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AN ANALYTICAL AND EMPIRICAL MEASURE OF THE DEGREE OF CONDITIONAL CONSERVATISM

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Abstract

The Vuolteenaho (2002) return decomposition is linear because it assumes that the market's return expectations are obtained solely from accounting information. By restricting accounting recognition rules to specific (and primarily) negative future cash flow shocks, conservative accounting drives a wedge between the market's return expectations that are based upon all positive and negative cash flow shocks and return expectations that are based solely on accounting numbers. This insight allow us to derive analytically a *nonlinear* relation between revisions to returns and earnings news for conservative firms, of which the Basu relation is a special case. This nonlinear relation is shown to be mathematically equivalent to two linear relations conditioned on the firm's degree of conservatism. From these relations, we derive a model-based measure of the degree of conservatism at the firm-year level which is a function of the determinants of conditional conservatism. To account for the endogeneity of the firm's degree of conservatism *and* mitigate potential sample selection bias (Dietrich, Muller and Reidl 2007), the model is implemented empirically using a switching regression approach in which the switch point, namely, the degree of conservatism, is both unobservable and endogenously determined. Consistent estimates of the parameters of the switching regression, including the endogenous determinants of conservatism posited by Watts, are obtained by simultaneous maximum likelihood estimation. The results indicate that the degree of conservatism is a positive function of contractual information asymmetry and litigation risk but a negative function of taxes.

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1 Introduction

This study develops a *model-based* measure of the degree of conditional conservatism at the firm-year level and uses this metric to empirically test Watt's (2003a,b) conjecture regarding the determinants of conditional conservatism.¹ More specifically, we develop a model of conditional conservatism that yields a nonlinear relation between revisions to returns, earnings news and discount rate news. Revisions to returns are defined as unexpected current period equity returns. Earnings news is the conceptually correct measure of an earnings surprise and is defined as the revision (shock) to the discounted sum of expected current and future earnings over the lifetime of the firm. Discount rate news is defined as the revision to the discounted sum of expected future returns over the lifetime of the firm. This nonlinear relation cannot be estimated by Ordinary Least Squares (OLS) without bias because of the (model-driven) form of the nonlinear relation and concomitant sample selectivity concerns [Maddala (1983, 1986, 1991), Shehata (1991), Dietrich, Muller and Riedl (2006)]. To mitigate these concerns, a switching regression methodology is employed in which the switch point, our proxy for the degree of conditional conservatism, is both unobservable and endogenously determined. We find empirically that our measure of the degree of conservatism is a positive function of contractual information asymmetry and litigation risk, and a negative function of taxes, partially confirming Watt's (2003a,b) conjecture.²

¹A number of empirical studies (e.g., Qiang 2007; Khan and Watts 2007; Lara, Osmá and Penalva 2009) have tested Watt's determinants of conditional conservatism using Basu (1997) and Basu-like measures of conditional conservatism. However, these studies do not address the endogeneity criticism of the Basu metric by Dietrich, Muller and Riedl (2007)—see also Maddala (1983, 1986, 1994)—nor a number of the other criticisms of the Basu measure by Givoly, Hayn and Natarajan (2007) and Pattaoukas and Thomas (2009).

²Callen, Segal and Hope (2009) also use the Vuolteenaho (2002) accounting framework to intuit a nonlinear relation between earnings news and returns. However, they fail to develop the nonlinear relation formally. More importantly, they do not develop a theory-based measure of the *degree* of conservatism. They also do not estimate the degree of conservatism endogenously.

We also validate our measure of the degree of conservatism. The estimated degree of conservatism is negatively associated with profitability and total accruals, consistent with more conservative firms reporting lower earnings and more negative accruals. Further, more conservative firms have higher market-to-book ratios consistent with the arguments of Roychowdhury and Watts (2007). In addition, consistent with Givoly et al. (2007), more conservative firms have higher variability in earnings and accruals, and are more likely to report losses. Finally, the degree of conservatism at the firm level is fairly stable.

In what follows, Section 2 describes the model and derives the nonlinear relation between revisions to returns, earnings news and discount rate news for the conservative firm. Proofs are relegated to an appendix. This section also derives the Basu (1997) relation rigorously as a special case. Section 3 discusses the econometrics of the endogenous switching regression methodology with special emphasis on the case where the switch point, that is, the firm's degree of conservatism, is not observable. Section 4 provides the empirical results. Section 5 concludes.

2 The Model

2.1 Revision to Returns and the Conservative Firm

Our model is based upon the Vuolteenaho (2002) accounting return decomposition framework. He shows that revisions to unexpected returns are a linear function of *accounting-based* earnings news and discount rate news. The return decomposition is linear because Vuolteenaho implicitly assumes that market expectations are conditioned solely on accounting information (earnings and book values of equity), so that revisions to expected returns are necessarily equal to revisions to expected earnings less revisions to expected discount rates over the lifetime of the firm. However, this return decomposition fails to consider the

conservative nature of the accounting system. By restricting accounting recognition rules to specific (and primarily) negative cash flow shocks, conservative accounting drives a wedge between the market's expectations, which are conditioned upon the immediate recognition of both positive and negative future cash flow shocks, and expectations based solely on conservative accounting numbers for which some negative shocks and almost all positive shocks remain unrecognized in earnings until realized. This wedge, as we will show formally, yields a nonlinear relation between unexpected returns, earnings news and discount rate news. This intuition is similar to that of Gonedes (1978) and Antle, Demski and Ryan (1994) who show that, except under very restrictive conditions, the relationship between revisions to returns and revisions to earnings need not be linear, or even monotone, if the accounting system uses a more restrictive information set than does the market.

A simple stylized example illustrates the nonlinear relation between revisions to returns and earnings news. Consider the stock price of a pharmaceutical company that acquired a pipeline of drugs. Subsequently, one of these drugs receives FDA approval. The company's equity price will adjust upwards immediately to the positive news. However, given restrictive conservative accounting revenue recognition rules, accounting earnings will adjust to this information only at a later date when sales revenues from the new drug are realized. Although earnings news is measured over the lifetime of the firm, nevertheless, earnings news in this example is zero because earnings news is the *change in current expectations* of future cash flows. Because conservative accounting does not recognize any of the positive future cash flows currently, investor expectations about future cash flows will not change if their information set is based solely on conservative accounting information. As a consequence, at the time of FDA approval, the revision to market returns is positive whereas the accounting-based earnings news is zero, resulting in zero correlation between revisions to

returns and earnings news. Conversely, suppose that the FDA suddenly disapproves one of the drugs in the pipeline because of severe side effects. In this case, not only will the company's equity price drop but conservative accounting will likely require the company to record a loss. Hence, for negative news, there is a positive correlation between revisions to returns and earnings news even if investors first learn of the negative future cash flow shock from non-accounting sources. The remainder of this section is devoted to formally deriving a nonlinear relation between market returns, earnings news and discount rate news for the conservative firm.

We model the market conceptually as reacting to all positive and negative shocks to the firm's future cash flows. Thus, we model the market as if it is privy to a symmetric accounting system, which reports all shocks to earnings whether positive and negative, and forms its return expectations based on those reports. We follow the Vuolteenaho (2002) approach to modeling the dynamics of the market's expectations, and assume that the dynamics follow a log-linear stationary Vector Autoregressive (VAR) process.³ More specifically, we assume that (log deflated) return and earnings dynamics can be described by the bivariate VAR process:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \alpha_2 roe_{t-1}^S + \eta_{1,t} \quad (1)$$

$$roe_t^S = \beta_0 + \beta_1 r_{t-1} + \beta_2 roe_{t-1}^S + \eta_{2,t} \quad (2)$$

where the superscript S denotes a symmetric accounting system, $roe_t^S = \log(1 + X_t^S / BV_{t-1}^S)$ = the log of (one plus) earnings deflated by prior period book value, r_t = the log of (one plus) the firm's cum dividend equity return and $\eta_{1,t}$ and

³There are a number of early empirical studies that model the time series of firm-level earnings as part of VAR processes, including Bar-Yosef, Callen, and Livnat (1987, 1996), and Finger (1994). More recent empirical work includes Morel (1999), Callen and Segal (2004), Callen, Hope and Segal (2005) and Callen, Livnat and Segal (2006). To the best of our knowledge, Garman and Ohlson (1980) is the first theoretical accounting study to analyze earnings within a VAR process.

$\eta_{2,t}$ are mean-zero shocks.⁴ In particular, roe_t^S are the (normalized) earnings from a symmetric neutral accounting system. Since no firm has a symmetric system, these are "as if" earnings.⁵ In contrast, r_t are actual market returns.⁶

While we model the market's dynamics as if investors react to a symmetric accounting system, in fact, accounting information is generated from a conservative accounting system. In particular, firms recognize negative shocks (perhaps partially) prior to their realization whereas positive shocks are deferred to future periods and recognized only when realized. In other words, the conservative firm's accounting earnings effectively right-hand truncate future cash flow shocks. To simplify the discussion, we initially assume that the firm is "extreme" conservative in the sense that the accounting system recognizes all negative future cash flow shocks in current earnings, deferring positive shocks to future periods. Subsequently, to define the degree of conservatism, we consider the case where firms partially defer some negative shocks (as well as all positive shocks) to future periods.

