 firm-year observations in panel B, except for correlations that include variability in return on net operating assets. These correlations utilize 36 observations in panel A and 330 observations in panel B. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for the following variables: B/P, NOA/P^{NOA}, ND/P and B/P - NOA/P^{NOA} (3 observations). Definitions of the variables can be found in the notes to tables 1, 2 and 4.

6.5 Regression Analysis

In this section, we examine how the alternative operating risk proxies – unlevered beta and variability in return on net operating assets – together with leverage, explain differences in future returns. We also include the enterprise book-to-price ratio in the regression analysis, to investigate whether it explains returns over those associated with the alternative operating risk proxies. In addition, ln (size) is included to control for the potential size-effect.

Table 6 reports regression coefficients estimated by pooling all firm-year observations – applying regression equation (2) – along with *t*-statistics in parentheses. Three panels are included in the table: panel A reports results for the full sample (546 observations), panel B includes firm-year observations where enterprise book-to-price is equal to or higher than 1 (66 observations) and panel C includes observations where enterprise book-to-price is lower than 1 (480 observations). Regressions including variability in return on net operating assets encompass 366 observations in panel A, 36 in panel B and 330 in panel C.

Regression I reports results for future returns regressed on unlevered beta. The estimated coefficient is positive across all panels, although not significant, consistent with the assumption of unlevered beta being an operating risk proxy. Regression II includes both unlevered beta and leverage, with the first controlling for supposed operating risk. In panel C, that includes observations where enterprise book-to-price is lower than 1 and covers the predominant part of the sample (88%), regression II yields a significantly negative coefficient on leverage. This is, yet again, a remarkable result. When enterprise book-to-price is added in regression III, the coefficient on leverage turns negative in panel A and is even more distinguishable negative in panel C. The coefficient on both unlevered beta and enterprise book-to-price is positive across all panels in regression III, which is in line with both measures being operating risk proxies rewarded with returns. The increase in significance and magnitude for the negative coefficient on leverage, however, begs the question as to which extent enterprise book-to-price isolates firm characteristics pertaining only to operating risk.

Regression IV displays results for returns regressed on variability in return on net operating assets. The estimated coefficients are positive across all panels, although not significant in panel A and C, and confirm the prediction of return variability being a proxy for operating risk. In regression V, both return variability and leverage are included, with the former controlling for supposed operating risk and the presumed negative relation between operating and financial risk. The estimated coefficient on leverage is

TABLE 6

Regression Analysis for B/P Decomposition with Alternative Proxies for Operating Risk

This table reports coefficients and t-statistics (in italics in parentheses) estimated from cross-sectional regressions of raw stock returns on B/P components, unlevered beta, variability in return on net operating assets and size, for the period 1986-2006.

Panel A: Full sample (sample size is 546 [366] firm-year observations)

	I	II	III	IV	V	VI	VII	VIII
Intercept	0,212	0,201	0,066	0,215	0,214	0,136	0,262	1,368
	(5,99)	*(4,91)*	*(1,16)*	*(8,34)*	*(7,10)*	*(2,56)*	*(5,16)*	*(4,02)*
Unlevered Beta	0,023	0,029	0,042				-0,049	-0,007
	(0,69)	*(0,81)*	*(1,20)*				*(-1,18)*	*(-0,17)*
σR_{NOA}				0,019	0,020	0,038	0,027	0,013
				(0,32)	*(0,33)*	*(0,62)*	*(0,44)*	*(0,22)*
NOA/P^{NOA}			0,262			0,174		0,128
			(3,38)			*(1,75)*		*(1,30)*
ND/P		0,021	-0,057		0,006	-0,073	-0,017	-0,133
		(0,55)	*(-1,27)*		*(0,10)*	*(-1,00)*	*(-0,28)*	*(-1,80)*
Size								-0,071
								(-3,56)
Adj. R^2	-0,001	-0,002	0,017	-0,002	-0,005	0,000	-0,004	0,032

Panel B: $NOA/P^{NOA} \geq 1$ (sample size is 66 [36] firm-year observations)

	I	II	III	IV	V	VI	VII	VIII
Intercept	0,301	0,228	-0,317	0,124	0,150	-1,046	0,308	2,831
	(1,95)	*(1,01)*	*(-0,56)*	*(0,99)*	*(1,00)*	*(-1,02)*	*(1,27)*	*(1,72)*
Unlevered Beta	0,251	0,305	0,347				-0,223	-0,151
	(1,06)	*(1,14)*	*(1,28)*				*(-0,84)*	*(-0,63)*
σR_{NOA}				3,367	3,429	3,103	3,822	2,838
				(2,14)	*(2,13)*	*(1,91)*	*(2,27)*	*(1,82)*
NOA/P^{NOA}			0,418			1,072		0,732
			(1,05)			*(1,17)*		*(0,87)*
ND/P		0,039	0,061		-0,033	0,003	-0,089	-0,215
		(0,44)	*(0,67)*		*(-0,32)*	*(0,02)*	*(-0,73)*	*(-1,69)*
Size								-0,203
								(-2,77)
Adj. R^2	0,002	-0,011	-0,009	0,092	0,068	0,078	0,059	0,235

Panel C: $NOA/P^{NOA} < 1$ (sample size is 480 [330] firm-year observations)

