Intrinsic Equity Valuation: An Empirical Assessment of Model Accuracy

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Abstract
The discounted cash flow model and relative valuation models are ever-increasingly prevalent in today’s investment-heavy environment. In other words, theoretically inferior models are used in practice. It is this paradox that has lead us to compare the discounted cash flow model (DCF), discounted dividend model (DDM), residual income-based model (RIVM) and the abnormal earnings growth model (AEGM) and their relative accuracy to observed stock prices. Adding to previous research, we investigate their performance in relation to the OMX30 index. What is more, we test how the performance of each model is affected by an extension of the forecast horizon. The study finds that AEGM outperforms the other models, both before and after extending the horizon. Our analysis was conducted by looking at accuracy, spread and the inherent speculative nature of each model. Taking all this into account, RIVM outperforms the other models. In this sense, one can question the rationale behind investor’s decision to primarily use the discounted cash flow model.
Definitions and terminology
While some of the models used in this study are straightforward, others require a deeper understanding of valuation and accounting principles. In this sense, equity valuation can in part be a narrow and complex topic. Thus, this part intends to give the reader the tools necessary to comprehend the more abstruse parts of this paper.

Residual income and Abnormal Earnings
Investors require a rate of return, compensation, on their invested equity. Therefore, even if a company is profitable, it may actually be unprofitable when this compensation is taken into account. The residual-income based valuation method only considers this “excess” capital. If a company earns more than its cost of capital it generates abnormal earnings, which is synonymous to residual income.

Accrual and Cash Accounting
Cash accounting only recognizes a transaction when there is an exchange of cash, an inflow or outflow of cash. Accrual accounting is an accounting principle that matches revenues to expenses. In other words, it does not take into account the actual cash transaction. Today, most companies use the latter principle because it gives a more accurate view of the company. It is a more complex procedure, which also makes valuation relatively more complex today than what is was before. In this sense, accounting principles have shifted and become more liberal.

Clean Surplus Relationship and Dirty Surplus Accounting
Clean surplus relationship (CSR) links the income statement and the balance sheet by assuming that all changes in book values has to flow through income, except transactions with shareholders (dividends, issues of shares and repurchase of shares). Accounting is considered to maintain a CSR when the profit or loss of the year corresponds to the difference in book value of equity at the beginning and the end of the year, adjusted for shareholder transactions. In other words, CSR ensures that actual earnings represent all gains and losses. Thus, when the relationship is applied book value represent a good estimate of value. On the contrary, if items affecting book value of equity do not flow through the income statement some value may be lost, or become harder to measure. This is called dirty surplus accounting.

Shareholders Equity, Book value and ROE
Shareholders equity represents the net value of a company. It is the difference between total assets minus liabilities:

\[ \text{Shareholder’s equity} = \text{Total Assets} - \text{Total Liabilities} \]

It is a fundamental concept in equity valuation. If a company were to be liquidated the shareholder’s equity is what would remain. It is also referred to as book value.

To measure a company’s ability to generate profit for its shareholders one can use ROE (Return on Equity):

\[ \text{ROE} = \frac{\text{Net Income}}{\text{Shareholder’s equity}} \]
In other words, similar to residual income, ROE can be used to express an investor’s point of view. A high ROE ratio would imply that the company is successful in using the shareholder’s equity effectively.

**Intrinsic and Relative Equity Valuation**

The actual value of a company or an asset is often referred to as a company’s intrinsic value, its real value, which may or may not reflect the market value. Commonly used techniques are discounting cash flows, dividends or earnings. In contrast, relative valuation, as opposed to intrinsic valuation, compares a company’s financial performance to that of others in the same industry. Multiples, for example EV/EBITA, P/E or EV/EBIT are commonly associated with this method.

**Terminal Values**

Terminal values or ”continuing value” calculation is used to discount a future value at the horizon. Theoretically, companies are assumed to last forever, but analysts usually make finite forecast calculations. Therefore, the terminal value is added to account for the future, beyond the forecast horizon.

**Steady State and Perpetual Growth**

The perpetuity and steady state growth rate is in this study used synonymously. They are used in terminal value calculations where a constant growth rate is assumed. In other words, steady state and perpetual growth is a constant growth rate into perpetuity.
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1. Introduction
Merger and acquisition (M&A) activity was up 32% in 2015 and marks “…the strongest year for deal making on record” and the value of worldwide M&A is now totaled to 4.7 trillion dollars (ThomsonReuters, 2015). For the economy as a whole, these numbers show the importance of companies merging and acquiring each other, but they also point to the necessity for methods to efficiently and adequately value companies. In other words, equity valuation is essential to understand the fundamental underpinnings of modern finance, its limitations and benefits.

