Valuation Errors Caused by Conservative Accounting in Residual Income and Abnormal Earnings Growth Valuation Models

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Kenth Skogsvik *)†)

Stockholm School of Economics

Beate E. Juettner-Nauroth **)†)

Deutsche Bundesbank, Hachenbur

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*) Address for correspondence: Stockholm School of Economics, Box 6501, SE-113 83 Stockholm, Sweden; phone: +46-8-736 93 07, email: kenth.skogsvik@hhs.se. Kenth Skogsvik is grateful for financial support from the Torsten and Ragnar Söderberg Foundations and FPG Pensionsgaranti.

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Abstract

The impact of conservative accounting in residual income valuation (RIV) and abnormal earnings growth (AEG) valuation modeling is investigated in this paper. Unconstrained and two types of constrained model specifications are evaluated regarding their ability to withstand biases in book values and earnings due to accounting conservatism. Given that the "clean surplus relation" holds and that the precision of forecasted accounting numbers is unaffected by the type of accounting principles, the unconstrained valuation models are – not surprisingly – found to be immune to conservatism. This does not hold for the constrained models, even though conservatism can be accommodated in these if the time-series specification of the conservative bias fulfils certain conditions. In a comparison between terminal value constrained models, the AEG model is found to be superior to the RIV model if the growth of the conservative bias in the terminal period is not too extreme. Comparing the information dynamics constrained models being proposed in Ohlson (1995) and Ohlson & Juettner-Nauroth (2005), the AEG model is potentially more accurate than the RIV model. However, in a company steady state setting with constant growth, there is no comparative advantage for the AEG model. Also, using the same set of forecasted accounting numbers in the information dynamics constrained RIV model as in the corresponding AEG model, the two models cannot be ranked.

1. Introduction and Summary

Contemporary research as well as teaching in accounting-based valuation has clearly been influenced by the valuation models that were proposed in Ohlson (1995), Feltham & Ohlson (1995), and Ohlson & Juettner-Nauroth (2005). In the first two articles a “residual income valuation” (RIV) framework was launched, specifying a certain linkage between earnings and book values of owners´ equity, and the value of owners´ equity. In the third article, another valuation approach – labelled “abnormal earnings growth” (AEG) valuation – was specified, promoting the idea that earnings and earnings growth rather should have a first-order importance in accounting-based valuation. A number of advantages of AEG valuation were pointed out in Ohlson (2005) and Ohlson & Gao (2006). As one of these advantages, AEG valuation was claimed to be less sensitive to measurement biases caused by conservative accounting.

In this paper valuation errors caused by conservative accounting in RIV and AEG valuation modeling are further analysed and compared. Two main questions will be addressed:

- To what extent can RIV and AEG valuation models accommodate conservatively biased accounting numbers? Will conservative accounting always cause errors in model-based equity values – or can the valuation models be immune to such measurement biases?
- Which type of modeling – RIV versus AEG valuation – is the least affected by accounting conservatism? Or, more specifically, if an investor is unable to make an assessment of the conservative bias in some accounting regime – which type of modeling is to be preferred?

Measurement biases of earnings and book values are specified as in Skogsvik (1998) and Zhang (2000), and both unconstrained and parsimonious model specifications are evaluated in the paper. The parsimonious models are constrained in the sense that either terminal values are presumed to be zero, or a constant growth factor is used to forecast residual income or abnormal earnings growth over infinite time horizons.

Throughout the paper it is assumed that the “clean surplus relation” holds in both unbiased and conservative accounting, and that company taxes are unaffected by the choice of accounting principles. In order to isolate valuation errors caused by conservative accounting, it is presumed that the valuation models would be without error if the accounting was unbiased. Differences between RIV or AEG equity values with conservative accounting and the corresponding values with unbiased accounting, will hence only be due to accounting conservatism.

The main results of the paper are as follows:

- Unconstrained RIV and AEG valuation models are unaffected by conservative accounting. Given that the precision of forecasted accounting numbers is unaffected by conservatism, this result is well-known (cf. Penman, 2006, pp. 593-603).
- Terminal value constrained RIV and AEG valuation models are in general affected by conservative accounting. The valuation error of the RIV model is non-positive and depends on the magnitude of the conservative bias of owners′ equity at the terminal point in time. The error of the AEG model depends on the capitalized growth of the conservative bias in the terminal period. The valuation error of the AEG model is smaller than the error of the RIV model if the growth in the terminal period is sufficiently small. If the terminal period coincides with the first year in a company "steady state" with non-negative growth, the AEG model is less affected by accounting conservatism.
- The information dynamics constrained RIV and AEG models – the core models in Ohlson (1995) and Ohlson & Juettner-Nauroth (2005) – are in general affected by accounting conservatism. However, the AEG model is able to accommodate a less restrictive time-series dynamics of the conservative bias, even though the empirical relevance of this advantage is somewhat moot. In a "steady state" setting, the information dynamics constrained RIV and AEG models are both unaffected by accounting conservatism.

The remainder of the paper is organized as follows. More general assumptions and model specifications are provided in section 2. In section 3, the characterization of accounting conservatism is outlined. The RIV models are evaluated in section 4 – in 4.1 the unconstrained model and in subsections 4.2 and 4.3 the terminal value and the information dynamics constrained specifications, respectively. Similarly, evaluations of the AEG models are presented in section 5 − the unconstrained model in subsection 5.1 and the constrained model specifications in 5.2 and 5.3. Conditions for the AEG models to be less affected by conservative accounting than the corresponding RIV models are provided in section 6. Concluding remarks follow in the last section.

2. Assumptions and Valuation Models

Two types of accounting-based valuation modeling are considered in the paper – one based on the profitability concept “residual income” labelled “residual income valuation” (RIV),[1] and the other based on “abnormal earnings growth”, labelled “abnormal earnings growth (AEG) valuation”.[2] Both types of modeling are consistent with the generic valuation approach commonly labelled “present value of expected dividends” (PVED). The following assumptions are henceforth presumed to hold throughout the paper:

(G-1) In both unbiased and conservative accounting, deviations from the “clean surplus relation” (i.e. that net income, dividends and/or new issues of equity capital account for all changes in the book value of owners´ equity) in future financial statements are expected to be zero.

(G-2) Market values are used in the accounting for dividends and new issues of equity capital in the financial statements. Dividends and/or new issues of owners´ equity are settled at the end of future reporting periods.

(G-3) The investment risk associated with future (net) dividend payments is incorporated in the required (expected) return on owners´ equity.

(G-4) The required (expected) return on owners´ equity is non-stochastic and has a flat term structure.

In order to simplify the notation, the valuation point in time occurs at t = 0 (immediately after any dividend and/or new issue of equity capital at the end of the previous period, have been settled). The following notation will be used:

P_t	=	value of owners´ equity based on PVED at time t, after capital transactions (dividend and/or new issue of equity capital) between the company and the owners at time t
$V_0^{...}$	=	value of owners´ equity according to model … at time t = 0, after capital transactions between the company and the owners at time t = 0
Bv_t	=	book value of owners´ equity at time t, after capital transactions between the company and the owners at time t
Div_t	=	dividend payment minus new issue of equity capital at time t
X_t	=	accounting earnings (= net income) accrued in period t

[1] Cf. Peasnell (1982), Ohlson (1995) and Feltham & Ohlson (1995), or earlier references such as Preinreich (1938) and Edwards & Bell (1961).
[2] AEG valuation is due to Ohlson & Juettner-Nauroth (2005).

r	$\equiv$	$R - 1 \;=\;$ required (expected) rate of return on owners´ equity
$X_{res,t}$	$\equiv$	$X_t - r \cdot Bv_{t-1} \;=\;$ residual income, accrued in period t
$E_0(\ldots)$	$=$	expectation operator, conditioned on the available information at time $t = 0$