In contrast to the symmetric accounting system dynamics, the extreme con-

⁴The definitions of r_t and roe_t (roe_t^S) are not arbitrary. They are a consequence of the structure of the Vuolteenaho (2002) model. Note that our definitions differ slightly from his. In particular, Vuolteenaho defines r_t as the excess return net of the risk-free rate so that the risk free has to be subtracted from roe_t in his equations (3) and (4). To simplify the notation, and without loss of generality, we define r_t to be gross of the risk-free rate, obviating the need to subtract the risk-free rate from roe_t . We subtract the risk-free rate from these variables in the empirical analysis, however.

⁵To simplify the notation, the "as if" data are denoted by a superscript to indicate whether the data are "generated" by the symmetric accounting system (roe_t^S) or by the conservative accounting system (r_t^C). Actual data (roe_t, r_t) are denoted without superscripts.

⁶Although the return dynamic does not appear to be a direct function of the earnings surprise, nevertheless, returns are necessarily a function of the earnings surprise since returns are a function of earnings news and the earnings surprise is a component of earnings news. See equation (B19) for the formal relation.

Although it is unnecessary, one can model the return dynamic as a direct function of the earnings surprise yielding qualitatively similar results to the analysis in the text. In particular, one can assume that the loglinear stationary VAR dynamic is of the form:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \alpha_2 roe_{t-1} + \eta_{1,t} + h\xi_t$$

$$roe_t = \beta_0 + \beta_1 r_{t-1} + \beta_2 roe_{t-1} + \xi_t$$

where h is a non-negative constant (bounded above by 1) measuring the extent to which returns are affected directly by earnings surprise and $\xi_t = \eta_{2,t}$ for the symmetric system and $\xi_t = \eta_{2,t}^- + \eta_{2,t-k}^+$ for the conservative system.

servative firm's dynamics are of the form:

$$r_t^C = \alpha_0 + \alpha_1 r_{t-1}^C + \alpha_2 roe_{t-1} + \eta_{1,t} \quad (3)$$

$$roe_t = \beta_0 + \beta_1 r_{t-1}^C + \beta_2 roe_{t-1} + \eta_{2,t}^- + \eta_{2,t-k}^+ \quad (4)$$

where $roe_t = \log(1 + X_t/BV_{t-1})$ = the log of (one plus) earnings deflated by prior period book value as obtained from the (extreme) conservative accounting system and r_t^C = the log of (one plus) cum dividend equity return assuming that returns are based on a conservative accounting system. In other words, r_t^C are "as if" returns that would obtain if the market restricts itself solely to the information provided by the (extreme) conservative accounting system, and roe_t is the actual book return on equity generated by the conservative accounting system.

The essential difference between the symmetric accounting system and the (extreme) conservative accounting system lies in the current earnings shock.⁷ From the market's perspective, the current earnings shock, denoted $\eta_{2,t}$, is mean-zero meaning that earnings are a function of both positive and negative earnings shocks. By contrast, the earnings of the extreme conservative firm is function of the earnings shock $\eta_{2,t}^- + \eta_{2,t-k}^+$ where $\eta_{2,t}^-$ takes on negative values only but is otherwise identical to $\eta_{2,t}$ and $\eta_{2,t}^+$ takes on positive values.⁸ Thus, in addition to current negative earnings shocks ($\eta_{2,t}^-$), the earnings of the conservative firm are also a function of positive earnings shocks ($\eta_{2,t-k}^+$) from period (t-k) that were deferred to period t because of conservatism.⁹ In contrast to the symmetric accounting system, the firm does not recognize current positive

⁷Earnings shocks arise out of future cash flow shocks. From now on we refer to future cash flow shocks as earnings shocks.

⁸In other words, $\eta_{2,t}^-$ ($\eta_{2,t}^+$) is a right (left)-truncated version of $\eta_{2,t}$ where the truncation point is zero.

⁹Of course, positive shocks not recognized in current earnings could be recognized in future earnings over a number of periods. In order to avoid undue modeling complexity, we assume throughout that recognition obtains in one period, namely, k periods ahead k=1,2,...

earnings shocks in current earnings under the conservative accounting system .

Note that unlike the mean of $\eta_{2,t}$, the mean of $\eta_{2,t}^-$ is necessarily negative, not zero. For example, if the current earnings shock facing the market is normally distributed, then the current earnings shock facing the extreme conservative firm is effectively half-normal. The mean of the half-normal is $-\sigma(2\pi)^{1/2}$ where σ is the standard deviation of $\eta_{2,t}$.

Given these dynamics, one can solve for earnings news (Ne_t) and expected return news (Nr_t)—both for a symmetric and conservative systems—as in Vuolteenaho (2002). Earnings news is defined as the discounted revision (shock) to earnings over the lifetime of the firm.¹⁰ Formally,

$$Ne_t = \Delta E_t \sum_{j=0}^{\infty} \rho^j roe_{t+j} \quad (5)$$

where ρ is a discount factor, $E_t(\cdot)$ is the expectations operator and $\Delta E_t(\cdot) = E_t(\cdot) - E_{t-1}(\cdot)$ denotes the revision or shock. Clearly, earnings news can be decomposed into the conventional earnings surprise ($\Delta E_t roe_t$) plus the shock to (discounted) expected future earnings ($\Delta E_t \sum_{j=1}^{\infty} \rho^j roe_{t+j}$). Similarly, discount rate (or expected return) news, defined formally as:

$$Nr_t = \Delta E_t \sum_{j=1}^{\infty} \rho^j r_{t+j} \quad (6)$$

is the shock to discount rates (expected future returns) over the lifetime of the firm.¹¹

With this background material, we are ready to demonstrate the relation between earnings news and (revisions to) returns. To simplify the discussion and proofs, we initially assume that future expected returns (discount rates) are unpredictable so that discount rate news is zero. We subsequently allow for

¹⁰Earnings news encompasses not only the current earnings surprise but also the impact of the shock on future discounted earnings. The importance of extending earnings shocks to future periods in "value relevance" studies has been emphasized by Gonedes (1974), Antle, Demski and Ryan (1994) and more recently by Callen (2008).

¹¹Note that the summation begins at 0 for earnings news and at 1 for discount rate news.

non-zero discount rate news. The prior discussion leads to our first proposition. All proofs can be found in Appendix B.

Proposition 1. Assume that earnings and returns follow the stationary bivariate log-linear VAR processes of equations (1) through (4) and that expected returns are unpredictable ($\alpha_i = 0, i = 0, 1, 2$) or intertemporally constant so that $Nr_t^C = 0$, where Nr_t^C denotes discount rate news of a conservative firm. The extreme conservative firm will exhibit a nonlinear relation between earnings news (Ne_t^C) and the revision to market returns of the form:

$$Ne_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2D * [r_t - E_{t-1}(r_t)] \quad (7)$$

where $D = 1$ when $[r_t - E_{t-1}(r_t)] \leq 0$ and 0 otherwise, $c_1 = \rho\beta_1/(1 - \rho\beta_2)$ and $c_2 = (1 - \rho\beta_1 - \rho\beta_2)/(1 - \rho\beta_2)$. Note in particular that $c_1 + c_2 = 1 > c_1$.

Proposition 1 indicates that the extreme conservative firm will exhibit a nonlinear asymmetric relation between earnings news and (revisions to) returns such that the coefficient on negative return news ($c_1 + c_2 = 1$) is greater than the coefficient on positive return news (c_1). Only in the case of negative shocks will changes in earnings news equal changes in the revision to market returns— $\partial Ne_t/\partial[r_t - E_{t-1}(r_t)] = c_1 + c_2 = 1$ when $D=1$. However, positive shocks are not recognized currently in the earnings of the conservative firm, although they are recognized currently by the market. Thus, changes in earnings news will be less than changes in revisions to market returns in the case of positive return shocks— $\partial Ne_t/\partial[r_t - E_{t-1}(r_t)] = c_1 < 1$ when $D=0$.

If expected returns are potentially predictable, so that discount rate news is not necessarily zero, then a similar relation obtains except that discount rate news has to be incorporated linearly into the former relation.¹² This is formalized in Corollary 1.

¹²Also, the parameters c_1 and c_2 take on different values.

Corollary 1. Assume that returns and earnings follow the stationary bivariate log-linear VAR processes of equations (1) through (4). The extreme conservative firm will exhibit a nonlinear relation between earnings news, discount rate news and the revision to returns of the form:

$$Ne_t^C - Nr_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2D * [r_t - E_{t-1}(r_t)] \quad (8)$$

where $D = 1$ when $[r_t - E_{t-1}(r_t)] \leq 0$ and zero otherwise, $c_1 = [\rho\alpha_1(\rho\beta_2 - 1) - \rho\beta_1(\rho\alpha_2 - 1)]/Z$, $c_2 = (1 - \rho\beta_1 - \rho\beta_2)/Z$ and $Z = (1 - \rho\alpha_1)(1 - \rho\beta_2) - \rho^2\alpha_2\beta_1$. Note in particular that $c_1 + c_2 = 1 > c_1$.

The intuition of Corollary 1 is similar to that of Proposition 1, except that shocks to returns come from two sources, shocks to discount rates as well as shocks to earnings. Since we assume that the information set regarding discount rate shocks ($\eta_{1,t}$) is the same for the market and the (extreme) conservative firm, discount rate news enters the pricing relation linearly. In addition, since increases (decreases) in discount rates reduce (increase) current returns, there will be a negative relation between the revision to current returns and discount rate news. Hence, the nonlinear relation between earnings news and (revisions to) returns holds for the extreme conservative firm net of discount rate news.

