Accounting and Business Valuation

Professor John O'Hanlon, BA, MA, FCA, Cert. Ed.

Department of Accounting and Finance
Lancaster University Management School
Lancaster University

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The supporting paper and the eight associated published journal articles are submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy by published work of Lancaster University.

Contents of Supporting Paper

1. Introduction

I hold an MA in Accounting and Finance from Lancaster University (1984). From 1984 to 2018, I was a full-time member of the academic staff of Lancaster University's Department of Accounting and Finance. From 2018 to September 2020, I was a part-time member of the academic staff of that department. I am now an Emeritus Professor of Accounting of Lancaster University.

The supporting paper and the eight associated published journal articles are submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy (PhD) by published work of Lancaster University. The published papers relate to three sub-areas in the broad field of Accounting and Business Valuation: (i) residual-income-based valuation, (ii) implied cost of capital and (iii) accounting for credit-loss impairment. Of the eight papers, three are sole-authored and five are co-authored. In selecting my papers for submission, I have excluded papers that have drawn on PhD theses that I have supervised.

For each of the five co-authored papers submitted, my summary of the paper includes reference to my assessment of the relative contributions of myself and my co-author(s). In the case of each co-author, I have a communication from the co-author confirming that he/she agrees with that assessment. Generally, it can be assumed that, for each of the papers submitted, the contribution of each author was approximately equal. In all cases, I had significant involvement in the research design, data analysis (where applicable) and drafting of the paper.

Section 2 of this supporting paper lists the eight papers submitted, together with citation information, journal-quality indicators and the names of co-authors where applicable. Section 3 includes, for each of the three sub-areas in which papers are submitted, consideration of the context for the papers submitted within that sub-area, a summary and discussion of each of the papers submitted within that sub-area, a review of the current state of knowledge and research in that sub-area, and comment on the location within that sub-area of the papers submitted. Section 4 concludes. Appendix 1 provides a full list of my publications, which may be helpful in situating the papers submitted within the overall body of my research. Appendix 2 contains an unpublished paper that is provided for information in relation to two of the published papers that are submitted.

2. List of Papers Submitted, Citations and Journal Rankings

I submit eight published papers in the following three sub-areas in the broad field of Accounting and Business Valuation.

(i) Residual-income-based valuation (5 papers);

(ii) Implied cost of capital (1 paper);

(iii) Accounting for credit-loss impairment (2 papers).

The table below lists, for each of the eight papers submitted, the title of the paper, the journal in which it was published, a link to the paper, the publication date, co-author(s) where applicable, Google Scholar citations as at August 2020, and the CABS ranking of the journal in which the paper was published. It also provides some additional information in respect of three papers. The last two rows of the table give my total Google Scholar citations and my h-index as at August 2020.

Summary of Papers Submitted for the Award of PhD by Published Work: John O'Hanlon 'Accounting and Business Valuation'

The eight published journal articles submitted for the award of PhD are listed below. The articles are available in the journals in which they were published.

	Papers submitted by sub-area	**Co-author(s)**	**Google Scholar citations (August 2020)**	**CABS ranking of journal (2018)**	**Notes**
	Residual-income-based valuation				
1.	Return/earnings regressions and residual income: Empirical evidence. *Journal of Business Finance and Accounting*, **1995**, 22 (1): 53-66. https://doi.org/10.1111/j.1468-5957.1995.tb00671		19	3	Algebraic derivations in an unpublished working paper by the author are referenced by papers 1 and 2. That working paper (O'Hanlon 1994) is provided for information in Appendix 2.
2.	The time series properties of the components of clean surplus earnings: U.K. evidence. *Journal of Business Finance and Accounting*, 1996, 23 (2): 159-183. https://doi.org/10.1111/j.1468-5957.1996.tb00904		24	3	
3.	Wall Street's contribution to management accounting: The Stern Stewart EVA financial management system. *Management Accounting Research*, **1998**, 9 (4): 421-444. https://www.sciencedirect.com/science/article/pii/S1044500598900890?via%3Dihub	K. Peasnell	297	3	
4.	Residual income and value-creation: The missing link. *Review of Accounting Studies*, **2002**, 7 (2-3): 229-245. https://link.springer.com/article/10.1023/A:1020230203952	K. Peasnell	113	4	
5.	Residual income valuation: Are inflation adjustments necessary? *Review of Accounting Studies*, **2004**, 9 (4): 375-398. https://link.springer.com/article/10.1007/s11142-004-7789-3	K. Peasnell	44	4	

	Papers submitted by sub-area	Co-author(s)	Google Scholar citations (August 2020)	CABS ranking of journal (2018)	Notes
	Implied cost of capital				
6.	Estimating the equity risk premium using accounting fundamentals. *Journal of Business Finance and Accounting*, **2000**, 27 (9-10): 1051-1083. https://doi.org/10.1111/1468-5957.00346	A. Steele	131	3	This paper was submitted by Professor Steele in an application for a PhD by published work from the University of Warwick. Professor Steele and I agreed in correspondence that our contributions to the paper were approximately equal.
	Accounting for credit-loss impairment				
7.	Did loan-loss provisioning by U.K. banks become less timely after implementation of IAS 39? *Accounting and Business Research*, **2013**, 43 (3): 225-258. https://www.tandfonline.com/doi/full/10.1080/00014788.2013.747260		22	3	
8.	Reflections on the development of the FASB's and IASB's expected-loss methods of accounting for credit losses. *Accounting and Business Research*, **2019**, 49 (6): 682-725. https://www.tandfonline.com/doi/full/10.1080/00014788.2018.1526665	N. Hashim and W. Li	1	3	
	Total number of citations for papers listed above		651		
	Other citation information for John O'Hanlon:				
	Total Google Scholar citations		1972		
	h-index		23		

3. Papers Submitted: Summaries and Context

3.1 Introduction

This section presents the eight papers submitted and related information within three subsections, each of which relates to a sub-area of literature within the broad area of Accounting and Business Valuation. The three sub-areas are as follows.

(i) *Residual-income-based valuation*

This sub-area relates to the residual income-based valuation model (RIVM), which became prominent in the late 1980s and early 1990s in relation to the valuation of businesses and in relation to the measurement of value creation for the purposes of performance measurement and compensation.

(ii) *Implied cost of capital*

This sub-area relates to the use of valuation models to infer the cost of capital. The models usually, but not necessarily, include accounting numbers.[1]

(iii) *Accounting for credit-loss impairment*

This sub-area relates to the accounting for credit losses, which is important in the measurement of the amortised cost of the financial assets that comprise most of banks' assets. The accounting for credit-loss impairment is a material input to banks' book value and earnings, which are important in the valuation of banks.

For each of the three sub-areas, this section first outlines the context for the papers submitted. Second, for each of the papers submitted in that sub-area, it provides a summary and discussion of the paper with selective reference to citations of the paper

[1] Although the literature on implied cost of capital could be said to have grown out of the literature on the residual-income-based valuation model and the related abnormal-earnings-growth-based valuation model, I treat the residual-income-based valuation literature and the implied cost of capital literature as separate literatures in this supporting paper. I do so partly because the literature on implied cost of capital has now developed into a major area of the literature in its own right and partly because some methods of estimating the implied cost of capital do not use the residual-income-based valuation model.

and with reference to any accompanying published discussion of the paper. Third, it considers the current state of knowledge and research in the sub-area. Fourth, it comments on the location of the papers submitted within the sub-area.

3.2 Residual-Income-Based Valuation

Residual income is earnings less a capital charge equal to book value times the cost of capital. It has a long history as a divisional performance measure (Solomons 1965). Management Accounting texts typically refer to residual income in that context. From the late 1980s, the measure started to become prominent in the literature on accounting-based valuation of businesses. The development of this branch of literature was initiated largely through the work in the late 1980s of James Ohlson. This work was reflected in a frequently-cited 1989 working paper (Ohlson 1989), reproduced in a book of readings edited by Brief and Peasnell (1996), and then developed through related articles that Ohlson authored or co-authored, notably Ohlson (1995), Feltham and Ohlson (1995) and Feltham and Ohlson (1996). An attractive feature of this body of work is that it combines:

(i) basic building blocks of finance theory, in particular the present-value model and dividend-policy irrelevance;

(ii) a basic representation of how accounting earnings, accounting book value and dividends (defined as total shareholder cash flows) link together through double-entry bookkeeping (the 'clean surplus relationship');

(iii) a simple representation of how accounting numbers evolve through time, by reference to realised accounting numbers, persistence measures and the arrival of 'other information' ('linear information dynamics' (LID)).

A prominent output from this body of work was the derivation of the residual income valuation model (RIVM), in which the value of equity is written, equivalently to the present value of expected future dividends (PVED), as book value of equity (an 'anchor' term) plus a 'premium' comprising the present value of expected future residual incomes. As was pointed out to Ohlson after his 'discovery' of this result, the RIVM had been 'discovered' in various guises on previous occasions, including by Peasnell (1982), Edwards and Bell (1961) and Preinreich (1938). However, Ohlson provided an important innovation in presenting the RIVM and related models in terms that linked them to the then rapidly increasing body of empirical research on relationships between accounting numbers and stock prices. The growth of such literature had been fuelled by the rapidly increasing accessibility of machine-readable accounting and finance data and computing resources. However, it could be argued that such literature needed to be supported by stronger theoretical foundations than were available at the time. The Ohlson-inspired residual-income-based valuation literature helped importantly in the provision of such theoretical foundations.

In the remainder of this subsection, I first summarise and discuss the five papers submitted in the area of residual-income-based valuation. My summary and discussion of each of these five papers includes reference to relevant preceding literature that provides context for those papers. I then consider the current state of knowledge and research on the residual-income-based valuation model and related models and consider the location of the submitted papers within the literature on residual-income-based valuation.

3.2.1 Paper 1. 'Return/earnings regressions and residual income: Empirical evidence'. *Journal of Business Finance and Accounting*, 1995, 22 (1): 53-66.

Single-authored paper.

[Google Scholar citations: 19]

The motivation for O'Hanlon (1995) came from the influential Ohlson-inspired body of work on residual-income-based valuation that originated and became influential in the late 1980s and the early 1990s. A notable feature of Ohlson's work was its development of the RIVM to give an expression for the market value of equity as a weighted average of book value and an earnings multiple. This result appeared in Ohlson (1995) but had previously appeared in earlier working papers, including Ohlson (1989) and Ohlson (1991). The specific motivation for O'Hanlon (1995) came from the then-emerging practice, exemplified by Easton and Harris (1991), of using Ohlson's residual-income-based weighted-average expression in first-difference form as authority for research designs for the examination of the association between stock returns and earnings.[2]

O'Hanlon (1995) noted that Ohlson's residual-income-based weighted-average equity valuation model makes particular assumptions about the residual-income generating process and about other properties of accounting numbers, and that such assumptions might not always be justified. First, the derivation of RIVM as equivalent to PVED is based in part on earnings being defined in 'clean surplus' form whereby periodic dividends could be substituted by periodic earnings less the periodic change in the book value of equity (Ohlson 1995, p. 663). Second, the Ohlson (1995) weighted-average model expresses the weights on the book-value and earnings-multiple terms as specified functions of residual-income persistence and the cost of equity. For example: in the market-value model, the weight on book value (earnings) is negatively

[2] See also, for example, Barth and Clinch (1998), which was published shortly afterwards and which referred to Ohlson (1995) as a source of authority for its return-earnings research design.

(positively) associated with residual-income persistence; in the related returns model, the weight on the level (first difference) of earnings is negatively (positively) associated with residual-income persistence. Third, the weighted-average model assumes that residual income has an unconditional mean of zero. This implies that book value is on average equal to market value which, as acknowledged and modelled in Feltham and Ohlson (1995) and Feltham and Ohlson (1996), is unlikely to be a valid assumption in general. Fourth, the weighted-average model assumes that residual income is generated by a process similar to an autoregressive process of order 1.[3] This process might well not characterise all companies' residual income series. In light of the role of residual income in providing theoretical underpinnings for returns/earnings regression models, O'Hanlon (1995) sought evidence on the implications of these residual-income-related issues for return/earnings regression models. It did so by estimating return/earnings regression models in which explanatory variables reflect company-specific estimates of the time series properties of residual income, estimated from data scaled to adjust for inflation and new issues of equity, and company-specific estimates of the cost of equity.

Using data for 28 U.K. companies, O'Hanlon (1995) estimates three return-earnings regression models. In each case, the model includes as explanatory variables the levels and first differences of both ordinary-profit-based variables and aggregate-clean-surplus-items-based variables, where aggregate 'clean surplus items' equals clean surplus earnings less ordinary profit. Model 1 is a standard return/earnings regression model in which stock return is regressed on the level and first difference of earnings without any explicit recognition of the time series properties of residual income or of the magnitude of the cost of equity. The paper's key innovation is in Model 2 and Model

[3] The residual-income generating process in Ohlson (1995) includes, in addition to the autoregressive term (previous-period residual income), an 'other information' term generated by a zero-mean autoregressive process of order 1. Empirical applications that cite Ohlson (1995) as a source of theoretical support often take no explicit account of this 'other information' term.

3, which take explicit account of estimates of the cost of equity and time series properties of ordinary-profit-based residual-income and clean surplus items. Consistent with Ohlson (1995), Model 2 assumes that scaled ordinary-profit-based residual income and clean surplus items are generated by a zero-mean autoregressive process of order 1 (AR (1) process).[4] Model 3 is more general than Model 2. Model 3 uses estimates of the present value of a stream of expected future residual incomes in terms of the parameters of any ARIMA (*p*,*d*,*q*) process, as given by the general valuation expression (4) on the basis of the general ARIMA (*p*,*d*,*q*) process given by expression (3).[5,6] The general expressions (3) and (4) in O'Hanlon (1995) might seem over-engineered for the purpose of dealing with time series processes likely to characterise accounting flows. However, in light of part of the motivation for the study, it was appropriate to avoid imposing a prior restriction on the time series processes to be considered.[7]

O'Hanlon (1995) reports that ordinary-profit-based residual income is largely generated by low-order autoregressive or moving-average processes and that aggregate clean surplus items are largely generated by a random process (ARIMA (0, 0, 0)). Its Model-2 results suggest that, in valuing stocks, the market weights the level and first difference of ordinary profit in a manner consistent with the belief that residual income

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[4] Model 2 is similar to an expression for stock return in Ohlson (1989, equation (9)). It includes within the explanatory variables company-specific estimates of the cost of equity and of persistence parameters from zero-mean AR (1) processes for components of clean surplus residual income.

[5] Model 3 is derived from a general expression for the market value of equity as the sum of book value and the present value of expected future clean surplus residual incomes. It expresses stock return as the sum of periodic earnings and the periodic change in the present value of expected future clean surplus residual incomes, where both terms are broken down into ordinary-profit and clean-surplus-items elements. It allows the components of clean surplus residual income to be generated by any class of ARIMA (*p*,*d*,*q*) process. It uses company-specific estimates of the cost of equity and of the parameters of the ARIMA (*p*,*d*,*q*) process. 'ARIMA' denotes Autoregressive Integrated Moving Average. In ARIMA (*p*,*d*,*q*), *p* denotes the order of the autoregressive process, *d* denotes the number of times the series needs to be differenced in order to make it stationary (i.e., transform it to a series with a constant mean), and *q* denotes the order of the moving average process.

[6] The derivation of O'Hanlon (1995)'s expression (4) for the present value of expected future residual incomes is provided in a predecessor working paper (O'Hanlon 1994). O'Hanlon (1994) is not one of the papers submitted for the award of PhD, but it is provided as supplementary information in Appendix 2.

[7] Some related studies had considered only a subset of potential generating processes. See, for example, Easton and Harris (1991) and Ramakrishnan and Thomas (1992).

is generated by a zero-mean autoregressive process of order 1 (AR(1)) similar to that assumed in Ohlson (1995). Its Model-3 results suggest that the market does not weight earnings information in accordance with the potentially more complex time series processes which best fit residual income series, although it notes that this result could be due to errors in variables introduced by the more complex modelling process. O'Hanlon (1995) concludes that, for researchers attempting to deal formally with the role of the cost of equity and the time series properties of residual income in return/earnings regressions, models such as Model 2, which assumes a relatively simple AR (1) process, provide a happy medium between a simple model with no explicit recognition of the numerical values of the cost of equity and residual-income persistence and a more complex model that allows residual income to be generated by any class of ARIMA (*p*,*d*,*q*) process. The results provide support for a simplifying assumption in return/earnings regression models that scaled earnings and residual income are generated by a relatively simple AR (1) time series process.

This paper was reproduced in the book of readings edited by Brief and Peasnell (1996) that was referred to previously.

References in Citations

Here and in discussing the other seven papers submitted, I focus on citations that make substantive comments on the paper. References to this paper in citations include:

- Rees (1997) cites the paper's results as providing support for basing related research designs on a relatively simple time series model;
- McLeay, Kassab and Helan (1997) cites the paper's results as providing support for basing related research designs on an assumed AR (1) process for residual income and for treating clean surplus items as 'noise'.

3.2.2 Paper 2. 'The time series properties of the components of clean surplus earnings: U.K. evidence'. *Journal of Business Finance and Accounting*, 1996, 23 (2): 159-183.

Single-authored paper.