It is well established that it is of importance for commercial organizations to generate wealth, both to please investors and for managers to raise capital. Consequently, even if the way of wealth distribution may vary, the creation of value is substantial for all firms. To measure financial performance managers usually rely on information and figures from the accounting system. Investors use firms published records to assist them when selecting stocks. In this regard, when evaluating firms there is practical interest between share prices and accounting information.

A traditional approach in financial theory to determine economic value is to capitalize future payoffs that an owner of an asset will receive. In other words, the current value of an investment is the payoff over the holding period discounted at the opportunity cost of capital. When applied in equity valuation this theoretical approach yields a variety of different techniques. The common thread is forecasting the future, but they differ in what payoff to forecast. In other words, the payoffs to be discounted can be defined in different ways. In addition, due to going concern these techniques all require terminal values to enable practical forecasts over a finite number of years.

As accounting principles has become more liberal over the years the difficulty in predicting income has increased. Consequently, the traditional equity valuation models based on distribution of wealth have given room for models based on accounting information. In other words, the focus has shifted towards predictions of earnings and book values rather than on dividends or cash flows. The goal of this paper is to take a closer look at these methods and evaluate their adequacy.

1.1 Problem Definition and Objective
Financial accounting has focused on the comparison of the residual income-based (RIVM) and the discounted cash flow models (DCF) for equity valuation (Penman & Sougiannis, 1998). On the subject of intrinsic equity valuation, Jennifer Francis, Per Olsson and Dennis R. Oswald (2000) argue that there is "… little to gain – and if anything something to lose- from selecting dividends or free cash flow over abnormal earnings as the fundamental attribute to be valued". Furthermore, Penman and Sougiannis (1998) conclude: "valuation errors are lower using accrual earnings techniques rather than cash flow and dividend discounting techniques". In other words, valuation based on discounting cash flows and dividends is less accurate and adds a degree of uncertainty compared to earnings.

Demirakos et al. (2004) and a more recent study by Shahed Imam, Richard Barker and Colin Clubb (2008) found that DCFM has gained some momentum in terms of popularity in recent times. According to aforementioned findings, there is a significant correlation between the popularity of DCFM valuation and the perceived need to feature the valuation as more
rational than it truly is. What is more, intrinsic equity valuation postulates a utilitarian criterion: an infinite time horizon. When applied in practice forecast are made in a finite period requiring a terminal value calculation at the horizon. Thus, its limitations (i.e. determining terminal values) have caused investors to also rely on more subjective valuation shortcuts (e.g. "multiples").

These studies have become the epitome of a universal question: what should analysts forecast? Should they focus on discounting cash flows, dividends or earnings? The question is not only relevant to analysts but also to students. A common question raised is why the different models yield different answers, when in theory they are equivalent. The choice, as this paper will show, is not between the models but the accounting within them.

Given the credibility and flexibility of the DCFM it has become a perennial form of equity valuation, but financial practitioners are ultimately the final pundits (Penman 2001). The models, though theoretically sound, have to be practical and easy to use (Penman, 2005). In other words, DCFM presents a predicament. As a model it is highly considered, but it has forced practitioners to use theoretically inferior models. Thus, we see an opportunity to investigate if there are other, inherently more accurate and reliable models that can be used as a compliment to DCFM.

1.2 Research Question
In regards to the above, this essay will focus on comparing the discounted dividends model (DDM), the discounted cash flow model (DCFM), the residual income-based model (RIVM), as well as the abnormal earnings growth valuation model (AEGM) and their relative performance to observed stock prices on the Swedish stock market. How do the estimates compare to actual market prices, assuming market efficiency, and which model is the most accurate? Finally, considering previous research (e.g. Penman 2005; Jorgensen, Lee and Yoo 2011) we also investigate the possible performance-enhancing effects of extending the forecast horizon from two to five years.

Previous research on the Swedish market is limited and, in that sense, this paper adds to the current literature.

1.3 Limitations
The time periods (2009-2011, 2009-2014) contain the most recent and high quality financial data. The time frames are not linked to any particular event. This study simply aims to test the models using the most recent, available data.

The data sample for this study consists of stocks from OMX Stockholm 30 (OMX30), which consist of the 30 most traded companies on the Stockholm Stock Exchange that fit our models well.

This study evaluates the tools that analysts have at their disposal when valuing equity. Thus, ex post data is used instead of ex ante, analyst forecasts. Unfortunately, analyst forecasts of earnings, dividends and cash flow are not widely reported. What is more, using ex post data is effective seeing as we only evaluate the models ability to predict stock prices and not the analyst, thus eliminating any biases that are likely to interfere with the evaluation (Penman & Sourgiannis, 1998). However, one cannot deny that ex ante, analyst forecast would add to this paper, but this is outside the scope of our study.
1.4 Disposition
Section 2 describes the four valuation models used in this study and how they have progressed throughout the years. In section 3 and 4, we present our chosen method and how we have collected the necessary data. Next, we present our results followed by a detailed analysis where we elaborate on the findings (section 5 and 6). Finally, in section 7, we conclude the paper by discussing the results, implications and where this might lead future research.
2. Previous Research