Given the assumptions (G-2), (G-3) and (G-4), the value of owners´ equity according to PVED is:

$$P_0 = \sum_{\tau=1}^{\infty} \frac{E_0(Div_\tau)}{R^\tau} \tag{PVED}$$

Inserting a horizon point in time t = T, PVED can equivalently be written as:

$$P_0 \;=\; \sum_{\tau=1}^{T} \frac{E_0(Div_\tau)}{R^\tau} \;+\; \sum_{\tau'=T+1}^{\infty} \frac{E_0(Div_{\tau'})}{R^{\tau'}} \;=\; \sum_{\tau=1}^{T} \frac{E_0(Div_\tau)}{R^\tau} \;+\; \frac{E_0(P_T)}{R^T} \tag{1}$$

The “clean surplus relation” as specified in (G-1) implies:

$$E_0(Bv_{\tau+1}) = E_0(Bv_\tau) + E_0(X_{\tau+1}) - E_0(Div_{\tau+1}) \tag{CSR}$$

Rewriting (CSR) so $E_0(Div_\tau)$ becomes the dependent variable and incorporating this into (PVED), the unconstrained RIV model – denoted RIV* – easily unfolds:

$$V_0^{RIV(*)} = Bv_0 \;+\; \sum_{\tau=1}^{T} \frac{E_0(X_\tau - r \cdot Bv_{\tau-1})}{R^\tau} \;+\; \frac{E_0(P_T - Bv_T)}{R^T} \tag{RIV*}$$

Given (G-1) to (G-4), obviously $V_0^{RIV(*)} = P_0$ according to PVED.

The unconstrained AEG valuation model – denoted $V_0^{AEG(*)}$ – can be derived through the following rewriting of (PVED):

$$V_0^{AEG(*)} \;=\; \sum_{\tau=1}^{T} \frac{E_0(Div_\tau)}{R^\tau} \;+\; \frac{E_0(P_T)}{R^T} \;=$$

$$= \frac{E_0(X_1)}{r} + \frac{E_0(Div_1)}{R} - \frac{E_0(X_1)}{r} \;+\; \frac{E_0(X_2)}{r \cdot R} + \frac{E_0(Div_2)}{R^2} - \frac{E_0(X_2)}{r \cdot R} \;+$$

$$+ \ldots.. + \frac{E_0(X_T)}{r \cdot R^{T-1}} + \frac{E_0(Div_T)}{R^T} - \frac{E_0(X_T)}{r \cdot R^{T-1}} + \frac{E_0(P_T)}{R^T} =$$

$$= \frac{E_0(X_1)}{r} + \sum_{\tau=1}^{T-1} \frac{E_0(X_{\tau+1} + r \cdot Div_\tau - X_\tau \cdot R)/r}{R^\tau} +$$

$$+ \frac{E_0(P_T + Div_T - X_T \cdot R/r)}{R^T} \qquad (AEG^*)$$

Similar to the structure of RIV*, the unconstrained AEG model consists of:

- The capitalized value of (expected) earnings in the first period ($E_0(X_1)/r$).
- The present value of capitalized (expected) abnormal earnings growth over the periods $\tau = 2, 3, \ldots, T$ ($\sum_{\tau=1}^{T-1}[E_0(X_{\tau+1} + r \cdot Div_\tau - X_\tau \cdot R)/r]/R^\tau$).
- The present value of the (expected) difference between the value of owners´ equity and the capitalized value of earnings at the horizon point in time ($E_0(P_T + Div_T - X_T \cdot R/r)/R^T$).

The unconstrained AEG* model was neither specified in Ohlson & Juettner-Nauroth (2005) nor Ohlson (2005), even though valuation errors due to the omission of a terminal value were evaluated in the latter article. However, allowing $T \to \infty$, invoking a constant relative growth less than r for $(X_{t+1} + r \cdot Div_t - X_t \cdot R)$, and consequently presuming that $E_0(P_T + Div_T - X_T \cdot R/r) \to 0$ as $T \to \infty$, the information dynamics constrained model in Ohlson & Juettner-Nauroth (2005) is easily obtained from (AEG*).

As AEG* is derived as a simple rewriting of (1), $V_0^{AEG(*)}$ is equivalent to (PVED). Note that assumption (G-1) (the "clean surplus relation") is not necessary for this result to hold. However, (G-1) will not cause any harm to the AEG valuation model, but rather put some discipline on the permissible accounting principles for the analyses to be carried out. Also, (G-1) will ensure that measures of abnormal earnings growth will unambiguously be linked to measures of residual income, i.e.:

$$E_0(X_{t+1} + r \cdot Div_t - X_t \cdot R) = E_0[(X_{t+1} - r \cdot Bv_t) - (X_t - r \cdot Bv_{t-1})] =$$

$$= E_0[\Delta(X_{res,t+1})] \qquad (2)$$

Expression (2) implies that abnormal earnings growth in period t+1 is equal to the difference between residual income in period t+1 and period t.

An additional assumption to be used in the analyses of the unconstrained and terminal value constrained models, is concerned with the available information to capital investors. It is in this regard presumed that investors are informed about the ability of companies to pursue business activities with non-zero net present values (NPV), in the sense that:

(G-5) Capital investors expect that companies at some (firm specific) point in time $t = T^{*} \geq 0$ only will be able to execute 0-NPV activities for all succeeding periods $T^{*}+1$, $T^{*}+2$,...

Given *unbiased* accounting and setting $T \geq T^{*}$, the terminal residual value in the unconstrained RIV model drops out. This follows since $E_0(Bv_{T*}) = E_0(P_{T*})$ when the accounting is unbiased (cf. the specification of conservative accounting in section 3 below). In AEG*, a similar result requires that the horizon point in time is set to $T \geq (T^{*} + 1)$, as unbiased accounting and the "clean surplus relation" imply that:

$$E_0\left(P_T + Div_T - X_T^{(u)} \cdot R / r\right) \;=\; E_0\left[Bv_{T-1}^{(u)} - X_T^{(u)} / r\right] \tag{3}$$

where: $...^{(u)}$ = (denotes) unbiased accounting

Assumption (G-5) allows for the following observation:

Observation 1: Given the "clean surplus relation" (G-1), only 0-NPV activities after $t = T^{*}$ (G-5) and an *unbiased* accounting regime, the expected terminal residual value in RIV* is zero if $T \geq T^{*}$. In AEG*, the expected terminal residual value is zero if $T \geq (T^{*} + 1)$.

Observation 1 deviates slightly from "Proposition I" in Ohlson (2005). This depends on the truncation error in the AEG model being specified as $E_0\left(P_T - X_{T+1} / r\right)$ at t = T by Ohlson, [3] while the truncation error in the unconstrained AEG model is $E_0\left(P_T + Div_T - X_T \cdot R / r\right)$. Assumption (G-5) implies that $E_0(X_T) \neq E_0\left(r \cdot Bv_{T-1}^{(u)}\right)$ for $T \leq T^{*}$, and hence that the truncation error in AEG* cannot be zero unless $T \geq T^{*} + 1$.

[3] Cf. Ohlson (2005), p. 333. Ohlson´s proposition is insidious in claiming that the truncation error at time t = T includes an assessment of X_{T+1}; ie. earnings for the first period after the terminal point in time. Also, the definition of the truncation error in Ohlson (2005) is inconsistent with the specification of the unconstrained AEG model.

3. Modeling Accounting Conservatism

Accounting conservatism means that the accounting principles being used in the financial statements are prudent, in the sense that:

- Acquisition costs of operating assets are written down or depreciated more quickly than what would be required according to fair cost matching principles (cf. Skogsvik, 1998).
- Operating assets and liabilities are impaired/appreciated in compliance with the principle of "lower of historical cost or market" and "higher of contractual obligation or market", respectively.
- Holding gains and unrealized profits in inventory and work-in-progress are not recognized in the financial statements, while unrealized losses are recognized when they occur or can be foreseen.
- Positive net present values of neither current nor future business projects are recognized in the financial statements.

The first and the fourth point refer to what commonly is labelled *unconditional* ("ex ante") conservatism, while the second and third point refer to *conditional* ("ex post") conservatism (cf. Ryan, 2006). Reasonably, in accounting-based valuation modeling the importance of conditional conservatism will be subordinated to the importance of unconditional conservatism, as future expected values of the former type of conservatism in general should be close to zero.