2.2 Comparing Different Levels of Conservatism

In the previous section, we defined an extreme conservative firm as one which recognizes all negative future cash flow shocks, no matter how small, in current earnings. While this analysis is instructive, ultimately firms are heterogenous in their degree of conservatism. Thus, the important question to be addressed is how does the nonlinear relation obtained above vary with the degree of the firm's conditional conservatism. The answer of course depends on the definition of the "degree of conservatism." In defining the degree of conservatism, we assume that conditional conservatism manifests in the accounts only to the extent that there

is a negative shock to future cash flows. This assumption is reasonable given the conservative nature of U.S. GAAP, where positive shocks are normally deferred until realized regardless of the firm's degree of conservatism.¹³ Conditional on negative shocks to future cash flows, we define the degree of conservatism as the minimum threshold for which the firm recognizes negative shocks in current earnings; the closer the threshold is to zero (in absolute value), the more conservative is the firm. In other words, the degree of conservatism is the minimum magnitude of negative shocks that would entail immediate recognition in current period earnings. Formally, firm B is more conservative than firm A if firm A recognizes earnings negative shocks of $-\gamma_t^A$ or worse in current earnings, whereas firm B recognizes earnings shocks of $-\gamma_t^B$ or worse in current earnings where $0 \leq \gamma_t^B < \gamma_t^A$. For example, suppose that firm A recognizes earnings shocks of -7% and worse whereas firm B recognizes earnings shocks of -4% and worse. Suppose that future cash flows are expected to fall by 6% (in present value terms). Firm B, the more conservative firm, will write down earnings by 6% in the current period whereas firm A, being less conservative, will defer writing down earnings until future periods when the shock to earnings (future cash flows) is realized.

In order to allow for various degrees of conservatism and, hence, partial right-truncations (below 0) of the earnings shock, we generalize the earnings dynamics of the extreme conservative firm as follows:

$$r_t^C = \alpha_0 + \alpha_1 r_{t-1}^C + \alpha_2 roe_{t-1} + \eta_{1,t} \quad (9)$$

$$roe_t = \beta_0 + \beta_1 r_{t-1}^C + \beta_2 roe_{t-1} + \eta_{2,t}^R + (\eta_{2,t-k} - \eta_{2,t-k}^R) \quad (10)$$

where $\eta_{2,t}^R$ denotes the right-truncated density of $\eta_{2,t}$ and $\eta_{2,t}^R \leq -\gamma_t$ ($\gamma_t \geq 0$). In addition to the current earnings shock ($\eta_{2,t}^R$), the earnings dynamic also

¹³The theory developed in this paper can readily be extended to account for positive shocks. Nevertheless, since conservatism in the face of positive news is a marginal phenomenon in U.S., GAAP, we prefer not to further complicate the model and the empirical work.

recognizes that portion of the period (t-k) shock ($\eta_{2,t-k} - \eta_{2,t-k}^R$) not recognized in period (t-k) because of accounting conservatism and deferred to period t.

Following on this definition, Proposition 2 shows the nonlinear relation between earnings news (less discount rate news) and revisions to returns for any degree of conservatism.

Proposition 2. Assume that returns and earnings follow the stationary bivariate log-linear VAR processes of equations (1), (2), (9) and (10). A conservative accounting firm that recognizes negative earnings shocks of $-\gamma_t$ or worse ($\gamma_t \geq 0$), will exhibit a nonlinear relation between earnings news and (the revision in) returns as specified by the nonlinear relation:

$$Ne_t^C - Nr_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2D * [r_t - E_{t-1}(r_t)] \quad (11)$$

where $D = 1$ if $r_t - E_{t-1}(r_t) \leq -\gamma_t(1 - \rho\alpha_1 - \rho\alpha_2)/(1 - \rho\beta_1 - \rho\beta_2)$ and zero otherwise, $c_1 = [\rho\alpha_1(\rho\beta_2 - 1) - \rho\beta_1(\rho\alpha_2 - 1)]/Z$, $c_2 = (1 - \rho\beta_1 - \rho\beta_2)/Z$ and $Z = (1 - \rho\alpha_1)(1 - \rho\beta_2) - \rho^2\alpha_2\beta_1$. Note in particular that $c_1 + c_2 = 1 > c_1$.

The nonlinear relation in Proposition 2 generalizes the nonlinear relation of Proposition 1. In proposition 1, the extreme conservative firm recognizes all negative earnings shocks, so that in the definition of the dummy variable D, $-\gamma_t = 0$; hence the nomenclature *extreme* conservative. In contrast, a firm that is less than extreme conservative will satisfy the same nonlinear relation except that $-\gamma_t$ in the definition of the dummy variable D will be less than zero. Therefore, the nonlinear relation between earnings news and (revision in) returns generalizes to any degree of conservatism and only the definition of the dummy variable changes.

Importantly, equation (11) and its concomitant dummy variable suggest a new metric for the degree of conservatism, namely $-\gamma_t$. $-\gamma_t$ is the degree of conservatism since this parameter determines how much of the negative shock

to future cash flows the firm is willing to recognize in current earnings. The smaller is $-\gamma_t$, the more conservative is the firm, with $-\gamma_t = 0$ for the extreme conservative firm. Interestingly, neither of the coefficients c_1 and c_2 of the nonlinear relation (11) are functions of the degree of conservatism $-\gamma_t$.

In the empirical section below, we will in fact estimate the unobservable $-\gamma_t$ endogenously as a function of the determinants of conditional conservatism espoused by Watts (2003a,b).

2.3 A Comparison with the Basu Relation

The nonlinear equation that we developed for the extreme conservative firm

$$Ne_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2D * [r_t - E_{t-1}(r_t)] + Nr_t \quad (12)$$

looks similar in form to the nonlinear Basu equation:

$$roe_t = b_0 + b_1r_t + b_2D^B * r_t \quad (13)$$

where D^B is a dummy variable that takes the value one if returns are negative and zero otherwise. However, these are fundamentally different equations, although it is possible to derive the Basu equation from Corollary 1. Such a proof is of interest since, despite the ubiquitous use of the Basu equation to measure the degree of conservatism empirically (Ryan 2006), we are unaware of a formal proof of the Basu relation.

One difference between the two equations is in fact minor but needs to be dealt with first. Basu define news in terms of returns whereas we define news as the revision to returns. A situation in which the firm earns a positive return of 5% but has a cost of capital (expected return) of 15% is bad news, a revision to returns of -10%, despite the positive return. Therefore, we shall re-interpret the Basu equation to be:

$$roe_t = b_0 + b_1[r_t - E_{t-1}(r_t)] + b_2D * [r_t - E_{t-1}(r_t)] \quad (14)$$

where $D = 1$ when $[r_t - E_{t-1}(r_t)] \leq 0$ and 0 otherwise. The other two major differences between the Basu equation (14) and our equation (12) is as follows. First, Basu has (normalized) earnings as his left-hand side variable whereas we have earnings news. Second, Basu does not allow for discount rate revisions whereas as we do. The next corollary derives the Basu equation formally from equation (12).

Corollary 2: Assume that returns and earnings follow the stationary bivariate log-linear VAR processes of equations (1) through (4). An extreme conservative firm will satisfy Basu's equation (14) if (i) all shocks to expected future cash flows beyond the current period are identically zero and (ii) discount rates are intertemporally constant or non-predictable.

This corollary indicates that two (fairly stringent) sufficient conditions will yield the Basu relation from underlying primitives.¹⁴ Whether these conditions hold is of course an empirical question.

3 Empirical Estimation of Conditional Conservatism

In the model considered above, the degree of conservatism is intimately related to the parameter $-\gamma_t$. To estimate $-\gamma_t$, we decompose equation (11) of Proposition 2 into two equations of the form:

$$Ne_t^C - Nr_t^C = c_0 + [r_t - E_{t-1}(r_t)] \quad (15)$$

$$\text{if } [r_t - E_{t-1}(r_t)] \leq -\gamma_t(1 - \rho\alpha_1 - \rho\alpha_2)/(1 - \rho\beta_1 - \rho\beta_2)$$

$$Ne_t^C - Nr_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] \quad (16)$$

$$\text{if } [r_t - E_{t-1}(r_t)] > -\gamma_t(1 - \rho\alpha_1 - \rho\alpha_2)/(1 - \rho\beta_1 - \rho\beta_2)$$

¹⁴These conditions are sufficient but not necessary. Perhaps, it is possible to derive the Basu relation with less stringent conditions but we have been unable to do so.

From the proof of Proposition 2 in Appendix B—see equations (B32) and (B33)—these latter equations can be reformulated as:

$$Ne_t^C - Nr_t^C = c_0 + [r_t - E_{t-1}(r_t)] \text{ if } \eta_{2,t} \leq -\gamma_t \quad (17)$$

$$Ne_t^C - Nr_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] \text{ if } \eta_{2,t} > -\gamma_t \quad (18)$$

The two regime structure of equations (17) and (18)—or (15) and (16)—conditioned on a truncated endogenous variable, namely, unexpected returns, implies that OLS will necessarily yield biased coefficient estimates [Maddala (1983,1986, 1991), Shehata (1991), Dietrich, Muller and Riedl (2006)]. Intuitively, conditioning on an endogenous variable results in sample selectivity bias unless one accounts for sample selectivity in the estimation procedure. Instead of OLS or a standard Heckman (1979) approach, we use the endogenous switching regression methodology discussed extensively by Maddala (1983, 1986, 1991) where the parameters are estimated by maximum likelihood. The two regime structure of our model lends itself to the switching regression approach. Unlike OLS, the switching regression approach yields consistent estimators of the parameters of equations (17) and (18) and of the switching parameter $-\gamma_t$. In essence, the two regime structure indicates that when the shock is less (more) than $-\gamma_t$ then the relation between earnings news and revisions to returns is described as in equation 17 (18). Since equation 17 (18) describes the relation between earnings news and revisions to returns when conservatism is (is not) manifested, $-\gamma_t$ necessarily measures the degree of conservatism.