2.1 Discounted Cash Flow Model (DCF)

Lundholm and O’Keefe (2001) identify that DCFM has had a special status throughout the 20th century due to its solid theoretical ground. Consequently, DCFM is the most commonly used and possibly the most taught valuation model at business schools around the world. Its dominant practical utilization has been demonstrated in research such as Demirakos, Strong and Walker (2004) or Imam, Barker and Clubb (2011). The presumption, according to Penman and Sougiannis (1998), is that free cash flow better represents value added over a short horizon than dividends. The general mathematical definition of DCFM is:

\[ V_0 = \sum_{t=1}^{\infty} \frac{FCF_t}{(1 + WACC)^t} \]  

Free cash flow (FCF) is derived by subtracting operating taxes and net investments from operating profit/loss. The latter is also known as earnings before interest and tax (EBIT). The discount factor is comprised by the weighted average cost of capital (WACC), which is the cost for all investor capital (Koller, Goedhart and Wessels, 2010):

\[ WACC = \frac{D}{D + E} \cdot \rho_d \cdot (1 - Tc) + \frac{E}{D + E} \cdot \rho_e \]  

Further, estimates of future cash flows are therefore based on forecasted income statements and balance sheets with the presumption that EBIT will change over time at a certain growth rate in the explicit forecast period. What is more, the model assumes a growth rate into perpetuity. This consistent approach, rather than forecasting in a direct way, is the primary strength of DCFM (Jennergren, 2011). What is more, DCFM is virtuous considering the fact that it discounts cash flows that are more conservative, as opposed to other models that use different payoffs. In practice, this can give the analyst a starting point and if combined with other, more liberal methods create a lower and upper bound interval for valuation purposes.

As mentioned previously, the uncertainty in forecasting future data and the limitations in providing reliable estimates over periods longer than a two-year horizon has given momentum to other unsophisticated valuation methods (Barker, 1999). Even so, later research points toward an increasing use of rationale valuation techniques and again with particular stress on DCFM (e.g. Demirakos, Strong & Walker, 2004).

With this background, Imam, Barker and Clubb (2011) set out to examine the use of different valuation models in practice among analysts in their research paper: “The Use of Valuation Models by UK Investment Analysts”. Data for the analysis is provided from 35 sell-side analysts from 10 major investment banks and 7 buy-side analysts at 3 asset management firms. Furthermore, the researchers collected 98 equity research reports, covered by the interview respondents on the sell-side. They argue that, in light of the broad disparity between practitioners and academics, their method increases validity and provides a clearer picture on what analysts say they do, in contrast to what they actually do.
The results indicate that DCFM is the dominant primary choice for valuation, especially from buy-side analysts. However, the analysts tend to use DCFM as a general tool in combination with unsophisticated models, in particular price earnings ratio (P/E) when valuing shares. Imam, Barker and Cubb (2011) further argue that the increased use of DCF techniques is derived from the client driven valuation approach, where analysts express a perceived need to portray their valuation as more rational than it truly is.

2.2 Dividend Discount Model (DDM)
J.B Williams (1938) challenged the current equity valuation paradigm at the time and developed a model for discounting future dividends which can be mathematically expressed as:

\[ V_0 = \sum_{t=1}^{\infty} \frac{DPS_t}{(1 + \rho_e)^t} \]  (3)

where \( V_0 \) is the current stock value, \( DPS_t \) the expected dividend at time \( t \) and \( \rho_e \) is the cost of capital. This gives us the ubiquitous dividend discount model.

M.J Gordon later on developed the original discounted dividend model on the basis that it neglected the condition of growth (Gordon & Shapiro, 1956; Gordon, 1959):

\[ V_0 = \sum_{t=1}^{\infty} \frac{DPS_1}{\rho_e - g} \]  (4)

where \( g \) represents steady state growth. For the model to work \( \rho_e > g \) has to hold, otherwise the result is an infinite share price. Henceforth, the model was more commonly known as the constant growth model.

Theoretically, discounting future dividends is intuitive and virtuous in its parsimony but problematic in its practical application. To calculate the intrinsic value of a company, the model postulates that companies last forever and that dividends remain stable over time. Consequently, it is appropriate to disregard companies that experience different growth rates up to a steady state. This is a major limitation. Terminal value calculations are also problematic, which will be discussed further later on in this paper.

Not only the model but also dividends in particular as the fundamental attribute to be valued has been the subject of considerable criticism. The volatile nature of the stock indexes implies that the movements in stock prices cannot realistically be associated with the change in dividends, lest the efficient market hypothesis holds (Shiller, 1981). Moreover, it has been argued that dividends are irrelevant in equity valuation on the grounds that investors can create their own cash flow by selling equity (Modigliani & Miller 1961). The expected payout would in other words not be related to the stock price.