Assuming that the "clean surplus relation" holds, a simple and non-ambiguous definition of conservative accounting can focus on the measurement bias of the book value of owners´ equity (i.e. financial plus operating assets, minus financial and operating liabilities).

- *Definition of Conservative Accounting:*

"Conservative accounting" denotes a set of accounting principles being characterized as follows:

$$\mathrm{Bv}_0^{(u)} - \mathrm{Bv}_0 = \mathrm{Cb}_0 \geq 0 \tag{4.a}$$

$$\mathrm{E}_0\left(\mathrm{Bv}_t^{(u)}\right) - \mathrm{E}_0\left(\mathrm{Bv}_t\right) = \mathrm{E}_0\left(\mathrm{Cb}_t\right) \geq 0 \ , \quad \text{for } t = 1,2,\ldots,T \ ; \ T \to \infty \tag{4.b}$$

$$\mathrm{E}_0\left(\mathrm{X}_t\right) = \mathrm{E}_0\left[\mathrm{X}_t^{(u)} - \left(\mathrm{Cb}_t - \mathrm{Cb}_{t-1}\right)\right] = \mathrm{E}_0\left(\mathrm{X}_t^{(u)}\right) - \mathrm{E}_0\left[\Delta\left(\mathrm{Cb}_t\right)\right] \tag{5}$$

Conservative accounting hence means that book values of owners´ equity are expected to be negatively biased. Obviously, this specification of conservative accounting hinges on the existence of unbiased accounting principles, where $E_0\left(Bv_t^{(u)}\right) = E_0\left(P_t\right)$ for $t \geq T^*$ (cf. Zhang, 2000). Also note that the bias of future earnings depends on the growth of the conservative bias in future periods ($\Delta(Cb_t)$). Only when the growth of the conservative bias is positive, will earnings be negatively biased; in particular, if $\Delta(Cb_t) = 0$ earnings wil be unaffected by accounting conservatism.

4. Conservative Accounting in RIV Modeling

The impact of conservative accounting in three RIV model specifications will be investigated in this section. The first one is the unconstrained RIV model (subsection 4.1), the second one is a terminal value constrained model (subsection 4.2) and the third one is an information dynamics constrained model (subsection 4.3). In the first constrained model, the terminal residual value in RIV* is postulated to be 0. The information dynamics constrained model implies that future residual income is expected to grow at a constant rate, and that the horizon point in time $T \rightarrow \infty$. The specification coincides with the benchmark model in Ohlson (1995) (formula (5)) when the exogenous variable "other information" is set to zero in the time-series of future expected residual income.

Valuation errors will be assessed as the difference between values of owners´ equity in a setting with conservative accounting and the corresponding values in a setting with unbiased accounting. The latter values are viewed as the correct equity values, and any deviations will solely be due to accounting conservatism. Notably, an evaluation of this type does not allow for any "undoing" of conservative biases in forecasted accounting numbers. Assessed valuation errors are thus representative for modeling applications being done *as if* the available accounting information was *unbiased*.

4.1. *The unconstrained RIV model*

Given *unbiased* accounting, the value of owners´ equity in the unconstrained RIV model − $V_{0,UB}^{RIV^*}$ − is:

$$V_{0,UB}^{RIV^*} = Bv_0^{(u)} + \sum_{\tau=1}^{T^*} \frac{E_0\left(X_\tau^{(u)} - r \cdot Bv_{\tau-1}^{(u)}\right)}{R^{\tau}} + \frac{E_0\left(P_{T^*} - Bv_{T^*}^{(u)}\right)}{R^{T^*}} =$$

$$= Bv_0^{(u)} + \sum_{\tau=1}^{T^*} \frac{E_0\left(X_\tau^{(u)} - r \cdot Bv_{\tau-1}^{(u)}\right)}{R^{\tau}} \tag{6}$$

With conservative accounting, book values of owners´ equity and earnings will be biased in accordance with expressions (4.a), (4.b) and (5) above, and as $E_0(P_{T*}) = E_0\left(Bv_{T*}^{(u)}\right) = E_0\left(Bv_{T*} + Cb_{T*}\right)$ we get:

$$V_{0,CB}^{RIV^*} = Bv_0 + \sum_{\tau=1}^{T*} \frac{E_0\left(X_\tau - r \cdot Bv_{\tau-1}\right)}{R^\tau} + \frac{E_0\left(Cb_{T*}\right)}{R^{T*}} \tag{7}$$

The valuation error of the unconstrained RIV model – denoted Dev_0^{RIV} – is calculated as the difference between (7) and (6):

$$Dev_0^{RIV^*} = V_{0,CB}^{RIV^*} - V_{0,UB}^{RIV^*} =$$

$$= -Cb_0 + \sum_{\tau=1}^{T*} \frac{E_0\left[\left(X_\tau - X_\tau^{(u)}\right) - r\left(Bv_{\tau-1} - Bv_{\tau-1}^{(u)}\right)\right]}{R^\tau} + \frac{E_0\left(Cb_{T*}\right)}{R^{T*}} =$$

$$= -Cb_0 + \sum_{\tau=1}^{T*} \frac{E_0\left[-\Delta\left(Cb_\tau\right) + r \cdot Cb_{\tau-1}\right]}{R^\tau} + \frac{E_0\left(Cb_{T*}\right)}{R^{T*}} \tag{8}$$

Since the “clean surplus relation” is presumed to hold in both unbiased and conservative accounting, it is easily shown that $Dev_0^{RIV(*)} = 0$.[4] Hence we have the following observation, elaborated first in Preinreich (1938) but often “rediscovered” in later research (cf., for example, Ohlson, 1995, p. 667):

Observation 2: Given the “clean surplus relation” (G-1), the unconstrained RIV model (RIV*) is unaffected by accounting conservatism.

The above result is hardly surprising – as long as accounting conservatism does not violate the “clean surplus relation”, the creation and/or realization of measurement biases will always be valuation neutral in unconstrained RIV modeling.

4.2. *The terminal value constrained RIV model*

The terminal value constrained RIV model – denoted RIV(TVC) – differs from RIV* in the sense that the terminal value $E_0\left(P_T - Bv_T\right)$ is postulated to be zero. Given *unbiased* accounting, the rationale for a model specification of this kind is obvious – if T = T* and the

[4] Proof in Appendix.

company steady state starts in period T^*+1, the expected terminal value in RIV^* is zero (*Observation 1*, section 2). However, the question is now concerned with the valuation error of RIV(TVC) when $T = T^*$ and the accounting is *conservatively* biased.

The valuation error of RIV(TVC) is calculated as the difference between $V_{0,CB}^{RIV(TVC)}$ and $V_{0,UB}^{RIV(TVC)}$, where:

$$V_{0,UB}^{RIV(TVC)} = Bv_0^{(u)} + \sum_{\tau=1}^{T^*} \frac{E_0\left(X_\tau^{(u)} - r \cdot Bv_{\tau-1}^{(u)}\right)}{R^\tau} \tag{9}$$

$$V_{0,CB}^{RIV(TVC)} = Bv_0 + \sum_{\tau=1}^{T^*} \frac{E_0\left(X_\tau - r \cdot Bv_{\tau-1}\right)}{R^\tau} =$$

$$= \left(B_0^{(u)} - Cb_0\right) + \sum_{\tau=1}^{T^*} \frac{E_0\left[X_\tau^{(u)} - \Delta\left(Cb_\tau\right) - r\left(Bv_{\tau-1}^{(u)} - Cb_{\tau-1}\right)\right]}{R^\tau} \tag{10}$$

Knowing that $-Cb_0 + \sum_{\tau=1}^{T^*} \frac{E_0\left[-\Delta\left(Cb_\tau\right) + r \cdot Cb_{\tau-1}\right]}{R^\tau} + \frac{E_0\left(Cb_{T^*}\right)}{R^{T^*}} = 0$ (cf. (8) and *Observation 2* in the previous subsection), the valuation error of RIV(TVC) is:

$$Dev_0^{RIV(TVC)} = V_{0,CB}^{RIV(TVC)} - V_{0,UB}^{RIV(TVC)} =$$

$$= -Cb_0 + \sum_{\tau=1}^{T^*} \frac{E_0\left[-\Delta\left(Cb_\tau\right) + r \cdot Cb_{\tau-1}\right]}{R^\tau} = -\frac{E_0\left(Cb_{T^*}\right)}{R^{T^*}} \tag{11}$$

(11) shows that the valuation error of the terminal value constrained RIV model is a function of the conservative bias of owners′ equity at the terminal point in time. As conservative accounting implies that $E_0\left(Cb_{T^*}\right) \geq 0$, the valuation error of $V_0^{RIV(TVC)}$ is non-positive. The result allows for the following proposition:

Proposition 1: Given the "clean surplus relation" (G-1), only 0-NPV activities after $t = T^*$ (G-5), RIV(TVC) with $T = T^*$ accommodates conservative accounting if (and only if) $E_0\left(Cb_{T^*}\right) = 0$, or equivalently if $\sum_{\tau=1}^{T^*} E_0\left[\Delta(Cb_\tau)\right] = -Cb_0$.