	I	II	III	IV	V	VI	VII	VIII
Intercept	0,175	0,217	0,108	0,203	0,223	0,143	0,279	1,122
	(4,93)	*(5,32)*	*(1,80)*	*(7,55)*	*(6,89)*	*(2,46)*	*(5,18)*	*(3,20)*
Unlevered Beta	0,033	0,014	0,019				-0,055	-0,023
	(1,01)	*(0,42)*	*(0,58)*				*(-1,31)*	*(-0,53)*
σR_{NOA}				0,020	0,005	0,017	0,010	0,001
				(0,34)	*(0,08)*	*(0,29)*	*(0,17)*	*(0,02)*
NOA/P^{NOA}			0,264			0,211		0,174
			(2,50)			*(1,63)*		*(1,35)*
ND/P		-0,127	-0,235		-0,104	-0,241	-0,143	-0,289
		(-2,06)	*(-3,14)*		*(-1,11)*	*(-1,92)*	*(-1,45)*	*(-2,28)*
Size								-0,055
								(-2,69)
Adj. R^2	0,000	0,007	0,018	-0,003	-0,002	0,003	0,000	0,023

Reported coefficients are estimated from cross-sectional regressions for the period 1986-2006. T-statistics are the coefficient divided by its standard error. Returns are raw returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. Definitions of the variables can be found in the notes to tables 1, 2 and 4. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for the following variables: B/P, NOA/P^{NOA}, ND/P and B/P - NOA/P^{NOA} (3 observations). Firm-years with negative values for NOA and/or P^{NOA} are also excluded (2 observations). The total number of firm-year observations is reduced for regressions that include variability in return on net operating assets. The sample size for these regressions is displayed in square brackets.

close to zero in panel A, slightly negative in panel B and distinctly negative in panel C. The strange relationship between leverage and returns thus persists after controlling for variability in return on net operating assets. In regression VI, enterprise book-to-price is added. The estimated coefficients are positive for both operating risk proxies across all panels, whereas the estimated coefficient on leverage turns negative in panel A and is even more distinguished, close to significant, in panel C. The puzzling results are similar to the ones received in regression III, once again leading to a questioning of enterprise book-to-price as an operating risk proxy. Finally, regression VIII includes all operating risk proxies, leverage and size. In panel A and C, the coefficient on unlevered beta and variability in return is close to zero and insignificant, whereas the coefficient on enterprise book-to-price is clearly positive, although not significant either. Yet again, the coefficient on leverage turns out strongly negative and significant, thereby still contradicting the basic notion of a reward to leverage.

Including two alternative operating risk proxies, unlevered beta and variability in return on net operating assets, does not alter the distinct negative relationship between leverage and return. If the alternative operating risk proxies, together with enterprise book-to-price, are assumed to capture all dimensions of operating risk, the possibility that the negative association between leverage and returns is a function of leverage being negatively correlated with unidentified operating risk proxies can be ruled out. The remaining question, though, is whether enterprise book-to-price captures only operating risk characteristics, or if the measure encompasses other risk factors as well. Given that unlevered beta and return variability (and, indeed, enterprise book-to-price) are exhaustive operating risk proxies, the explanatory power of enterprise book-to-price, in a regression together with the two, should be diminished. As regression VIII in table 6 demonstrates, the explanatory power does decrease, verifying that our additional proxies capture operating risk. However, the coefficient and the *t*-statistic are still relatively high, implying that enterprise book-to-price reflects not only operating risk, but additional risk characteristics as well. The estimated coefficient on leverage in panel A turns negative when adding enterprise book-to-price to a regression including either unlevered beta or variability in return (c.f. the difference between regressions II and III and regressions V and VI) and becomes even more negative and significant in panel C (c.f. the difference between regressions II and III and regressions V and VI). These results imply that the additional risk characteristics presumably captured by enterprise book-to-price could be associated to financial risk and positively related to returns. The leverage component, then, presumably captures the negative aspects of leverage. If this is so, a variable that reflects and isolates the positive leverage effect is omitted from the regressions. This matter is further elaborated on in the following section.

7 Alternative Model of Expected Return

The analyses thus far points to a negative relationship between leverage and return. Including alternative operating risk proxies does not alter the negative relationship, but imply that the anomalous finding could be an artifact of improper proxies for operating and financial risk. If enterprise book-to-price encompasses a leverage effect, it fails to isolate operating risk. This could, at the same time, indicate that the leverage component (ND/P) fails to incorporate all aspects of financial risk, making it an inadequate proxy. In this section, we hypothesize that *both* B/P constituents fail to properly explain operating and financial risk factors in returns, and propose an alternative model aiming to resolve the puzzling irregularity.

7.1 Miller and Modigliani: Revisited

Recall from leverage formula (3), postulated by Miller and Modigliani (1958), that expected return to equity (r_E) is determined by the return to unlevered equity (r_U), pertaining to operating risk, and leverage (ND/P), which, in interaction with the difference between unlevered return and expected return to net debt, reflects financial risk. An assumption made by Penman et al (2007), which is central to their entire analysis, is that enterprise book-to-price substitutes the role of r_U and that ND/P captures financial risk. The reasoning underpinning this hypothesis is that, since B/P explains returns, the components of B/P should do so as well. Our previous analyses suggest that assuming that the B/P components capture and isolate operating and financial risk is, at best, tentative. Besides potentially omitting a component that pertains to and isolates the positive leverage effect, the regression analysis in Penman et al (2007) yields low values on the adjusted coefficients of determination (adjusted R^2), which leads to a questioning of the relevance of the obtained results. Although significance levels are generally high, as for many of the coefficients on leverage, the low adjusted R^2 values imply that the fraction of variations in stock returns explained is limited. Similar to Penman et al (2007), the adjusted coefficients of determination are low in our preceding regression analyses as well.

In response to our findings thus far and the uncertainties surrounding the adequacy of the model used by Penman et al (2007), we propose an alternative approach to examine the relationship between leverage and expected returns.