Finally, accounting principles have shifted from being more conservative to being more liberal, essentially making it harder to predict income. In other words, deciding the dividend growth rate is ultimately very troublesome. Fluctuations in market value, currency and interest rates or “random events” also make predicting income and subsequently dividends
difficult (Hawkins 1977; Gordon 1959). As a result, DDM can, from a practical standpoint, be considered to be inadequate in its function to determine stock prices.

2.3 Residual Income Valuation Model (RIVM)

Modigliani and Miller (1961), (from now on referred to as MM) gave rise to what is described as the dividend conundrum; that is, the valuation of a stock's intrinsic value is dependent on future dividends but in line with Shiller’s (1981) observations the payouts do not actually provide any useful information (Penman, 1992). As a result, attempts have been made to derive a firm’s economic value from accounting numbers (e.g. Peasnell 1982). This is called market based accounting research and deals with the relationship between market prices and accounting information (Lev & Ohlson, 1982).

On the subject of developing a parsimonious framework for incorporating accounting-based information, Ohlson (1995) transformed the traditional discounted-dividend model relating to Gordon (1959) to express the value of equity in regards to accounting variables such as earnings and book values (RIVM):

\[ V_0 = BV_0 + \sum_{t=1}^{\infty} \frac{RI_{t+1}}{(1 + r_e)^t} \]  

where \( V_0 \) is the value at time \( t \), \( BV_0 \) is book value per share in time \( t \), \( RI_{t+1} \) is the abnormal earnings (residual income) and \( r_e \) is the cost of equity capital. In short, the model states that the current stock value is equal to the current book value of a company plus the present value of all future residual income or abnormal earnings (S. Pirie, M. Smith, 2005).

The economic concept of residual income is that it explicitly considers the cost of equity capital, in other words the opportunity cost of the shareholders. In the long run, a company is expected to earn its cost of capital; any earnings in excess of the cost of capital are called abnormal earnings (Ohlson 1995):

\[ RI_{t+1} = earnings_{t+1} - r_e \times BV_t = (ROE_t - r_e) \times BVPS_{t-1} \]  

An important assumption in the transformed model is that the clean surplus relationship (CSR) or clean surplus accounting holds, which states that all accounting earnings are equal to all changes in book value except transactions with shareholders\(^1\) (Ohlson 1995; Peasnell 1982).

Since RIVM assumes the CSR holds on a total equity basis, a change in the number of shares outstanding will affect the CSR on a per share basis, thus undermining the foundation of the model (Ohlson, 2005). Furthermore, firms across countries violate this relationship by withholding recognized gains or losses from the net income, which Isidro, O’Hanlon and Young (2006) refer to as “dirty surplus accounting flows”.

A plethora of authors have studied the relationship between stock prices and accounting information (e.g. Lev and Ohlson 1982, Penman and Sougiannis, 1998). They find that RIVM is not only limited to the measurements used but also to the user: “[o]ur ability

\(^1\) i.e. dividends, issues and repurchases of shares.
unambiguously to infer financial information usefulness from capital market evidence is obviously restricted” (Lev, 1989 p. 154). Furthermore, the study concludes that the correlation between earnings and stock value is low and that the relationship between earnings and returns shows ample fluctuations over time. Thus, the usefulness of these parameters and the earnings measurement as such is limited. One should also recall that the model relies on the same theory as the DDM and is therefore subject to the same theoretical and practical limitations.

2.4 Abnormal Earnings Growth Model (AEGM)

This leads us to the AEGM proposed by Ohlson and Juettnner (henceforth referred to as OJ) in 2005. In this model, the current price of the share depends on forward earnings per share and their future growth (OJ, 2005):

\[ Z_t = [EPS_{t+1} + \rho_e \cdot DPS_t] - (1 + \rho_e) \cdot EPS_t \] (7)

where \( EPS_t \) is expected earnings per share at the end of period \( t \) and \( DPS_t \), the expected dividend at the same date, expected being the key word here. \( Z_t \) is defined as the capitalized increase in abnormal earnings per share at time \( t \).

In this sense, the model focuses not on future “wealth distributions”, i.e. dividends, but on earnings (Jennergren & Skogsvik, 2007). Penman (2005) argues that there are significant advantages in using the AEGM to calculate the intrinsic value of a company, the primary being its independency of clean surplus relationship. Practically, this corresponds well to analysts’ tendency to estimate earnings and not book values. For an analyst, the AEGM is intuitively more attractive since it does not anchor on book values (that look to the past), but on future earnings (that look to the future).

The above statement in conjunction with the “canceling error” concept shows the drawbacks of using RIVM over AEGM: Ohlson (2005) argues that perfect balance sheets result in perfect earnings measures, given the clean surplus relationship. But the converse is not true. A constant deducted from a perfect balance sheet will not change the earnings measure, thus remaining perfect. Consequently, a perfect balance sheet cannot be inferred from perfect measures of earnings. In addition, since CSR does not hold on a per share basis it makes the AEGM much more convenient.