To the best of our knowledge, the only accounting study to use a switching regression methodology to date is Shehata (1991), who analyzes the impact of SFAS No. 2 on R&D expenditures. Prior to SFAS No. 2, firms could choose to expense or capitalize R&D. Since sample firms align themselves endogenously along these two regimes (capitalizers or expensers), an endogenous switching re-

gression approach that accounts for sample selectivity suggests itself naturally. Although similar, there is one major difference between Shehata's environment and ours which simplifies his analysis considerably. In his case too, sample selection is endogenous. However, in Shehata's case, sample separation, namely, which firms are the expensers and which are the capitalizers, is observable so that an efficient two-step maximum likelihood estimation procedure is feasible. In our case, since the endogenously determined degree of conservatism $-\gamma_t$ is unobservable, the switching regression is of the unknown sample separation variety. Therefore, we estimate the switching regression parameters by a simultaneous maximum likelihood approach described below rather than the standard two-step maximum likelihood approach.¹⁵

We elect to model the firm's degree of conservatism (the switch point) based on the conjecture of Watts (2003a,b). Watts argues that firms' demand for conservatism is an increasing function of contractual information asymmetry, litigation risk, and tax avoidance. Inter alia, one purpose of this study is to determine empirically if in fact the degree of conservatism is an increasing function of these latter factors.

We denote the determinants of the degree of firm conservatism by the vector Z_t . Let ψ be the vector of parameters that relates the degree of conservatism $-\gamma_t$ to Z_t . Our empirical model then takes the three-equation form:

$$Ne_t^C - Nr_t^C = c_0 + [r_t - E_{t-1}(r_t)] + u_{1t} \quad \eta_{2,t} \leq -\gamma_t \quad (19)$$

$$Ne_t^C - Nr_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + u_{2t} \quad \eta_{2,t} > -\gamma_t \quad (20)$$

$$-\gamma_t = Z_t\psi + \mu_t \quad (21)$$

where $[u_{1t}, u_{2t}, \mu_t]$ is a mean-zero vector. Equation (19) and (20) simply repli-

¹⁵On estimating a switching regression of the unknown sample separation variety by simultaneous maximum likelihood, see Dickens and Grant (1985), Garcia et al. (1997) and Hu and Schiantarelli (1998).

cate the two model-driven regimes of equations (17) and (18) but inclusive of mean-zero error terms. Equation (21) relates the unobservable degree of conservatism $-\gamma_t$ to its endogenous determinants Z_t inclusive of a mean-zero error term.

Since $-\gamma_t$ is unobservable, equation (21) cannot be estimated directly. Instead, we substitute equation (21) into equations (19) and (20) to obtain:

$$Ne_t^C - Nr_t^C = c_0 + [r_t - E_{t-1}(r_t)] + u_{1t} \quad Z_t\psi + \varepsilon_t \geq 0 \quad (22)$$

$$Ne_t^C - Nr_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + u_{2t} \quad Z_t\psi + \varepsilon_t < 0 \quad (23)$$

where $\varepsilon_t = \mu_t - \eta_{2,t}$ is a zero-mean error term.

We estimate the empirical model—equations (22) and (23)—allowing the parameters of the equations to be unconstrained. Formally,

$$Ne_t^C - Nr_t^C = d_0 + d_1[r_t - E_{t-1}(r_t)] + u_{1t} \quad Z_t\psi + \varepsilon_t \geq 0 \quad (24)$$

$$Ne_t^C - Nr_t^C = f_0 + f_1[r_t - E_{t-1}(r_t)] + u_{2t} \quad Z_t\psi + \varepsilon_t < 0 \quad (25)$$

We then test to see if $d_1 = 1$ and if $f_1 < d_1$. Following Maddala (1983, 1986), we assume that the mean-zero vector $[u_{1t}, u_{2t}, \varepsilon_t]$ is normally distributed with variance-covariance matrix:¹⁶

$$\begin{pmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_{22} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{pmatrix}.$$

Although we cannot observe the firm's degree of conservatism and, hence, the regime that the firm is in, we can specify and calculate the probability with which each regime occurs:

¹⁶Since one can only estimate $\varphi/\sigma_\varepsilon$ and not φ and σ_ε separately, we normalize σ_ε to equal 1.

$$\begin{aligned}
\text{Prob} (Ne_t^C - Nr_t^C &= d_0 + d_1[r_t - E_{t-1}(r_t)] + u_{1t}) \\
&= \text{Prob} (Z_t\psi + \varepsilon_t \geq 0) \\
&= \text{Prob} (\varepsilon_t \geq -Z_t\psi) \\
&= \Phi(-Z_t\psi)
\end{aligned} \tag{26}$$

$$\begin{aligned}
\text{Prob} (Ne_t^C - Nr_t^C &= f_0 + f_1[r_t - E_{t-1}(r_t)] + u_{2t}) \\
&= \text{Prob} (Z_t\psi + \varepsilon_t < 0) \\
&= \text{Prob} (\varepsilon_t < -Z_t\psi) \\
&= 1 - \Phi(-Z_t\psi)
\end{aligned} \tag{27}$$

where Φ is the normal distribution function. The likelihood density function (L_t) for each observation of $Ne_t - Nr_t$ is a weighted conditional density function of u_{1t} and u_{2t} with weights $\text{Prob} (\varepsilon_t < -Z_t\psi)$ and $\text{Prob} (\varepsilon_t \geq -Z_t\psi)$. Specifically,

$$\begin{aligned}
L_t &= \phi(u_{1t} | \varepsilon_t \geq -Z_t\psi) \Phi(-Z_t\psi) + \phi(u_{2t} | \varepsilon_t < -Z_t\psi) [1 - \Phi(-Z_t\psi)] \\
&= \phi(u_{1t})\Phi\left(\frac{-Z_t\psi - (\sigma_{1\varepsilon}/\sigma_1^2)u_{1t}}{[1 - (\sigma_{1\varepsilon}^2/\sigma_1^2)]^{1/2}}\right) + \phi(u_{2t})\Phi\left(\frac{-Z_t\psi - (\sigma_{2\varepsilon}/\sigma_2^2)u_{2t}}{[1 - (\sigma_{2\varepsilon}^2/\sigma_2^2)]^{1/2}}\right)
\end{aligned}$$

where ϕ is the normal density function. Maximizing $\sum_t \log(L_t)$ yields estimates of the parameters d_0, f_0, d_1, f_1 of equations (24) and (25) and ψ of equation (19).

3.1 The Sample

The data for this study are obtained from annual COMPUSTAT and monthly CRSP files for the years 1962 to 2006. Return on equity is computed as income before extraordinary items (DATA18) scaled by the beginning of the period stockholders' equity (DATA60). Annual stock returns are computed from

monthly CRSP data adjusted for dividends, starting nine months before and ending three months after the fiscal year-end. The risk-free rate is the annualized three month T-Bill rate.

We impose the following restrictions on the data. We remove firms in the financial industry (SIC 6000-6999). We require non-missing values of contemporaneous and one lag of each of book return on equity, annual market equity returns, and the book to market ratio (computed as book value of equity scaled by market value of equity). We eliminate small firms with market cap of less than \$10M. We remove the top and bottom one percent of the variables that are required for the VAR estimation—current and lagged of each of annual returns, book return on equity and the book-to-market ratio. Imposing these restrictions results in a sample of 101,241 (10,917) firm-years (firms). We use this sample to estimate the VAR system and the earnings and discount rate news.

The switching regression is estimated based on firm-years for which the revision to unexpected returns is negative (See Section 4.2), where the revision to unexpected returns is the residual from the return equation in the VAR system—see equation A2a in Appendix A. The initial sample consists of 49,611 observations. Each observation has to have non-missing standard deviation of stock returns, leverage, effective tax rate, and high litigation dummy. Standard deviation of stock returns is computed using monthly returns in the preceding three years. We require a minimum of 12 non-missing monthly returns. Leverage is computed as the sum of long-term debt (DATA9), debt in current liabilities (DATA34), preferred shares (DATA130), and notes payable (DATA206), scaled by total assets (DATA6). The effective tax rate is computed as income tax expense over the past three years scaled by total pretax income over the same period. Income tax expense is computed as income tax expense (DATA16) minus deferred taxes (DATA50). Income before tax is computed as pretax income (DATA170) minus minority interest (DATA49). If the effective tax rate is neg-

ative or greater than the statutory maximum tax rate then we set it to zero or to the maximum statutory tax rate, respectively. The high litigation dummy takes the value of 1 if the firm belongs to an industry with a high incidence of litigation, and zero otherwise. Following Francis et al. (1996), we classify the following 4-digits SIC codes as high-litigation industries: 2833-2836, 3570-3577, 7370-7374, 3600-3674, and 5200-5961.