Our starting point is leverage formula (3). By rearranging, the right hand side of the formula can be broken down into three components:

$$r_E = r_U + r_U \frac{ND}{P} - r_{ND} \frac{ND}{P}$$

To control for temporal variations in the risk free rate (r_F) and focus on the premium received for holding stocks, r_F is subtracted from expected returns:

$$r_E - r_F = (r_U - r_F) + (r_U - r_F) \frac{ND}{P} - (r_{ND} - r_F) \frac{ND}{P} \tag{6}$$

The left hand side of equation (6) corresponds to the equity return in excess of the risk free rate, commonly referred to as the equity risk premium. The first component on the right hand side, (r_U – r_F), is the operating risk premium. The unlevered return to equity is equivalent to the return to the firm's net operating assets, and thereby pertains to and isolates operating risk. The second component is a product of the operating risk premium and leverage, which we term the compounding component. The name refers to the compounding effect that leverage has on the operating risk premium and, in continuation, on the variability in equity return. The increase in expected return prompted by the component is not a result of an increase in leverage per se, but rather a consequence of the compounding effect that leverage has on operating risk. The third and last component reflects interest costs and is a product of the required return to net debt in excess of the risk free rate (i.e., the credit spread) and leverage. Whereas the compounding component represents the positive aspect of leverage in expected returns, the interest cost component represents the negative aspect. This component expresses the fact that increased interest costs in themselves do not yield a premium, but rather lowers expected return (leverage only yields a premium in interplay with potential operating risk related to the debt financed asset). The unequivocally negative effect on expected return induced by the interest cost component has its origin in the characteristics of interest payments. Higher interest costs undoubtedly lower the payoff to equity holders, but – due to the predictability of interest payments – do not increase the financial risk appreciably, and thereby not expected return.

7.2 The Twofold Leverage Effect

Equation (6) prescribes that the effect of leverage on expected return is twofold. The regression analyses have thus far not taken this into consideration, thereby omitting the complicating circumstance that leverage does not affect expected return in one direction only. The relatively high explanatory power of enterprise book-to-price, after controlling for the supposedly exhaustive operating risk proxies unlevered beta and variability in return on net operating asset, leads us to believe that the positive leverage effect is captured by enterprise book-to-price. The anomalous negative relationship between leverage and returns could then be a result of the leverage component, conditional upon enterprise book-to-price, incorporating only the negative aspect of leverage and not the positive compounding effect. If the positive and the negative components of leverage are not explicitly specified in the regression equation, and if enterprise book-to-price captures some of or all the positive leverage effect, a negative relation between leverage and returns is expected rather than surprising.

To examine whether the theorized twofold leverage effect are observed in the data, we specify a regression equation:

$$r_{Et+1} - r_{Ft+1} = \alpha + \lambda_1 (r_{Ut+1} - r_{Ft+1}) + \lambda_2 (r_{Ut+1} - r_{Ft+1}) \frac{ND_t}{P_t} - \lambda_3 \frac{ND_t}{P_t} + \cdots + \varepsilon_t \tag{7}$$

In accordance with the operating risk explanation, λ_1 is expected to be positive. The coefficient on the compounding component, λ_2, is also expected to be positive, reflecting a combination of a positive leverage and operating risk effect. Lastly, the coefficient on leverage alone, λ_3, is predicted to be negative, capturing the negative effect of interest costs on the equity premium. The credit spread is not specified in the regression equation since the required return on net debt is difficult to estimate. The coefficient on leverage alone should, however, reflect the negative impact of interest costs.

As in preceding analyses, raw returns (r_E) are measured for the 12-month period beginning four months after the fiscal year-end. The Swedish one-year T-bill rate serves as a proxy for the risk free rate, and the measurement point in time corresponds to when equity returns are measured. Unlevered return to equity (r_U) is estimated using CAPM (equation [4]). Unlevered betas are calculated by stripping (levered) betas of leverage, in accordance with equation (5), and measured at the end of the fiscal year. The Swedish total market index return[11] serves as a proxy for the market return (r_M) and is measured for the same period as equity returns. Leverage is calculated using the same method as in earlier analyses. The sample period spans over 21 years, beginning in the end of fiscal year 1986 for financial statement data and four months later for return data. Table 7 reports correlations between the components of equation (7), as well as enterprise book-to-price and size, whereas table 8 displays results for returns regressed on different combinations of the components. Reported correlation and regression coefficients are estimated by pooling all firm-year observations, since, as before, the relationship between variables is assumed to be constant over the sample period. *T*-statistics are reported in parentheses below each regression coefficient.

TABLE 7

Correlations between Alternative model components, NOA/P^{NOA} and Size

This table reports cross-sectional correlations for the period 1986-2006. Spearman correlation coefficients are displayed in the upper diagonal, and Pearson correlation coefficients in the lower diagonal.

Full sample (sample size is 548 firm-year observations)						
	r_U - r_F	(r_U - r_F) x ND/P	ND/P	Size	NOA/P^{NOA}	r_E - r_F
r_U - r_F	---	0,464	0,010	-0,051	0,091	0,516
(r_U - r_F) x ND/P	0,173	---	0,199	-0,077	0,149	0,293
ND/P	-0,015	0,256	---	-0,142	0,705	-0,029
Size	-0,007	-0,115	-0,279	---	-0,237	-0,118
NOA/P^{NOA}	0,096	0,212	0,554	-0,301	---	0,085
r_E - r_F	0,403	0,212	0,002	-0,151	0,107	---

Correlation coefficients utilize a total number of 548 firm-year observations. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for ND/P and NOA/P^{NOA} (3 observations). The definitions of these variables, and size, can be found in the notes to tables 1 and 2. Raw returns (r_E) are measured over a 12-month period for each firm, starting four months after the fiscal year-end. r_F is approximated as the one-year Swedish T-bill rate and measured in the same period as r_E. Unlevered return to equity (r_U) is estimated using CAPM (equation [4]). Unlevered betas are calculated by stripping (levered) betas of leverage, in accordance with equation (5), and measured at the end of the fiscal year. The Swedish total market index return serves as a proxy for the market return (r_M) and is measured for the same period as r_E.