To furthermore illustrate the differences between the RIVM and AEGM one can create a non-parsimonious model, which assumes a clean surplus relationship (Jennergren & Skogsvik, 2007):

\[ V_0 = \frac{EPS_1}{\rho_e} + \frac{1}{\rho_e} \sum_{t=1}^{T} \frac{1}{(1 + \rho_e)^t} \cdot Z_t \] (8)

where the intrinsic value is anchored on capitalized EPS, \( Z_t \) is the abnormal earnings growth up to period \( t \). If \( Z_t = 0 \) then the value becomes the capitalized earnings for year one. Conversely, if \( Z_t \) is expected to grow, the expected earnings will be inflated compared to the normal earnings performance. In this respect, the model does not measure abnormal earnings as such; instead it measures the effect of changes in abnormal earnings growth (Penman, 2005). This, in conjunction with the DDM, gives us the parsimonious AEG model, which this paper will intend to use:
where R is \((1+\rho_e)\) and \(\gamma\) is equal to \((1+g_{ae})\) meaning the growth in abnormal earnings growth in the future period. The right term holds the property of constant growth (Gordon and Shapiro, 1956), where changes in \(\gamma\) have a significant amplified effect on the ratio. The effect of \(\gamma\) is strongest when approaching R. Competition in the long run will force abnormal earnings down towards zero, which has a negative effect on \(\gamma\) (Penman, 2005).

To summarize, AEGM consists of two components: capitalized next period earnings and the present value of all future abnormal earnings growth defined as the capitalized next period earnings adjusted for dividends (Jorgensen, Lee and Yoo, 2011). Further, it does not require any anchoring on book values, neither does it rely on the clean surplus relationship and calculating on a per share basis does not lead to any adverse effects. In addition, AEGM builds on the premise that earnings are a better measurement for equity valuation than book values. But as Penman (2005) states, there are some disadvantages to leaving out book values. Given fair valuation, book values have a practical and sufficient role in valuation: “assets beget earnings”, (Penman, 2005 p. 373). Moreover, anchoring the valuation on future EPS can be viewed as ambiguous and entails speculation about the future. AEGM is in that sense a speculative model. Not only does it incorporate a speculative forecast for earnings but also for cost of capital (Penman 2005). Levered accounting numbers also presents a predicament. Firms can inflate EPS and EPS growth by borrowing but according to MM (1961) borrowing does not generate value, which is assumed by OJ (2005).

That being said, book value might seem as the most appropriate “starting point” in valuing equity, but as theory and research show capitalized next period expected earnings is a better approximation of equity market value (Ohlson, 2005).

As a concluding remark, and in respect the above, the abnormal earnings method takes on a different approach to equity valuation. By looking at the growth in abnormal earnings it differs from the residual income-based model that has a more fundamental approach. Growth is also a complex addition in the sense that is highly speculative. It relies on the analyst to efficiently and accurately determine the future, which of course is a very complicated procedure. Analysts combine their knowledge, intuition and judgment to determine growth rates. From a theoretical point of view, this concept becomes difficult to apply. It is important to remember that AEGM, as well as other valuation models, might differ in terms of practical utility. For example, industrial companies with a lot of assets will potentially yield better valuation results when RIVM is used, opposed to AEGM. Conversely, AEGM will be a better fit for companies that depend highly on earnings. In other words, the model will vary in its practical usefulness depending on what company it is applied on.

### 2.5 Model Comparison

While financial theory and teaching focus on DCFM as a basis for equity valuation, extensive empirical research has focused on comparing DCFM and other models for equity valuation. Feltham and Ohlson (1995) developed a model to study the relation between value and accounting numbers, Bernard (1995) followed by examining RIVM and DDM and their ability to explain stock price variation. He concludes that 68 percent of the variability in stock prices can be explained by the forecasted RIVM accounting variables, 29 percent by DDM.
Bernard, especially, argues that research should bear on fundamental analysis, not focus on explaining stock price behavior. One is also reminded of the dividend conundrum (Penman 1992) and the obstacle it represents. These studies worked as a catalyst and were an essential role in the shift towards a more fundamental take on “capital market research”.

Akin to the aforementioned studies, Penman and Sougiannis (1998) deliberate on issues related to terminal value calculations and compares DDM, DCFM and a technique based on accrual earnings applied to a finite-horizon forecast. Valuations are based on average ex post realizations of financial statements and used to calculate intrinsic values. Values are then averaged into portfolios to reduce valuations errors. If this is successful, ex-post realizations are estimates of ex-ante errors of the valuations models. The study concludes that the accounting-based methods (RIVM and earnings technique) performed better than the cash flow and dividend model.