Proposition 1 implies that $V_{0,CB}^{RIV(TVC)}$ is unaffected by accounting conservatism if the conservative bias at the valuation point in time together with $\Delta\left(Cb_t\right)$ for all periods up to

$t = T$, are such that $Cb_0 + \sum_{\tau=1}^{T^*} E_0(\Delta(Cb_\tau)) = 0$. The negative valuation impact due to Bv_0 being smaller than $Bv_0^{(u)}$ will then exactly be compensated by the positive bias of residual income in future periods.

4.3. *The information dynamics constrained RIV model*

In the "information dynamics constrained" RIV model specification (denoted RIV(IDC)), residual income is expected to grow at a constant periodic rate (less than r) and the horizon point in time $T \to \infty$. With *unbiased* accounting, the information dynamics constrained model is hence:

$$V_{0,UB}^{RIV(IDC)} = Bv_0^{(u)} + \frac{E_0\left(X_1^{(u)} - r \cdot Bv_0^{(u)}\right)}{R - \gamma} \tag{12}$$

where: γ = 1 + relative growth of expected unbiased residual income in periods $t = 1, 2, \ldots, T;\ T \to \infty$

The time series specification of future (expected) unbiased residual income is:

$$E_0\left(X_{\tau+1}^{(u)} - r \cdot Bv_\tau^{(u)}\right) = E_0\left(X_{res,\tau+1}^{(u)}\right) = \gamma \cdot E_0\left(X_{res,\tau}^{(u)}\right) \tag{13}$$

Given *unbiased accounting* and knowing that the company eventually will pursue only 0-NPV projects, assumption (G-5) is now replaced with (G-5′): [5]

(G-5′) The parameter γ incorporates that the company over time increasingly will engage in 0-NPV projects, and in the long run only pursue 0-NPV activities; hence $0 \leq \gamma < 1{,}0$. [6]

In accordance with (G-5′), investors realize that future expected values of residual income given *unbiased* accounting will go towards zero in the long run. This is a reasonable assumption given that competitive market conditions prevail in company input-/output markets, implying that companies in the long run are expected to pursue only 0-NPV activities.

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[5] An exact mapping between T^* in assumption (G-5) and γ in (G-5′) is hard to pinpoint, even though T^* and γ in principle should be positively related. That is, if $E_0\left(X_1^{(u)} - r \cdot Bv_0\right) \neq 0$ and T^* is close in time, γ will have a low value, and vice versa.

[6] In order to avoid an oscillating time series for $E_0\left(X_t^{(u)} - r \cdot Bv_{t-1}^{(u)}\right)$, γ is assumed to be non-negative.

Presuming that investors leave γ unchanged in a valuation setting with financial statements based on conservative accounting, RIV(IDC) will be:

$$V_{0,CB}^{RIV(IDC)} = Bv_0 + \frac{E_0(X_1 - r \cdot Bv_0)}{R-\gamma} =$$

$$= \left(Bv_0^{(u)} - Cb_0\right) + \frac{E_0\left[X_1^{(u)} - \Delta(Cb_1) - r\left(Bv_0^{(u)} - Cb_0\right)\right]}{R-\gamma} \tag{14}$$

Leaving γ unchanged implies the following time series for future expected values of $(X_t - r \cdot Bv_{t-1})$:

$$E_0(X_{t+1} - r \cdot Bv_t) = \gamma \cdot E_0\left[(X_t^{(u)} - \Delta(Cb_t)) - r(Bv_{t-1}^{(u)} - Cb_{t-1})\right] =$$

$$= \gamma \cdot E_0(X_{res,t}^{(u)}) - \gamma \cdot E_0\left[\Delta(Cb_t) - r \cdot Cb_{t-1}\right] \tag{15}$$

The time series hence means that $E_0\left[\Delta(Cb_t) - r \cdot Cb_{t-1}\right]$ goes towards zero as $t \to \infty$. That is, in the long run the conservative bias of residual income is expected to fade away, in principle at the same pace as unbiased residual income fades away over time. This is actually the only permissible time series specification for this measure of "adjusted" bias growth in RIV(IDC), given that (13) holds.[7]

As $V_{0,UB}^{RIV(IDC)}$ in (12) is postulated to be the correct value of owners´ equity, the valuation error caused by accounting conservatism in RIV(IDC) is:

$$Dev_0^{RIV(IDC)} = V_{0,CB}^{RIV(IDC)} - V_{0,UB}^{RIV(IDC)} = \frac{Cb_0(\gamma - 1) - E_0\left[\Delta(Cb_1)\right]}{R-\gamma} \tag{16}$$

(16) shows that the valuation error of RIV(IDC) depends on both the value of Cb_0 and the growth of the conservative bias in the first period. Since $(\gamma - 1) < 0$, the error will be negative for all non-negative values of $E_0\left[\Delta(Cb_1)\right]$, and a stronger growth of the conservative bias in the first period will make the error more negative. Only if $E_0\left[\Delta(Cb_1)\right] < Cb_0(\gamma - 1)$, can the valuation error of RIV(IDC) be positive.

[7] Given the time series specification of unbiased residual income in (13), the time series dynamics of conservatively biased residual income can be written as:

$$E_0(X_{t+1} - r \cdot Bv_t) = \gamma^{\bullet} \cdot E_0(X_t - r \cdot Bv_{t-1}) = \gamma \cdot E_0(\Delta(X_{res,t}^{(u)})) - \gamma^{x} \cdot E_0\left[\Delta(Cb_t) - r \cdot Cb_{t-1}\right] \tag{15´}$$

As $E_0(\Delta(X_{res,t}^{(u)})) \to 0$ when $t \to \infty$, the factor $\gamma^{\bullet}$ can only be equal to γ if $\gamma^{x} = \gamma$, and hence $\gamma^{\bullet} = \gamma$.

Combining (16) with the time series specification implied by (15) gives the following “conservative irrelevance” proposition:

Proposition 2: Given the “clean surplus relation” (G-1), a constant relative growth $(\gamma-1)$ of residual income given *unbiased* accounting (G-5´), RIV(IDC) accommodates conservative accounting if (and only if) $E_0[\Delta(Cb_t)] = E_0[Cb_{t-1}(\gamma-1)]$, for $t \geq 1$.

The information dynamics constrained RIV model is hence unaffected by conservative accounting if the growth of the conservative bias in period t coincides with the growth of unbiased residual income in the same period. A negative growth of the conservative bias equal to $Cb_{t-1}(\gamma-1)$ in the first period implies that future values of residual income will be positively biased, and exactly compensate for the negative bias of the book value of owners´ equity at the valuation date.

5. Conservative Accounting in AEG Valuation Modeling

Three specifications of AEG valuation modeling will be analysed in this section − the unconstrained model AEG*, a terminal value constrained model, AEG(TVC), and an information dynamics constrained model, AEG(IDC). Parallel to the analyses in the previous section, the terminal value is set to zero in the terminal value constrained model, and the abnormal earnings growth is assumed to be growing at a constant rate in the information dynamics constrained model.

As in the evaluation of the RIV models, the impact of conservative accounting will be assessed in relation to values of owners´ equity in a setting with unbiased accounting. Likewise all evaluations presume that no “undoing” of the conservative bias of forecasted accounting numbers takes place.