[11] Datastream code TOTMKSD

TABLE 8

Regression Analysis for Alternative model components, NOA/P^NOA and Size

This table reports coefficients and t-statistics (in italics in parentheses) estimated from cross-sectional regressions of raw stock returns on alternative model components, NOA/P^{NOA} and size, for the period 1986-2006.

Full sample (sample size is 548 [546] firm-year observations)	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Intercept	0,128	0,152	0,125	0,114	0,166	0,122	1,069	0,983
	(5,95)	*(6,65)*	*(5,20)*	*(5,29)*	*(6,57)*	*(5,12)*	*(4,27)*	*(3,73)*
$r_U - r_F$	0,636		0,636	0,596		0,593	0,592	0,584
	(10,29)		*(10,28)*	*(9,60)*		*(9,53)*	*(9,64)*	*(9,40)*
$(r_U - r_F)$ x ND/P		1,155		0,798	1,233	0,844	0,805	0,790
		(5,06)		*(3,72)*	*(5,22)*	*(3,79)*	*(3,66)*	*(3,51)*
ND/P			0,007		-0,049	-0,028	-0,063	-0,086
			(0,21)		*(-1,28)*	*(-0,79)*	*(-1,76)*	*(-2,06)*
Size							-0,057	-0,054
							(-3,80)	*(-3,53)*
NOA/P^{NOA}								0,078
								(1,08)
Adj. R^2	0,161	0,043	0,159	0,180	0,044	0,179	0,199	0,199

Reported coefficients are estimated from cross-sectional regressions for the period 1986-2006. T-statistics are the coefficient divided by its standard error. Returns are raw returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. Definitions of the variables can be found in the notes to tables 1, 2 and 7. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for ND/P and NOA/P^{NOA} (3 observations). Firm-years with negative values for NOA and/or P^{NOA} are excluded from the regression that include NOA/P^{NOA} (2 observations). The total number of firm-years used in the regression analysis is 548 (546).

Regression I in table 8 yields a highly significant positive coefficient on $(r_U - r_F)$, in line with a premium received for operating risk. When the compounding component is alone, in regression II, the estimated coefficient is significant and positive, as predicted. This is, however, not evidence of a positive leverage effect, since the positive incremental return could pertain to the operating risk premium. Regression IV includes both the operating risk premium and the compounding component. The operating risk premium supposedly serves as a control for the positive compounding effect attributable to operating risk and the positive, and still strongly significant, coefficient on the compounding component in regression IV should pertain exclusively to leverage. We argue that this is the positive leverage effect that previous analyses potentially have failed to identify. Regression III includes the operating risk premium (and hence a control for operating risk) and leverage alone. The estimated coefficient on leverage is close to zero and insignificant, suggesting that leverage alone is an inadequate proxy for financial risk. In regression V, comprising both leverage and the compounding component, the estimated coefficient on leverage turns negative. This result can be interpreted as the compounding component capturing the positive aspect of leverage and the effect of leverage alone is reduced to the negative impact related to interest costs. Regression VI includes all the variables specified in equation (7). The estimated coefficients, positive on the operating risk premium and the compounding component and negative on leverage alone, are in line with our predictions. After controlling for the size-effect, in regression VII, the negative coefficient on leverage alone is even more distinguished. Lastly, enterprise book-to-price is added to the regression. The weak and insignificant coefficient on enterprise book-to-price, compared to in previous analyses, testifies of a limited explanatory power once (r_U-r_F) is included as a control for operating risk.

The regression analysis in table 8 yields much higher values on adjusted coefficients of determination (adjusted R^2) compared to in previous regression analysis and to the values obtained in the study by Penman et al (2007), suggesting that our alternative model explains a higher fraction of variations in stock returns. We believe that this has to do with a number of reasons. Firstly, the model used by Penman et al (2007) takes a starting point in the B/P effect, which explains only a fraction of variations in stock returns, whereas our alternative model is set out to explain the entire variation in returns. A second explanation is the failure by Penman et al (2007) to identify and separately analyze the two opposite effects of leverage in expected returns that our results clearly demonstrates. This failure probably leads to a model misspecification that could have a negative impact on adjusted R^2 values. Lastly, there is a high covariance between equity returns (r_E) and the market return (r_M), which should enhance the explanatory power of our model, since r_M is a constituent of $r_{U.}$

8 Discussion and Concluding Remarks

The starting point for this thesis is a theoretical disaggregation of the B/P ratio, laid out by Penman et al (2007), into two components: enterprise book-to-price, assumed to reflect operating risk, and a leverage component, supposedly capturing financial risk characteristics in stock returns. Using Swedish data, we regress stock returns on the components in cross section and find a negative relationship between leverage and returns, conditional upon enterprise book-to-price. The observed negative relation is in line with the findings of Penman et al (2007) and contradicts the widely accepted finance notion of leverage being rewarded with higher return. The result further survives under controls for returns associated with levered beta and size, commonly nominated as reward for risk in extant asset pricing models.