[Google Scholar citations: 24]

In common with O'Hanlon (1995), the motivation for O'Hanlon (1996) came from the Ohlson-inspired body of work on residual-income-based valuation. O'Hanlon (1996) focuses on the implications of the time series properties of scaled residual income within models of the value of equity.

O'Hanlon (1996) explicitly recognises an issue with regard to the stationarity of series of accounting earnings (and components thereof) that was then not typically explicitly addressed in the residual-income-based valuation literature. The estimation of autoregressive and moving-average models for a time series requires that the series should be stationary in the sense that it has a constant mean. Differencing a series *d* times is intended to transform the series to a stationary series. However, accounting earnings series can plausibly be expected to grow exponentially over time. For example, earnings might grow at 5% per year on average. In this case, its first difference will also grow at 5% per year, its second difference will also grow at 5% per year, and so on. Differencing such a series any number of times cannot be relied upon to produce a stationary series. In order reliably to transform such a series to a series that is stationary (or can be made stationary by differencing), some sort of deflation or inflation of accounting flows is required. O'Hanlon (1995) dealt with this issue by adjusting for inflation and new issues of equity. A more natural approach is to deflate accounting flows by book value, which gives rise to variables that are similar to standard profitability measures. This approach is adopted in O'Hanlon (1996). It is noted that, if book-value-scaled ordinary profit (here termed accounting rate of return (ARR)) and book-value-scaled ordinary-profit-based residual income differ only by an assumed-constant cost of capital, the parameters of the ARIMA generating process for ARR are the same as those for book-value-scaled residual income except for the constant term in models of levels of the series.

O'Hanlon (1996) identifies and estimates company-specific time series processes for ordinary-profit-based scaled residual income (and ARR) and book-value-scaled clean surplus items within the structure depicted by expression (3) in O'Hanlon (1996). Expression (3) represents a general ARIMA (*p*,*d*,*q*) generating process for scaled residual income, and can also be applied to other components of book-value-scaled clean surplus residual income. O'Hanlon (1996) presents in its expression (4) an expression for the value of equity in terms of the parameters of any ARIMA (*p*,*d*,*q*) process for book-value-scaled residual income represented by expression (3). This book-value-scaled expression, which includes book-value-scaled versions of the earnings terms from expression (4) in O'Hanlon (1995), is used in O'Hanlon (1996) as a basis for describing a number of special cases of ARR-based valuation models.[8]

O'Hanlon (1996) reports evidence on the time series properties of components of book-value-scaled clean-surplus earnings for U.K. companies across 16 sectors. The principal results of the analysis are that the predominant processes for book-value-scaled ordinary profit (and residual income) are ARIMA (1,0,0) (51% of the companies in the sample), ARIMA (0,0,1) (19% of the companies) and ARIMA (0,1,0) (18% of the companies). It is noted that, if the ARIMA (0,0,0) and ARIMA (0,1,0) processes are viewed as extreme special cases of ARIMA (1,0,0) and grouped within that class, ARIMA (1,0,0) is appropriate for 77% of the companies. O'Hanlon (1996) shows that

[8] A derivation of the book-value-scaled expression (4) in O'Hanlon (1996) is given in O'Hanlon (1994), which is provided for information in Appendix 2 of this supporting paper..

the predominant ARIMA (1,0,0) process for book-value-scaled ordinary-profit gives rise to an ordinary-profit-based valuation model that is a weighted average of (i) a term containing the mean of ordinary-profit-based ARR and (ii) a term containing the current level of ordinary-profit-based ARR. The weights on these two terms are functions of the persistence parameter for ARR (and for ordinary-profit-based residual income): for high (low) values of ARR persistence, the current level of ARR (the mean of ARR) is relatively important. The estimated ARR persistence parameters from the ARIMA (1,0,0) process suggest that the weight on the ARR mean term is predicted to be, on average, about eight times higher than that on the ARR levels term, with some variation by industry. The generating process for components of book-value-scaled clean-surplus earnings other than ordinary profit is predominantly a random ARIMA (0,0,0) process.

Published Discussion

Stephen Ryan wrote a discussion of O'Hanlon (1996) that was published in the same volume (Ryan 1996). Ryan makes a number of interesting points about the paper. I summarise the principal of these as follows.

- Ryan (1996) argues that, although O'Hanlon (1996) reports that ARR is well described by an ARIMA (1,0,0) (or AR (1)) process, he believes that 'at a disaggregated level, such as the level of transactions, … accounting is better described by moving average (MA) processes than by AR processes.' (Ryan 1996, p. 186). He argues that the good fit of an AR (1) process may arise because aggregate earnings combines components that are generated by a number of different order MA processes which, when aggregated, approximate an AR (1) process. I believe that this is a plausible, although difficult-to-test, hypothesis.

- Ryan (1996) acknowledges that 'deflation by book value is a natural way to remove explosive properties from the income variables.' (Ryan 1996, p. 187). However, he notes that deflation by a book value that is assumed to grow at a constant rate, as in the constant-perpetual-growth-based valuation model in expression (4) in O'Hanlon (1996), implies questionable assumptions about the evolution over time of income and dividends. This is a valid point. However, it should also be noted that a simplifying assumption of constant perpetual future growth in any one of book value, income and dividends in any constant-perpetual-growth-based valuation model effectively implies an assumption that the other two items will also grow at that same rate in perpetuity.[9]
- Ryan (1996) notes that lagged recognition of economic income will both increase the mean of ARR and increase the persistence of deviations from the mean of ARR and that 'as a result, a firm with substantial lagged recognition will have a smaller weight attached to a higher mean ARR in (O'Hanlon's) equation (5.1).' (Ryan 1996, 188). This is an insightful way of describing the joint effect of lagged recognition on the level and persistence of ARR.

References in Citations

References to the paper in citations include:

- Joos (2001) cites the paper's demonstration that differencing might not make a series stationary where the series is growing exponentially.
- Kelly and Tahir (2009) refer to the evidence on the time series properties of earnings reported in the paper.

[9] An assumption of different constant perpetual growth rates for different items would imply an assumption that ARR would approach an implausible value of zero or infinity in the future.

3.2.3 Paper 3. 'Wall Street's contribution to management accounting: The Stern Stewart EVA financial management system'. *Management Accounting Research*, 1998, 9 (4): 421-444.

Joint with Kenneth Peasnell. The overall contributions of the two authors were approximately equal. The original idea for this paper, and for its title, came from Professor Peasnell. Links to literature from the 1960s and 1970s benefited particularly from Professor Peasnell's familiarity with that literature. The drafting of analytical content and text was done jointly.

[Google Scholar citations: 297]

O'Hanlon and Peasnell (1998) was motivated by another rediscovery of the residual-income-based valuation relationship. In the 1990s, the consulting firm Stern Stewart promoted measures termed EVA (Economic Value Added) and MVA (Market Value Added) as measures of value creation that might be used in business valuation and for the purpose of management compensation systems. EVA is a measure of operating residual income based on accounting numbers adjusted to eliminate a number of claimed distortions. Such claimed distortions include the non-recognition of internally-generated intangible assets and the earnings management that can arise from discretionary accounting treatments such as those relating to bad-debt and warranty provisions. MVA is the excess of the economic value of the entity over the adjusted book value of its net operating assets, the latter of which is treated as a measure of invested capital. EVA was promoted as a measure of periodic value creation, and MVA was promoted as a measure of total value creation. The interpretation of EVA and MVA as measures of periodic value creation and total value creation, respectively, was justified by reference to a version of the RIVM in which the value of the entity is stated as being equal to invested capital plus the present value of expected future EVAs (Stewart 1991; O'Byrne 1997).

O'Hanlon and Peasnell (1998) describes key features of Stern Stewart's EVA system. It considers how the recommended adjustments to accounting numbers might facilitate the interpretation of invested capital as a measure of the economic value of the capital invested and might facilitate the interpretation of EVA as a measure of periodic value creation. In relation to these matters, it also explores properties of a 'bonus bank', which Stern Stewart advocate as a means of allowing periodic bonus accrual to mimic value creation and/or destruction by not being subject to upper and lower limits and by potentially being negative. It observes that some features of the EVA system are motivated by issues addressed in literature on performance measurement and residual income from the 1960s and 1970s. See, for example, Solomons (1965).

An important feature of the paper is that it notes limitations of periodic EVA and of MVA as measures of value creation. It makes two important points. First, it notes that MVA cannot be interpreted in general as a measure of value creation because it is measured relative to an adjusted book value of net operating assets that includes recognised gains and losses, as well as invested capital, and is not therefore a pure measure of invested capital. Second, it shows analytically that periodic EVA will only be equal to periodic abnormal economic return if it is supplemented by a measure of periodic change in unrecorded goodwill less a capital charge based on beginning-of-period unrecorded goodwill. The issues that arise with respect to EVA and MVA as measures of value creation form part of the motivation for Paper 4.

References in Citations

The paper has been widely cited, as an account of the value-based management approach and of issues arising with the EVA variant of residual income in performance measurement. See, for example, Beattie (2005) and Dambrin and Robson (2011).

3.2.4 Paper 4. 'Residual income and value-creation: The missing link'. *Review of Accounting Studies*, 2002, 7 (2-3): 229-245.

Joint with Kenneth Peasnell. The overall contributions of the authors were approximately equal. The original idea of linking value creation to the sum of past and future residual incomes came from me. The detailed analytical work, drafting of text and construction of supporting examples was done jointly.

[Google Scholar citations: 113]

O'Hanlon and Peasnell (2002) was largely motivated by issues regarding the economic interpretation of periodic residual income (or EVA) and economic value relative to invested capital (or MVA) referred to in Paper 3 (O'Hanlon and Peasnell 1998).

The principal contribution of the paper is that it develops a relatively simple and intuitive formal expression for excess value created (EVC), which is an unscaled ('dollar') measure of abnormal economic return, in terms of past and expected future residual incomes. The key contributions of the paper are:

(i) In light of the fact that book value comprises both invested capital and realised gains and losses and is not therefore a pure measure of capital invested by shareholders that can be used in the measurement of value creation, the paper proposes a pure measure of invested capital termed 'unrecovered capital'. This comprises cumulative shareholder cash flows (issues of equity less payouts) augmented by the required rate of return on the investment. The measure is similar to a measure of shareholders' equity proposed in a text on a proposed conceptual framework for financial accounting by Anthony (1983, chapter 4).

(ii) Book value of equity at time t is equal to unrecovered capital at time t plus the terminal value at time t of residual incomes earned up to time t. This relationship is 'the missing link' referred to in the title of the paper. (Proposition 1)

(iii) Combination of Proposition 1 and RIVM (the economic value of equity at time t less the book value of equity at time t is equal to the time-t present value of expected future residual incomes) gives the result that excess value created (EVC) at time t, equal to economic value less unrecovered capital (invested capital), is equal to the sum of the terminal value of realised residual incomes up to time t and the present value of expected future residual incomes at time t. (Proposition 2).

Other results in the paper include developments of Proposition 2 that allow for EVC to be measured over an interval that starts after incorporation. It is noted that the analysis in the paper complements that of Anthony (1983) by showing how a measure proposed in that study articulates with excess return.

Published Discussion

James Ohlson, who is the author of seminal papers that initiated the modern literature on residual-income-based valuation, wrote a discussion of this paper that was published in the same volume (Ohlson 2002). This discussion includes the following suggestion that the paper makes a significant contribution:

> 'O'Hanlon and Peasnell's paper [OP, henceforth] on residual income and value creation makes a significant contribution to the literature. A backward-looking analysis of residual income is not only of mathematical interest, as it extends the usual forward-looking residual income valuation relationship (RIVR, to use OPs acronym), but also critical to the concept inherent in residual income and its applications. As a consequence, my major complaint about the paper pertains to a phrase in the title, "The Missing Link." My comments will argue that phrase understates the importance of the OP analysis: *The retrospective residual income formula* (RIBR/EVC) *takes on a more central role as compared to the usual prospective formula* (RIVR).' (Ohlson 2002, p. 247) (Italics are in the original text.)

References in Citations

References to the paper in citations include:

- Yee (2005) cites the paper as evidence of the role of past accounting numbers in valuation.
- A review paper by Magni (2009) cites the concept of unrecovered capital that is developed in this paper. An analytical paper by Magni (2016) cites and makes use of the concept of unrecovered capital.

3.2.5 Paper 5. 'Residual income valuation: Are inflation adjustments necessary?'. *Review of Accounting Studies*, 2004, 9 (4): 375-398.

> *Joint with Kenneth Peasnell. The overall contributions of the authors were approximately equal. The original idea for this paper came from Professor Peasnell after he had read Ritter and Warr (2002) and had noted the nature of a claim made in that paper and the need to address it. The detailed analytical work, drafting of text and construction of supporting examples was done jointly.*
>
> *[Google Scholar citations: 44]*

O'Hanlon and Peasnell (2004) was prompted by the following claim by Ritter and Warr (hereinafter, RW) in a 2002 paper in the *Journal of Financial and Quantitative Analysis*:

> '…we demonstrate how residual income models must be adjusted to deal with inflation. For these models to produce accurate measures of true economic value they should use real required returns, adjust depreciation for the distorting effects of inflation, and make adjustments for leverage-induced capital gains.' (Ritter and Warr 2002, pp. 59-60)

In making their claim that the RIVM needs to be adjusted in the ways described above, RW cite a number of prominent empirical studies that they claimed had erroneously used RIVM without the necessary adjustments for inflation. The papers that RW cited in relation to their claim include Frankel and Lee (1998) and Lee, Myers, and Swaminathan (1999). The essential points made by RW in support of their claim are as follows:

i. The historic cost accounting on which RIVM is conventionally based results in under-stated depreciation. RIVM should be based on profit numbers where depreciation is stated on a replacement-cost basis.
ii. The historic cost accounting on which RIVM is conventionally based ignores gains arising from the erosion in the value of debt resulting from inflation. These gains should be recognised.
iii. If the required return used in calculating the residual income (or EVA) capital charge is stated in nominal terms rather than in real (inflation-adjusted) terms, residual income is underestimated. The required return used in calculating residual income should be stated in real terms.
iv. The use of a nominal cost of equity to discount expected future residual incomes may result in real residual incomes being discounted at a nominal rate. The discount rate (capitalisation rate) used to discount expected future residual incomes should be the real (inflation-adjusted) cost of equity rather than the nominal cost of equity.

It is reasonable to assume that anyone who has a high degree of familiarity with the theory and practice of RIVM would know, without having to undertake any formal analysis, that the claim by RW that RIVM must be adjusted for inflation cannot be correct. However, due to the prominence of the valuation model to which the claim related, the relative complexity of the issues addressed and the intuitive appeal of individual elements of RW's claim, it appeared appropriate to set the record straight.

O'Hanlon and Peasnell (2004) demonstrate that the following adjustments all cancel out, provided that they are done correctly and consistently:

i. statement of depreciation and assets on a replacement-cost basis;

ii. inclusion of a capital-maintenance charge that reflects changes in the purchasing power of equity (equal to assets less debt);

iii. statement of the residual-income capital charge on an inflation-adjusted basis;

iv. statement of the discount rate on an inflation-adjusted basis.

As part of its analysis, the paper demonstrates that the version of RIVM proposed by RW is essentially a special case of the general RIVM. The paper also makes the point that, although implementing RIVM in nominal terms and implementing it in inflation-adjusted terms are equally correct, the inflation-adjusted formulation has significantly more scope for error and internal inconsistency due to the complexity involved.

It is relevant to note here that some of the concern about failure to deal with inflation that is reflected in RW really relates to errors that might be made in making forecasts in nominal terms, for example by assuming that residual income is expected to remain constant in nominal terms in perpetuity.

References in Citations

References to the paper in citations include:

- Gregory, Saleh and Tucker (2005) note the evidence in this paper that there is no need to formulate RIVM in real terms, and that nominal and inflation-adjusted versions of the model should produce identical valuations.
- Lin, Lee, Chao and Liu (2015) cite the paper in support of the view that there is no need to formulate the residual income valuation model on an inflation-adjusted basis and as evidence of the potential complexity involved in making inflation adjustments to historical-cost accounting numbers.

3.2.6 The Residual Income Valuation Model and Related Models: Consideration of the Current State of Knowledge and Research

As indicated at the beginning of subsection 3.2, the residual-income-based valuation literature provides an important framework within which the relevance of accounting numbers for business valuation can be modelled and examined empirically. The Ohlson (1995) LID-based model, which assumes an unconditional mean of zero for residual income, provides an intuitively appealing representation of business value in terms of book value and earnings, where the relative weight on earnings is positively associated with the persistence of residual income. The Ohlson (1995) model and developments of it provide a theoretical rationale for tests of association between stock prices and accounting numbers. Such models have now become accepted as a standard source of authority for value-relevance regression models in which stock price is the dependent variable and book value (or components thereof) and earnings (or components thereof) are explanatory variables. See for example, Barth, Beaver and Landsman (1998), Barth, Beaver, Hand and Landsman (1999) and Burke and Wieland (2017).