5.1. *The unconstrained AEG valuation model*

Given *unbiased* accounting, the unconstrained AEG model follows straightforwardly from (AEG*):

$$V_{0,UB}^{AEG^*} = \frac{E_0\left(X_1^{(u)}\right)}{r} + \sum_{\tau=1}^{T^*-1}\frac{E_0\left(X_{\tau+1}^{(u)} + r\cdot Div_\tau - X_\tau^{(u)}\cdot R\right)/r}{R^\tau} +$$

$$+ \frac{E_0\left(P_{T*} + Div_{T*} - X_{T*}^{(u)}\cdot R/r\right)}{R^{T*}} \qquad (17)$$

With conservative accounting, the unconstrained AEG model also follows directly from (AEG*), and replacing X_t with $\left[X_t^{(u)} - \Delta(Cb_t)\right]$ one obtains:

$$V_{0,CB}^{AEG^*} = \frac{E_0\left(X_1^{(u)} - \Delta(Cb_1)\right)}{r} + $$
$$+ \sum_{\tau=1}^{T^*-1} \frac{E_0\left[\left(X_{\tau+1}^{(u)} - \Delta(Cb_{\tau+1})\right) + r \cdot Div_\tau - \left(X_\tau^{(u)} - \Delta(Cb_\tau)\right) \cdot R\right]/r}{R^\tau} +$$
$$+ \frac{E_0\left[P_{T^*} + Div_{T^*} - \left(X_{T^*}^{(u)} - \Delta(Cb_{T^*})\right) \cdot R/r\right]}{R^{T^*}} \tag{18}$$

The valuation bias due to accounting conservatism is now:

$$Dev_0^{AEG^*} = V_{0,CB}^{AEG^*} - V_{0,UB}^{AEG^*} =$$
$$= \frac{E_0\left(-\Delta(Cb_1)\right)}{r} + \sum_{\tau=1}^{T^*-1} \frac{E_0\left[-\Delta(Cb_{\tau+1}) + \Delta(Cb_\tau) \cdot R\right]/r}{R^\tau} +$$
$$+ \frac{E_0\left(\Delta(Cb_{T^*}) \cdot R/r\right)}{R^{T^*}} = 0 \tag{19}$$

As a parallel result to *Observation 2* for the RIV* model, we have:

Observation 3: The unconstrained valuation model AEG* is unaffected by accounting conservatism.

Given the axiomatic derivation of AEG*, *Observation 3* is well-known in the accounting literature. Subtracting and adding the terms $E_0\left[\left(\Delta(Cb_t)/r\right)/R^{t-1}\right]$ (in addition to $E_0\left[\left(X_t^{(u)}/r\right)/R^{t-1}\right]$) around future dividends discounted to a present value as in (18), cannot affect the value of owners´ equity.[8]

5.2. *The terminal value constrained AEG valuation model*

In line with *Observation 1*, the expected terminal value in (AEG*) is equal to 0 with *unbiased* accounting if $T \geq (T^* + 1)$. Hence, in order for a terminal value constrained AEG model to have no valuation error when the accounting is unbiased, the horizon point in time is

[8] Note that the "clean surplus relation" of accounting (assumption (G-1)) is not required for the unconstrained AEG model to be unaffected by accounting conservatism.

set to T = (T* + 1).[9] With this value of T, the terminal value constrained models are as follows:

$$V_{0,UB}^{AEG(TVC)} = \frac{E_0\left(X_1^{(u)}\right)}{r} + \sum_{\tau=1}^{T^*}\frac{E_0\left(X_{\tau+1}^{(u)} + r \cdot Div_\tau - X_\tau^{(u)} \cdot R\right)/r}{R^\tau} \tag{20}$$

$$V_{0,CB}^{AEG(TVC)} = \frac{E_0\left(X_1\right)}{r} + \sum_{\tau=1}^{T^*}\frac{E_0\left(X_{\tau+1} + Div_\tau \cdot r - X_\tau \cdot R\right)/r}{R^\tau} =$$

$$= \frac{E_0\left(X_1^{(u)} - \Delta\left(Cb_1\right)\right)}{r} +$$

$$+ \sum_{\tau=1}^{T^*}\frac{E_0\left[\left(X_{\tau+1}^{(u)} - \Delta\left(Cb_{\tau+1}\right)\right) + r \cdot Div_t - \left(X_\tau^{(u)} - \Delta\left(Cb_\tau\right)\right)\cdot R\right]/r}{R^\tau} \tag{21}$$

The difference between $V_{0,CB}^{AEG(TVC)}$ and $V_{0,UB}^{AEG(TVC)}$ is then:

$$Dev_0^{AEG(TVC)} = \frac{E_0\left(-\Delta\left(Cb_1\right)\right)}{r} + \sum_{\tau=1}^{T^*}\frac{E_0\left[-\Delta\left(Cb_{\tau+1}\right) + \Delta\left(Cb_\tau\right)\cdot R\right]/r}{R^\tau} \tag{22}$$

(19) together with *Observation 3* in subsection 5.1 showed that $Dev_0^{AEG^*} = 0$, in turn implying that:

$$Dev_0^{AEG(TVC)} = \frac{E_0\left[-\Delta\left(Cb_{T^*+1}\right) + \Delta\left(Cb_{T^*}\right)\cdot R\right]/r}{R^{T^*}} - \frac{E_0\left[\Delta\left(Cb_{T^*}\right)\cdot R\right]/r}{R^{T^*}} =$$

$$= -\frac{E_0\left[\Delta\left(Cb_{T^*+1}\right)\right]/r}{R^{T^*}} \tag{22′}$$

The valuation error of the terminal value constrained AEG model is thus equal to the negative present value of the capitalized bias growth in period (T*+ 2). This gives us the following "conservative irrelevance" proposition:

Proposition 3: Given only 0-NPV activities after τ = T* (G-5), AEG(TVC) with T = (T* + 1) accommodates conservative accounting if (and only if) $E_0\left[\Delta\left(Cb_{T^*+1}\right)\right] = 0$.

[9] Given knowledge about the characteristics of AEG* as expressed in *Observation 1* (section 2), setting T = (T* + 1) in AEG(TVC) would be a natural choice.

Knowing that the "missing" terminal value in $V_{0,CB}^{AEG,TVC}$ is $E_0\left[P_{T^*+1} + Div_{T^*+1} - \left(X_{T^*+1}^{(u)} - \Delta\left(Cb_{T^*+1}\right)\right)\cdot R/r\right]/R^{T^*+1}$, and that the "clean surplus relation" implies that this can be rewritten as $E_0\left[B_{T^*}^{(u)} - \left(X_{T^*+1}^{(u)} + \Delta\left(Cb_{T^*+1}\right)\cdot R\right)/r\right]/R^{T^*+1}$,[10] it is easy to see that the terminal value drops out if $\Delta\left(Cb_{T^*+1}\right) = 0$. Notably this also means that $V_{0,CB}^{AEG,TVC}$ and $V_{0,CB}^{AEG^*}$ coincide when $\Delta\left(Cb_{T^*+1}\right) = 0$.

5.3. *The information dynamics constrained AEG valuation model*

In line with Ohlson & Juettner-Nauroth (2005) and given *unbiased* accounting, the information dynamics constrained AEG valuation model – denoted AEG(IDC) – is specified as:

$$V_{0,UB}^{AEG(IDC)} = \frac{E_0\left(X_1^{(u)}\right)}{r} + \frac{E_0\left[X_2^{(u)} + r\cdot Div_1 - X_1^{(u)}\cdot R\right]/r}{R-\gamma'} \tag{23}$$

where: γ' = 1 + relative change of expected unbiased abnormal earnings growth in periods t = 1, 2, …,T; $T \rightarrow \infty$

Given *unbiased* accounting and knowing that the company will pursue only 0-NPV projects in the long run, assumption (G-5) is now replaced with (G-5´´):

(G-5´´) The parameter γ' incorporates that the company over time increasingly will engage in 0-NPV projects, and in the long run only pursue 0-NPV activities; hence $0 \le \gamma' < 1{,}0$.