The methodological approach applied by Penman et al (2007) when decomposing the B/P effect could, from our point of view, be put to question in some respects. The inclusion of enterprise book-to-price as a component that should capture and isolate operating risk is, according to the authors, speculative, and justified only by the assumption that if one component of B/P (leverage) captures financial risk, the remaining component (enterprise book-to-price) should capture operating risk. We believe that, even though the decomposition of B/P is mathematically justified, the assignment of its components to an operating and a financing part creates such a large potential source of error that it should have been more thoroughly investigated by Penman et al (2007). Furthermore, we consider it to be a divergence between what the study aims to explore, and what it actually explores. If the aim is to examine how the B/P components are related to the subsequent stock returns that their composite B/P forecasts, how should leverage – a risk characteristic that is not only a constituent of B/P, but an indicator of risk in other asset pricing models such as the one from Miller and Modigliani (1958) – isolate and capture only those variations in returns attributable to B/P? If leverage explains more than so, which seems likely, the leverage component fails to capture what it is supposed to. Put differently, the decomposition of B/P as a starting point for the analysis is problematic, since it results in a "mismatch" between the B/P components. On the one hand, enterprise book-to-price is a "forced" measure that potentially fails to capture operating risk, but theoretically isolates variations in returns only associated with the B/P effect. On the other hand, leverage is a credible measure that theoretically reflects all financing risk, but potentially captures variations in returns in excess of those attributable to the B/P effect.

In the second part of the thesis, we question the role of enterprise book-to-price by hypothesizing that the observed negative association between leverage and returns could be a result of leverage being negatively correlated with omitted operating risk factors. We test this theory by including two alternative operating risk proxies, unlevered beta and variability in return on net operating assets, in the analysis. The additional risk proxies do not alter the negative relationship between leverage and returns, leaving the anomaly unsolved. The results, however, indicate that enterprise book-to-price reflects not only operating risk, but a positive leverage effect as well.

The regression analyses in the first two parts of the thesis yield surprisingly low values on the adjusted coefficients of determination (adjusted R^2), thus explaining only a small part of the variation in stock returns. The low adjusted R^2 values is consistent with the values obtained in the analysis by Penman et al (2007) and, according to us, leads to concerns regarding the relevance of the results. The low adjusted R^2 values and the uncertainties regarding the model used by Penman et al (2007), calls for a different approach when examining the association between leverage and returns.

In the last part of the thesis, we investigate whether the observed negative relation between leverage and returns could be a result of the regression analysis thus far failing to adequately identify and isolate the effect of leverage. We propose an alternative model of expected return, derived from the notions of Miller and Modigliani (1958), which recognizes that leverage affects expected returns in two directions: a positive effect stemming from the compounding impact that leverage has on operating risk and a negative effect attributable to interest costs.

Besides recognizing the complicating twofold leverage effect, our alternative model explains a much higher proportion of the variations in stock returns than the model used in the previous analysis and by Penman et al (2007). Our findings show that the relationship between leverage and returns is complex and that a recognition and clear specification of the opposite leverage effects is required in order to draw adequate conclusions when examining the association between leverage and returns. In this light, the perverse negative relation found by Penman et al (2007) could be a consequence of a failure to sufficiently develop the interaction between operating and financial risk factors and thus identify the two separate effects of leverage, that our results clearly points at.

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Appendices

A. Tables

TABLE 1

Mean Annual Size-Adjusted Returns for Portfolios Formed on Book-to-price (B/P) and its Components

This table reports mean size-adjusted returns over the subsequent 12 months for portfolios formed on B/P, enterprise book-to-price, market leverage and the difference between B/P and enterprise book-to-price (the financial component), for the period 1986-2006.

Panel A: Future returns for B/P portfolios

			Mean Value for Each Portfolio			
Portfolio	N	Mean B/P	Future Returns	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}
1	138	0,202	-0,068	0,233	0,105	-0,031
2	130	0,369	0,005	0,417	0,182	-0,048
3	131	0,586	0,001	0,636	0,295	-0,050
4	149	0,987	0,053	0,940	0,644	0,047

Panel B: Future returns for enterprise book-to-price (NOA/P^{NOA}) portfolios

			Mean Value for Each Portfolio			
Portfolio	N	Mean NOA/P^{NOA}	Future Returns	B/P	ND/P	B/P - NOA/P^{NOA}
Negative	2	---	-0,071	0,461	-0,547	---
1	138	0,197	-0,057	0,225	-0,024	0,027
2	131	0,434	-0,003	0,369	0,189	-0,065
3	130	0,651	0,003	0,573	0,395	-0,079
4	147	0,961	0,050	0,985	0,687	0,024

Panel C: Future returns for market leverage (ND/P) portfolios

			Mean Value for Each Portfolio			
Portfolio	N	Mean ND/P	Future Returns	B/P	NOA/P^{NOA}	B/P - NOA/P^{NOA}
1	137	-0,111	0,000	0,375	0,309	0,066
2	131	0,085	-0,007	0,454	0,480	-0,027
3	131	0,294	-0,004	0,527	0,606	-0,080
4	149	0,928	0,005	0,804	0,839	-0,035

(Continued)

TABLE 1 - *Continued*

Panel D: Future returns for portfolios formed on B/P - NOA/P^{NOA}

			Mean Value for Each Portfolio			
Portfolio	N	Mean B/P - NOA/P^{NOA}	Future Returns	B/P	NOA/P^{NOA}	ND/P
1	138	-0,163	0,012	0,432	0,595	0,488
2	131	-0,063	-0,025	0,511	0,574	0,255
3	131	-0,004	-0,022	0,593	0,597	0,216
4	148	0,142	0,026	0,644	0,502	0,294

The portfolios are constructed by ranking all firm observations each calendar year on B/P and its components. The observations are partitioned into four portfolios based on the value of the measure ranking each portfolio, displayed at the head of each panel. The values range from the lowest, in portfolio 1, to the highest, in portfolio 4. If the number of annual observations is uneven, thus preventing an equal partitioning into the four portfolios, the outermost observations are, in a consistent manner, primarily placed in portfolio 4 and secondarily (if two or three uneven observations) in portfolio 4 and 1. As a consequence, these portfolios contain more observations than do portfolio 2 and 3. In panel B, negative values for NOA/P^{NOA} are placed into a separate portfolio. Extreme values that lie more than 10 standard deviations from the time-series mean are excluded (3 observations). The total number of firm-years used in the analysis is 548.