Developments of the modelling technique that was used to derive the Ohlson (1995) weighted-average model have allowed for the weights on accounting numbers to reflect the 'real world' more closely than in the case of Ohlson (1995). Feltham and Ohlson (1995) develop the Ohlson (1995) model to allow that the accounting for operating assets might be biased (conservative) in the sense that economic value is greater than book value on average and that expected future operating residual income is positive on average. Feltham and Ohlson (1996) provide what I believe to be a highly insightful representation of economic value in terms of accounting numbers in which the excess of economic value over book value is expressed as, in part, a function of (i) unrecognised positive-net-present-value opportunities and (ii) the excess of the accounting depreciation rate over the economic depreciation rate. The Ohlson and

Feltham/Ohlson papers continue to be extensively cited in academic papers as authorities on the valuation implications of accounting numbers. For example, Amir, Kirschenheiter and Willard (2001) and Laux (2013) cite Feltham and Ohlson (1996) in relation to the valuation implications of depreciation-related deferred-tax liabilities. Extended LID-based models have further examined the roles of earnings components and dividends (Stark 1997; Ohlson 1999; Pope and Wang 2005; Clubb 2013).

Also, the RIVM has sometimes been used as a means of estimating business value on the basis of accounting numbers for the purpose of identifying mispriced stocks. See, for example, Frankel and Lee (1998).

In the mid-2000s, James Ohlson and co-authors developed a model that is sometimes termed the Abnormal Earnings Growth Model (AEGM) (Ohlson 2005; Ohlson and Juettner-Nauroth 2005; Ohlson and Gao 2006). This model is essentially a development of the RIVM. It uses a measure termed abnormal earnings growth (AEG). AEG is equal to periodic growth in earnings in excess of the growth that would occur if a normal rate of return (at the cost of capital) were earned on the retained earnings of the previous period. AEG is also equal to the first difference of residual income. The AEGM expresses the value of a business as being equal to the sum of:

- a forward-price-earnings-based valuation, where the price-earnings ratio is equal to the reciprocal of the cost of capital, described in Ohlson (2005, p. 343) as a benchmark price-to-forward-earnings ratio;
- a premium comprising the present value of capitalised expected future AEGs.

Although it may appear to have a complex and not immediately intuitive derivation, the AEGM has the intuitive appeal that it uses forward earnings, a forward price-earnings ratio and forecasts of earnings growth, all of which relate naturally to standard elements of the practice of business valuation.

I also note here the significant contribution of the RIVM and AEGM literature to the literature on implied cost of capital, which is considered in a subsequent subsection in relation to Paper 6 (O'Hanlon and Steele 2000).

Papers proposing refinements to the RIVM and related models continue to be published. Bach and Christensen (2016), with reference to an earlier paper by Feltham and Ohlson (1999) that proposed certainty-equivalent reductions to forecast residual incomes, propose a residual-income-based valuation model in which risk is dealt with through a consumption-CAPM-based adjustment to the forecast residual income (numerator) rather than through the cost of capital (denominator). Gao, Myers, Myers and Wu (2019), motivated by analysis in Ohlson and Johannesson (2016), examine empirically what they term hybrid valuation models. The hybrid models examined are adaptations of the AEGM and the RIVM. In the case of the AEGM, the benchmark forward-price-earnings element based on the reciprocal of the cost of capital is replaced by a normal forward price-earnings element based on peer firms. A related modification is made to RIVM through the use of a 'normal' price-to-book ratio. Empirical application of these hybrid models indicates that they perform well relative to alternative models with respect to valuation accuracy and with respect to the estimation of implied costs of capital that reflect systematic risk and expected returns.

I now briefly consider the evidence for the adoption of RIVM and related models in practice. The residual income valuation model now typically appears as one of the valuation methods in professional and consulting texts on business valuation. See, for example, Antill and Lee (2008) and Koller, Goedhart and Wessels (2015), where residual income is typically termed 'economic profit'. However, my observation is that such texts and the valuation reports produced by equity analysts tend to treat cash-flow-based methods and multiples-based methods as the predominant valuation methods. In my experience of referring to analyst reports in my teaching of Financial Statement Analysis, it is rare to find valuations based on residual income/economic profit/EVA. It is more common to find references to the 'spread' between accounting profitability and the cost of capital, which is equal to book-value-scaled residual income, as an indicator of actual and/or expected performance. The EVA variant of residual income continues to be referred to in texts on value-based management. See, for example, Young and O'Byrne (2001) and Stewart (2013).

The literature on the RIVM and the AEGM has contributed substantially to putting academic accounting research that is concerned with the association between economic value and accounting numbers onto a firmer theoretical footing. The number of papers published within this literature has reduced in recent years. My feeling is that this literature has largely done its work and that its insights have now become impounded into the knowledge bases within relevant literatures. The RIVM-related literature has contributed some valuable headline messages to teachers of Financial Statement Analysis. For example, it is valuable to encourage students to ask: (i) is a company's market-to-book premium plausible in light of expected future residual incomes? (ii) is the excess of a company's market value over a cost-of-capital-based forward P/E valuation plausible in light of expected future abnormal earnings growth?

3.2.7 Comments on the Location of Papers 1, 2, 3, 4 and 5 Within the Literature on Residual- Income-Based Valuation

The substantial residual-income-based literature has had a significant impact on the theoretical and empirical academic literature on the relationship between the value of businesses and accounting numbers. The papers considered in this section have contributed, at different stages, to the development of that literature. O'Hanlon (1995) and O'Hanlon (1996) were written at the time when this literature was emerging as a major influence on the empirical literature on accounting-based valuation. Through the consideration of a broad set of time series processes, they provide evidence of the appropriateness of assuming for the purpose of valuation-related models that scaled accounting earnings and residual income are generated by a relatively simple AR (1) process. O'Hanlon and Peasnell (1998) reviewed the use of a residual income measure, termed EVA, which was becoming prominent in the consulting literature as a measure of value creation. Issues raised in that paper were then addressed further in O'Hanlon and Peasnell (2002), which articulated a 'missing link' that allowed value creation to be written as the sum of past residual incomes and expected-future residual incomes. O'Hanlon and Peasnell (2004) examined analytically the claim that the RIVM must be written in inflation-adjusted form and demonstrated that this is not the case.

3.3 Implied Cost of Capital

Studies using accounting numbers to estimate the implied cost of capital (ICC) started to be published in the early 2000s. The literature was motivated largely by the view that historic-realised-return-based measures of required rates of return and of risk premia were too high to serve as plausible ex-ante estimates of such measures. The existence of the then recently prominent RIVM, which provided a link between business values, forecast earnings and a discount rate that is conceptually an ex-ante cost of capital, prompted the use of the RIVM and related models as a basis for estimating the ICC.

In the remainder of this subsection, I first summarise and discuss Paper 6 of this submission (O'Hanlon and Steele 2000), which appears to be the earliest published paper on accounting-based ICC. My summary and discussion of the paper include reference to its context. I then consider the current state of knowledge and research on ICC and the location of the submitted paper within the literature on ICC.

3.3.1 Paper 6. 'Estimating the equity risk premium using accounting fundamentals'. *Journal of Business Finance and Accounting*, 2000, 27 (9-10): 1051-1083.

Joint with the late Anthony Steele. The contributions of the authors were approximately equal. The original idea for this paper came from Professor Steele. In correspondence between Professor Steele and myself in relation to Professor Steele's intention to submit this paper as part of an application for a PhD by published work from the University of Warwick, Professor Steele and I agreed that our contributions to the paper were approximately equal. In that correspondence, it was noted by Professor Steele that I had contributed particularly to the econometric analysis and the finalisation of the published version of the paper.

[Google Scholar citations: 131]

O'Hanlon and Steele (2000) was initially motivated by Professor Steele's work as a member of the U.K.'s Monopolies and Mergers Commission (MMC) in the late 1990s. As a member of the MMC, Professor Steele had observed debates about the cost of capital/required rate of return that should be assumed for regulated entities under review. In particular, he had noted the wide divergence between the higher estimates proposed by the regulated entities and the lower estimates proposed by the regulators. For example, as quoted in the paper, British Gas plc proposed a cost of capital that was about 6% higher than the rate proposed by the relevant regulator. Central to such disagreements was disagreement regarding the magnitude of the market risk premium to be used in estimating the cost of capital. An important contributor to such disagreement was the difference between estimates of the risk premium that investors appeared to require at the time and historic-realised-return-based measures of the risk premium, the latter of which are not necessarily reliable as estimates of the ex-ante required risk premium. Professor Steele and I felt that the combination of Professor Steele's MMC experience and analytical skills, including in relation to the residual income valuation model, and my own experience of dealing analytically and empirically with the residual income valuation model could produce a novel method of estimating an ICC and risk premium. We therefore decided to collaborate on this paper.

O'Hanlon and Steele (2000) (Paper 6) uses a version of the RIVM due to Ohlson (1995) and related papers to develop an expression in which book-value-scaled unrecognised goodwill (market value of equity less book value of equity) (URG) is a function of (i) a parameter that is a function of residual-income persistence/growth and the cost of equity and (ii) return on equity (ROE) times another parameter that is also a function of residual-income persistence/growth and the cost of equity. Estimation of these two parameters from a company-specific regression of a time series of scaled URG on a corresponding time series of ROE and the division of the first parameter (times -1) by the second parameter provides an estimate of the horizontal intercept from the regression of URG on ROE. This is the estimate of the implied cost of equity. In order to avoid econometric complications arising from the division of one estimated parameter by another estimated parameter, we reverse the regression model such that ROE is the dependent variable and URG is the explanatory variable. Here, the vertical intercept coefficient gives the estimate of the implied cost of equity, with the slope coefficient being a function of the cost of equity and growth. An estimate of expected growth can be obtained from the intercept and slope coefficients taken together, although O'Hanlon and Steele (2000) did not focus on growth and did not report such growth estimates. In order to estimate the market risk premium, we might have simply subtracted a measure of the risk-free rate from our costs of equity. However, we chose to adhere more closely to the theory of Finance, which predicts that the relationship between the market risk premium (the expected return on the market portfolio less the risk-free rate) and the cost of equity is determined by undiversifiable risk as measured by equity beta. We therefore estimate the market risk premium as the slope of the

Securities Market Line measured by a regression of company-specific estimates of the cost of equity on corresponding estimates of equity beta. Our estimates of the market risk premium are in the range of 4% to 6%, which is consistent with what the MMC was assuming at the time.

O'Hanlon and Steele (2000) was primarily motivated as a source of evidence on the U.K. market risk premium rather than as a source of a new method of estimating the cost of capital. However, it is the latter for which this paper appears to have received more prominent citations, some of which are reproduced later in this subsection. I should emphasise that, at the time it was being written, O'Hanlon and Steele (2000) was not the only study that was using accounting numbers to estimate the implied cost of capital. As discussed later in this subsection, a working paper by Claus and Thomas (1997) used analyst-earnings-based-forecasts of residual income together with assumed growth rates to estimate costs of capital. This contrasted with our approach in two ways. First, it required that an assumption be made about growth, whereas our method allowed expected growth and the ICC to be estimated simultaneously from the data. Second, it used analysts' forecasts of earnings whereas we used realised earnings which, as noted later by Easton (2006), avoids the danger that ICC estimates may be distorted by bias in analysts' earnings forecasts.[10]

Published Discussion

Mark Tippett wrote a discussion of O'Hanlon and Steele (2000) that was published in the same volume (Tippett 2000). This discussion included the following in its Conclusion section, which I believe summarises the principal points made in the discussion. The first paragraph is fairly complimentary with regard to the work's link

[10] The work reported in Claus and Thomas (1997) was later published in Claus and Thomas (2001).

with economic theory and its novelty. The second paragraph expresses caveats about the paper's results. These caveats are fair and well argued. They are consistent with critiques, such as those in Roll (1977) and Roll and Ross (1994), of empirical applications involving the CAPM.

> 'An appealing feature of the O'Hanlon and Steele paper is that it is firmly rooted in economic theory. Thus, one can have little doubts about why their regression equations take the form that they do, nor indeed, why certain variables are included in the form they are and others are omitted. It thus represents a refreshing departure from the data snooping mentality based on easy access to data sets, software packages and the latest econometric nuance that characterises much of what is now passed off as 'scholarly' research in the accounting discipline. The novel and original idea behind the O'Hanlon and Steele paper is that it seeks to provide an estimate of the equity risk premium using a parsimonious interpretation of the equity valuation model developed by Ohlson (1995). A clever insight allows O'Hanlon and Steele to turn the pricing relationship implied by this model into one which relates the firm's accounting rate of return to its cost of equity capital. Estimates of the cost of equity capital obtained by this process are then regressed on estimated betas to return an estimate of the equity risk premium which, it is claimed, avoids many of the problems encountered by researchers in the past.
>
> It is my contention, however, that there are so many imponderables at both the theoretical and empirical levels it is all but impossible to make a concrete assessment of the credibility of the estimate of the equity risk premium that O'Hanlon and Steele come up with. These imponderables arise out of the use of numerical methods to derive measures which proxy for some true but unknown variables, the estimation of betas using an inefficient index portfolio and the likelihood that the structural model on which their analysis is founded, is seriously misspecified. Thus, whilst it is clear that they report a different estimate of the market risk premium when compared to some (but not all) papers in the area, this might or might not be due to problems with a mis-specified (and certainly inefficient) modelling procedure and/or the econometric procedures they employ. Furthermore, if the results reported by Roll and Ross (1994) and Ashton and Tippett (1998) amongst others are correct, it is clear that there are currently few, if any, analytical bases for determining whether one estimate of the market risk premium can be claimed to be 'better' than another.' (Tippett 2000, pp. 1101-1102)

References in Citations

O'Hanlon and Steele (2000), which is the first published paper to use accounting numbers in measuring the ICC, has been cited frequently. Furthermore, it has been recognised by Peter Easton, one of the most eminent specialists in the measurement of ICC, as an important contribution to that area of study. For example (Easton 2006) notes that O'Hanlon and Steele (2000) allows for the simultaneous estimation of the cost of capital and expected growth:

> 'The appeal of O'Hanlon and Steele (2000), Easton, Taylor, Shroff and Sougiannis (2002) and Easton (2004) is that they simultaneously estimate the expected rate of return and the expected rate of growth that are implied by the data. No other method does this. The other methods assume a growth rate and calculate the expected rate of return that is implied by the data and the assumed growth rate.' (Easton 2006, p. 376)[11]

Also, Easton (2006) notes what he sees as an advantage of the O'Hanlon and Steele (2000) method in that, by using realised earnings rather than analysts' forecasts of earnings, it avoids upward bias in cost of capital estimates arising from possible upward bias in analysts' forecasts of earnings:

> 'Another shortcoming of the Easton, Taylor, Shroff and Sougiannis (2002) method (and all methods that rely on analysts' forecasts) is that the estimates of the implied expected rate of return may not be an indication of the cost of capital. The method in O'Hanlon and Steele (2000) does not suffer from this bias.' (Easton 2006, p. 393)

An empirical study by Easton and Sommers (2007) cites O'Hanlon and Steele (2000) as the basis for important elements of its empirical research design:

> 'The method we use for estimating the expected rate of return that is implied by prices and current accounting data is an adaptation of the method that O'Hanlon and Steele (2000) use to estimate the equity premium for the United Kingdom.' (Easton and Sommers 2007, p. 985)

> 'The analyses in O'Hanlon and Steele (2000) are based on realized earnings rather than earnings forecasts. Following the essence of the idea in O'Hanlon and Steele (2000), which is summarized in equation (3), we transform this equation to form the following regression relation….' (Easton and Sommers 2007, p. 991)

[11] I note again that, although the method developed in O'Hanlon and Steele (2000) involved the estimation of parameters from which the cost of capital and expected growth could both be estimated simultaneously, O'Hanlon and Steele (2000) focused on estimates of the cost of capital and did not report expected growth rates.

A later paper by Firth, Rui and Wu (2011) cites a reference by Easton (2006) to O'Hanlon and Steele (2000) in support of its research design:

> See Easton (2006) for a discussion of this model. He states that the O'Hanlon and Steele (2000) model is the most suitable model for estimating the cost of capital. The model does not use analysts' forecasts and so is free from the bias inherent in the forecasts. (Firth, Rui and Wu 2011, p. 379)

3.3.2 Implied Cost of Capital: Consideration of the Current State of Knowledge and Research

The published literature on accounting-based measures of ICC originated in the early 2000s. The first published paper was O'Hanlon and Steele (2000) (Paper 6 of this submission, referred to above). O'Hanlon and Steele (2000) was written at around the same time as Claus and Thomas (2001), which was preceded by a working paper issued in 1997 (Claus and Thomas 1997). O'Hanlon and Steele (2000) and Claus and Thomas (2001) were both motivated in part by the observation that estimates of risk premia based on past realised stock returns were too high to be plausible proxies for the ex-ante risk premium.

Claus and Thomas (2001) (CT) aimed to estimate the equity risk premium in the U.S. and a number of other markets on the basis of estimates of ICC. They calculated ICCs from stock price together with an application of RIVM that used analyst-earnings-forecast-based forecasts of residual income up to a medium-term forecast horizon and a terminal value based on assumed post-horizon growth in residual income: the ex-ante ICC was the discount rate that equated stock price to book value plus the present value of the forecast residual incomes. CT reported evidence that the risk premium was of the order of 3%, which was substantially lower than historic-realised-return-based estimates quoted at the time. A contemporaneous paper by Gebhardt, Lee and Swaminathan (2001) (GLS) is similar in many respects to CT. In common with CT, it applies to U.S. data an implementation of RIVM that uses analyst-based forecasts of residual income. GLS's innovation is that the terminal value in its application of RIVM is based on assumed reversion of return on equity (ROE) to industry norms, where one method excludes loss-making firms in calculating these norms and one method includes them. In common with CT, GLS report evidence that risk premia are lower than realised-return-based estimates.