In a similar vein, Francis, Olsson and Oswald (2000) examined the reliability and accuracy of the DDM, DCFM and RIVM respectively. They extended previous research by comparing individual companies, not portfolio estimates, concluding that RIVM performed better compared to DDM and DCFM, and finally that DCFM performed better than DDM. Using an accuracy metric, the absolute deviation between observed stock prices and their calculated value was determined, or: \( V_t - P_t / P_t \) was 30 percent for RIVM, 41 percent for DCFM and finally 69 percent for DDM.

Courteau et al. (2000) used Value Line’s forecasts of future prices in the terminal value calculations of each model. They wanted to empirically assess whether or not the models would show the same value when a price-based terminal value was used. In this study, the highest median absolute percentage error comes from RIVM, rather than DDM and DCFM (14,32, 13,71 and 13,72 % respectively). In other words, to some surprise, RIVM is outperformed. But when employing similar values to those used in Penman and Sougiannis (1998) they find that RIVM outperforms DCFM. R squared is highest in RIVM (82,16 %) compared to DCFM (62,75 %) and 79,59, 67,66 percent respectively under the zero growth and 2 percent growth assumption.

Lundholm and O’Keefe (2001) published a paper that stands in stark contrast to previous research. They criticized Penman and Sougiannis (1998), Courteau et al. (2000) and Francis, Olsson and Oswald (2000), dismissing their studies and concluding that: “[r]esearch efforts in valuation would be better spent on the study of how to make more accurate forecasts of financial statement data, not in how to represent and discount the resulting flows of value” (p.332). They argue that practical implementations of the models do not create differences since the models are theoretically equivalent.

In response, Penman (2001) contends that Lundholm and O’Keefe’s paper contains fundamental misconceptions about accounting and valuation. Valuation models help analysts understand what companies are worth, but in order to do that they need to know what to value. Hitherto, this study has touched on models that forecast dividends, cash flow, and earnings, that are theoretically equivalent but the accounting differs. Penman (2001) argues that “the choice is not between models but between accounting within the model” (p. 683). In other words, one has to focus on what is good or bad accounting from a valuation perspective.
At a later date, Penman (2005) published a paper comparing RIVM with AEGM and their advantages and disadvantages. The foundation of this paper was based on the practical aspect of valuation, meaning when choosing between the models it comes down to how useful they are. In a straightforward study, Penman (2005) estimates the value of all U.S. traded equities in the period (1975-2002) with two years ahead projected data from analysts. The study assumed a long-term growth rate of 4% for both $g_{aeg}$ and $g_{riv}$, and a 10% constant cost of capital. To compare RIVM and AEGM all forecasted values were divided by the current price ($V/P$), assuming the median closest to $V/P=1.0$ is the superior model for valuation. This study concludes that RIVM with a median of $V_{riv}/P=1.0$ is superior in explaining current prices, where the median estimate-to-stock price ratio of AEGM was 2.02.

Jorgensen, Lee and Yoo (2011) contributed by further investigating the valuation accuracy of RIVM and AEGM in a similar study. However, it diverged in three essential ways. First, the forecast horizon was extended from two years up to five years. Second, in contrast to the use of raw equity value estimates they pointed toward a multiple valuation approach “...which restricts the analysis to ‘unbiased’ pricing errors” (p.454). Third, additional understanding of the underperformance of the AEGM to RIVM was provided through an analysis of future ROE. Similar to Penman (2005) the study included observations of US firms with forecast data from analysts, but in the period 1984 to 2005.

The results of the analysis proved the AEGM to perform significantly better when increasing the forecast horizon from two to five years. However, it was still outperformed by the RIVM. In addition, the comparison of actual ROE and predicted ROE suggests that the difference in valuation accuracy is due to the assumptions of the future earnings growth. The authors argue that “[i]n particular, the noise contained in current earnings may affect short term earnings growth expectations, distort long-term earnings expectations, and ultimately reduce the valuation accuracy of the two-period OJ estimates” (p. 469).
3. Method
Seeing as there are few previous studies made on the Swedish stock market, this empirical analysis sets out to compare intrinsic equity valuation calculations based on the DDM, DCFM, RIVM and AEGM. These intrinsic values, derived from ex-post payoffs, are compared with observed stock prices. Values are then averaged into portfolios to reduce valuations errors. If this is successful, ex-post realizations are estimates of ex ante errors of the valuations models. This assumption is standard in capital market research (Penman and Sougiannis, 1998).

Another way to make the same comparison is to use intrinsic values calculated from ex ante forecasts made by analysts. Unfortunately, it has been difficult to find forecasted analyst’s estimates and therefore it seems wise to follow Penman and Sougiannis (1998) and Francis, Olsson, Oswald’s (2000) example and use realized ex post payoffs as a proxy for our estimates.