In addition to requiring non-missing values of the variables above, we mitigate potential outliers by eliminating the top and bottom percentile of earnings news, discount rate news, revision to unexpected returns and standard deviation of monthly stock returns. These restriction reduce the sample available for the switching analysis to 46,253 (9,215) firm-years (firms).

Table 1 shows the distribution of the major variables of interest for the full sample. Sample firms exhibit large variation in market capitalization; the mean and median market values of equity are \$1,544 million and \$148 million, respectively. The mean (median) cum dividend equity market returns is 17% (10%). The mean and median returns on book value of equity are 11% and 12%, respectively. The median book-to-market ratio is 0.64. The median effective tax rate is 0.34 and the median standard deviation of monthly stock returns is 11%.

4 Empirical Results

In this section, we present the empirical results. We first provide statistics of the VAR estimation results and the news items. We then show the results of the switching regression. Finally, we present the results of a validation analysis of our degree of conservatism measure as derived from the estimated switching functions.

4.1 Estimation of Earnings News, Discount Rate News, and Revisions to Unexpected Returns

To empirically examine the associations between earnings news, discount rate news and unexpected returns, and to construct a measure of the degree of conservatism, we need estimates of earnings news and expected return news. The latter in turn necessitate estimates of expected future returns and expected future earnings. Following Campbell (1991), Campbell and Ammer (1993), Vuolteenaho (2002), Callen and Segal (2004), and Callen et al. (2005, 2006), we implement the return decomposition using a parsimonious log-linear vector autoregressive (VAR) model with state variables consisting of log stock returns, log of one plus book return on equity (earnings scaled by initial book value of equity), and the log book to market ratio. Appendix A describes the estimation procedure in detail.

We estimate the VAR equations by industry using the Fama and French (1997) industry classification. Table 2, Panel A shows the mean estimated parameters across industries and their standard errors.¹⁷ The standard errors are computed using the Fama-Macbeth (1973) method. The significant parameter estimates imply that returns are positively and significantly associated with past earnings and the past book-to-market ratio. Earnings are significantly and positively associated with past returns and past earnings and negatively associated with the past book-to-market ratio. The book-to-market ratio is positively and significantly related to past returns, past earnings, and the past book-to-market ratio.

To facilitate the analysis, we generate firm-year estimates of earnings news and expected return news by estimating the firm-year variance-covariance ma-

¹⁷We necessarily estimate the VAR in mean-adjusted form in order to preempt potential estimation complexities due to the assumed truncated error term in the earnings (roe) regression arising out of conservatism. Mean adjustment transforms the error term so that it becomes mean-zero. On this issue, see the discussion surrounding equation (B9) in Appendix B.

trix and assuming that within-industry observations have the same VAR coefficient matrix. For example, earnings news [Equation (A6) in Appendix A] is a function of the VAR coefficient matrix [A] and the residuals from the VAR regressions [Equations (A2a) through (A2c)]. Thus, earnings news can be estimated at the firm-year level using the VAR coefficient matrix and the vector of residuals $\Sigma_{it} = [e1_{it}, e2_{it}, e3_{it}]$ where e_j is the estimated residual from equation j and i (t) is the firm (time) index.

Table 2, Panel B provides descriptive statistics of discount rate news (Nr_t^C), earnings news (Ne_t^C), and revisions in returns ($r_t - E_{t-1}(r_t)$). The mean and median of Ne_t^C (0.012 and 0.033, respectively) are positive and significant indicating that the earnings news is “good” on average. The mean and median Nr_t^C are also significantly positive (0.003 and 0.005, respectively) and, similar to the findings of Vuolteenaho (2002), Callen and Segal (2004), and Callen et al. (2005, 2006), significantly smaller than Ne_t^C , indicating that earnings news is the main driver of revisions in unexpected returns at the firm level. The mean and median revisions in unexpected returns (0.002 and 0.009, respectively) are also positive, consistent with the positive mean and median earnings news.

4.2 Switching Regression Estimation

We estimate the switching regression using observations with negative revision to unexpected returns. This restriction is a consequence of our definition of the degree of conservatism and the assumptions behind the model, in particular the assumption that firms defer all positive shocks to future periods when the cash flow effects are realized. In addition, we define the degree of conservatism (DCON) as the minimum threshold for which the firm recognizes negative shocks (to future cash flows) in current earnings; the closer the threshold is to zero (in absolute value), the more conservative is the firm.

Despite conditioning on negative news, sample selectivity, insofar as positive

news is concerned, is not a problem. In general, sample selectivity is a problem only to the extent one tries to generalize the estimated parameters based on a selected non-random sample to the entire population. Indeed, if we should apply parameters estimated from the negative news sample to the case of positive return shocks as well, then sample selectivity is at issue.¹⁸ But, our intent is to apply our parameter estimates to negative news situations only, obviating sample selectivity issues in this regard.

Nevertheless, sample selectivity is an issue even as it concerns negative news because of the (potential) endogeneity of returns *and* the model structure. Specifically, returns are likely to be an endogenous since returns react (at least partially) to the information conveyed by earnings news and discount rate news.¹⁹ Moreover, the degree of conservatism is endogenously determined as a function of (unexpected) returns. Some firms choose to recognize more negative shocks in current earnings and others less, *conditioned* on negative revisions to returns. The switching regression methodology accounts for the endogeneity of the switch point, that is, the degree of conservatism and the endogeneity of returns, thus yielding consistent parameter estimates. Indeed, the switch point methodology is natural in our context given the two regime structure of the model; one regime in which the firm chooses to recognize the negative shock in current earnings, because the shock is greater than or equal to the switch point (in absolute value), and the other regime in which the firm defers the negative shock to future earnings because the shock is less than the switch point.

¹⁸Indeed, one limitation of our study is that we cannot measure the degree of conservatism for firm-years with positive revisions to returns.

¹⁹The endogeneity of returns *with respect to earnings* (as opposed to earnings news) has recently been downplayed by Ball and Kothari (2007) in the context of Basu (1997) and more generally by Ball and Shivakumar (2008). We are agnostic on this issue. The latter papers are irrelevant for ours both because returns are far more likely to be a function of earnings news than earnings and also because endogeneity of the switch point is an issue in our model even if returns are not an endogenous function of earnings news. In the case of Basu (1997), the switch point itself is not endogenous; the switch point is defined by positive or negative (revisions to) returns.

Thus, even the negative news sample is not random and OLS will yield biased coefficients.

The switching regression methodology in our analysis yields a system of three estimated equations: (i) an equation that describes the relation between earnings news and unexpected returns when the firm recognizes the negative shock in current earnings, which we elect to call the conservative regime, (ii) an equation that describes the relation between earnings news and unexpected returns when the firm defers the negative shock to future periods, which elect to call the deferral regime and (iii) an equation that describes the relation between the (unobservable) degree of conservatism (i.e., the switching point) and its endogenous determinants.

Table 3 presents the switching regression results.²⁰ Panel A gives the descriptive statistics of the variables used in the estimation for the negative news sample. The negative news sample statistics for those variables that proxy for the determinants of conservatism are very similar to the entire news sample (Table 1) with the exception of size. The average market value of the switching sample is 1,046 million as compared with 1,544 million for the entire sample. Panels B and C show the parameter estimates for the three equations—conservative and deferral regimes and the endogenous switching point equation.

Panel B shows that the coefficient on unexpected returns for the conservative regime (1.963) and the coefficient on unexpected returns for the deferral regime (0.931) are positive and significant at the 1% significance level. Although the coefficient for the conservative regime is significantly greater than 1, nevertheless, as predicted by the model, the coefficient for the conservative regime is significantly greater than the coefficient for the deferral regime at the 1% significance level. The intercepts are positive and significant as predicted by the

²⁰ Although the regression results are presented in the table below in reverse regression form, switching regressions are necessarily estimated in direct form with revisions to returns as the dependent variable.

model, although they are significantly different from each other. This is likely due to the fact that the intercept terms typically pick up the effects of correlated omitted variables that could differ across the equations.

The estimated endogenous and unobserved degree of conservatism is assumed to be a function of proxies for the demand for conditional conservatism as posited by Watts (2003a,b) including leverage, the standard deviation of monthly stock returns, firm size, litigation risk, and the tax rate. Leverage is a proxy for the agency conflict between shareholders and bondholders. The higher the degree of leverage, the greater is the demand for conservatism by bondholders in order to constrain diversion of resources from the firm to equity holders. The standard deviation of returns is a proxy for operational uncertainty. The greater is the firm's operational uncertainty, the greater is the demand for conservatism by shareholders primarily because managerial performance is harder to verify and less certain. In addition, firms with greater operational uncertainty are exposed to a greater litigation risk because of higher risk of shareholder losses. Litigation risk increases the demand for conservatism because litigation is much more likely when earnings and net assets are overstated. The tax rate should also increase the demand for conservatism in order to minimize tax liabilities to the extent that taxable income and book income are related. The relation between size and the degree of conservatism is ambiguous. On one hand, larger firms face lower operational uncertainty and, therefore, lower demand for conservatism. On the other hand, larger firms are likely to have more resources and, hence, are subject to greater litigation risk, which increases the demand for conservatism. Overall, with the exception of size and consistent with Watt's conjecture, we expect that all other determinants will be positively associated with the degree of conservatism.