B/P is measured as the book value of equity (B) to the market value of equity (P). Enterprise book-to-price (NOA/P^{NOA}) is the book value of net operating assets (NOA) relative to the market value of net operating assets (P^{NOA}), where P^{NOA} is the sum of P and net debt (ND). Net debt equals the book value of financial liabilities minus financial assets (assumed to equal the market value of net debt), and ND/P is market leverage. All ratios are calculated at fiscal year-end.

Returns are size-adjusted returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. The size-adjustment is made by ranking all firm-year observations on market capitalization, measured at the fiscal year-end preceding the 12-month return period, and assigning them into four portfolios. The equal-weighted return for the respective size portfolio is then subtracted from the raw return in order to compute the size-adjusted return. Both variable and return numbers reported in the table are portfolio means.

TABLE 2

Correlations between B/P, Its components, Size, Beta and Returns

This table reports mean cross-sectional correlations for the period 1986-2006. Reported correlations are average coefficients across the 21 years in the sample, with weights based on the number of observations each year. Spearman correlation coefficients are displayed in the upper diagonal, and Pearson correlation coefficients in the lower diagonal.

Panel A: Correlations ($NOA/P^{NOA} \geq 1$)

	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	Size	Beta	Size-adj. Returns	Raw Returns
B/P	---	0,716	0,331	0,824	-0,071	0,163	0,054	0,016
NOA/P^{NOA}	0,687	---	-0,156	0,444	-0,155	0,063	0,156	0,069
ND/P	0,293	-0,153	---	0,594	-0,072	0,115	-0,350	-0,199
B/P - NOA/P^{NOA}	0,773	0,346	0,558	---	-0,087	0,201	-0,049	-0,068
Size	-0,030	-0,103	-0,157	-0,039	---	0,324	0,024	-0,263
Beta	0,177	0,020	0,095	0,234	0,380	---	-0,019	-0,082
Size-adj. returns	0,053	0,235	-0,286	-0,186	-0,011	-0,091	---	0,841
Raw returns	0,001	0,168	-0,153	-0,197	-0,254	-0,138	0,904	---

Panel B: Correlations ($NOA/P^{NOA} < 1$)

	B/P	NOA/P^{NOA}	ND/P	B/P - NOA/P^{NOA}	Size	Beta	Size-adj. Returns	Raw Returns
B/P	---	0,892	0,385	-0,104	-0,040	0,087	0,061	0,052
NOA/P^{NOA}	0,877	---	0,680	-0,439	-0,036	0,093	0,031	0,018
ND/P	0,405	0,671	---	-0,875	-0,046	0,073	-0,023	-0,029
B/P - NOA/P^{NOA}	-0,047	-0,469	-0,766	---	0,010	-0,049	0,011	0,025
Size	-0,059	-0,058	-0,136	0,045	---	0,206	0,093	-0,068
Beta	0,054	0,050	0,012	0,011	0,232	---	-0,092	-0,115
Size-adj. returns	0,058	0,065	-0,030	-0,026	0,051	-0,058	---	0,958
Raw returns	0,042	0,045	-0,023	-0,010	-0,117	-0,075	0,975	---

Correlations coefficients utilize a total number of 66 firm-year observations in panel A and 482 firm-year observations in panel B. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for the following variables: B/P, NOA/P^{NOA}, ND/P and B/P - NOA/P^{NOA} (3 observations). The definitions of these variables can be found in the notes to table 1. Size is the natural logarithm of market capitalization, ln (P), measured at fiscal year-end. Beta is estimated from a linear regression model using weekly firm and market return data for the fiscal year for which B/P and its components are measured. The market return in the beta calculation is based on the market capitalization weighted MSCI World Index. Size-adjusted returns are calculated by ranking all firm-year observations on market capitalization, measured at the fiscal year-end preceding the 12-month return period, and assigning them into four portfolios. The equal-weighted return for the respective size portfolio is then subtracted from the raw return in order to compute the size-adjusted return.

TABLE 3

Regression Analysis for B/P Decomposition

This table reports time-series means and t-statistics (in italics in parentheses) for coefficients estimated from annual cross-sectional regressions of raw stock returns on B/P, B/P components, size and beta, for the period 1986-2006.

Panel A: Full sample (sample size is 546 firm-year observations)

	I	II	III	IV	V	VI	VII
Intercept	0,136	0,151	0,229	0,222	0,140	0,194	0,565
	(1,83)	*(2,02)*	*(3,68)*	*(3,46)*	*(1,66)*	*(2,26)*	(1,60)
B/P	0,156						
	(1,45)						
NOA/P^{NOA}		0,130			0,190	0,082	0,190
		(1,20)			*(1,38)*	*(0,64)*	(1,19)
ND/P			0,026		-0,046		-0,085
			(0,35)		*(-0,57)*		(-1,01)
$B/P - NOA/P^{NOA}$				0,122		0,197	
				(0,57)		*(0,70)*	
Size							-0,029
							(-1,37)
Beta							0,082
							(1,29)
Adj. R^2	0,071	0,070	0,027	0,013	0,102	0,111	0,118

Panel B: $NOA/P^{NOA} \geq 1$ (sample size is 66 firm-year observations)

	I	II	III	IV	V	VI	VII
Intercept							
B/P							
NOA/P^{NOA}							
ND/P							
	NOT MEANINGFUL BECAUSE OF THE LOW NUMBER OF OBSERVATIONS						
$B/P - NOA/P^{NOA}$							
Size							
Beta							
Adj. R^2							

(Continued)