Jorgensen, Lee and Yoo (2011) examined the effects of an extended forecast horizon from two to five years. In light of their results, especially the performance-enhancing effects of extending the horizon, this study aims to see if those results also pertain to the Swedish stock market. Thus, the period in this study is divided into two periods, ranging from 2009-2011 and 2009-2014 respectively. Are two or five year forecast periods to be preferred?
3.1 Model specification

For DDM, DCFM, RIVM and AEGM, intrinsic equity value will be calculated using model equation formulations derived from specifications presented in the literature review. Further, the same formulas will be applied when calculating intrinsic value when extending time horizon. The model formulations for this study’s calculations are:

DDM:

\[
V_0 = \sum_{t=1}^{T} \frac{DPS_t}{(1 + \rho_e)^t} + \frac{DPS_{T+1}}{\rho_e - g_{ss}} \frac{(1 + \rho_e)^T}{(1 + \rho_e)^T} \tag{10}
\]

DCFM:

\[
V_0 = \sum_{t=1}^{T} \frac{FCF_t}{(1 + WACC)^t} + \frac{FCF_{T}}{WACC - g_{ss}} \frac{(1 + WACC)^T}{(1 + WACC)^T} \tag{11}
\]

RIVM:

\[
V_0 = BVPS_0 + \sum_{t=1}^{T} \frac{(ROE_t - \rho_e) \cdot BVPS_{t-1}}{(1 + \rho_e)^t} + \frac{BVPS_{T}}{(1 + \rho_e)^T} \tag{12}
\]

AEGM:

\[
V_0 = \frac{EPS_1}{\rho_e} + \sum_{t=1}^{T} \frac{Z_t}{\rho_e} \frac{(1 + \rho_e)^t}{(1 + \rho_e)^T} + \frac{Z_{T+1}}{\rho_e} \frac{\gamma}{(R - \gamma)(1 + \rho_e)^T} \tag{13}
\]

where

- \( V_0 \) = the intrinsic value of equity at time 0;
- \( DPS_t \) = dividend per share at time t;
- \( FCF_t \) = free cash flow at time t;
- \( BVPS_t \) = book value per share at time t;
- \( ROE_t \) = return on equity at time t;
- \( EPS_t \) = earnings per share at time t;
- \( Z_t \) = growth in abnormal earnings at time t;
- \( \rho_e \) = cost of equity capital at valuation date;
- \( WACC \) = weighted average cost of capital;
- \( g_{ss} \) = perpetual growth rate;
- \( R \) = \( (1 + \rho_e); \) and
- \( \gamma \) = \( (1 + g_{AEG}); \).
3.1.1 Terminal values

Terminal values are calculated using the general form of terminal value (Penman, 1997), but with some differences between the models. When calculating the terminal value for DDM, \( (DPS_{T+1}) \) is derived by bringing last forecasted dividends \( (DPS_t) \) forward using the perpetual steady state growth rate \( (g_{ss}) \). In the same way the terminal value of DCFM and RIVM is derived from the latest forecasted values \( (FCF_t \text{ respectively BVPS}_t) \). For AEGM, the calculation of \( Z_{T+1} \) differs in the way that \( Z_t \) is brought forward using the perpetual growth in abnormal earnings growth \( (g_{AEG}) \). Thus, the terminal values for the models are derived in a similar manner by forwarding the latest forecasted value, mathematically expressed as:

\[
\begin{align*}
DPS_{T+1} &= DPS_t \times (1 + g_{ss}); \\
FCF_{T+1} &= FCF_t \times (1 + g_{ss}); \\
BVPS_t &= BVPS_t \times (1 + g_{ss}); \text{ and} \\
Z_{T+1} &= Z_t \times (1 + g_{AEG}).
\end{align*}
\]

Previous studies use a perpetual growth rate of 4% (e.g. Francis, Olsson & Oswald, 2000), which is quite optimistic in the current market situation. Therefore, this study will set the perpetual growth rates at \( g_{ss} = g_{AEG} = 2\% \) on the assumption of being more realistic.

Terminal values often have a significant impact on the valuation. Therefore, the difficulties in developing reliable assumptions make terminal value calculations problematic. While terminal values stretch to infinity, analysts in practice most often deal with a finite valuation period (Penman, 1997; Demirakos 2008).

3.1.2 Cost of equity capital

For all models except DCFM, the cost of equity capital is this study’s chosen discount factor to capitalize payoffs. The cost of equity capital is given by the ubiquitous capital asset pricing model (CAPM):

\[
\rho_e = r_f + \beta_j \cdot [E(r_m) - r_f]
\]  

(14)

where the cost of equity \( (\rho_e) \) is equal to the risk free rate, \( \beta_j \) the firm-specific beta and the final term is the market risk premium. The risk-free rate is based on 10-year Swedish treasury bonds. The market-risk premium is set to 6% (e.g. Penman & Sougiannis 1998; Francis, Olsson, Oswald 2000; Copeland, Koller & Murrin 1994; Steward 1991).