Given our setting in which we estimate the degree of conservatism using the negative news sample and the ubiquitous unconditional conservatism of

U.S. GAAP, we predict that the intercept on the determinants equation—which provides an estimate of the unconditional degree of conservatism—will have a negative sign. Since the degree of conditional conservatism is higher the closer the switching point is to zero, we expect positive coefficients on all the determinants of conservatism.

Panel C presents the estimates of the determinants of the degree of conservatism. The intercept is negative and significant consistent with it being a proxy for unconditional conservatism. The estimated coefficients on leverage, standard deviation of monthly stock returns, and litigation risk are significant and positive as predicted by Watts (2003a,b). A positive and significant coefficient is also obtained when operational efficiency is measured by the bid-ask spread instead of the standard deviation of monthly stock returns (untabulated). These results imply that the greater the asymmetry of information in debt contracts (as proxied by leverage), the greater the asymmetry of information in equity contracts (as proxied by the variability of the firm’s equity returns and the bid-ask spread), and the greater the litigation risk, the more likely is the firm to be in the high conservatism regime for a given negative shock to future cash flows. The coefficient on size is also positive and significant, indicating that the greater litigation risk dominates the lower operational uncertainty at least with respect to the demand for conservatism.

The coefficient estimate on the tax variable, which is significantly negative, is contrary to Watts’s hypothesis. However, there are good reasons why the parameter estimates for the tax rate does not conform. Watts argues that firm tax minimization activities will lead to an increase in the demand for conservatism on its financial statements. This posited tax effect is based on the notion that income for tax purposes is closely related to net income on the firm’s financial statements. One could argue alternatively that conservatism and tax expense are essentially substitutes for each other to the extent that they both

reduce net income and net asset values so that as tax expense increases, the demand for conservatism goes down. The latter notion rather than the former is consistent with our empirical results.

We use the estimated determinants equation to compute the degree of conservatism, henceforth DCON, for the sample firm-years with negative unexpected returns. In essence, DCON is the predicted value of the switching point for bad news years.

4.3 Validation of the Degree of Conservatism Measure

Table 4 shows various statistics for DCON. Panel A presents summary statistics of DCON, which has mean and median values of -0.251 and -0.367, respectively. The negative sign for DCON is predicted by the model. Figure 1 shows DCON over the sample period. The figure indicates that the degree of conservatism has increased over time. Interestingly, the degree of conservatism appears to be at its highest point in 2002-2004 coinciding with the major accounting scandals and the ensuing Sarbanes-Oxley Act. Panel B presents statistics on the main determinants of the degree of conservatism.

In order to estimate which of the determinants has the most impact on the degree of conservatism, we standardize the parameters estimates in Table 2, Panel C.²¹ These results indicate that operational uncertainty (proxied by the standard deviation of returns) has by far the greatest impact on the degree of conservatism followed by taxes, size, high litigation and leverage in that order.

The remaining panels of Table 4 validate the DCON measure. In panels C and D we examine the association between DCON and profitability, size, accruals, and the market-to-book ratio. Panel C shows that DCON is negatively correlated with the firm profitability as measured by roe and positively corre-

²¹Absent an explicit dependent variable in the determinants of conservatism regression, we standardize the regression coefficients using only the standard deviation of the independent variables. Since the latter include a dummy variable for high litigation, one should interpret these standardized coefficients with caution.

lated with the incidence of losses and the market-to-book ratio. These correlations are consistent with DCON being a measure of the degree of conservatism. Specifically, the more conditionally conservative the firm, the smaller should be its book profitability and the larger its unconditional conservatism as measured by the market-to-book ratio (Roychowdhury and Watts 2007). Furthermore, the more conditionally conservative the firm, the greater the incidence of firm losses.

Panel D further ranks DCON by deciles and shows the means of the selected variables discussed above for each decile. The results indicate that the incidence of losses and the market-to-book ratio increase monotonically with DCON deciles. In contrast, profitability and total accruals decrease monotonically with DCON deciles. The panel also shows the volatility of accruals and ROE increase monotonically with DCON deciles, consistent with Givoly et. al (2006), who argue that conservatism is manifested partly in greater volatility of accruals and profitability.

Since conservatism is a policy variable, it should be fairly stable over time. Panel E provides evidence on the stability of DCON. DCON is ranked by terciles of high, medium and low degrees of conservatism for period t and period $t+1$. The diagonal shows that DCON is fairly stable. For example, high, medium and low DCON's in period t have a probability of 76%, 60% and 74%, respectively of remaining in the same tercile in period $t+1$.

5 Conclusion

This paper models conditional conservatism within the Vuolteenaho (2002) return decomposition framework. Conceptualizing conditional conservatism as a truncated shock to earnings, the model generates a *nonlinear* relation between earnings news and (revision in) returns. The Basu equation is derived analyti-

cally from this nonlinear relation as a special case, albeit under rather stringent conditions. The model is then applied empirically, in tandem with a switching regression methodology, to estimate the endogenous and unobservable degree of conditional conservatism at the firm-year level. We then are able to test the Watts (2003 a,b) conjecture of the determinants of conditional conservatism in a manner that obviates sample selectivity biases.

With one exception, we find that the degree of conservatism is a positive function of the determinants of conservatism as posited by Watts. Specifically, the degree of conservatism is increasing with operational uncertainty, leverage and litigation risk. Only taxes yield contrary result, most probably because taxes are a substitute for conditional conservatism.

We also validate the degree of conservatism metric. We find that the measure is negatively associated with profitability and total accruals, and positively associated with the incidence of losses, the market-to-book ratio and the volatilities of accruals and earnings. These findings are consistent with conservative firms having lower earnings, more negative accruals, greater unconditional conservatism and greater volatilities of earnings and accruals as posited by the literature.

6 Appendices

6.1 Appendix A: Estimation of the Vuolteenaho Model

Since the "as if" symmetric earnings and the "as if" conservative returns are not visible, we estimate the VAR using actual returns and conservative earnings. This is consistent with the theory if we assume that "as if" returns are a linear stochastic function of actual market returns.²²

²²Formally, we assume that $r_t^C = \delta_0 + \delta_1 r_t + \zeta_t$ where the δ_i are parameters and ζ_t is either a mean-zero error term or a positively truncated error term or the sum of the two.

In general, the VAR estimation is facilitated by assuming that the dynamics of the data are well described by a (stationary) time-series model. Specifically, define $z_{i,t}$ to be a vector of firm-specific state variables that follows the vector autoregressive process:

$$z_{i,t} = Az_{i,t-1} + \eta_{i,t} \quad (\text{A1})$$

Consistent with Vuolteenaho (2002), Callen and Segal (2004), and Callen, Hope, and Segal (2005), the VAR coefficient matrix A is assumed to be constant over time and over firms. The error term vectors $\eta_{i,t}$ are vectors of shocks and are assumed to have a variance-covariance matrix Ω and to be independent of all variables known at $t-1$.

We estimate a parsimonious VAR where the state variables consist of log of one plus equity returns (r_t), log of one plus book return on equity (roe_t), and the log book to market ratio (bm_t).²³The VAR model can then be described as a system of (mean-adjusted) equations:

$$r_t = \alpha_1 r_{t-1} + \alpha_2 roe_{t-1} + \alpha_3 bm_{t-1} + \eta_{1t} \quad (\text{A2a})$$

$$roe_t = \beta_1 r_{t-1} + \beta_2 roe_{t-1} + \beta_3 bm_{t-1} + \eta_{2t} \quad (\text{A2b})$$

$$bm_t = \gamma_1 r_{t-1} + \gamma_2 roe_{t-1} + \gamma_3 bm_{t-1} + \eta_{3t} \quad (\text{A2c})$$

We estimate the regressions separately by industry (using the Fama and French (1997) classifications) using weighted least squares with one pooled regression per state variable.²⁴ Each annual cross-section is weighted equally by deflating the data for each firm-year by the number of firms in that year.²⁵

²³The book to market ratio is included in the parsimonious VAR because our model is generated from this ratio. Vuolteenaho (2002) similarly includes the book to market ratio in his VAR specifications. It also controls for the firm's growth prospects.

²⁴Industry subscripts are suppressed in the above equations.

²⁵Using OLS gives similar results.

As shown by Campbell (1991), the variance decomposition of these valuation models can be implemented empirically by combining the residuals from the VAR estimation with the unexpected current return valuation equation. Formally, let $e'_k = (0, \dots, 1, \dots, 0)$, where the 1 is in the i 'th position. The unexpected change in returns is computed as:

$$r_t - E_{t-1}(r_t) = e'_1 \eta_{it} \quad (\text{A3})$$

Equation (A1) implies that forecasts of the state vector $z_{i,t}$ can be computed as:

$$E_t z_{i,t+1+j} = A^{j+1} z_{i,t} \quad (\text{A4})$$

Using equation (A4), the revision in expected future returns (discount rate news) is computed as:²⁶

$$\begin{aligned} & \Delta E_t \sum_{j=1}^{\infty} \rho^j r_{t+j} \\ &= E_t \sum_{j=1}^{\infty} \rho^j r_{t+j} - E_{t-1} \sum_{j=1}^{\infty} \rho^j r_{t+j} \\ &= e'_1 \rho A (I - \rho A)^{-1} \eta_{i,t} = \lambda'_i \eta_{i,t} \end{aligned} \quad (\text{A5})$$

Similarly, the revision in expected current and future earnings (earnings news) is computed as:

²⁶Following Vuolteenaho (2002), Callen and Segal (2004), and Callen, Hope and Segal (2005), we assume that $\rho = 0.967$. The results are not sensitive to this assumption for reasonable values of ρ .

$$\begin{aligned}
& \Delta E_t \sum_{j=0}^{\infty} \rho^j (roe_{t+j} - i_t) \\
= & E_t \sum_{j=0}^{\infty} \rho^j (roe_{t+j} - i_t) - E_{t-1} \sum_{j=0}^{\infty} \rho^j (roe_{t+j} - i_t) \\
= & e_2'(I - \rho A)^{-1} \eta_{i,t} = \lambda_2' \eta_{i,t}
\end{aligned} \tag{A6}$$

6.2 Appendix B: Proofs of the Propositions

Proof of Proposition 1.