TABLE 3 – *Continued*

Panel C: $NOA/P^{NOA} < 1$ (sample size is 480 firm-year observations)	I	II	III	IV	V	VI	VII
Intercept	0,176	0,218	0,220	0,222	0,209	0,230	0,751
	(1,87)	*(2,49)*	*(3,69)*	*(3,66)*	*(2,06)*	*(2,41)*	*(1,79)*
B/P	0,053						
	(0,40)						
NOA/P^{NOA}		-0,026			0,015	-0,004	-0,029
		(-0,21)			*(0,09)*	*(-0,03)*	*(-0,13)*
ND/P			-0,027		-0,015		-0,041
			(-0,28)		*(-0,15)*		*(-0,35)*
$B/P - NOA/P^{NOA}$				0,183		0,120	
				(0,50)		*(0,33)*	
Size							-0,040
							(-1,49)
Beta							0,142
							(1,93)
Adj. R^2	0,019	0,008	0,040	0,068	0,058	0,074	0,078

Reported coefficients are means from annual cross-sectional regressions for the period 1986-2006. T-statistics are estimated from the time-series of coefficients, in accordance with Fama and Macbeth (1973) and Penman et al (2007). Returns are raw returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. Definitions of the variables can be found in the notes to tables 1 and 2. Extreme values, that lie more than 10 standard deviations from the time-series mean, are excluded for the following variables: B/P, NOA/P^{NOA}, ND/P and $B/P - NOA/P^{NOA}$ (3 observations). Firms-years with negative values for NOA and/or P^{NOA} are also excluded (2 observations). The total number of firm-years used in the regression analysis is 546. In panel B, annual cross-sectional regressions are not meaningful due to the low number of firm-year observations for $NOA/P^{NOA} \geq 1$.

TABLE 4

Mean Annual Raw Returns for Portfolios Formed on Unlevered Beta and Variability in Return on Net Operating Assets

This table reports mean size-adjusted returns over the subsequent 12 months for portfolios formed on unlevered beta and variability in return on net operating assets (σ RNOA), for the period 1986-2006.

Panel A: Future returns for Unlevered Beta portfolios

			Mean Value for Each Portfolio					
Portfolio	N	Mean Unlevered Beta	Future Returns	B / P	NOA / P^{NOA}	ND / P	B / P - NOA / P^{NOA}	σR_{NOA}
1	137	0,214	-0,039	0,558	0,589	0,522	-0,031	0,098
2	131	0,573	-0,026	0,657	0,673	0,449	-0,016	0,079
3	131	0,878	-0,001	0,545	0,585	0,258	-0,040	0,136
4	149	1,505	0,055	0,440	0,430	0,057	0,010	0,257

Panel B: Future returns for σR_{NOA} portfolios

			Mean Value for Each Portfolio					
Portfolio	N	Mean σR_{NOA}	Future Returns	B / P	NOA / P^{NOA}	ND / P	B / P - NOA / P^{NOA}	Unlevered Beta
1	92	0,029	-0,052	0,653	0,717	0,513	-0,064	0,701
2	87	0,053	-0,002	0,554	0,613	0,320	-0,058	0,779
3	87	0,088	-0,010	0,467	0,494	0,138	-0,027	0,945
4	100	0,390	0,041	0,380	0,344	0,017	0,037	1,119

The portfolios are constructed by ranking all firm observations each calendar year on unlevered beta and variability in return on net operating assets, following the same methodology as in table 1. Extreme values that lie more than 10 standard deviations from the time-series mean are excluded (3 observations). The total number of firm-years used in the analysis is 548 in panel A and 366 in panel B.

Unlevered beta is calculated as levered beta divided by (1 + ND/P). Variability in return on net operating assets is measured as the standard deviation of the return on net operating assets for the prior five years. This requires six years of continuous data and reduces the sample in panel B. Other variables are defined in the notes to table 1.

Returns are size-adjusted returns and measured over a 12-month period for each firm, starting four months after the fiscal year-end. The size-adjustment is made by ranking all firm-year observations on market capitalization, measured at the fiscal year-end preceding the 12-month return period, and assigning them into four portfolios. The equal-weighted return for the respective size portfolio is then subtracted from the raw return in order to compute the size-adjusted return. Both variable and return numbers reported in the table are portfolio means.

B. Datastream Definitions of Variables and Codes

B.1 Common Equity (WC03591)

Common Equity represents common shareholders' investment in a company. It includes but is not restricted to:

- Common stock value
- Retained earnings
- Capital surplus
- Capital stock premium
- Cumulative gain or loss of foreign currency translation, if included in equity per FASB 52 treatment
- Monetary correction-capital (03482)
- Goodwill written off (03491)
- For Non-U.S. Corporations preference stock which participates with the common/ordinary shares in the profits of the company
- For Non-U.S. Corporations, if shareholders equity section is not delineated then the following additional accounts are included: Appropriated and unappropriated retained earnings
- Net income for the year, if not included in retained earnings (majority share of income is only included)
- Compulsory statutory/legal reserves without specific purpose
- Discretionary Reserves if other companies in that country include in their delineated shareholders' equity
- Negative Goodwill.

It excludes:

- Common treasury stocks
- Accumulated unpaid preferred dividends For U.S. Corporations excess of involuntary liquidating value for outstanding preferred stock over stated value is deducted
- Redeemable common stock (treated as preferred)

B.2 Market Capitalization (WC08001)

Market Price-Year End * Common Shares Outstanding

If Common Shares Outstanding is not available for the current year or prior year, then Common Shares Outstanding-Current is used.

For companies with more than one type of common/ordinary share, market capitalization represents the total market value of the company.

This item is also available at the security level for 1987 and subsequent years.

