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Trends in statistically based quarterly cash-flow prediction models

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ABSTRACT

This paper provides a succinct review and synthesis of the literature on statistically based quarterly cash-flow prediction models. It reviews extant work on quarterly cash-flow prediction models including: (1) complex, cross-sectionally estimated disaggregated-accrual models attributed to Wilson (1986, 1987) and Bernard and Stober (1989), (2) parsimonious ARIMA models attributed to Hopwood and McKeown (1992), (3) disaggregated-accrual, time-series regression models attributed to Lorek and Willinger (1996), and (4) parsimonious ARIMA models with both adjacent and seasonal characteristics attributed to Lorek and Willinger (2008, 2011). Due to the unavailability of long-term cash-flow forecasts attributed to analysts, increased importance has been placed upon the development of statistically based cash-flow prediction models given their use in firm valuation. Specific recommendations are also provided to enhance future research efforts in refining extant statistically based quarterly cash-flow prediction models.

1. Introduction

This paper provides an overview and synthesis of research devoted to statistically based, quarterly cash-flow prediction models, a topic of considerable interest to academic researchers in accounting and finance, financial analysts, standard-setting boards like the Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB), and retail investors. It is timely to undertake this task due to recent empirical findings (e.g., Lorek & Willinger, 2011) that have considerably altered the understanding of: (1) the key time-series properties of reported quarterly cash-flow from operations (CFO), (2) the joint impact of quarter-to-quarter (adjacent) and quarter-by-quarter (seasonal) autocorrelation in the time series of quarterly CFO, (3) and the recommended structural form(s) of statistically based quarterly CFO prediction model(s). Finally, it also provides a set of recommendations for future research seeking to refine extant statistically based quarterly CFO prediction models.

The current paper is directly related to Nurnberg (2006) and Herrmann, Saudagaran, and Thomas (2006). Nurnberg provides a cautionary note pertaining to the use of the CFO series in valuation contexts similar to those that we describe. He questions the inherent superiority of CFO vis-à-vis the earnings series. While there is no question that earnings numbers are more readily subject to manipulation by opportunistic managers, the CFO series, nevertheless, may also be managed using acquisition and disposition transactions as discussed by Nurnberg. Such distortions serve to undermine the pristine nature of the CFO series and reduce the usefulness of CFO numbers in the valuation contexts described herein. Moreover, they provide a cautionary note and underscore a potential limitation of employing CFO numbers in firm valuations.

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Herrmann et al. (2006) argue that the use of fair value measures for property, plant, and equipment vis-à-vis historical cost may serve to enhance the predictive value of accounting series. If Hermann et al.'s analytical reasoning is substantiated via empirical testing, then the inherent advantages of CFO versus earnings in valuation settings may be mitigated. Herrmann et al. (2006) suggest further that the use of historical costs for valuing property, plant, and equipment in the United States, unless such assets are impaired, may serve to undermine the usefulness of accounting numbers for economic decisions. To the extent that fair value measures replace historical costs across diverse asset classes, the importance of the predictive performance of the CFO models described herein may be diminished.

2. Background

In some ways, the current paper is reminiscent of O'Hanlon's (1995) work summarizing the univariate time-series properties of earnings data. Both papers summarize extant work on the modeling of two different but important financial series – earnings and cash flows. While O'Hanlon's study focuses primarily upon earnings, both annual and quarterly, the current paper is focused on statistically based prediction models for quarterly CFO data. Kim and Kross (2005) observe that valuation models employed by analysts typically favor the use of CFO as an input series as opposed to net earnings thereby enhancing interest in specifying the time-series properties of CFO. Therefore, the objects of prediction, both of considerable importance to accounting and finance researchers and practitioners, are different. Additionally, the current paper discusses very recent research efforts highlighting novel advancements in the modeling of quarterly CFO as well as providing suggestions for future modeling efforts. Finally, the current paper provides an important linkage between the modeling of quarterly net earnings and quarterly CFO by citing recent evidence by Lorek and Willinger (2011) that the Brown–Rozeff $(100)\times(011)$ ARIMA time-series model originally popularized on quarterly earnings data some forty years ago provides the most accurate multi-step ahead quarterly CFO predictions currently.[1]