Provided that the "clean surplus relation" holds, we know from (2) that:

$$E_0\left[X_{t+2}^{(u)} + r\cdot Div_{t+1} - X_{t+1}^{(u)}\cdot R\right] = E_0\left(X_{res,t+2}^{(u)} - X_{res,t+1}^{(u)}\right) \tag{24}$$

In the analysis of the information dynamics constrained RIV model it was assumed that $E_0\left(X_{res,t+1}^{(u)}\right) = \gamma\cdot E_0\left(X_{res,t}^{(u)}\right)$, in turn implying:

$$E_0\left(X_{t+2}^{(u)} + r\cdot Div_{t+1} - X_{t+1}^{(u)}\cdot R\right) - E_0\left(X_{t+1}^{(u)} + r\cdot Div_t - X_t^{(u)}\cdot R\right) =$$

$$= E_0\left[\gamma\cdot\left(X_{res,t+1}^{(u)}\right) - \gamma\cdot\left(X_{res,t}^{(u)}\right)\right] - E_0\left(X_{res,t+1}^{(u)} - X_{res,t}^{(u)}\right) =$$

[10] Cf. AEG* and expression (3) in section 2.

$$= (\gamma - 1) \cdot E_0\left(X_{t+1}^{(u)} + r \cdot Div_t - X_t^{(u)} \cdot R\right) \tag{25}$$

(25) means that values of abnormal earnings growth in AEG(IDC) change at the rate (γ – 1) over time, i.e. the same rate as for residual income in the information dynamics constrained RIV model. Formally we have:

Observation 4: Given the "clean surplus relation" of accounting (G-1), an *unbiased* accounting regime and 0-NPV activities as specified in (G-5´), the relative growth of $E_0\left[X_{t+1}^{(u)} + r \cdot Div_t - X_t^{(u)} \cdot R\right]$ and $E_0\left(X_t^{(u)} - r \cdot Bv_{t-1}^{(u)}\right)$ are the same; i.e. $\gamma' = \gamma$.

Presuming that investors use γ in AEG(IDC) also when the accounting is conservative, the value of owners´ equity becomes:

$$V_{0,CB}^{AEG(IDC)} = \frac{E_0(X_1)}{r} + \frac{E_0\left[X_2 + r \cdot Div_1 - X_1 \cdot R\right]/r}{R - \gamma} =$$

$$= \frac{E_0\left[X_1^{(u)} - \Delta(Cb_1)\right]}{r} +$$

$$+ \frac{E_0\left[X_2^{(u)} - \Delta(Cb_2) + r \cdot Div_1 - \left(X_1^{(u)} - \Delta(Cb_1)\right) \cdot R\right]/r}{R - \gamma} \tag{26}$$

Leaving γ unchanged in a setting with conservative accounting now means that:

$$E_0\left(X_{res,t+2} - X_{res,t+1}\right) = \gamma \cdot E_0\left(X_{res,t+1} - X_{res,t}\right) =$$

$$= \gamma \cdot E_0\left[\left(X_{t+1}^{(u)} - r \cdot Bv_t^{(u)}\right) - \left(X_t^{(u)} - r \cdot Bv_{t-1}^{(u)}\right)\right]$$

$$- \gamma \cdot E_0\left[\left(\Delta(Cb_{t+1}) - r \cdot Cb_\tau\right) - \left(\Delta(Cb_\tau) - r \cdot Cb_{\tau-1}\right)\right] \tag{27}$$

As $0 \le \gamma < 1{,}00$, the expected change in the "adjusted" conservative bias growth $E_0\left[\left(\Delta(Cb_{t+1}) - r \cdot Cb_t\right) - \left(\Delta(Cb_t) - r \cdot Cb_{t-1}\right)\right]$ goes towards zero in the long run. Given that expression (25) holds, this is actually the only permissible time series specification for this measure of "adjusted" bias growth in AEG(IDC).

The valuation error due to accounting conservatism in AEG(IDC) is now:

$$Dev_0^{AEG(IDC)} = V_{0,CB}^{AEG(IDC)} - V_{0,UB}^{AEG(IDC)} =$$

$$= \frac{E_0[-\Delta(Cb_1)]}{r} - \frac{E_0[\Delta(Cb_2) - \Delta(Cb_1)\cdot R]/r}{R-\gamma} =$$

$$= \frac{E_0[\Delta(Cb_1)]\cdot\gamma - E_0[\Delta(Cb_2)]}{r(R-\gamma)} \tag{28}$$

Expression (28) shows that the error caused by conservative accounting in the information dynamics constrained AEG model depends on the expected growth of the conservative bias in the first and the second period. A necessary condition for $Dev_0^{AEG(IDC)} = 0$ is now that $E_0[\Delta(Cb_2)] = E_0[\Delta(Cb_1)]\cdot\gamma$, since the numerator on the RHS of (28) then becomes zero. Combining this result with the required time series for the "adjusted" conservative bias growth implied by (27), the following "conservative irrelevance" proposition is obtained:

Proposition 4: Given the "clean surplus relation" (G-1) and a constant relative periodic change $(\gamma - 1)$ of abnormal earnings growth given *unbiased* accounting (G-5´´), AEG(IDC) accommodates conservative accounting if (and only if) $E_0[\Delta(Cb_{t+1})] = E_0[\Delta(Cb_t)]\cdot\gamma,\ t \geq 1.$

Proposition 4 allows for some benchmark observations. First, if there is no growth in the conservative bias in future periods (ie. $E_0[\Delta(Cb_{t+1})] = E_0[\Delta(Cb_t)] = 0$), the valuation error of AEG(IDC) is zero. Second, if both $E_0[\Delta(Cb_1)]$ and $E_0[\Delta(Cb_2)]$ are positive but $E_0[\Delta(Cb_{t+1})] < E_0[\Delta(Cb_t)]$, AEG(IDC) can be unbiased. This would be possible if the negative bias of $E_0(X_1)/r$ is fully "counter-balanced" by the positive bias of $E_0[X_2 + r\cdot Div_1 - X_1\cdot R]/r(R-\gamma)$ in (26) above. The result indicates that the AEG(IDC) model can be more robust to accounting conservatism than RIV(AEG), as the latter model cannot accommodate a positive future growth of the conservative bias (cf. Proposition 2, subsection 4.3).

6. AEG versus RIV Models when the Accounting is Conservative

Propositions 1 to 4 above provide conditions for constrained RIV and AEG valuation modeling to be unaffected by conservative accounting. A complementing question is now whether it would be possible to assess whether RIV or AEG modeling is more or less distorted by accounting conservatism. Or, stated somewhat differently, given that an accounting regime is conservatively biased – which type of modeling is associated with the smallest valuation errors?

Regarding the unconstrained models RIV* and AEG*, a first result is obvious. As both models are unaffected by accounting conservatism, no ranking of these models is possible. On the other hand, all constrained RIV and AEG models are potentially affected by valuation errors due to conservative accounting, as indicated by Propositions 1 to 4. In order to settle which type of modeling that is associated with the smallest errors, comparisons between these models are carried out in the following two sub-sections.