As noted above, O'Hanlon and Steele (2000) (OS) adopted a substantially different approach based on the Ohlson (1995) version of the RIVM. The OS approach gave rise to a company-specific regression model in which realised ROE is regressed on scaled contemporaneous unrealised goodwill (URG). The estimated intercept coefficients from the company-specific regression models are the company-specific implied costs of equity. These are then used, together with CAPM betas and the Securities Market Line, to estimate the risk premium. OS reported evidence that the risk premium was of the order of 5%. Easton, Taylor, Shroff and Sougiannis (2002) (ETSS) used an ICC-estimation method that is similar to that used by OS. Although the two papers were written at around the same time, it appears that the two sets of authors developed their similar methods independently of each other. ETSS developed a cross-sectional regression model in which a forward ROE measure (where the numerator is an accumulation of several years of forward forecast earnings) is regressed on the price-to-book ratio. Similar to OS, estimates of the cost of equity and growth can be extracted simultaneously from the combination of the intercept and slope coefficients. ETSS report risk premia in the region of 5%.

Easton (2006) stresses the sensitivity of ICC estimates to growth assumptions and advises the use of methods such as those used by OS and ETSS that allow for implied growth expectations to be estimated from the data rather than being assumed.

The ETSS method for simultaneous estimation of ICC and growth was later developed further by Nekrasov and Ogneva (2012) to allow growth estimates to be conditioned by firm-specific characteristics. Ashton and Wang (2013) also propose a method for simultaneous estimation of the cost of equity and growth. Their method is conceptually similar to the ETSS method but aims to relax some of the potentially restrictive assumptions underlying ETSS.

Gode and Mohanram (2003) (GM) add to the set of accounting-based ICC-estimation methods with a method based on the Abnormal Earnings Growth Model (AEGM) which, as noted previously, can be seen as a development of the RIVM that uses the first difference of residual income. GM use analyst earnings forecasts to implement a short-horizon version of the AEGM attributed to Ohlson and Juettner-Nauroth (2005) (OJ). Using this formulation, they measure the ICC as the discount rate that equates price to the model-based value. They use their OJ-model-based ICC estimates to estimate U.S. risk premia which they then compare with estimates from two RIVM methods. The RIVM methods are similar to those used by GLS, with one of the methods excluding loss firms in the estimation of industry norms (RIV1) and the other including them (RIV2). GM examine the quality of their ICC estimates by comparing them with risk factors and with realised returns, a validation practice that henceforth became common in the literature. They report that their ICCs from methods based on AEGM and RIV1 are associated with risk factors and that their estimates based on RIV2 are not. They also report that their estimates based on RIV1 outperform those based on AEGM and RIV2 in terms of association with future realised returns.

An influential paper by Easton (2004) develops the AEGM-based approach to ICC estimation. Most notably, it adds the following three measures to the set of accounting-based measures of ICC:

- $r_{\Delta agr}$. This is an AEGM-based measure of ICC. It is derived from a regression model, based on the AEGM but similar in some respects to those used by ETSS and OS, that simultaneously estimates the long-run change in the rate of abnormal growth in earnings (Δagr) and the associated implied cost of equity ($r_{\Delta agr}$).
- r_{PEG}. Easton (2004) shows that a simple special case of the AEGM, in which growth in abnormal earnings growth is zero and dividends are zero, expresses price at time 0 as the excess of expected time-2 earnings over expected time-1 earnings divided by the square of the cost of equity.[12] This simplified version of the AEGM allows the ICC (r_{PEG}) to be given by the square root of the reciprocal of 100 times the PEG (price-earnings to growth) ratio.[13]
- r_{MPEG}. This is the implied cost of equity given by a calculation similar to that used in calculating r_{PEG} but with the modification that expected time-2 earnings includes earnings on assumed-reinvested time-1 dividends.

The AEGM-based measures proposed in Easton (2004) have subsequently become standard measures of ICC. A closely related paper by Easton and Monahan (2005) compares ICC estimates from these measures and from other measures, including those due to CT and GLS, with realised returns. It reports that none of the ICC measures are positively associated with realised returns. This result illustrates the need for caution in using realised returns as a basis for estimating required rates of expected return and in using required rates of expected return as a basis for forecasting actual returns.

[12] There is a straightforward intuition for the cost of equity squared appearing in the denominator of this simple version of the AEGM. In the general AEGM, the expected future abnormal-earnings-growth terms are all capitalised as perpetuities, which involves division by the cost of equity. Calculation of a flat perpetuity of such terms requires a further division by the cost of equity. The numerator is thus divided by the cost of equity squared.

[13] The PEG ratio is the ratio of (i) the forward price-earnings ratio and (ii) the earnings growth rate expressed as a percentage. For example, if the forward price-earnings ratio is 11 and the earnings growth rate is 10%, the PEG ratio is 1.1 (=11/10). This would give a measure of r_{PEG} equal to $(1/(100*1.1))^{0.5}$ = 0.095346 (9.5346%).

Recent literature has seen a focus on the possibility, referred to earlier in the summary of OS, that upward bias in analysts' earnings forecasts might induce upward bias in ICC estimates derived from such forecasts. Easton (2006) and Easton and Sommers (2007) initially highlighted this danger. Both papers noted that the use of realised earnings, as in OS, is one way of avoiding the problem of analyst-forecast bias. Another way of dealing with the problem of analyst-forecast bias in ICC estimation is through the use of model-based earnings forecasts as inputs to the ICC-estimation models. This approach is explored by Hou, van Dijk and Zhang (2012), who report that their model-based estimates of ICC outperform analyst-forecast-based estimates on the criterion of association with returns, and by Li and Mohanram (2014), who report that their model-based method of estimating ICC outperforms the Hou, van Dijk and Zhang (2012) method on the criteria of association with returns and association with risk factors. Another way of dealing with the problem is to attempt to remove the bias from the analyst earnings forecasts. Such an approach is adopted by Mohanram and Gode (2013), who report that such adjustment improves the quality of ICC estimates on the criterion of association with returns, and by Larocque (2013), who reports that such adjustment does not improve the association of ICC estimates with realised returns.

Some subtler methodological issues have also been raised with regard to ICC estimation. Hughes, Liu and Liu (2009) and Penman, Zhu and Wang (2019) both note that there is a standard assumption in ICC estimation that the future cost of capital is expected to be constant over time, whereas in reality it may be expected to be time-varying. Penman, Zhu and Wang (2019) also argue that it needs to be recognised that growth estimates produced by simultaneous estimation of ICC and earnings growth are affected by how items on the balance sheet are accounted for. Furthermore, Penman, Zhu and Wang (2019) argue that ICC-estimation methods that simultaneously estimate

ICC and growth are effectively treating growth as something that needs to be controlled for in estimating ICC rather than as a potential risk factor that needs to be treated as an input to the ICC estimate. Whilst concerns such are those raised by Hughes, Liu and Liu (2009) and Penman, Zhu and Wang (2019) are conceptually justified, dealing with such matters at an empirical level would pose a significantly greater challenge than dealing with factors such as analyst-forecast bias.

Some studies have used ICC-estimation methods that do not use accounting numbers. Brav, Lehavy and Michaely (2005) propose and use a method based on prices, target prices and dividends. This method has also been used by Francis, LaFond, Olsson and Schipper (2004) and Garcia Lara, Garcia Osma and Penalva (2011). Botosan and Plumlee (2005) compare ICC estimates derived from dividend-based valuation models with estimates derived from the RIVM (GLS), from the AEGM and from a PEG-ratio-based model. They do so by reference to the estimates' association with firm risk factors. They report that the association with risk factors is strongest for one of the dividend-based estimates and the PEG-ratio-based estimate. Botosan, Plumlee and Wen (2011) report further evidence in support of dividend-based and PEG-ratio-based methods by reference both to realised returns and to risk factors.

The use of accounting-based measures of ICC has now become standard in the accounting literature in tests of whether things that are believed to be 'good things' give rise to a measurable beneficial outcome in the form of reduced cost of capital. For example, Hail and Leuz (2006) use such measures in an international examination of effects of legal institutions and securities regulation. Guedhami and Mishra (2009) and Chen, Chen and Wei (2011) use such methods to examine the association between corporate-governance factors and cost of capital. A number of studies have used such methods to examine the association between the cost of capital and measures of accounting quality and measures of disclosure (Hribar and Jenkins 2004; Francis, Nanda and Olsson 2005; Kim and Sohn 2013; Li 2015; Blanco, Garcia Lara and Tribo 2015). Most of these studies report evidence that things that are believed to be 'good things' are associated with lower costs of capital. Based on the applications referred to here, the currently favoured methods for ICC estimation appear to be the CT and GLS RIVM-based methods, methods based on AEGM and the relatively simple PEG-ratio-based methods.

3.3.3 Comments on the Location of Paper 6 Within the Literature on Implied Cost of Capital

It appears that, although it may not have been the first paper written on the subject, O'Hanlon and Steele (2000) was the first published paper that implemented an accounting-based method for measuring ICC. Since the early 2000s a vast literature has developed, and continues to develop, on this subject. Accounting-based ICC methods have now become a standard tool for seeking evidence of outcomes associated with a number of factors including those related to securities regulation, corporate governance and accounting quality. The particular ICC-estimation method proposed by O'Hanlon and Steele (2000) is not now frequently used, but its simultaneous estimation of cost of capital and growth and its use of realised accounting numbers, rather than forecasts, have been prominently cited as possible approaches to dealing with problems in ICC estimation.

3.4. Accounting for Credit-Loss Impairment

Accounting for credit-loss impairment is a key element in the measurement of the amortised cost of the financial assets that are stated on that basis on banks' balance sheets. Such assets typically comprise about 70% of banks' assets and are typically in the region of five to ten times larger than book equity. Measurement of the amortised cost of such a material class of banks' assets is important in the calculation of regulatory capital and as an input to measures such as book equity and earnings, which are used in the valuation of banks.

In the remainder of this subsection, I first summarise and discuss the two papers submitted in the sub-area of accounting for credit-loss impairment. My summary and discussion of each of these two papers includes reference to relevant preceding events and literature that provide context for the paper. I then consider the current state of knowledge and research on credit-loss impairment and the location of the submitted papers within the literature on credit-loss impairment.

3.4.1 Paper 7. 'Did loan-loss provisioning by U.K. banks become less timely after implementation of IAS 39?'. *Accounting and Business Research*, 2013, 43 (3): 225-258.

Single-authored paper.

[Google Scholar citations: 22]

In the decades prior to the financial and banking crisis of the late 2000s, regulation in relation to accounting for credit-loss impairment had seen some oscillation in emphasis between the potentially conflicting aims of (i) ensuring that allowances for credit losses fully reflect in a timely manner credit-loss-relevant information and are therefore not understated and (ii) ensuring that allowances for credit losses are not overstated as a means of facilitating earnings and capital management, of which there is much evidence in the academic literature. At the time of the financial and banking crisis, both in the U.S. and under International Financial Reporting Standards (IFRS), the second of these considerations was more heavily weighted than the first. Credit-loss impairment was measured under the incurred-loss method, and both regimes had seen recent re-affirmations of restrictive evidence requirements for the recognition of credit losses. Further details on this context are provided later in this supporting paper in the summary and discussion of Hashim, Li and O'Hanlon (2019) (Paper 8).

In the wake of the financial and banking crisis, it was suggested that the strict evidence requirements of the incurred-loss method had prevented the timely recognition of predictable credit losses prior to the crisis, thereby exacerbating the crisis (Dugan 2009; Financial Crisis Advisory Group 2009). Partially in response to such comment, the FASB and the IASB had embarked upon paths that would loosen the evidence requirements for the recognition of losses and make their recognition more timely (IASB 2009; FASB 2010; FASB/IASB 2011). In relation to concerns about the timeliness of the incurred-loss method of accounting for credit losses, Gebhardt and Novotny-Farkas (2011) had examined whether the implementation in the European Union (EU) of the incurred-loss method required by *IAS 39 Financial Instruments: Recognition and Measurement* (IASB 2003) had resulted in less timely recognition of credit losses. Using a measure of asymmetric timeliness used by Nichols, Wahlen and Wieland (2009) that was developed from a measure initially developed by Ball and Shivakumar (2005), Gebhardt and Novotny-Farkas (2011) report evidence that the IAS 39 incurred-loss method had reduced the timeliness of loss recognition relative to the pre-IAS 39 regimes across the EU. Also, the Select Committee on Economic Affairs of the U.K. House of Lords had conducted in 2010-2011 an enquiry into the Auditing profession (House of Lords 2011a; House of Lords 2011b). This enquiry had included some discussion of the concept of 'prudence', which had been removed, with some controversy, from the 2010 version of the IASB's 2010 Conceptual Framework (IASB 2010).[14] Some witnesses claimed that the adoption of the incurred-loss requirements of IAS 39 in the U.K., as part of the U.K.'s adoption of IFRS, had caused U.K. accounting for credit losses to become damagingly less prudent than it had previously been.

O'Hanlon (2013) (Paper 7) addresses the question of whether the adoption of IAS 39 in the U.K. had made the U.K.'s accounting for credit losses less timely. It did so by examining the timing of loan-loss recognition relative to the eventual charge-off of loans. It used a hand-collected data set for 12 quoted U.K. banks and 25 unquoted U.K. banks. The use of these hand-collected data allowed the research design to take account of complications reflected in Figure 1 of the paper. Also, it allowed the research design to deal with potential shortcomings of the use of charge-offs to measure the timeliness of loss recognition.[15] The paper reports evidence that the adoption of IAS 39 in the U.K. did not reduce the timeliness of credit-loss recognition, and that for the subset of quoted banks it increased it. The inference is robust to an asymmetric-timeliness-based test similar to that conducted in the EU-wide study by Gebhardt and Novotny-Farkas (2011). It is also robust to comparison with a replication of the test on machine-readable data for U.S. banks, which were not directly affected by IAS 39.

In interpreting the U.K. results in O'Hanlon (2013), it is noted that pre-IAS 39 U.K. GAAP already included what was effectively an incurred-loss method for accounting for credit losses that could be argued to have had less strict, or at least less

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[14] 'Prudence' had been an aspect of 'reliability' in the pre-2010 IASB Conceptual Framework. Due in part to concern that references to 'prudence' might wrongly encourage downward bias in the amounts at which net asset values are stated in financial statements, references to 'prudence' were absent from IASB (2010). However, references to 'prudence' were reinstated in the IASB's 2018 Conceptual Framework (IASB 2018) on the clearly-stated basis that 'prudence' denotes the exercise of caution under uncertainty and should not be regarded as a route to the introduction of downward bias into reported net asset values.

[15] In light of evidence in Liu and Ryan (2006) that US banks may have overstated charge-offs in order to help conceal excessive loan-loss expensing, O'Hanlon (2013) measures charge-offs net of next-year recoveries.

strictly-worded, evidence requirements than IAS 39. Any negative impact of IAS 39 on timeliness of credit-loss recognition may therefore have been less strong in the U.K. than in other countries that had more liberal pre-IAS 39 methods of accounting for credit losses. If anything, it appeared that the stricter evidence requirements of IAS 39, which might be expected to act as an affirmation of the incurred-loss evidence requirement, had tended to enhance the timeliness of recognition of credit losses.[16]

The evidence in O'Hanlon (2013) that incurred-loss and stricter incurred-loss evidence requirements may not necessarily be bad things is relevant to debate on accounting for credit losses referred to later in this supporting paper.

References in Citations

References in citations include the following:

- Singleton-Green (2015, p. 127). 'O'Hanlon (2013) is a reminder that investigating the relationship between financial reporting and the financial crisis is not identical with investigating the role of mandatory IFRS adoption in the financial crisis. O'Hanlon (2013) argues that U.K. banks were using an incurred loss method of calculating loan loss provisions for some time before they were required to adopt IFRS.'
- Marton and Runesson (2017, p. 163). 'Using a model similar to ours, O'Hanlon (2013) focuses on the predictive ability of LLP; however, the sample is limited to U.K. banks. We add to the findings in these studies by making a distinction between high- and low-judgment standards, with variations cross-sectionally and

[16] O'Hanlon (2013) noted that the years immediately after the effective date of IAS 39 saw the implementation of the Basel 2 framework (BCBS 2006), which may have had some effect in improving the quality of the information on credit losses reflected in financial statements.

over time. We highlight the potential impact of country-variant enforcement and bank-level incentives in this setting.'

- Giner and Mora (2019, p. 740). '… O'Hanlon (2013) shows that the less forward-looking approach followed by IAS 39 (with stricter evidence requirements compared with the prior U.K. model) did not result in less timely loss recognition.'

3.4.2 Paper 8. 'Reflections on the development of the FASB's and IASB's expected-loss methods of accounting for credit losses'. *Accounting and Business Research*, 2019, 49 (6): 682-725.

Joint with Noor Hashim and Weijia Li. This paper is one of several outputs from a body of work undertaken by myself, Noor Hashim and Weijia Li on the development of expected-loss-based methods of accounting for credit losses. The overall contributions of the three authors to this body of work, including to the work reported in this paper, were approximately equal. The original idea for this body of work and the original idea for this paper came from me. In relation to the body of work on which this paper is based, I acted as the lead in a research-grant bid to the Institute of Chartered Accountants in England and Wales (ICAEW) and in liaising with the European Parliament on a commissioned report by the three authors. The three authors all contributed importantly to the design of the work to be undertaken and to the work itself, in the form of consultations with observers of the process of development of expected-loss methods, examination of meeting records and examination of comment-letter responses. I took the lead in the drafting of this paper, with significant input from and consultation with my two co-authors.