B.3 Long Term Debt (WC03251)

Long term debt represents all interest bearing financial obligations, excluding amounts due within one year. It is shown net of premium or discount. It includes but is not restricted to:

- Mortgages
- Bonds
- Debentures
- Convertible debt
- Sinking fund debentures
- Long term bank overdrafts
- Long term notes
- Long term bills
- Medium term loans
- Long term royalties
- Long term contracts
- Industrial revenue bonds
- Notes payable, due within one year and to be refunded by long term debt when carried as non-current liability
- Long term prepaid contracts
- Advances and production payments
- Talent and broadcasting rights
- Capitalized lease obligations
- Revolving credit
- Long term advances from subsidiaries/associated companies
- Compulsory convertible debt (South Africa)
- Eurodollar borrowing
- Long term liability in connection with ESOP
- Federal Home Loan advances
- It excludes:
- Current portion of long term debt
- Pensions
- Deferred taxes
- Minority interest

B.4 Short Term Debt and Current Portion of Long Term Debt (WC03051)

Short Term Debt & Current portion of long term debt represents that portion of debt payable within one year including current portion of long term debt and sinking fund requirements of preferred stock or debentures.

It includes but is not restricted to:

- Current portion of long-term debt (18232)
- Notes payable, arising from short-term borrowings
- Current maturities of participation and entertainment obligations
- Contracts payable for broadcast rights
- Current portion of advances and production payments
- Current portion of long term debt that must be paid back during the next twelve months and included in long term debt
- Bank Overdrafts
- Advances from subsidiaries/associated companies, if the term of the loan is not known it is assumed to be long term debt
- Current portion of preferred stock of a subsidiary
- Treasury tax and loan demand notes
- Short sales of U.S. government securities
- Eurodollar borrowings, if not reported separately and the amount cannot be separated
- It includes but is not restricted to:
- Federal Funds (liability) securities sold under repurchase agreements (03055)
- It includes but is not restricted to:
- Securities sold under repurchase agreements (03056)

It excludes:

- Securities loaned

B.5 Cash and Short Term Investments (WC02001)

Cash and short term investments represents the sum of cash and short term investments

It includes but is not restricted to:

- Cash on hand
- Undeposited checks
- Cash in banks
- Checks in transit
- Cashier's checks
- Credit card sales
- Drafts
- Cash in escrow
- Restricted cash
- Money orders
- Letters of credit
- Demand deposits (non-interest bearing)
- Mortgage bond proceeds held in escrow
- Bullion, bullion in transit
- Short-term obligations of the U.S. Government
- Stocks, bonds, or other marketable securities listed as
- Short-Term Investments
- Time Certificates of Deposit
- Time deposits
- Eurodollar bank time deposits
- U.S. Government treasury bills
- Corporate Securities - stocks, bonds
- Municipal securities
- Commercial Paper
- Money market mutual fund shares
- Post Office checking/GIRO accounts (non-U.S. corporations only)
- Post Office savings accounts (non-U.S. corporations only)
- Post Office time deposits (non-U.S. corporations only)
- Central Bank Deposits
- Temporary Investments

It excludes:

- Commercial Paper issued by unconsolidated subsidiaries to Parent company (included in receivables)
- Amount due from sale of debentures (included in receivables)
- Checks written by the company but not yet deposited and charged to the company's bank account

- Promissory Notes

B.6 Operating Income (WC01250)

Operating income represents the difference between sales and total operating expenses.

B.7 Stock Returns (Return Index, RI)

A return index (RI) is available for individual equities and unit trusts. This shows a theoretical growth in value of a share holding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity or unit trust at the closing price applicable on the ex-dividend date. For unit trusts, the closing bid price is used.
For all countries except the USA and Canada detailed dividend payment data is only available on Datastream from 1988 onwards. Up to this time the RI is constructed using an annualised dividend yield, as follows:

$$RI_t = RI_{t-1} * \frac{PI_t}{PI_{t-1}} * \left(1 + \frac{DY_t}{100} * \frac{1}{N}\right)$$

Where:
RI_t = return index on day t
RI_{t-1} = return index on previous day
PI_t = price index on day t
PI_{t-1} = price index on previous day
DY_t = dividend yield % on day t
N = number of working days in the year (taken to be 260)
From 1988 onwards (and from 1973 for US and Canadian stocks), the availability of detailed dividend payment data enables a more realistic method to be used in which the discrete quantity of dividend paid is added to the price on the ex-date of the payment. Then:

$$RI_t = RI_{t-1} * \frac{P_t}{P_{t-1}}$$

except when t = ex-date of the dividend payment D_t then:

$$RI_t = RI_{t-1} * \frac{P_t + D_t}{P_{t-1}}$$

Where:
P_t = price on ex-date

P_{t-1} = price on previous day
D_t = dividend payment associated with ex-date *t*

Gross dividends are used where available and the calculation ignores tax and re-investment charges. Adjusted closing prices are used throughout to determine price index and hence return index.

At this point the RI is calculated back to the base date.

C. List of Companies Included in the Final Sample

- ABB Ltd
- Assa Abloy AB
- Alfa Laval AB
- Astra Zeneca Plc
- Atlas Copco AB
- Axfood AB
- Boliden AB
- Electrolux AB
- Elekta AB
- Eniro AB
- Ericsson AB
- Getinge AB
- Hennes & Mauritz AB
- Hexagon AB
- Holmen AB
- JM AB
- Lundin Petrolium AB
- Meda AB
- Modern Times GRP MTG
- NCC AB
- Nobel Biocare HLDG
- Nobia AB
- OMX AB
- Peab AB
- Q-Med AB
- SAAB AB
- SAS AB
- Scania AB
- SKF AB
- SSAB AB
- Sandvik AB
- Seco Tools AB
- Securitas AB

- Skanska AB
- Svenska Cellulosa AB
- Swedish Match AB
- TELE2 AB
- Telia Sonera AB
- TietoEnator OYJ
- Trelleborg AB
- AB Volvo