Since Proposition 1 is a special case of Proposition 2, we begin with the more general bivariate stationary VAR formulation required for the proof of Proposition 2 and then specialize to Proposition 1.

Consider the stationary bivariate log-linear VAR system of the form:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \alpha_2 roe_{t-1}^S + \eta_{1,t} \tag{B1}$$

$$roe_t^S = \beta_0 + \beta_1 r_{t-1} + \beta_2 roe_{t-1}^S + \eta_{2,t} \tag{B2}$$

representing the market's information (equivalent to a neutral accounting system) where $E_{t-1}(\eta_{1t}) = E_{t-1}(\eta_{2t}) = 0$. Because of stationarity, it is straightforward to show that

$$r_t = \alpha_1 r_{t-1} + \alpha_2 roe_{t-1}^S + \eta_{1,t} \tag{B3}$$

$$roe_t^S = \beta_1 r_{t-1} + \beta_2 roe_{t-1}^S + \eta_{2,t} \tag{B4}$$

where with slight abuse of notation r_t and roe_t^S are now mean-adjusted.

Computing earnings news (equation (5)) conditional on the markets expectations as per Vuolteenaho (2002), we obtain:

$$Ne_t^S = \frac{\rho\beta_1}{Z} \eta_{1,t} + \frac{1 - \rho\alpha_1}{Z} \eta_{2,t} \tag{B5}$$

where Ne^S denotes earnings news for the symmetric neutral accounting system (that is, the market) and $Z = (1 - \rho\alpha_1)(1 - \rho\beta_2) - \rho^2\alpha_2\beta_1$.

Now let us consider an asymmetrical extreme conservative accounting system that recognizes all negative shocks to earnings, whether realized or not, but defers all positive shocks to the future when realized. To simplify the analytics, we assume that positive shocks are always realized k periods hence.

Specifically,

$$r_t^C = \alpha_0 + \alpha_1 r_{t-1}^C + \alpha_2 roe_{t-1} + \eta_{1,t} \quad (\text{B6})$$

$$roe_t = \beta_0 + \beta_1 r_{t-1}^C + \beta_2 roe_{t-1} + \eta_{2,t}^- + \eta_{2,t-k}^+ \quad (\text{B7})$$

This is the same stationary log-linear VAR system as before with two differences. First, the error term in the earnings equation $\eta_{2,t}^-$ is asymmetrical, taking on negative values only, but otherwise is identical to $\eta_{2,t}$. Second, the equation includes the $(t-k)$ period earnings shock $\eta_{2,t-k}^+$ that was not recognized in period $(t-k)$ earnings because of conservatism.²⁷

As with the neutral accounting system, we proceed to mean adjust the conservative system. This yields

$$r_t^C = \alpha_1 r_{t-1}^C + \alpha_2 roe_{t-1} + \eta_{1,t} \quad (\text{B8})$$

$$roe_t = \beta_1 r_{t-1}^C + \beta_2 roe_{t-1} + \eta_{2,t}^* \quad (\text{B9})$$

where $\eta_{2,t}^* = \eta_{2,t}^- - E_{t-1}(\eta_{2,t}^-)$ and the variables r_t^C and roe_t are once more (with slight abuse of notation) mean-adjusted. Note that $E_{t-1}(\eta_{2,t-k}^+)$ is a constant for $k \geq 1$ and for expositional simplicity is assumed to have been included in the constant term β_0 . Crucially, note that $E_{t-1}(\eta_{2,t}^*) = 0$ even though $\eta_{2,t}^*$ is distributed asymmetrically (e.g., truncated normal).

²⁷We could also add a period t mean zero error term to reflect general uncertainty and also to account for positive and negative cash flow shocks that both occur and are realized in period t . Since the theoretical analysis is not affected by this additional error term, we do not include it here.

Solving for earnings news of the extreme conservative accounting system, denoted Ne^C , yields:²⁸

$$Ne_t^C = \frac{\rho\beta_1}{Z}\eta_{1,t} + \frac{1-\rho\alpha_1}{Z}\eta_{2,t}^* \quad (\text{B10})$$

Comparing Ne^C with Ne^S shows that the difference in the two earnings news measures lies in the error terms of the earnings equation.

To prove Proposition 1, we simplify the analysis by assuming that $\alpha_1 = \alpha_2 = 0$ so that expected return news $Nr = 0$. This is the case where interest rates are not predictable so that returns are driven by the earnings dynamic alone. We generalize to the case of non-zero expected return news in the corollary.

Since the market recognizes both positive and negative earnings shocks, and noting that $\alpha_1 = \alpha_2 = Nr = 0$, yields by equations (3) and (4) of Vuolteenaho (2002) and equation (B5) above

$$\begin{aligned} r_t - E_{t-1}(r_t) &= Ne_t^S \\ &= \frac{\rho\beta_1}{(1-\rho\beta_2)}\eta_{1,t} + \frac{1}{(1-\rho\beta_2)}\eta_{2,t} \end{aligned} \quad (\text{B11})$$

For the extreme conservative accounting system, we obtain instead:

$$\begin{aligned} Ne_t^C &= \frac{\rho\beta_1}{(1-\rho\beta_2)}\eta_{1,t} + \frac{1}{(1-\rho\beta_2)}\eta_{2,t}^* \\ &= \frac{\rho\beta_1}{(1-\rho\beta_2)}\eta_{1,t} + \frac{1}{(1-\rho\beta_2)}[\eta_{2,t}^- - E_{t-1}(\eta_{2,t}^-)] \end{aligned} \quad (\text{B12})$$

Before proceeding, note that stationarity guarantees that $1/(1-\rho\beta_2) > 0$ (Moreover, it is quite implausible for $1/(1-\rho\beta_2) < 0$ since that would imply that a positive shock to earnings reduces earnings news in a symmetric neutral accounting system.)

²⁸We employ Vuolteenaho's direct formula for earnings news which, in terms of his nomenclature, equals $e'2[I-\rho\Gamma]^{-1}$. The indirect formula always yields linearity *by construction* and is, therefore, inappropriate for our analysis.

Suppose that the shock is negative so that $\eta_{2,t} < 0$. In this case $\eta_{2,t}^- = \eta_{2,t}$ and, using (B11), equation (B12) simplifies to:

$$Ne_t^C = [r_t - E_{t-1}(r_t)] - \frac{1}{(1 - \rho\beta_2)} E_{t-1}(\eta_{2,t}^-) \quad (\text{B13})$$

If instead the shock is positive so that $\eta_{2,t} > 0$, then $\eta_{2,t}^- = 0$ and equation (B12) becomes:

$$Ne_t^C = [r_t - E_{t-1}(r_t)] - \frac{1}{(1 - \rho\beta_2)} E_{t-1}(\eta_{2,t}^-) - \frac{1}{(1 - \rho\beta_2)} \eta_{2,t} \quad (\text{B14})$$

Noting that $r_t - E_{t-1}(r_t) = \eta_{1,t}$ from equation (B3) and substituting into equation (B11) yields:

$$r_t - E_{t-1}(r_t) = \frac{\eta_{2,t}}{(1 - \rho\beta_1 - \rho\beta_2)} \quad (\text{B15})$$

Since by stationarity $(1 - \rho\beta_1 - \rho\beta_2) > 0$, equation (B15) allows us to re-express equations (B13) and (B14), respectively, as:

$$Ne_t^C = c_0 + [r_t - E_{t-1}(r_t)] \quad (\text{B16})$$

when $r_t - E_{t-1}(r_t) < 0$ and

$$Ne_t^C = c_0 + \frac{\rho\beta_1}{(1 - \rho\beta_2)} [r_t - E_{t-1}(r_t)] \quad (\text{B17})$$

when $r_t - E_{t-1}(r_t) > 0$ where $c_0 = -E_{t-1}(\eta_{2,t}^-)/(1 - \rho\beta_2)$, a positive constant.

We can further express equation (B16) and (B17) in the nonlinear regression form:

$$Ne_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2 D * [r_t - E_{t-1}(r_t)] \quad (\text{B18})$$

where $D = 1$ if $r_t - E_{t-1}(r_t) \leq 0$ and 0 otherwise. Here $c_1 = \rho\beta_1/(1 - \rho\beta_2)$ and $c_2 = (1 - \rho\beta_1 - \rho\beta_2)/(1 - \rho\beta_2) > 0$. Note that $c_1 < 1$ by stationarity so that

the slope for negative revision in returns ($c_1 + c_2 = 1$) is greater than the slope for positive revisions in returns c_1 .

Proof of Corollary 1.