[Google Scholar citations: 1]

Hashim, Li and O'Hanlon (2019) is one of several outputs from a body of research undertaken with my co-authors on issues associated with the lengthy and difficult process whereby, in the wake of the financial and banking crisis of the late 2000s, the FASB and the IASB developed expected-loss methods of accounting for credit-loss impairment. The development of these methods culminated in the inclusion by the IASB of its expected-loss method in *IFRS 9 Financial Instruments* (IASB 2014) and in the issue by the FASB of *Accounting Standards Update No. 2016-13. Financial*

Instruments – Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments (FASB 2016). The body of research by myself, Noor Hashim and Weijia Li was initiated through a research-grant bid to the Institute of Chartered Accountants in England and Wales (ICAEW) in which I took the lead. In addition to this paper, this body of work currently includes:

- a report commissioned by the European Parliament in connection with the process for EU endorsement of *IFRS 9 Financial Instruments* (IASB 2014) (O'Hanlon, Hashim and Li 2015);
- an academic paper based on the report to the European Parliament (Hashim, Li and O'Hanlon 2016);
- an ICAEW report based on analysis of comment letters written in response to standard-setters' recommendations (O'Hanlon, Hashim and Li 2018);
- an as-yet-unpublished working paper (Hashim, Li and O'Hanlon 2020).

Hashim, Li and O'Hanlon (2019) (Paper 8) was based on an invited presentation by myself at a Symposium at the 2017 Congress of the European Accounting Association. It aims to provide an overview of the development of expected-loss methods by the FASB and the IASB, focusing in particular on difficulties that arose during the process including those that resulted in failure to achieve FASB/IASB convergence on accounting for credit losses. Some key contributions of the paper are as follows.

First, Hashim, Li and O'Hanlon (2019) describes institutional context for the development of expected-loss methods. It describes how, in the decades prior to the financial crisis, there was some oscillation between (i) concern in the wake of the savings and loan crisis of the late 1980s to ensure that allowances for credit losses were not understated and (ii) concern in the wake of the SunTrust Banks case of the late

1990s to ensure that allowances for credit losses were not overstated in order to facilitate earnings and capital management. At the onset of the financial crisis of the late 2000s, the U.S. regulatory context in relation to accounting for credit losses remained tilted towards the latter concern. See SAB 102[17] and FFIEC (2001). IFRS in relation to accounting for credit losses were also tilted towards the latter concern: the 2003 revision of IAS 39 saw a reaffirmation of the incurred-loss evidence requirements of IAS 39 including through a statement that 'Losses expected as a result of future events, no matter how likely, are not recognised' (IASB 2003, paragraph 59). The paper also provides some context relating to regulatory capital, noting that measurement of regulatory capital under the Basel internal-ratings-based approach includes deduction of the excess of expected losses over eligible provisions (allowances) that are deducted in arriving at book equity. The paper notes that the concept of 'expected loss' and its use in measuring capital were well established in bank regulation before the term 'expected loss' became commonly used in relation to accounting for credit losses.

Second, Hashim, Li and O'Hanlon (2019) provides some context for the development of expected-loss methods from three areas of the academic literature. The literature on the use of allowances for credit losses for the purposes of earnings management and capital management by banks is relevant because concern about such manipulation was central in motivating the standard-setters' relatively strict pre-crisis evidence requirements for the recognition of credit losses. Prior literature referenced in the paper that provides evidence of such management includes Moyer (1990), Beatty, Chamberlain and Magliolo (1995), Collins, Shackelford and Wahlen (1995), Kim and Kross (1998), Ahmed, Takeda and Thomas (1999), Lobo and Yang (2001), Kanagaretnam, Lobo and Mathieu (2003), Shrieves and Dahl (2003), Hasan and Wall

[17] SAB 102 is available from: https://www.sec.gov/interps/account/sab102.htm [Accessed 10 April 2018].

(2004), Kanagaretnam, Lobo and Yang (2004), Liu and Ryan (2006), Anandarajan, Hasan and McCarthy (2007), Perez, Salas-Fumas and Saurina (2008), Fonseca and Gonzalez (2008), Huizinga and Laeven (2012) and Bouvatier, Lepetit and Strobel (2014). Relatively recent papers by Beck and Narayanamoorthy (2013) and Balla and Rose (2015), suggest that restricting earnings management through incurred-loss evidence requirements may have resulted in less timely loss recognition. Also, the literature on conditional and unconditional conservatism is relevant to consideration of the relative benefits of higher loss allowances and lower loss allowances. Hashim, Li and O'Hanlon (2019) cites evidence from a number of studies, both from the general conservatism literature including Ball and Shivakumar (2005), Ryan (2006) and Roychowdhury and Watts (2007), and from the conservatism literature in relation to banks including Nichols, Wahlen and Wieland (2009). Furthermore, the literature on the association between accounting for credit losses and the stability of the financial system is relevant because concern about such association was responsible in part for the standard-setters' action on accounting for credit losses in the wake of the crisis. Hashim, Li and O'Hanlon (2019) reviews a number of papers related to this issue. These include Beatty and Liao (2011), who predict and find that banks with relatively untimely credit-loss recognition make relatively large reductions in their lending during recessions, and Bushman and Williams (2015), who report that delayed loss recognition results in adverse systemic effects due to a clustering of vulnerability to downside risk among banks.

Third, the paper describes and reviews the standard-setters' development of their expected-loss methods of accounting for credit losses by reference to five exposure documents and related recommendations. This part of the paper focuses in particular on issues that caused difficulty for the standard-setters and issues that impeded

FASB/IASB convergence. Reference is made to statements made in publications and in recorded meetings by members of standard-setting boards. Some reference is also made to results from the authors' analysis of comment letters that are reported in more detail in other related papers by the authors. A key inference from this description and review is that, although the FASB and IASB readily agreed on a liberalisation of the evidence requirements for the recognition of credit losses, FASB/IASB convergence was impeded by an underlying difference of preference between the FASB and the IASB with regard to how conservative it is appropriate to be in accounting for such losses, with the FASB apparently being subject to stronger bank-regulatory-related pressure than the IASB. The FASB eventually approved its Current Expected Credit Loss (CECL) model, which required full recognition of all expected future (lifetime) credit-losses on in-scope financial assets at each reporting date including on the first reporting date after origination or purchase of the asset. A loss recognised at that time is sometimes referred to as a 'day-one loss'. The IASB eventually approved a less conservative method under which 12-months expected losses would be recognised for all in-scope financial assets at day one, with lifetime expected losses being recognised for assets that experienced subsequent deterioration in credit quality. Central to the FASB/IASB disagreement was the issue of the recognition of expected credit losses at day one, which is conceptually flawed in that it involves recognising expected credit losses that are already reflected in the transaction price. The IASB was willing to accept what it acknowledged was the conceptually-flawed day-one recognition of 12 months expected losses as part of a method for approximating outcomes from a conceptually supportable spreading of the recognition of initially-expected credit losses over time. The FASB could not accept partial recognition of expected credit losses, and required day-one recognition of all initially-expected credit losses.

Fourth, the paper highlights problems likely to emerge in years after the effective dates of the IASB expected-loss method (2018) and the FASB's CECL method (fiscal years beginning after December 15, 2019 for SEC filers; fiscal years beginning after December 15, 2020 for other public business entities).[18] We refer here to two issues. First, the FASB's proposal that loss allowances should cover lifetime expected losses for all in-scope assets was seen as posing implementation problems that many preparers did not feel able to deal with. Second and related to the previous point, the conceptually-flawed recognition of expected losses at day-one could have a number of adverse consequences including the disincentivising of lending in difficult times.[19]

Fifth, the paper provides a suggestion for an alternative route that the standard-setters might have taken in order to avoid the problems inherent in their chosen expected-loss path. It is noted that the concept of expected loss came from the bank regulatory world and that, 'although it may be consistent with the way in which bank regulators require expected losses on exposures to be reflected for the purpose of determining banks' capital requirements, this approach is not easily justified for the purpose of measuring credit-loss expense and loss allowances in financial statements' (Hashim, Li and O'Hanlon 2019, p. 713). Hashim, Li and O'Hanlon (2019) argues that

[18] For all entities other than SEC filers that are not defined as smaller reporting companies, the effective date for the FASB's CECL method was subsequently postponed to fiscal years beginning after December 15, 2022

[19] As far as the FASB's CECL model was concerned, problems emerged more rapidly than anticipated by Hashim, Li and O'Hanlon (2019). Subsequent to the finalisation of Hashim, Li and O'Hanlon (2019) and prior to the effective date of the FASB's CECL method, serious concerns were raised in the U.S. Congress about likely adverse effects of the requirement to recognise lifetime expected losses on all in-scope assets and the requirement to recognise such losses at day one. In mid-2019, two related bills were introduced in the U.S. Senate and the U.S. House of Representatives. These bills would delay implementation of CECL and require quantitative study of its likely effects on, among other things, the availability of credit, the competitiveness of U.S. banks and the U.S. economy in general. In November 2019, the FASB delayed the effective date of CECL to fiscal years beginning after December 15, 2022 for all entities other than SEC filers that are not defined as smaller reporting companies. On January 15, 2020, the proceedings of a U.S. House of Representatives hearing on oversight of standard-setters were dominated by robust questioning of the FASB Chair about CECL, about its likely effects and about why its likely effects had not been more fully examined by the FASB before FASB (2016) was issued. In March 2020, the *Coronavirus Aid, Relief, and Economic Security Act* (the CARES Act) gave all U.S. banks a time-limited opt-out from implementation of CECL.

the standard-setters could probably have dealt satisfactorily with the problems of lack of timeliness in accounting for credit losses, without introducing the problem of day-one loss and related issues, by settling for benefits from the readily-agreed liberalisation of the evidence requirements for recognition of credit losses within an adapted incurred-loss-like structure. In relation to this, it is observed that expectations can fit within an incurred-loss-type framework, and that thinking about 'incurred loss' and 'expected loss' in the following way may have been helpful:

> i. Any method of accounting for credit losses must use a current (as at the loss-recognition date) information set of some sort;
> ii. Any method of accounting for credit losses operates in a setting in which financial assets were originally recognised at a transaction price (amount lent or purchase price) that can normally be expected to have reflected expectations at the initial-recognition date of future shortfalls relative to contractual cash inflows;
> iii. The information set referred to in (i) is used, explicitly or implicitly, to make estimates of ***expected*** future cash flows (or shortfalls relative to contractual or previously expected amounts) and risk in relation to a financial asset or financial assets;
> iv. These estimates are used, explicitly or implicitly, to arrive at an appropriate carrying value for a financial asset or financial assets;
> v. The appropriate carrying value is then compared with the pre-existing carrying value of the asset or assets to establish what loss if any has been ***incurred*** and should be recognised as an impairment within a loss allowance. (Hashim, Li and O'Hanlon 2019, 712-713)

In commenting on the characterisation quoted above, the reviewer of the paper said '…I commend the authors for the most enlightening structure to analyze the terms 'expected' and 'incurred'… The structure is most helpful (and could be seen as a contribution of the paper in its own right)'.

Hashim, Li and O'Hanlon (2019) is to be reproduced in a book drawing on papers in the special issue of *Accounting and Business Research* in which the paper was published.[20]

[20] The book is expected to be published by Routledge in 2021 with the title *Accounting and Debt Markets: Four Pieces on the Role of Accounting Information in Debt Markets* (ISBN (Hardback) 978-0-367-68889-9).

References in Citations

At the time of writing this supporting paper, Hashim, Li and O'Hanlon (2019) had only recently been published. Citation data is therefore limited. Some of the studies from the related body of work referred to above have been cited, mainly in relation to the history of the development of expected-loss methods or the properties of methods of accounting for credit-loss impairment. According to Google Scholar at August 2020, Hashim, Li and O'Hanlon (2016) has been cited 28 times and O'Hanlon, Hashim and Li (2015) has been cited 11 times.

3.4.3 Accounting for Credit-Loss Impairment: Consideration of the Current State of Knowledge and Research

As noted above, the decades prior to the financial and banking crisis of the late 2000s saw concern to avoid understatement of credit-loss allowances, which was then over-ridden by earnings-management-related concern to avoid overstatement of allowances. The onset of the financial and banking crisis saw a reversion to a predominance of concern to avoid understatement of allowances which, at least in the U.S. at the time of writing, seems as if it might be over-ridden by another reversion to a predominance of concern to avoid overstatement of allowances. Much of this oscillation reflects the tension between the desirability that accounting for credit-loss impairment should be sensitive to credit-loss-relevant information and the desirability that it should not be vulnerable to manipulation. The literature referred to in Hashim, Li and O'Hanlon (2019) under the headings of (i) earnings management and capital management by banks, (ii) conditional and unconditional conservatism and (iii) the association between accounting for credit losses and the stability of the financial system relates to this context. The issue of the effect of tighter incurred-loss evidence requirements in the

U.K. that was examined in O'Hanlon (2013) and the review of the development of the FASB (2016) and IASB (2014) expected-loss methods in Hashim, Li and O'Hanlon (2019) contribute to understanding of issues that arose in the wake of the crisis.

At the time of writing, accounting for credit-loss impairment is a topical issue and can be expected to remain so for the foreseeable future. The literature in this area can be expected to be substantial and fast-moving in years after the effective dates of the FASB (2016) and IASB (2014) accounting standards. In particular, it is likely that, as sufficient post-effective-date credit-loss-impairment data become available, there will be many empirical studies of the effects of the new expected-loss methods, including with regard to:

- informativeness for investors and other stakeholders, including in relation to timeliness of loss recognition, comparability, susceptibility to earnings management, value relevance and risk relevance;
- the amount and/or quality of lending by banks;
- usefulness of banks' accounting information for contracting purposes;
- financial stability.

As at the time of writing, I am unaware of any such completed empirical studies based on post-effective-date credit-loss-allowance data. However, there are a number of recent studies that have explored properties of expected loss methods in other ways. I now consider literature that has emerged in this area since Hashim, Li and O'Hanlon (2019) was written.

Bischof, Laux and Leuz (2018) review evidence from the financial crisis that is relevant to the link between accounting and financial stability. A number of important issues emerge from their review. They note that, as reported by Badertscher, Burks and Easton (2012), fair-value accounting (FVA) was less influential in creating problems during the financial crisis than was claimed at the time. They note that 'It is a misconception that FVA dominates banks' balance sheets (e.g., Laux and Leuz, 2010). For banks, loans constitute by far the largest category, and a large fraction of banks' losses occurred in the loan books. However, banks apply amortized cost accounting for almost their entire loan portfolio.' (Bischof, Laux and Leuz 2018). Bischof, Laux and Leuz (2018) also note that under-reporting of loan losses prior to the crisis of the late 2000s could be detected in fair-value disclosures and in Form 8-K disclosures, which were not constrained by requirements regarding the accounting recognition of credit losses. This suggests that the incurred-loss method was less of a binding constraint on the timeliness of credit-loss recognition than is sometimes suggested, with a substantial element of the lack of timeliness coming from managers' reluctance to exercise the discretion available to them. Their findings suggest that accounting for loan losses may have given rise to a material problem in the crisis but that the incurred-loss method of accounting for such losses may not have been the main cause of this problem.

Vijayaraghavan (2019) reports evidence that is also supportive of the view that the incurred-loss method itself was not a major source of lack of timeliness in accounting for credit losses. That study reports that, by varying the weights applied to inputs, it was possible to construct a prediction model that outperforms the then-current GAAP incurred-loss model in the prediction of future loan losses without expanding the information set beyond what is available to be used under the incurred-loss model.

Gomaa, Kanagaretnam, Mestelman and Shehata (2019) employ an experimental method to compare the likely properties of credit-loss provisioning under the IAS 39 incurred-loss method and the IFRS 9 expected-loss method. On the basis of their experiment, they predict that the effect of the liberalisation of evidence requirements under the IFRS 9 expected-loss method relative to the incurred-loss method will increase the amount and adequacy of loss allowances. Importantly, they also predict that this benefit can be achieved without a material offsetting cost in the form of increased earnings management.

Abad and Suarez (2017) conducted a study for the European Systemic Risk Board (ESRB) Task Force on the implications for financial stability of the Introduction of IFRS 9. They use assumed loan-portfolio properties to compare the levels of allowances and the responses to negative shocks for a number of methods of measuring loan impairment. Their analysis predicts that the IFRS 9 method will increase loss allowances relative to incurred loss by about 1.5% of the amount of loan exposures.

In another study of likely effects of the IFRS 9 expected-loss method, Kund and Rugilo (2019) use European bank stress-test results from 2014 to 2018 to examine the effect of the IFRS 9 method in alleviating the 'cliff effect' of the type that is likely to occur under the IAS 39 incurred-loss method. Because of the more liberal loss-recognition evidence requirements of IFRS 9 relative to IAS 39 and the up-front recognition of 12-months expected losses, they believe that the cliff effect should be less severe under IFRS 9 than under IAS 39. However, they note that this benefit would be obtained at the cost of recognition of losses at day one 'which might deter managers from acquiring such loans in the first place' (Kund and Rugilo 2019, p.24).