6.1. ***AEG versus RIV – the terminal value constrained models***

The valuation error associated with the terminal value constrained RIV model is $-E_0(Cb_{T^*})/R^{T^*}$ according to (11) above. Given conservatively biased accounting, this error is non-positive. As the sign of the valuation error of the terminal value constrained AEG model – $Dev_0^{AEG(TVC)}$ in (22′) above – is indeterminate, the following two conditions have to hold for AEG(TVC) to be better than RIV(TVC):

$$Dev_0^{AEG(TVC)} = -\frac{E_0[\Delta(Cb_{T^*+1})]}{r\cdot R^{T^*}} > -\frac{E_0(Cb_{T^*})}{R^{T^*}} \qquad (29.a)$$

and

$$Dev_0^{AEG(TVC)} = -\frac{E_0[\Delta(Cb_{T^*+1})]}{r\cdot R^{T^*}} < \frac{E_0(Cb_{T^*})}{R^{T^*}} \qquad (29.b)$$

Solving (29.a) and (29.b) gives the following (necessary and sufficient) conditions for the AEG model to be more accurate than the corresponding RIV model:

$$E_0[Cb_{T^*}\cdot r-\Delta(Cb_{T^*+1})]>0 \qquad (29.a′)$$

and

$$E_0[Cb_{T^*}\cdot r+\Delta(Cb_{T^*+1})]>0 \qquad (29.\ b′)$$

The valuation error associated with AEG(TVC) is hence smaller than the valuation error for RIV(TVC) if the expected growth of the conservative bias in period (T^*+1) is larger than $-E_0(Cb_{T^*})\cdot r$, but smaller than $E_0(Cb_{T^*})\cdot r$. The following proposition follows:

Proposition 5: Given the "clean surplus relation" (G-1), only 0-NPV activities after $\tau = T^*$ (G-5), the error for AEG(TVC) is smaller than the error for RIV(TVC) if (and only if) $-E_0(Cb_{T*}) \cdot r < E_0[\Delta(Cb_{T*+1})] < E_0(Cb_{T*}) \cdot r$. Conversely, if $E_0[\Delta(Cb_{T*+1})] < -E_0(Cb_{T*}) \cdot r$ or $E_0[\Delta(Cb_{T*+1})] > E_0(Cb_{T*}) \cdot r$, RIV(TVC) is superior to AEG(TVC).

The terminal value constrained AEG model works better in situations with more modest changes of the accounting bias in period T^*+1. As T^*+1 is the first period in the company steady state, one might expect that $E_0[\Delta(Cb_{T*+1})] = E_0(Cb_{T*}) \cdot g_{ss}$, with g_{ss} being a constant growth rate. Given that $-r < g_{ss} < r$, AEG(TVC) would then be affected by smaller valuation errors than RIV(TVC). However, if $g_{ss} < -r$ (not an unrealistic assumption for more mature companies, or companies extracting natural resources with limited economic lives), the terminal value constrained RIV model will be more accurate than the corresponding AEG model.

6.2. ***AEG valuation versus RIV – the information dynamics constrained models***

A comparison between the information dynamics constrained RIV and AEG models have to be consistent with *Proposition 2* (subsection 4.3) and *Proposition 4* (subsection 5.3). This turns out to be more complex than to just make a comparison between $Dev_0^{RIV(IDC)}$ and $Dev_0^{AEG(IDC)}$, as these errors are conditioned on model-specific time series of the "adjusted" conservative bias growth, or changes in the "adjusted" conservative bias growth. That is, $Dev_0^{RIV(IDC)}$ is conditioned on

$$E_0[\Delta(Cb_{t+1}) - r \cdot Cb_t] = \gamma \cdot E_0[\Delta(Cb_t) - r \cdot Cb_{t-1}], \qquad (30)$$

while $Dev_0^{AEG(IDC)}$ is conditioned on

$$\begin{aligned} &E_0[(\Delta(Cb_{t+2}) - r \cdot Cb_t) - (\Delta(Cb_{t+1}) - r \cdot Cb_t)] = \\ &= \gamma \cdot E_0[(\Delta(Cb_{t+1}) - r \cdot Cb_t) - (\Delta(Cb_t) - r \cdot Cb_{t-1})]. \qquad (31) \end{aligned}$$

As shown in Ohlson (2005), the time series specification of the "adjusted" conservative bias growth in (30) is consistent with the time series dynamics of the change in this conservative bias growth in (31), but the converse does not hold. Hence we have:

Proposition 6: Given that RIV(IDC) accommodates conservative accounting, AEG(IDC) also accommodates conservative accounting. The converse is not true.

Proposition 6 means that both RIV(IDC) and AEG(IDC) accommodate accounting conservatism if, for example, $E_0[\Delta(Cb_{t+1})] = E_0[\gamma \cdot Cb_{t-1} \cdot (\gamma - 1)] <$
$< E_0[Cb_{t-1} \cdot (\gamma - 1)] = E_0[\Delta(Cb_t)]$, ie. a decreasing conservative bias over time where the decrease in period t + 1 is smaller than the decrease in period t. However, if there is an increasing conservative bias in the sense that $E_0[\Delta(Cb_{t+1})] = E_0[\Delta(Cb_t)] \cdot \gamma$, only the AEG model is able to provide the correct value of owners´ equity. Another example would be a "no growth" scenario, i.e. $E_0[\Delta(Cb_\tau)] = 0$ for $t \geq 1$. Referring back to Proposition 2 and Proposition 4, it is easily recognized that only AEG(IDC) can accommodate a scenario of this kind.

A particularly interesting case is a steady state scenario, with only 0-NPV activities and a constant relative growth of the conservative bias over time. Accounting numbers are in general postulated to grow at the same pace ($= g_{ss}$) in a scenario of this kind, and hence $E_0[\Delta(Cb_{t+1})] = E_0[Cb_t(1 + g_{ss}) \cdot g_{ss}] = E_0[\Delta(Cb_t)(1 + g_{ss})]$. Setting $g_{ss} = \gamma - 1$, it is easily seen that both Proposition 2 and Proposition 4 would be fulfilled, and hence that both RIV(IDC) and AEG(IDC) give the correct equity value. Interestingly, as $E_0(X_t^{(u)} - r \cdot Bv_{t-1}^{(u)}) = 0$ in this scenario, the time series for $E_0(X_t - r \cdot Bv_{t-1})$ is then solely governed by the time series specification for $E_0[\Delta(Cb_t) - r \cdot Cb_{t-1}]$ in the RIV model. Likewise, the time series for $E_0[(X_{t+1} - r \cdot Bv_t) - (X_t - r \cdot Bv_{t-1})]$ would solely be governed by the time series specification for $E_0[(\Delta(Cb_{t+1}) - r \cdot Cb_t) - (\Delta(Cb_t) - r \cdot Cb_{t-1})]$ in the AEG model. This implies that g_{ss} in a steady state does not have to be equal to $(\gamma - 1)$,[11] and as long as $-1{,}00 \leq (1 + g_{ss}) < R$ both RIV(IDC) and AEG(IDC) will work.

Proposition 6 might give the impression that AEG(IDC) dominates RIV(IDC) regarding the ability to accommodate accounting conservatism.[12] However, this impression is somewhat deceptive. AEG(IDC) allows for positive future growth in $E_0(Cb_t)$, but as stated in Proposition 4 only as long as $E_0[\Delta(Cb_{t+1})] = E_0[\Delta(Cb_t)] \cdot \gamma$. Since $0 \leq \gamma < 1{,}0$ this means that

[11] Cf. subsection 4.3, footnote 7 in particular.
[12] Cf. also the analysis in Ohlson & Gao (2006), pp. 54-56, proposing that AEG(IDC) in general is more versatile than RIV(IDC).

$E_0[\Delta(Cb_{t+1})] \to 0$ as t → ∞, ie. in the long run the conservative bias $E_0[Cb_t] \to K$, K being some non-negative constant. The virtue of this time series for $E_0[Cb_t]$ is rather moot. First, it is by no means clear that the growth of $E_0[\Delta(Cb_{t+1})]$ should be governed by the parameter γ (specifying the time series of unbiased residual income). Second, a constant conservative bias $E_0[Cb_t]$ means that $E_0(Cb_t)/E_0(Bv_t) \to 0$ when t → ∞ if the long run growth of owners´ equity is positive, and $E_0(Cb_t)/E_0(Bv_t) \to \infty$ if this growth is negative. As one rather would expect that $E_0(Cb_t)/E_0(Bv_t) \to k$, $0 < k < \infty$, in the long run (cf. Runsten, 1998, ch. 5, and Skogsvik, 1998) neither alternative appears to be realistic. Only in a steady state setting with $g_{ss} = 0$ would it be possible for $E_0(Cb_t)/E_0(Bv_t) \to k$ as t → ∞ with the required time-series dynamics for $E_0[\Delta(Cb_{t+1})]$; ie. the advantage of AEG(IDC) would then be constrained to zero-growth steady states.