Bowen, Burgstahler, and Daley (1986) discuss several reasons why accounting researchers and members of the investment community should be interested in cash-flow forecasting. Such interest may be linked to a multitude of decision settings that rely upon CFO predictions as inputs including risk assessment, the accuracy of credit-rating predictions, and firm valuation. Moreover, domestic and international standard-setting bodies in accounting have underscored the primacy of CFO forecasting by stating the importance future cash flows have to investors and creditors and emphasizing that prediction of CFO provides a central rationale for the existence of accrual accounting (IASB/FASB, 2006, p. 18). Therefore, interest in deriving relatively accurate, long-term CFO forecasts is high among academics as well as business professionals.

This paper concentrates upon reviewing work on quarterly rather than annual CFO prediction models for several reasons. First, quarterly CFO data may potentially exhibit both quarter-to-quarter (adjacent) and quarter-by-quarter (seasonal) autocorrelations simultaneously whereas such seasonal autocorrelations are not possible in annual CFO data making the latter series basically unsuitable for extensive time-series modeling. Second, Box–Jenkins ARIMA time-series models provide a family of relatively powerful yet parsimonious prediction models that are particularly suitable for modeling quarterly data. Third, the extant time-series literature in accounting pertaining to earnings provides useful clues in precisely how ARIMA prediction models for quarterly CFO data may be identified. Specifically, researchers like Lorek (1979), among others, enhanced the predictive ability of annual earnings by employing a conditioning database of quarterly rather than annual earnings data. Similarly, relatively recent empirical work on CFO data has also employed this disaggregation approach to enhance predictive performance (see Lorek & Willinger, 2011).

The current unavailability of widely disseminated analysts' multi-step-ahead quarterly CFO forecasts has increased interest in understanding the statistical properties of quarterly CFO data (Barniv, Myring, & Thomas, 2005). Numerous financial statement analysis texts emphasize the need for such long-term CFO forecasts which serve as inputs to firm valuation models (e.g., Lundholm & Sloan, 2007; Palepu & Healy, 2008; Penman, 2007). Ironically, the multi-step-ahead quarterly CFO forecasts generated by the statistically based prediction models discussed in this paper currently represent the *only* source of long-term quarterly CFO forecasts that are presently available. Without such relatively long-term CFO forecasts, analysts and investors must resort to cruder "back of the envelope" valuation techniques perhaps employing earnings as a proxy for CFO in conjunction with average industry multiples as opposed to using a conceptually more rigorous valuation approach like discounted cash flows.

Research assessing the efficacy of statistically based quarterly cash-flow prediction models is not as extensive as that devoted to annual work. Dechow, Kothari, and Watts (1998), Barth, Cram and Nelson (2001), and Kim and Kross (2005) have examined the predictive ability of annual CFO. One advantage of annual work is the ability to obtain large samples of firms given the cross-sectional estimation procedures that the aforementioned works typically employ. A potential disadvantage, however, is that rigorous analysis of sample autocorrelation functions is precluded given the lack of time-series data. Dechow et al. (1998) speculate that since the measurement interval inherent in quarterly data is shorter, the analytics and empirics of quarterly CFO modeling are considerably more complex than that employed on annual CFO data. The potential seasonality inherent in quarterly CFO data seemingly contributes to such incremental complexity. Nevertheless, researchers have

[1] We employ customary $(pdq)\,X\,(PDQ)$ ARIMA notation where (p,P) are regular and seasonal autoregressive parameters, respectively; (d,D) are consecutive and seasonal differences, respectively; and (q,Q) are regular and seasonal moving-average parameters.