Chae, Sarama, Vojtech and Wang (2018) use Californian mortgage-loan data to model the predicted effects of CECL provisioning on the size and timing of loss allowances in the face of differing sets of expectations (actual and counterfactual) regarding future house prices. They predict that CECL-based provisioning will tend to be less pro-cyclical than provisioning under the incurred-loss method. They note however that comparisons of provisions across banks and across time might be complicated by the increased scope under CECL for modelling assumptions to differ across banks and across time. These points are consistent with the recurrent conflict between the desirability of permitting loss allowances to reflect a broad information set and the desirability of preventing loss allowances from being unduly subjective and thereby vulnerable to an undesirable level of manipulation.

3.4.4 Comments on the Location of Papers 7 and 8 Within the Literature on Accounting for Credit-Loss Impairment

Concern with regard to accounting for credit-loss impairment has appeared to oscillate decade-by-decade between concern to avoid understatement of loss allowances and concern to avoid overstatement of such allowances. Prior to the financial and banking crisis of the late 2000s, accounting standard-setters had positioned themselves at the latter part of the spectrum. The crisis, which prompted criticism of the restrictive nature of the incurred-loss-based rules on the accounting recognition of credit-loss impairment, saw a shift in concern toward the former part of the spectrum. Both O'Hanlon (2013) and Hashim, Li and O'Hanlon (2019) report evidence relevant to this latest shift in concern that has been reflected in the replacement of incurred-loss methods by expected-loss methods. Both papers suggest that the concern and criticism directed at the incurred-loss method in the wake of the crisis may have been excessive. Hashim, Li and O'Hanlon (2019) suggest that the action taken in replacing incurred-loss methods by expected-loss methods, particularly in the U.S., may give rise in the future to objections that lenders are being required to recognise unduly large loss allowances. Recent activity in the U.S. Congress and action by the FASB, shortly before the first effective date of the FASB's CECL method, already indicate evidence of this. It can be predicted that the issues highlighted in Hashim, Li and O'Hanlon (2019) will continue to be a prominent subject of academic accounting literature for many years to come.

4. Conclusion

The three sub-areas addressed by the eight papers submitted for the award of PhD are all important elements of the accounting literature relating to business valuation. Literature on the residual income valuation model (RIVM) and related models has contributed importantly to the academic study of the relationships between accounting numbers and business value. It also contributes to practice and accounting research on the measurement of value creation for performance-measurement purposes. Literature on implied cost of capital (ICC) draws upon accounting-based valuation models, including the RIVM, to provide techniques for the estimation of implied ex-ante measures of the cost of capital. Such measures are important both in the valuation of businesses and in academic research on the benefits of stronger institutional arrangements, stronger corporate governance and higher accounting quality. Literature on accounting for credit-loss impairment informs the study and practice of the amortised-cost-based measurement of financial assets. Because of the materiality of the assets measured at amortised cost on banks' balance sheets, the measurement of such assets is a material input to measures such as earnings and book value that are important in the valuation of banks. The papers that I have submitted have each contributed to some degree to one of these three sub-areas of the literature in the broad area of Accounting and Business Valuation.

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Appendix 1

Full Listing of Author's Publications

A.1 Papers in Refereed Journals

Items in bold type are those that are submitted for the award of PhD by published work.

1. Gao, Z., W. Li and J. O'Hanlon. 2019. The informativeness of U.S. banks' statements of cash flows. *Journal of Accounting Literature* 43 (2019): 1-18.
2. **Hashim, N., W. Li and J. O'Hanlon. 2019. Reflections on the development of the FASB's and IASB's expected-loss methods of accounting for credit losses. *Accounting and Business Research* 49 (6): 682-725.**
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Appendix 2

Additional Unpublished Paper Provided for Information:

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CLEAN SURPLUS RESIDUAL INCOME AND EARNINGS BASED VALUATION MODELS

John O'Hanlon

CLEAN SURPLUS RESIDUAL INCOME AND EARNINGS BASED VALUATION MODELS

JOHN O'HANLON

DEPARTMENT OF ACCOUNTING AND FINANCE
LANCASTER UNIVERSITY
LANCASTER LA1 4YX
UK
Telephone: (44) (0)524-65201

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CLEAN SURPLUS RESIDUAL INCOME AND EARNINGS BASED VALUATION MODELS

ABSTRACT

Motivated by the fact that residual income based models of the link between the value of equity capital and the outputs of accrual accounting recently appearing in the literature have been based on particular assumed classes of residual income time series process, this paper presents a general residual income based expression for the value of equity capital which allows for clean surplus residual income to be generated by any class of ARIMA time series process. It shows that other models appearing in the literature are re-arrangements of special cases of this general expression. Further, motivated by the possibility that unscaled residual income data might plausibly exhibit explosive characteristics which would make it inappropriate to attempt to fit ARIMA models, a general expression for the value of equity is presented in terms of residual income scaled by book value. Re-arrangements of a number of simple special cases of this expression are explored. It is shown that, depending upon the time series properties of the scaled residual income measure, various combinations of the mean Accounting Rate of Return, the current level of Accounting Rate of Return, the current first difference of Accounting Rate of Return and a lagged Market to Book term can appear in accounting based models of the value of equity.

CLEAN SURPLUS RESIDUAL INCOME AND EARNINGS BASED VALUATION MODELS

1. Introduction

Accounting earnings appear to play a key role in the formation of analysts' recommendations and are used by accountants and tax authorities as part of the process of valuing the equity capital of unquoted companies. Also, there is a voluminous academic and professional literature dealing with competing accounting earnings constructs. However, there appears to be no generally accepted model of the relationship between accounting earnings and the value of equity capital. As well as hampering the task of financial statement analysts and accounting standard setters, the lack of such a model appears to have contributed to the puzzlingly low levels of association between the behaviour of stock prices and the behaviour of earnings that is generally observed in market based accounting research studies (Lev (1989)).

Some attention has recently been devoted to a model proposed by Ohlson (1991) which is derived by superimposing particular assumptions about the time series properties of clean surplus residual income on a model described by Peasnell (1982) in which the value of equity capital is stated, consistently with the dividend capitalisation model, as the sum of the book value of equity capital and the present value of expected future clean surplus residual income[1]. Ohlson's model expresses the market value of a company's equity capital as the sum of book value and a clean surplus residual income multiple. A rearrangement of it expresses the market value of a company's equity

[1]Clean surplus earnings includes all items, except for injections and distributions of capital, which affect the book value of equity capital. It comprises both accounting profit as disclosed in the financial statements and items which by-pass the income statement and are charged/credited directly to reserves. Clean surplus residual income is clean surplus earnings minus a capital charge based on opening book value.

capital as, partially, a weighted average of the book value of equity capital and a total earnings multiple. The models proposed in Ohlson's pathbreaking work are interesting in that they suggest how the predictive properties of accounting can be used, within a model which is consistent with the dividend capitalisation model, to draw inferences about the value of equity capital. The issues raised by models of the type proposed by Ohlson are of obvious importance to financial statement analysts and are also of interest to academic researchers concerned with the design of tests intended to observe the relationships between stock price and the outputs of accounting. For example, a number of recent studies have used Ohlson's weighted average formulation in support of research designs involving the regression of stock return on price deflated levels and price deflated differences of total earnings (for example Easton and Harris (1991) and Penman (1991)). Ramakrishnan and Thomas (1992) follow Ohlson in proposing three models of the value of equity capital, each of which is based on a separate set of assumptions about the ARIMA time series process which generates residual income.

Section 2 of this paper provides a general framework for residual income based models of the type proposed by Ohlson (1991) and Ramakrishnan and Thomas (1992) by presenting a general expression for the value of equity capital as the sum of book value and the present value of clean surplus residual income which allows clean surplus residual income to be generated by any class of ARIMA process. It is shown that models already in the literature are re-arrangements of special cases of this general expression. Because unscaled residual income has the potential to exhibit explosive characteristics which might cause it to be inappropriate to attempt to fit ARIMA models to the unscaled data, Section 3 presents a re-formulated general expression for the value of equity capital which uses the time series properties of residual income scaled by book value rather than the time series properties of the unscaled residual income series itself. A number of special cases of this re-formulated general model are then investigated and it is shown that each collapses to a model containing one or more Accounting Rate of Return variables with the relative importance of the terms in the models being determined by profitability persistence. Section 4 concludes the study.

2. A general expression for value of equity in terms of the time series properties of unscaled clean surplus residual income.

2.1 The expression

In the following analysis it is assumed that dividends are paid at balance sheet dates which occur at yearly intervals.

The dividend capitalisation model is as follows:

$$P_t = \sum_{\tau=1}^{\infty} E_t[d_{t+\tau}]R^{-\tau} \tag{1}$$

where P_t is the market value of the company's equity capital at year end t, $d_{t+\tau}$ is the dividend expected to be paid at year end $t+\tau$, R is one plus the (assumed constant) cost of equity capital and $E_t[.]$ indicates expectations at year end t. Defining clean surplus earnings for the year ended at year end t (x_t), hereafter termed "earnings for year t", as

$$x_t = y_t - y_{t-1} + d_t$$

where y_t denotes the book value of shareholders' funds at year end t, and defining clean surplus residual income (x^a) for year t as

$$x_t^a = x_t - (R-1)\,y_{t-1} \quad ,$$

the dividend capitalisation model can be transformed to the following (Peasnell (1982)):

$$P_t = y_t + \sum_{\tau=1}^{\infty} E_t[x_{t+\tau}^a]\,R^{-\tau} \quad . \tag{2}$$

This model expresses the value of the equity capital at year end t as the sum of the book value of equity capital at year end t and the present value of expected future x^a, this second term representing unrecorded goodwill. It is a general expression, consistent with the dividend capitalisation model, of the relationship between the value of equity capital and the outputs of accrual accounting. In order to make use of the relationship for the purposes of valuing equity capital, some method for estimating expected future x^a is required. Ohlson (1991) has proposed a model in which x^a is assumed to have an unconditional mean of zero and in which, if one ignores an "other information" term, it is generated by an autoregressive process of order (1) (ARIMA (1,0,0)). Ramakrishnan and Thomas (1992) propose three price models: one of which is similar to Ohlson's in allowing x^a to be generated by an ARIMA(1,0,0) process, one of which allows the first difference of x^a to be generated by an AR(1) process (ARIMA (1,1,0)) and one of which allows the first difference of x^a to be generated by a moving average process of order 1 (ARIMA (0,1,1)).

In this section of the paper, I derive a general residual income based pricing model in which it is assumed that clean surplus residual income (x^a) can be generated by any class of ARIMA (p,d,q) process as follows:

$$(\Delta^d x_t^a - \overline{\Delta}^d x^a) = \sum_{c=1}^{c=p} \omega_c (\Delta^d x_{(t-c)}^a - \overline{\Delta}^d x^a) - \sum_{j=1}^{j=q} \theta_j e_{(t-j)} + e_t \qquad (3)$$

where ω_c is an autoregressive coefficient of order c, θ_j is a moving average coefficient of order j, e_t is a zero mean, independently and identically distributed disturbance term, p, d, and q are orders of the autoregressive process, differencing and moving average process respectively, $\Delta^d x^a$ denotes the dth difference of x^a and $\overline{\Delta}^d x^a$ is the mean of the dth difference of x^a. An expression for the present value of expected future x^a (i.e. the second term on the right hand side of (2)) when x^a is generated by (3) is derived below.

The expression is broken down into five components: 4(i), 4(ii), 4(iii), 4(iv) and 4(v). Firstly, the present value of the effect of the mean of the dth difference of the series is computed. If d=0, this will be the mean capitalised as a level perpetuity:

$$\frac{\overline{\Delta}^0 x^a}{R-1} = \frac{\overline{x}^a}{R-1} \quad .$$

However, if d = 1, x^a will be expected to increase by the mean of the first difference of the series in every future year. This gives rise to an expectation of a perpetuity of perpetual streams suggesting a capitalisation factor of $R/(R-1)^2$, the R in the numerator being necessary because $1/(R-1)^2$ alone would imply that the first realisation is expected to occur at year end 2 rather than year end 1. Generally where the order of differencing is d the value of this term is:

$$\overline{\Delta}^d x^a \left(\frac{R^d}{(R-1)^{(d+1)}} \right) \quad . \qquad (4.i)$$

Secondly, where the order of differencing is greater than zero, the effect on the present value of expected future x^a of the differences of the series of order lower than d have to be accounted for. If d =

1, one would need to capitalise the effect of the mean of the first difference of the series via (4.i) above. However, one would also need to capitalise as a perpetuity (at 1/(R-1)) the level of the series from which the expected future differences represent deviations (i.e. the current difference of order zero). If d = 2, as well as capitalising the effect of the mean of the second difference via (4.i), one would need to capitalise the difference of order zero at 1/(R-1) and the difference of order one at $R/(R-1)^2$. Generally, where the order of differencing is d, (4.ii) becomes:

$$\left(\sum_{z=0}^{z=(d-1)\,[d>0]} \Delta^z x_t^a \left(\frac{R^z}{(R-1)^{(z+1)}} \right) \right) \quad . \qquad (4.ii)$$

Thirdly, it is necessary to capitalise the effect that the current deviation from the mean of the dth difference of the series exerts on future expectations via the autoregressive terms in the model. In the case of an undifferenced series, the application of the autoregressive terms to a current unit deviation of x^a around its mean value will have the following effect on the un-discounted sum of current and expected future x^a (here "delta" denotes "change in"):

$$\sum_{i=0}^{\infty} \frac{delta(x_{t+i}^a - \bar{x}^a)}{delta(x_t^a - \bar{x}^a)} = 1 + \sum_{c=1}^{c=p} \omega_c \sum_{i=0}^{\infty} \frac{delta(x_{t+i}^a - \bar{x}^a)}{delta(x_t^a - \bar{x}^a)} \quad .$$

Re-arrangement of this gives

$$\sum_{i=0}^{\infty} \frac{delta(x_{t+i}^a - \bar{x}^a)}{delta(x_t^a - \bar{x}^a)} \left(1 - \sum_{c=1}^{c=p} \omega_c \right) = 1$$

$$\sum_{i=0}^{\infty} \frac{delta(x_{t+i}^a - \bar{x}^a)}{delta(x_t^a - \bar{x}^a)} = \frac{1}{\left(1 - \sum_{c=1}^{c=p} \omega_c \right)} \quad .$$

To arrive at the effect of a current unit deviation of x^a around its mean value on the discounted sum of current and expected future x^a

requires the replacement of ω_c by (ω_c/R^c) to give

$$PV_t\left[\sum_{i=0}^{\infty} \frac{delta(x_{t+i}^a-\bar{x}^a)}{delta(x_t^a-\bar{x}^a)}\right] = \frac{1}{\left(1 - \sum_{c=1}^{c=p} \frac{\omega_c}{R^c}\right)}$$

where $PV_t[.]$ denotes present value at year end t. If the series is differenced once, every item needs to be capitalised as 1 plus a perpetuity. This involves multiplying by

$$\left(1+\frac{1}{R-1}\right)=\left(\frac{R}{R-1}\right) \quad .$$

If the series is differenced d times the multiplier becomes

$$\left(\frac{R}{R-1}\right)^d$$

giving rise to

$$\frac{1}{\left(\frac{R-1}{R}\right)^d\left(1-\sum_{c=1}^{c=p} \frac{\omega_c}{R^c}\right)} \quad . \qquad \textbf{(4.iii.a)}$$

This expression, however, includes both

(i) the effect of the current deviation on the current level of x^a which is already included in book value

and (ii) the effect, via the orders of differencing lower than d, of the current deviation on the present value of expected future x^a which has already been dealt with within (4.ii).