8. Concluding remarks

In the quest for more useful equity valuation models, both residual income and abnormal earnings growth modeling stand out as worthwhile contributions. As neither RIV nor AEG valuation has much to say about any required accounting principles, one might expect that "anything goes" in both types of modeling. However, this only holds for the unconstrained model specifications. In terminal value and information dynamics constrained models, the magnitude and/or variations of the accounting conservative bias typically create valuation errors.

Conservative accounting causes the book value of owners´ equity to be negatively biased, and accounting earnings to be negatively or positively biased. In RIV modeling this means that the "valuation anchor" – the book value of owners´ equity – will be negatively biased, but that future residual income can be either negatively or positively biased. The bias of the "valuation anchor" in AEG modeling – capitalized next period earnings – depends on the growth of the conservative bias in the first period. If this is positive, the "valuation anchor" will be negatively biased, and vice versa. However, the bias of earnings in the first period has an opposite effect on the abnormal earnings growth for the following period.

It has been shown that both terminal value and information dynamics constrained RIV and AEG models allow for conservative accounting under certain conditions. In principle, all of these conditions are in line with the notion of the "cancelling error theorem" (Ohlson, 2005), in the sense that biases in future residual income compensate for the negative bias of owners' equity at t = 0 in RIV modeling, while biases in future earnings cancel out in the summation of capitalized earnings and capitalized abnormal earnings growth in AEG modeling.

In order to further analyse the "conservative irrelevance" propositions put forth in the paper, differences between the valuation errors of comparable models have been evaluated. Regarding the constrained model specifications, it has been found that:

- The terminal value constrained AEG valuation model is superior to the corresponding RIV model if the expected conservative bias at the horizon point in time is positive and the growth of the conservative bias is in the interval $\left] -E_0(Cb_{T^*}) \cdot r, E_0(Cb_{T^*}) \cdot r \right[$ in period (T^*+1) (*Proposition 5*, subsection 6.1).
- Provided that the information dynamics constrained RIV model accommodates conservative accounting, the information dynamics constrained AEG model will also allow for conservative accounting, but the opposite does not hold (*Proposition 6*, subsection 6.2).

The first result is closely related to "Proposition II" in Ohlson (2005).[13] However, Ohlson´s proposition is based on a more stylized setting, where a company goes towards a steady-state setting with $0 < g_{ss} < r$ and $E_0[\Delta(Cb_{t+1})] = E_0[Cb_t] \cdot g_{ss}$. This means that $0 \leq E_0[\Delta(Cb_{t+1})] < E_0[Cb_t] \cdot r$, in turn implying that Ohlson´s proposition is a special case of *Proposition 5* in this paper. The second result is in line with "Proposition III" in Ohlson (2005).[14]

Compared to previous research – in particular Ohlson & Juettner-Nauroth (2005), Ohlson (2005) and Ohlson & Gao (2006) – the paper provides a sharper assessment of the sensitivity to accounting conservatism in RIV and AEG modeling. It has for example been shown that:

- AEG(TVC) is affected by smaller valuation errors than RIV(TVC) as long as the growth of the conservative bias in period T* + 1 is not too extreme. Given a steady state setting with non-negative growth in period T*+1, AEG(TVC) dominates RIV(TVC). However, if there is negative growth less than $-E_0(Cb_{T^*}) \cdot r$, RIV(TVC) will be affected by smaller valuation errors than AEG(TVC).
- Given a plausible time-series dynamics of residual income given *unbiased* accounting, RIV(IDC) allows for conservative accounting if $E_0(Cb_\tau) \to 0$ as $\tau \to \infty$, while AEG(IDC) allows for conservative accounting if $E_0(Cb_\tau) \to K \geq 0$, as $\tau \to \infty$. Hence

[13] Cf. p. 336, Ohlson (2005).
[14] Cf. p. 339, Ohlson (2005).

RIV(IDC) can be more valid for companies characterized by negative growth in the long run, while AEG(IDC) can be more valid for companies characterized by zero growth in the long run. Also, RIV(IDC) and AEG(IDC) work equally well in a company steady state where γ is replaced by $(1+g_{ss})$ in the models.

The choice of a particular valuation model in empirical research is often driven by a desire for both modeling validity and parsimony. The constrained RIV and AEG models are supposed to be helpful in accounting-based valuation with limited access to forecasts of accounting numbers. In this regard, RIV(IDC) only requires the assessment of Bv_0 and the prediction of $E_0(X_1)$, while AEG(IDC) requires predictions of $E_0(X_1), E_0(Div_1)$ and $E_0(X_2)$. The AEG model hence requires additional forecasts – $E_0(Div_1)$ at the end of the first period and $E_0(X_2)$ for the second period – as compared to the RIV model. One might argue that this creates an "unfair" advantage for the AEG model, and that AEG(IDC) rather should be compared with the following specification of RIV(IDC):

$$V_{0,CB}^{RIV(IDC)'} = Bv_0 + \frac{E_0(X_1 - r \cdot Bv_0)}{1+r} + \frac{E_0(X_2 - r \cdot Bv_1)}{(1+r)(R-\gamma)} \tag{32}$$

Analyzing $V_{0,CB}^{RIV(IDC)'}$ in the same manner as $V_{0,CB}^{RIV(IDC)}$ in subsection 4.3, one finds that RIV(IDC)´ accommodates conservative accounting if $E[\Delta(Cb_t)] = E_0[Cb_{t-1}(\gamma-1)]$ for $t \geq 2$ (instead of $t \geq 1$ for $V_{0,CB}^{RIV(IDC)}$). The new model specification permits any value of $E_0[\Delta(Cb_1)]$, meaning that the applicability of this information dynamics constrained RIV model has improved. In a setting where T* = 1 (and consequently γ being replaced by $(1+g_{ss})$ on the RHS of (32)), $V_{0,CB}^{RIV(IDC)'}$ would actually be equal to $V_{0,UB}^{RIV(IDC)}$; ie. without error. Proposition 4 shows that AEG(IDC) would not generate an error-free value in a setting of this kind unless $E_0[\Delta(Cb_2)] = E_0[\Delta(Cb_1)] \cdot (1+g_{ss})$.

Appendix: Proof that $\mathbf{Dev_0^{RIV(*)} = 0}$

Given the "clean surplus relation" of accounting, $\mathrm{Dev}_0^{\mathrm{RIV}(*)}$ in (8) can be written as:

$$
\begin{aligned}
\mathrm{Dev}_0^{\mathrm{RIV}(*)} &= -\mathrm{Cb}_0 + \sum_{\tau=1}^{T^*} \frac{E_0\left[\left(\mathrm{Cb}_{\tau-1} - \mathrm{Cb}_\tau\right) + r \cdot \mathrm{Cb}_{\tau-1}\right]}{R^\tau} + \frac{E_0\left(\mathrm{Cb}_{T^*}\right)}{R^{T^*}} = \\
&= -\mathrm{Cb}_0 + \sum_{\tau=1}^{T^*} \frac{E_0\left(\mathrm{Cb}_{\tau-1}\right) \cdot R}{R^\tau} - \sum_{\tau=1}^{T^*} \frac{E_0\left(\mathrm{Cb}_\tau\right) \cdot R}{R^{\tau+1}} + \frac{E_0\left(\mathrm{Cb}_{T^*}\right)}{R^{T^*}} = \\
&= \left(-\mathrm{Cb}_0 + \frac{\mathrm{Cb}_0 \cdot R}{R}\right) + \sum_{\tau=2}^{T^*} \frac{E_0\left(\mathrm{Cb}_{\tau-1}\right) \cdot R}{R^\tau} - \sum_{\tau=2}^{T^*+1} \frac{E_0\left(\mathrm{Cb}_{\tau-1}\right) \cdot R}{R^\tau} + \\
&\quad + \frac{E_0\left(\mathrm{Cb}_{T^*}\right)}{R^{T^*}} = \\
&= \frac{E_0\left(\mathrm{Cb}_{T^*}\right) \cdot R}{R^{T^*+1}} - \frac{E_0\left(\mathrm{Cb}_{T^*}\right)}{R^{T^*}} = 0
\end{aligned}
\tag{A.1}
$$

Hence, $\mathrm{Dev}_0^{\mathrm{RIV}(*)} = 0$ and the unconstrained RIV model is unaffected by accounting conservatism.

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