Proposition 1 assumed for simplicity that $\alpha_1 = \alpha_2 = 0$ so that $Nr_t = 0$. If $Nr_t \neq 0$, then for the market (neutral accounting system) one obtains—see Vuolteenaho—the linear relation

$$r_t - E_{t-1}(r_t) = Ne_t^S - Nr_t^S \quad (\text{B19})$$

where Ne_t^S is defined by equation (B5) and expected return news (Nr_t^S) is defined by:

$$Nr_t^S = \frac{[\rho\alpha_1(1 - \rho\beta_2) + \rho^2\alpha_2\beta_1]}{Z}\eta_{1,t} + \frac{\rho\alpha_2}{Z}\eta_{2,t} \quad (\text{B20})$$

For the extreme conservative firm, Ne_t^C is defined by equation (B10) and expected return news (Nr_t^C) is defined by:

$$Nr_t^C = \frac{[\rho\alpha_1(1 - \rho\beta_2) + \rho^2\alpha_2\beta_1]}{Z}\eta_{1,t} + \frac{\rho\alpha_2}{Z}\eta_{2,t}^* \quad (\text{B21})$$

Comparing earnings news for the market and the extreme conservative firm—equations (B5) and (B10)—yields:

$$Ne_t^C = Ne_t^S + \frac{1 - \rho\alpha_1}{Z}(\eta_{2,t}^* - \eta_{2,t}) \quad (\text{B22})$$

Similarly, comparing expected return news for the market and the extreme conservative firm—equations (B20) and (B21)—yields:

$$Nr_t^C = Nr_t^S + \frac{\rho\alpha_2}{Z}(\eta_{2,t}^* - \eta_{2,t}) \quad (\text{B23})$$

Subtracting equation (B23) from (B22) yields:

$$\begin{aligned}
Ne_t^C - Nr_t^C &= Ne_t^S - Nr_t^S + \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}(\eta_{2,t}^* - \eta_{2,t}) \\
&= r_t - E_{t-1}(r_t) + \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}(\eta_{2,t}^* - \eta_{2,t}) \\
&= r_t - E_{t-1}(r_t) + \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}(\eta_{2,t}^- - E_{t-1}(\eta_{2,t}^-) - \eta_{2,t}) \\
&= c_0 + r_t - E_{t-1}(r_t) + \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}(\eta_{2,t}^- - \eta_{2,t}) \quad (\text{B24})
\end{aligned}$$

where the second equality follows from equation (B19) and $c_0 = -[(1 - \rho\alpha_1 - \rho\alpha_2)/Z]E_{t-1}(\eta_{2,t}^-)$, a constant.

When $\eta_{2,t} \leq 0$, $\eta_{2,t}^- = \eta_{2,t}$ and equation (B24) becomes:

$$Ne_t^C = c_0 + [r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B25})$$

When $\eta_{2,t} > 0$, $\eta_{2,t}^- = 0$ and equation (B24) becomes:

$$Ne_t^C = c_0 + [r_t - E_{t-1}(r_t)] - \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}\eta_{2,t} + Nr_t^C \quad (\text{B26})$$

It can be shown that

$$(1 - \rho\beta_1 - \rho\beta_2)[r_t - E_{t-1}(r_t)] = (1 - \rho\alpha_1 - \rho\alpha_2)\eta_{2,t} \quad (\text{B27})$$

where by stationarity $(1 - \rho\beta_1 - \rho\beta_2) > 0$ and $(1 - \rho\alpha_1 - \rho\alpha_2) > 0$.²⁹ Thus,

equations (B25) and (B26) can be formulated as follows:

When $[r_t - E_{t-1}(r_t)] \leq 0$,

$$Ne_t^C = c_0 + [r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B28})$$

²⁹Substituting (B5) and (B20) into equation (B19), yields:

$r_t - E_{t-1}(r_t) = \frac{\rho\beta_1 - [\rho\alpha_1(1 - \rho\beta_2) + \rho^2\alpha_2\beta_1]}{Z}\eta_{1,t} + \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}\eta_{2,t}$. Noting that $r_t - E_{t-1}(r_t) = \eta_{1,t}$ from equation (B3) and substituting into the latter result yields equation (B27).

When $[r_t - E_{t-1}(r_t)] > 0$,

$$Ne_t^C = c_0 + \frac{[\rho\alpha_1(\rho\beta_2 - 1) - \rho\beta_1(\rho\alpha_2 - 1)]}{Z}[r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B29})$$

Equations (B28) and (B29) can be rewritten as one equation of the form:

$$Ne_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2D * [r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B30})$$

where $D = 1$ when $[r_t - E_{t-1}(r_t)] \leq 0$ and zero otherwise, $c_0 = -[(1 - \rho\alpha_1 - \rho\alpha_2)/Z]E(\eta_{2t}^-)$, $c_1 = [\rho\alpha_1(\rho\beta_2 - 1) - \rho\beta_1(\rho\alpha_2 - 1)]/Z$, $c_2 = (1 - \rho\beta_1 - \rho\beta_2)/Z$. Note that $c_1 + c_2 = 1$ and by stationarity $c_1 < 1$. Again, the impact of negative return shocks on earnings news, namely, $c_1 + c_2 = 1$ is greater than the impact of positive return shocks c_1 .

Proof of Proposition 2.

We assumed in the derivation of Propositions 1 that zero is the truncation point for the (extreme) conservative firm. Consider instead a firm that is less conservative in that it only recognizes negative shocks below some $-\gamma_t < 0$ ($\gamma_t \geq 0$). Let $\eta_{2,t}^R$ takes values of $\eta_{2,t}$ for values below $-\gamma_t$ and zero otherwise. We use the same approach as in the proof of Proposition 1 except that now $\eta_{2,t}^* = \eta_{2,t}^R - E_{t-1}(\eta_{2,t}^R)$. Define $c_0 = -[(1 - \rho\alpha_1 - \rho\alpha_2)/Z]E_{t-1}(\eta_{2,t}^R)$. From equation (B24), we obtain

$$Ne_t^C - Nr_t^C = c_0 + r_t - E_{t-1}(r_t) + \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}(\eta_{2,t}^R - \eta_{2,t}) \quad (\text{B31})$$

Thus, when $\eta_{2,t} \leq -\gamma_t$, $\eta_{2,t}^R = \eta_{2,t}$ so that equation (B31) yields:

$$Ne_t^C = c_0 + [r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B32})$$

In contrast, when $\eta_{2,t} > -\gamma_t$, $\eta_{2,t}^R = 0$ and equation (B31) becomes:

$$Ne_t^C = c_0 + [r_t - E_{t-1}(r_t)] - \frac{(1 - \rho\alpha_1 - \rho\alpha_2)}{Z}\eta_{2,t} + Nr_t^C \quad (\text{B33})$$

Substituting $[r_t - E_{t-1}(r_t)]$ for $\eta_{2,t}$ using equation (B27) allows us to redescribe equations (B32) and (B33) and the associated inequalities as:

$$Ne_t^C = c_0 + [r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B34})$$

when $r_t - E_{t-1}(r_t) \leq -\gamma_t(1 - \rho\alpha_1 - \rho\alpha_2)/(1 - \rho\beta_1 - \rho\beta_2)$ and

$$Ne_t^C = c_0 + \frac{\rho\beta_1}{Z}[r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B35})$$

when $r_t - E_{t-1}(r_t) > -\gamma_t(1 - \rho\alpha_1 - \rho\alpha_2)/(1 - \rho\beta_1 - \rho\beta_2)$. Combining equations (B34) and (B35) gives

$$Ne_t^C = c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2D * [r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B36})$$

where $D = 1$ if $r_t - E_{t-1}(r_t) \leq -\gamma_t(1 - \rho\alpha_1 - \rho\alpha_2)/(1 - \rho\beta_1 - \rho\beta_2)$ and 0 otherwise, $c_0 = -[(1 - \rho\alpha_1 - \rho\alpha_2)/Z]E(\eta_{2,t}^-)$, $c_1 = [\rho\alpha_1(\rho\beta_2 - 1) - \rho\beta_1(\rho\alpha_2 - 1)]/Z$, $c_2 = (1 - \rho\beta_1 - \rho\beta_2)/Z$. Again, $c_1 + c_2 = 1 > c_1$.

Proof of Proposition 3

From equation (5), we have that

$$\begin{aligned} Ne_t^C &= \Delta E_t \sum_{j=0}^{\infty} \rho^j roe_{t+j} \\ &= roe_t - E_{t-1}(roe_t) + \Delta E_t \sum_{j=1}^{\infty} \rho^j roe_{t+j} \end{aligned} \quad (\text{B37})$$

Substituting equation (B37) into the equation (8) of Corollary 1, yields:

$$roe_t = E_{t-1}(roe_t) - \Delta E_t \sum_{j=1}^{\infty} \rho^j roe_{t+j} + c_0 + c_1[r_t - E_{t-1}(r_t)] + c_2 D * [r_t - E_{t-1}(r_t)] + Nr_t^C \quad (\text{B38})$$

where $D = 1$ when $[r_t - E_{t-1}(r_t)] \leq 0$ and zero otherwise. Assuming that $\Delta E_t \sum_{j=1}^{\infty} \rho^j roe_{t+j} = 0$, and $Nr_t^C = 0$ yields the Basu relation.³⁰

³⁰These are only sufficient conditions for Basu to hold. The same result obtains if one is willing to assume instead that $\Delta E_t \sum_{j=1}^{\infty} \rho^j roe_{t+j}$, and Nr_t^C are constants.

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