It is therefore necessary to subtract the following from (4.iii.a):

$$1 + \sum_{z=0}^{z=(d-1)\,[d>0]} \left(\frac{R^z}{(R-1)^{z+1}}\right) = \frac{R^d}{(R-1)^d} \quad .$$

Subtracting this and multiplying by the current deviation from the mean of the dth difference of the series gives:

$$\left(\frac{1}{\left(\frac{R-1}{R}\right)^{d}\left(1-\sum_{c=1}^{c=p}\frac{\omega_c}{R^c}\right)}-\left(\frac{R}{R-1}\right)^{d}\right)\left(\Delta^d x_t^a-\overline{\Delta}^d x^a\right) \quad . \qquad \textbf{(4.iii)}$$

Fourthly, if p > 1 the effect on the present value of expected future x^a of past deviations from the mean of the dth difference will also need to be accounted for. This can be achieved by multiplying the effect of past deviations from the mean on the present value of expected future deviations from the mean by (4.iii.a), thus reflecting the fact that each effect will be expected to trigger off a secondary effect via the autoregressive terms:

$$\left(\frac{1}{\left(\frac{R-1}{R}\right)^{d}\left(1-\sum_{c=1}^{c=p}\frac{\omega_c}{R^c}\right)}\right)\left(\sum_{c=2}^{c=p}\sum_{s=1}^{s=(c-1)}\frac{\omega_c\left(\Delta^d x_{(t-s)}^a-\overline{\Delta}^d x^a\right)}{R^{(c-s)}}\right) \quad . \qquad \textbf{(4.iv)}$$

Fifthly, where the process generating x^a contains moving average term(s), it is necessary to reflect the effect on the present value of expected future x^a of current and past error terms. Again it is necessary to multiply the discounted effect on future deviations from the mean of current and past disturbance terms by (4.iii.a) in order to reflect the fact that each effect will be expected to trigger off a secondary effect via the autoregressive terms:

$$-\left(\frac{1}{\left(\left(\frac{R-1}{R}\right)^{d}\left(1-\sum_{c=1}^{c=p}\frac{\omega_c}{R^c}\right)\right)}\right)\left(\sum_{j=1}^{j=q}\sum_{k=0}^{k=(j-1)}\frac{\theta_j e_{(t-k)}}{R^{(j-k)}}\right) \quad . \qquad \textbf{(4.v)}$$

Combining the five terms (4.i) to (4.v) gives the present value of expected future clean surplus residual income. Substituting this combination for the second term on the right hand side of (2) gives:

$$P_t = y_t + \overline{\Delta}^d x^a\left(\frac{R^d}{(R-1)^{(d+1)}}\right) + \left(\sum_{z=0}^{z=(d-1)\,[d>0]} \Delta^z x_t^a\left(\frac{R^z}{(R-1)^{(z+1)}}\right)\right)$$
$$+ \left(\frac{1}{\left(\frac{R-1}{R}\right)^d\left(1-\sum_{c=1}^{c=p}\frac{\omega_c}{R^c}\right)} - \left(\frac{R}{R-1}\right)^d\right)\left(\Delta^d x_t^a - \overline{\Delta}^d x^a\right)$$
$$+ \left(\frac{1}{\left(\frac{R-1}{R}\right)^d\left(1-\sum_{c=1}^{c=p}\frac{\omega_c}{R^c}\right)}\right)\left(\sum_{c=2}^{c=p}\sum_{s=1}^{s=(c-1)}\frac{\omega_c\left(\Delta^d x_{(t-s)}^a - \overline{\Delta}^d x^a\right)}{R^{(c-s)}}\right) \tag{4}$$
$$- \left(\frac{1}{\left(\left(\frac{R-1}{R}\right)^d\left(1-\sum_{c=1}^{c=p}\frac{\omega_c}{R^c}\right)\right)}\right)\left(\sum_{j=1}^{j=q}\sum_{k=0}^{k=(j-1)}\frac{\theta_j e_{(t-k)}}{R^{(j-k)}}\right) \; .$$

This expression is consistent with the earnings persistence measures used by Kormendi and Lipe (1987) and Collins and Kothari (1989) each of which measures the effect on the value of equity of a shock in the capitalisable variable (earnings) series.

2.2. Relationship of the general expression with other models

It can be shown that a number of theoretical price models recently proposed in the literature, none of which explicitly contain a residual income term, are consistent with the general expression (4).

Ramakrishnan and Thomas (1992) (RT) use three sets of assumptions about the time series properties of residual income, each of which gives rise to a different price model. The first generating process assumed by RT for residual income is ARIMA (1,0,0) with no constant which is the following special case of (3):

$$x_t^a = \omega x_{t-1}^a + e_t \quad . \tag{3.1}$$

The special case of (4) to which this gives rise is

$$P_t = y_t + \left(\frac{1}{1-\frac{\omega}{R}} - 1\right) x_t^a$$
$$= y_t + \left(\frac{\omega}{R-\omega}\right) x_t^a \qquad (4.1)$$

which can be re-arranged (See Appendix 1) to give the following model proposed by RT as the "Book Value Model":

$$P_t + d_t = (y_{t-1} + x_t)\left(\frac{R(1-\omega)}{R-\omega}\right) + \left(1 - \frac{R(1-\omega)}{R-\omega}\right) x_t \left(\frac{R}{R-1}\right) \quad . \qquad (5.1)$$

An alternative re-arrangement of (4.1) which, with the addition of an "other information" variable, appears in Ohlson (1991) is the following weighted average model (See Appendix 1)[2]:

$$P_t = y_t\left(1 - \frac{(R-1)\omega}{R-\omega}\right) + \left(\frac{(R-1)\omega}{R-\omega}\right)\left(x_t\left(\frac{R}{R-1}\right) - d_t\right) \quad . \qquad (5.1.a)$$

A second generating process for residual income assumed by RT is ARIMA (0,1,1) with no constant which is the following special case of (3):

$$(x_t^a - x_{t-1}^a) = -\theta e_{t-1} + e_t \quad . \qquad (3.2)$$

This gives rise to the following special case of (4):

$$P_t = y_t + \frac{x_t^a}{R-1} - \frac{\theta e_t}{R-1} \quad . \qquad (4.2)$$

This can be re-arranged (See Appendix 1) to give the following model

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[2]A returns equation based on (5.1.a), which has been used by a number of authors including Easton and Harris (1991) and Penman (1991) to justify research designs based on the regression of stock returns on levels and differences of earnings, is as follows:

$$r_t = \frac{\left(1 - \frac{(R-1)\omega}{R-\omega}\right) x_t}{P_{t-1}} + \frac{\left(\frac{R\omega}{R-\omega}\right)(x_t - x_{t-1})}{P_{t-1}} + \frac{\left(\frac{(R-1)\omega}{R-\omega}\right) d_{t-1}}{P_{t-1}}$$

where

$$r_t = \frac{P_t + d_t - P_{t-1}}{P_{t-1}}$$

proposed by RT as the "Market Value Model":

$$P_t+d_t=\left(x_t\frac{R}{R-1}\right)(1-\theta)+\theta(P_{t-1}+x_t) \quad . \tag{5.2}$$

A third generating process for residual income assumed by RT is ARIMA (1,1,0) with no constant which is the following special case of (3):

$$(x_t^a-x_{t-1}^a) = \omega(x_{t-1}^a-x_{t-2}^a) + e_t \quad . \tag{3.3}$$

This gives rise to the following special case of (4):

$$P_t=y_t+\frac{x_t^a}{R-1}+\left(\frac{1}{\left(\frac{R-1}{R}\right)\left(1-\frac{\omega}{R}\right)}-\left(\frac{R}{R-1}\right)\right)(x_t^a-x_{t-1}^a) \tag{4.3}$$

which can be re-arranged (See Appendix 1) to give the following model proposed by RT as the "Earnings Model":

$$P_t+d_t = x_t\left(\frac{R}{R-1}\right)\left(1+\frac{R\omega}{R-\omega}\right)-\frac{R\omega}{R-\omega}\left(x_t+x_{t-1}\left(\frac{R}{R-1}\right)-d_{t-1}\right) \quad . \tag{5.3}$$

3. General expression for value of equity in terms of time series properties of the Rate of Residual Income

3.1 The expression

Model (4) and the special cases of it described in the preceding section each assume implicitly that the unscaled residual income series is capable of being transformed into a stationary series through differencing. However, since unscaled residual income is the difference between earnings and a capital charge based on book value, time series of which might each plausibly exhibit the characteristics of an explosive series, it is possible that unscaled residual income might itself exhibit the characteristics of an explosive series. This possibility is illustrated in Appendix 2 which explores the possible behaviour of unscaled residual income under conservative accounting in a certainty setting. If such explosive characteristics are present, it would not be possible to transform unscaled residual income into a stationary series through differencing and model (4), and each of its special cases, would be inappropriate[3]. Such circumstances would suggest the desirability of constructing earnings based price models incorporating the time series properties of a scaled measure of residual income rather than of unscaled residual income itself. In view of this potential problem, expression (4) is re-formulated here in terms of a scaled residual income measure. In keeping with the paper's focus on the investigation of accounting based expressions for the value of equity capital, the scaling variable chosen is accounting book value and the scaled variable is Rate of Residual Income, denoted by χ^a, where

$$\chi_t^a = \frac{x_t^a}{y_{t-1}} \quad .$$

Here it is assumed that χ^a_t is generated by the following process which is of the same form as (3) except that x is replaced by χ throughout:

$$(\Delta^d \chi_t^a - \overline{\Delta}^d \chi^a) = \sum_{c=1}^{c=p} \omega_c (\Delta^d \chi_{(t-c)}^a - \overline{\Delta}^d \chi^a) - \sum_{j=1}^{j=q} \theta_j e_{(t-j)} + e_t \quad . \qquad (6)$$

For the sake of convenience, p, d, q, ω, and θ are now used to describe

[3]The possibility of such an occurrence can also be confirmed by observation of actual data. For example the explosive characteristics of the clean surplus residual income series of AAH Holdings, a UK company, for the period 1969-1993 prevents the fitting of an autoregressive model of order 1 for d=0, d=1, d=2 and d=3.

the ARIMA process generating the Rate of Residual Income and thus capture profitability persistence. For the meaning of these items of notation, see (3).

The re-formulation of model (4) such that its inputs are drawn from the χ^a series, and the time series properties thereof, can be achieved by the replacement of x^a by χ^a, the multiplication of all χ^a forecast terms by y_{t-1} and the replacement of the discount factor R by an (assumed constant) growth deflated discount factor, γ. γ is defined as

$$\gamma = \frac{R}{(1+g)} \quad ,$$

where g is the (assumed constant) rate of growth in book value[4]. The re-formulated model is therefore:

$$\begin{aligned} P_t = y_t + \Bigg[& \overline{\Delta}^d \chi^a \left(\frac{\gamma^d}{(\gamma-1)^{(d+1)}} \right) + \left(\sum_{z=0}^{z=(d-1)\,[d>0]} \Delta^z \chi^a_t \left(\frac{\gamma^z}{(\gamma-1)^{(z+1)}} \right) \right) \\ & + \left(\frac{1}{\left(\frac{\gamma-1}{\gamma}\right)^d \left(1 - \sum_{c=1}^{c=p} \frac{\omega_c}{\gamma^c}\right)} - \left(\frac{\gamma}{\gamma-1}\right)^d \right) \left(\Delta^d \chi^a_t - \overline{\Delta}^d \chi^a\right) \\ & + \left(\frac{1}{\left(\frac{\gamma-1}{\gamma}\right)^d \left(1 - \sum_{c=1}^{c=p} \frac{\omega_c}{\gamma^c}\right)} \right) \left(\sum_{c=2}^{c=p} \sum_{s=1}^{s=(c-1)} \frac{\omega_c \left(\Delta^d \chi^a_{(t-s)} - \overline{\Delta}^d \chi^a\right)}{\gamma^{(c-s)}} \right) \\ & - \left(\frac{1}{\left(\left(\frac{\gamma-1}{\gamma}\right)^d \left(1 - \sum_{c=1}^{c=p} \frac{\omega_c}{\gamma^c}\right)\right)} \right) \left(\sum_{j=1}^{j=q} \sum_{k=0}^{k=(j-1)} \frac{\theta_j e_{(t-k)}}{\gamma^{(j-k)}} \right) \Bigg] y_{t-1} \quad . \end{aligned} \tag{7}$$

[4]It can readily be appreciated that, if zero growth (100% payout) is expected in the future, the χ^a expectations can be converted to x^a expectations simply by multiplying through by y_{t-1}. Adjustment for constant growth in the scaling variable (book value) can be achieved by modifying the discount factor.

3.2 Special cases of the general expression for the value of equity in terms of time series properties of the Rate of Residual Income.

In Section 2 it was shown that Ohlson (1991) and RT (1992) had used special cases of model (4) to develop insights into the circumstances under which certain variables, such as book value, earnings and the lagged market value of equity, were important in explaining the current market value of equity. This section takes a number of plausible special cases of model (7) and re-arranges them so that the value of equity capital is stated as a function of recognisable accounting variables such as Accounting Rate of Return. The special cases considered are those in which the Rate of Residual Income is generated by the following processes: ARIMA (1,0,0) with constant, ARIMA (1,1,0) without constant, ARIMA (0,0,1) with constant and ARIMA (0,1,1) without constant. Throughout the following analysis note that

$$\chi_t^a = A_t - (R-1)$$

where A_t is the Accounting Rate of Return (ARR) at time t.

ARIMA (1,0,0) (With constant)

The special case of (6) which describes this process is:

$$(\chi_t^a - \overline{\chi}^a) = \omega(\chi_{t-1}^a - \overline{\chi}^a) + e_t \quad . \tag{6.1}$$

The appropriate special case of (7) is

$$P_t = y_t + \left[\frac{\overline{\chi}^a}{\gamma - 1} + (\chi_t^a - \overline{\chi}^a)\left(\frac{\omega}{\gamma - \omega}\right)\right] y_{t-1} \quad . \tag{7.1}$$

Addition of the constant (R-1) to the χ terms included in the second term in the square bracket and substitution of

$$y_t = y_{t-1}(1+g) = y_{t-1}\left(\frac{(R-1-g)}{\gamma-1}\right)$$

gives

$$P_t = y_{t-1}\left[\frac{\bar{A}-g}{\gamma-1} + (A_t-\bar{A})\left(\frac{\omega}{\gamma-\omega}\right)\right]$$

where $\bar{A}$ is the mean ARR. Note here that, since (R-1) is assumed to be constant, the parameters of the time series process generating A except for the mean and the constant are the same as those of the time series process generating χ. Thus, ω is the AR(1) coefficient of both the Rate of Residual Income series and the ARR series. Substitution of

$$\frac{\omega}{\gamma-\omega} = \frac{1-\frac{\gamma(1-\omega)}{\gamma-\omega}}{\gamma-1}$$

and some re-arrangement gives

$$P_t = y_{t-1}\left[\frac{(\bar{A}-g)}{\gamma-1}\left(\frac{\gamma(1-\omega)}{\gamma-\omega}\right) + \frac{(\bar{A}-g)}{\gamma-1}\left(1-\frac{\gamma(1-\omega)}{\gamma-\omega}\right) + \frac{(A_t-\bar{A})}{\gamma-1}\left(1-\frac{\gamma(1-\omega)}{\gamma-\omega}\right)\right]$$

which collapses to

$$P_t = y_{t-1}\left[\frac{(\bar{A}-g)}{\gamma-1}\left(\frac{\gamma(1-\omega)}{\gamma-\omega}\right) + \frac{(A_t-g)}{\gamma-1}\left(1-\frac{\gamma(1-\omega)}{\gamma-\omega}\right)\right] \quad . \qquad (8.1)$$

Thus, if the level of the Rate of Residual Income is generated by an autoregressive process of order 1 with constant, the value of equity capital can be modelled as lagged book value times a weighted average of

i) a term containing the mean ARR

and ii) a term containing the current level of ARR.

There is an immediate intuitive interpretation of this result. If ARR follows an AR(1) process (i.e. it is I(0)), the value of equity capital is based partly on the long run mean to which ARR is anchored and partly on the current level of ARR from which the series is expected eventually to revert to its long run mean. The weights attached to the two items are each functions of ω which captures the persistence of profitability. As ω approaches zero $\bar{A}$ is relatively important; as it approaches 1 A_t is relatively important. In the limiting case of a random walk ($\omega = 1$), A_t is the only ARR variable that appears in the expression.

ARIMA (1,1,0) (No constant)

The special case of (6) which describes this process is:

$$\Delta\chi_t^a = \omega\Delta\chi_{t-1}^a + e_t \quad . \tag{6.2}$$

The appropriate special case of (7) is:

$$P_t = y_t + \left[\frac{\chi_t^a}{\gamma-1} + \Delta\chi_t^a\left(\frac{\gamma}{\gamma-1}\right)\left(\frac{\omega}{\gamma-\omega}\right)\right]y_{t-1} \tag{7.2}$$

which upon re-arrangement similar to that carried out in the case of the ARIMA (1,0,0) process gives

$$P_t = y_{t-1}\left[\frac{A_t-g}{\gamma-1} + \Delta A_t\left(\frac{\gamma}{\gamma-1}\right)\left(\frac{\omega}{\gamma-\omega}\right)\right]$$

$$= y_{t-1}\left[\frac{A_t-g}{\gamma-1} + \Delta A_t\left(\frac{\gamma}{\gamma-1}\right)\left(\frac{1 - \frac{\gamma(1-\omega)}{\gamma-\omega}}{\gamma-1}\right)\right]$$

$$= y_{t-1}\left[\frac{A_t-g}{\gamma-1} + \Delta A_t\left(\frac{\gamma}{(\gamma-1)^2}\right)\left(1 - \frac{\gamma(1-\omega)}{\gamma-\omega}\right)\right] \quad . \tag{8.2}$$

Thus, if the first difference of the Rate of Residual Income is generated by an autoregressive process of order 1, the value of equity capital can be modelled as a function of

i) a term containing the current level of ARR and ii) a term containing the current first difference of ARR. Again there is a readily appreciable intuitive interpretation of this result. If ARR follows an ARIMA (1,1,0) (i.e. it is I(1)) the ARR variables of interest differ from those that figured in the AR(1) case. Here, the relevant variables are the current level, which in the I(1) case is permanently impounded in expectations of future realisations of the variable, and the current first difference, which provides information regarding the level to which future differences are expected to cause the series to asymptote. Again the relative importance of the two items depends upon the magnitude of the ω coefficient[5].

ARIMA (0,0,1) (With constant)

The special case of (6) which describes this process is:

$$\chi_t^a = \overline{\chi}^a - \theta e_{t-1} + e_t \quad . \tag{6.3}$$

The appropriate special case of (7) is:

$$P_t = y_t + \left[\frac{\overline{\chi}^a}{\gamma - 1} - \frac{\theta e_t}{\gamma}\right] y_{t-1} \tag{7.3}$$

which upon re-arrangement gives

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[5]The reader may note that, of the four special cases investigated here, the ARIMA (1,1,0) case is the only one that does not give rise to a weighted average representation. This apparent anomaly is removed if it is (somewhat implausibly) assumed that the mean of the first difference of ARR (denoted by $\overline{\Delta A}$) is not zero. Under such a condition expression (8.2) expands to

$$P_t = y_{t-1}\left[\frac{A_t - g}{\gamma - 1} + \Delta\bar{A}\left(\frac{\gamma}{(\gamma-1)^2}\right)\left(\frac{\gamma(1-\omega)}{\gamma-\omega}\right) + \Delta A_t\left(\frac{\gamma}{(\gamma-1)^2}\right)\left(1 - \frac{\gamma(1-\omega)}{\gamma-\omega}\right)\right]$$

which contains a weighted average of (i) a term containing the mean of the first difference of ARR and (ii) a term containing the current first difference of ARR. Here, the contrast with the AR(1) case is clear: the ARIMA (1,0,0) case gives a weighted average representation including terms containing (i) the mean of ARR and (ii) the current level of ARR; the ARIMA (1,1,0) case gives a representation including a current level term plus a weighted average of terms containing (i) the mean of the first difference of ARR and (ii) the current first difference of ARR.

$$P_t = y_{t-1}\left[\frac{\bar{A}-g}{\gamma-1} - \frac{\theta e_t}{\gamma}\right] . \qquad (7.3.i)$$

Since

$$e_t = (A_t-\bar{A}) + \theta e_{t-1}$$

and

$$e_{t-1} = \left(\frac{\bar{A}-g}{\gamma-1} - \frac{P_{t-1}}{y_{t-2}}\right)\frac{\gamma}{\theta} ,$$

(7.3.i) can be re-arranged to give

$$P_t = y_{t-1}\left[\frac{\bar{A}-g}{\gamma-1} - \frac{\theta}{\gamma}\left((A_t-\bar{A}) + \gamma\left(\frac{\bar{A}-g}{\gamma-1} - \frac{P_{t-1}}{y_{t-2}}\right)\right)\right] .$$

Further re-arrangement gives

$$P_t = y_{t-1}\left[\frac{(\bar{A}-g)}{\gamma-1}(1-\theta) + \left(M_{t-1}(1+g) - \frac{(A_t-\bar{A})}{\gamma}\right)\theta\right] \qquad (8.3)$$

where M_{t-1} is the Market to Book ratio at time t-1. Thus, if the level of the Rate of Residual Income is generated by a moving average process of order 1, the value of equity capital can be modelled as y_{t-1} times a weighted average of

i) a term containing the mean ARR

and ii) a term containing the excess of the current level of ARR over the mean level of ARR and a lagged Market to Book term.

Note that this re-arrangement of the MA(1) special case, and the re-arrangement of the ARIMA (0,1,1) special case given below, each include lagged Market to Book terms. This mirrors the RT result that an ARIMA (0,1,1) process in unscaled residual income gives rise to a weighted average formulation for the value of equity capital which includes a lagged market value term. As far as the intuition underlying the MA(1) case is concerned, one notes that as with the AR(1) case $\overline{A}$ and A_t each appear, with A_t now being capitalised as a single period effect (through multiplication by $1/\gamma$) rather than as a decaying perpetuity effect. However, the intuition for the inclusion of the lagged Market to Book term is less clear, especially when one considers that a positive time series dependency in χ, which would give a negative value for θ, would give rise to a negative relationship between P_t and M_{t-1}. (A similar situation arises in the RT "Market Value Model" (expression (5.2) above).) An explanation of this situation is that the inclusion of $\theta M_{t-1}(1+g)$ acts primarily to reverse the effect of $-\theta\overline{A}/(\gamma-1)$ which has been included in the first term during the process of re-arranging (7.3.i) into an expression containing recognisable accounting variables on the right hand side[6].

ARIMA (0,1,1) (No constant)

The special case of (6) which describes this process is:

$$\chi_t^a = \chi_{t-1}^a - \theta e_{t-1} + e_t \quad . \qquad \textbf{(6.4)}$$

The appropriate special case of (7) is:

$$P_t = y_t + \left[\frac{\chi_t^a}{\gamma-1} - \frac{\theta e_t/\gamma}{\gamma-1/\gamma}\right] y_{t-1} \qquad \textbf{(7.4)}$$

which upon re-arrangement gives

$$P_t = y_{t-1}\left[\frac{A_t-g}{\gamma-1} - \frac{\theta}{\gamma-1}e_t\right] \quad . \qquad \textbf{(7.4.i)}$$

[6]Recall from the special case of the fundamental valuation model (7.3.i) that the θ term attaches to the current period shock not to the long run mean.

Since

$$e_t = (A_t - A_{t-1}) + \theta e_{t-1}$$

and

$$e_{t-1} = \left(\frac{A_{t-1}-g}{\gamma-1} - \frac{P_{t-1}}{y_{t-2}}\right)\frac{\gamma-1}{\theta} \quad ,$$

(7.4.i) can be re-arranged as follows:

$$P_t = y_{t-1}\left[\frac{A_t-g}{\gamma-1} - \frac{\theta}{\gamma-1}\left((A_t-A_{t-1}) + \left((A_{t-1}-g) - \frac{P_{t-1}}{y_{t-2}}(\gamma-1)\right)\right)\right] \quad .$$

Further re-arrangement gives:

$$P_t = y_{t-1}\left[\frac{(A_t-g)}{\gamma-1}(1-\theta) + (M_{t-1}(1+g))\theta\right] \quad . \qquad (8.4)$$

Thus, if the first difference of the Rate of Residual Income is generated by a moving average process of order 1, the value of equity capital can be modelled as y_{t-1} times a weighted average of

i) a term containing the current level of ARR

and ii) a term containing the lagged Market to Book term.

The contrast with the MA(1) case lies primarily in the disappearance of the $\overline{A}$ term, A_t now being the only ARR variable which appears.

To conclude with respect to analysis of the four special cases, those cases in which the Rate of Residual Income and ARR are I(0) give rise to expressions for the value of equity capital which feature the mean of ARR and the current level of ARR whilst those cases in which the Rate of Residual Income and ARR are I(1) give rise to expressions which feature the current level of ARR and, in the case of ARIMA (1,1,0), the current first difference of ARR. The moving average representations also contain lagged Market to Book terms. The relative importance of the variables in the various models is determined by terms capturing the persistence of profitability.

4. Conclusion

This paper presents a general expression for the value of equity capital in terms of book value and clean surplus residual income expectations where clean surplus residual income can be generated by any class of ARIMA time series process and shows that various residual income based models of the relationship between the value of equity and the outputs of accrual accounting which are in the literature are consistent with the general expression. Because of the possibility that unscaled residual income might exhibit behaviour which would make the unscaled series unsuitable for the estimation of ARIMA processes, a general expression for the value of equity capital in terms of the Rate of Residual Income is then presented. A number of special cases of this expression are investigated. It is found that if the level of ARR is generated by an AR(1) process with constant the value of equity capital is a function of the mean of ARR and the current level of ARR. If the first difference of ARR is generated by an ARIMA (1,1,0) process with no constant, the relevant ARR variables are the current level and the current first difference. In the case in which the level of ARR is generated by an MA(1) process with constant, it is found that the value of equity capital is a function of the mean ARR and a term containing both the excess of the current level of ARR over the mean of ARR and a lagged market to book term. When the first difference of ARR is generated by an MA(1) process with no constant, it is found that the value of equity capital is a function of the level of ARR and a lagged market to book term. Of the special cases investigated, those in which the Rate of Residual Income and ARR are I(0) suggest a role for the mean of ARR and the current level of ARR in equity valuation; those in which the Rate of Residual Income and ARR are I(1) suggest a role for the current level of ARR and, in the ARIMA (1,1,0) case, the current first difference of ARR.

Appendix 1: Reconciliation of equation (4) with models in Ramakrishnan and Thomas (1992) (RT) and Ohlson (1991)

i. ARIMA (1,0,0) (No constant)

The special case of (4) to which this gives rise is

$$P_t = y_t + \left(\frac{1}{1-\frac{\omega}{R}} - 1\right)x_t^a$$
$$= y_t + \left(\frac{\omega}{R-\omega}\right)x_t^a \quad . \tag{4.1}$$

This can be re-arranged as follows:

$$P_t = y_t + (x_t - (R-1)\ (y_t - x_t + d_t))\frac{\omega}{R-\omega}$$
$$= y_t\left(1 - \frac{(R-1)\,\omega}{R-\omega}\right) + \frac{R\omega x_t}{R-\omega} - \frac{(R-1)\,\omega d_t}{R-\omega}$$
$$= y_t\frac{R(1-\omega)}{R-\omega} + \frac{\omega\,(R-1)}{R-\omega}\left(x_t\left(\frac{R}{R-1}\right) - d_t\right)$$
$$= y_t\frac{R(1-\omega)}{R-\omega} + \left(1 - \frac{R(1-\omega)}{R-\omega}\right)\left(x_t\left(\frac{R}{R-1}\right) - d_t\right)$$
$$P_t + d_t = y_t\frac{R(1-\omega)}{R-\omega} + \left(1 - \frac{R(1-\omega)}{R-\omega}\right)\left(x_t\left(\frac{R}{R-1}\right)\right) + d_t\left(\frac{R(1-\omega)}{R-\omega}\right)$$
$$= (y_t + d_t)\left(\frac{R(1-\omega)}{R-\omega}\right) + \left(1 - \frac{R(1-\omega)}{R-\omega}\right)x_t\left(\frac{R}{R-1}\right)$$
$$= (y_{t-1} + x_t)\left(\frac{R(1-\omega)}{R-\omega}\right) + \left(1 - \frac{R(1-\omega)}{R-\omega}\right)x_t\left(\frac{R}{R-1}\right) \quad .$$

(5.1)

This is termed the "Book Value Model" in RT. An alternative re-arrangement of the third line of the above gives

$$P_t = y_t\left(1 - \frac{(R-1)\,\omega}{R-\omega}\right) + \left(\frac{(R-1)\,\omega}{R-\omega}\right)\left(x_t\left(\frac{R}{R-1}\right) - d_t\right) \tag{5.1.a}$$

which expresses the value of equity as a weighted average of (i) book value and (ii) an earnings multiple less d_t. This expression, with the addition of an "other information" variable appears in Ohlson (1991).

ii. ARIMA (0,1,1) (No constant)

The special case of (4) to which this gives rise is

$$P_t = y_t + \frac{x_t^a}{R-1} - \frac{\theta e_t}{R-1} \tag{4.2}$$

which, defining x^n_t as $y_{t-1}(R-1)$, gives

$$\begin{aligned} P_t + d_t &= y_{t-1} + x_t - d_t + d_t + \frac{x_t^a}{R-1} - \frac{\theta e_t}{R-1} \\ &= \frac{x_t^n}{R-1} + x_t + \frac{x_t^a}{R-1} - \frac{\theta e_t}{R-1} \\ &= x_t\left(\frac{R}{R-1}\right) - \frac{\theta e_t}{R-1} \quad . \end{aligned}$$

Note that, in the case of the class of time series model assumed,

$$e_t = x_t^a - (x_{t-1}^a - \theta e_{t-1})$$

which, with the addition of $y_{t-1}(R-1)$ to the first and second terms on the right hand side gives

$$\begin{aligned} e_t &= x_t - (y_{t-1}(R-1) + x_{t-1}^a - \theta e_{t-1}) \\ &= x_t - P_{t-1}(R-1) \quad . \end{aligned}$$

Therefore

$$\begin{aligned} P_t + d_t &= x_t\left(\frac{R}{R-1}\right) - \theta\left(\frac{x_t - P_{t-1}(R-1)}{R-1}\right) \\ &= x_t\left(\frac{R}{R-1}\right) - \theta\left(\frac{x_t R}{R-1} - \frac{(R-1)\,x_t}{R-1} - P_{t-1}\right) \\ &= \left(x_t \frac{R}{R-1}\right)(1-\theta) + \theta\,(P_{t-1} + x_t) \quad . \end{aligned} \tag{5.2}$$

This is termed the "Market Value Model" in RT.

iii. ARIMA (1,1,0) (No constant)

The special case of (4) to which this gives rise is

$$P_t=y_t+\frac{x_t^a}{R-1}+\left(\frac{1}{\left(\frac{R-1}{R}\right)\left(1-\frac{\omega}{R}\right)}-\left(\frac{R}{R-1}\right)\right)(x_t^a-x_{t-1}^a) \tag{4.3}$$

which, defining x^n_t as in section (ii) above, gives

$$\begin{aligned}
P_t&=y_t+\frac{x_t^a}{R-1}+\left(\frac{R}{R-1}\right)\left(\frac{\omega}{R-\omega}\right)(x_t^a-x_{t-1}^a)\\
P_t+d_t&=y_{t-1}+x_t-d_t+d_t+\frac{x_t^a}{R-1}+\left(\frac{R\omega}{(R-1)\ (R-\omega)}\right)(x_t^a-x_{t-1}^a)\\
&=\frac{x_t^n}{R-1}+x_t+\frac{x_t^a}{R-1}+\left(\frac{R\omega}{(R-1)\ (R-\omega)}\right)(x_t^a-x_{t-1}^a)\\
&=x_t\left(\frac{R}{R-1}\right)+\left(\frac{R\omega}{(R-1)\ (R-\omega)}\right)(x_t^a-x_{t-1}^a)\quad .
\end{aligned}$$

Since

$$\begin{aligned}
(x_t^a-x_{t-1}^a)&=(x_t-x_{t-1}-(R-1)\ (y_{t-1}-y_{t-2}))\\
&=(x_t-x_{t-1}-(R-1)\ (x_{t-1}-d_{t-1}))\quad ,
\end{aligned}$$

cum dividend price can be written as

$$\begin{aligned}
P_t+d_t&=x_t\left(\frac{R}{R-1}\right)+\left(\frac{R\omega}{R-\omega}\right)\left(\left(\frac{x_t-x_{t-1}}{R-1}\right)-(x_{t-1}-d_{t-1})\right)\\
&=x_t\left(\frac{R}{R-1}\right)+\left(\frac{R\omega}{R-\omega}\right)\left(\frac{x_t}{R-1}-x_{t-1}\left(\frac{R}{R-1}\right)+d_{t-1}\right)\\
&=x_t\left(\frac{R}{R-1}\right)+x_t\left(\frac{R}{R-1}\right)\left(\frac{R\omega}{R-\omega}\right)-x_t\left(\frac{R\omega}{R-\omega}\right)-\frac{R\omega}{R-\omega}\left(x_{t-1}\left(\frac{R}{R-1}\right)-d_{t-1}\right)\\
&=x_t\left(\frac{R}{R-1}\right)\left(1+\frac{R\omega}{R-\omega}\right)\ -\ \frac{R\omega}{R-\omega}\left(x_t+x_{t-1}\left(\frac{R}{R-1}\right)-d_{t-1}\right)\quad .
\end{aligned}$$

(5.3)

This is termed the "Earnings Model" in RT.

Appendix 2: Behaviour through time of unscaled residual income under conservative accounting in a certainty setting

In this Appendix it is shown that it is plausible that unscaled residual income might exhibit explosive characteristics. For this purpose an analysis is made of the behaviour of unscaled residual income in a certainty setting under a particular assumed type of conservative accounting. The following simple set of circumstances is assumed:

i) A company is incorporated at time 0 with an initial equity capital of P_0. There are no further infusions of equity capital.

ii) The initial equity capital is invested in its entirety in the company's operations which generate economic income at a constant rate, R-1, this rate being equal to the constant cost of equity capital. The company's investment is thus in a zero net present value activity.

iii) The company's business generates an annual free cash flow representing a constant proportion of beginning of year economic value. This free cash flow is paid out as a dividend. The dividend yield, denoted by D, is thus constant. The annual dividend is always less than the annual accounting earnings.

Conservatism is assumed to manifest itself in the reporting as annual accounting income of a constant proportion ($C < 1$) of annual economic income. It is assumed that the initial investment in the company of P_0 is recorded in the books at P_0 (i.e $y_0 = P_0$) and that subsequent divergence of y from P occurs as the result of the "under-reporting" of income.

Residual income at time t is earnings at time t less a capital charge based on the accounting book value at time t-1:

$$x_t^a = P_0\left((R-D)^{t-1}(R-1)C - \left(1+\sum_{s=1}^{t-1}(R-D)^{s-1}((R-1)C-D)\right)(R-1)\right)$$

$$= P_0(R-1)\left((R-D)^{t-1}C - \left(1+\left(\frac{(R-D)^{t-1}-1}{(R-1)-D}\right)((R-1)C-D)\right)\right)$$

$$x_t^a = P_0(R-1)\left(\frac{(R-1)C-D}{R-1-D}-1\right)$$
$$+ P_0(R-1)\left(C-\frac{(R-1)C-D}{R-1-D}\right)(R-D)^{t-1} \quad .$$

For the special case of C=1

$$x_t^a = 0 \qquad \textit{for all } t.$$

For a typical case in which $C < 1$ and $D > 0$, x^a will have a "base value" of

$$P_0(R-1)\left(\frac{(R-1)C-D}{R-1-D}-1\right)$$

and an initial (negative) value at time 1 of

$$P_0(R-1)(C-1) = P_0(R-1)C - y_0(R-1) \quad .$$

In subsequent periods, unscaled residual income will move explosively away from its "base value".

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