3.1.3 Weighted average cost of capital

For DCFM calculations, the discount factor consists of the weighted average cost of capital (WACC):

\[
WACC = \frac{D}{D + E} \cdot \rho_d \cdot (1 - Tc) + \frac{E}{D + E} \cdot \rho_e
\]  

(15)

where \( D \) is the total interest bearing debt, \( E \) is the total shareholders equity, \( \rho_d \) represent the cost of debt, \( Tc \) is the tax rate and \( D+E \) constitutes the total market value of financing. In this study the corporate tax rate is set to 22%, in line with current Swedish standards.
3.1.4 Extension of the forecast horizon
To investigate what possible performance-enhancing effects an extension of the forecast horizon might have on the results the forecast horizons of DDM, DCFM, RIVM and AEGM are extended from a two to five-year period.

3.2 Model evaluation
In this study, models will be evaluated by measuring performance in terms of accuracy and spread by measurements commonly used in previous research. Accuracy captures how close the intrinsic value is to the observed stock prices, and spread indicates how reliable the models are by capturing the variation in accuracy. In this study, the chosen accuracy measures are: mean V/P, MAPE, mean PE, and median PE. Standard deviation of PE will be calculated for each model to measure spread.

Firstly, performance will be evaluated using V/P where V is the intrinsic value of the stock and P the observed stock price:

\[
V/P = \frac{V_{0,j}}{P_{0,j}} \tag{16}
\]

Another method, MAPE (mean absolute pricing error) will also be used and aims to assess a model’s accuracy:

\[
MAPE = \frac{1}{n} \sum_{j=1}^{n} \left| \frac{V_{0,j} - P_{0,j}}{P_{0,j}} \right| \tag{17}
\]

The absolute value is summed for every valuation point in the portfolio and divided by the number of firms (n). Hence, absolute values are unsigned and are designed to measure how far the value deviates from zero. In other words, MAPE measures the size of the pricing error where a smaller value equates to a lower accuracy score.

Finally, PE, short for signed pricing error, will also be used and is similar to MAPE with the difference that it measures the direction rather than size of the pricing error. In other words, signed pricing error will include any value, positive or negative. PE is mathematically expressed as:

\[
PE = \frac{V_{0,j} - P_{0,j}}{P_{0,j}} \tag{18}
\]

To enable comparable measures between models the PE variable will be calculated as both mean and median in all portfolios.
4. Data
Data will be collected using Orbis where historical financial statement items can be found and is exclusively used in our study. Using only one database is advantageous because the same variables are used throughout the study, thus eliminating errors caused by the use of different directories. In line with the previous chapter about limitations, our sample consists of the 30 most traded companies on the Swedish stock market (OMX30). They are relatively large, mature and stable companies and thus fit handsomely into our models. As is standard, financial firms are omitted because of their rather unconventional accounting, as well as companies that do not report or have enough data available, which gives a final sample of 20 companies, all of which were listed on the OMX30 index on December 31, 2009 (e.g. Demirakos, 2008).^2

Table 2. Median key variables

<table>
<thead>
<tr>
<th>Year t</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Of firms</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Firm characteristics (MSEK)

| Market cap | 107 669 | 85 846 | 61 160 | 72 174 | 57 370 | 44 907 |
| Operational revenues | 90 324 | 89 356 | 92 575 | 98 026 | 92 070 | 81 434 |
| EBIT | 6 357   | 6 680   | 7 673   | 8 294   | 5 714   | 6 769   |

Payoffs (SEK)

| EPS | 6,27 | 7,39 | 7,64 | 9,31 | 7,44 | 8,27 |
| BVPS | 50,16 | 47,78 | 48,78 | 48,39 | 45,70 | 46,48 |
| DPS | 4,45 | 4,22 | 4,01 | 4,02 | 3,69 | 3,80 |
| ROE | 18,62 | 20,17 | 22,97 | 26,11 | 22,50 | 21,76 |

Discount rate (%)

| Risk-free rate | 3,24 | 3,21 | 1,68 | 1,51 | 2,39 | 1,01 |
| Risk premium | 6 | 6 | 6 | 6 | 6 | 6 |
| CAPM | 5,99 | 5,99 | 5,98 | 5,98 | 5,99 | 5,98 |
| WACC | 5,72 | 5,70 | 5,89 | 5,99 | 5,91 | 6,18 |

^2 A full sample list can be found in Appendix 7.1.
5. Results
The results presented in Table 3 show the accuracy and spread of each model chosen for the study. Three different accuracy metrics are used (V/P, MAPE, PE) and a measurement to assess spread (STD PE) to evaluate the performance of each model over a two and five year period respectively. A mean V/P of 1 would indicate that the calculated intrinsic value is equal to the observed stock price. For MAPE, a lower value means it is more accurate. Multiplying the MAPE-score by 100 makes it a percentage error.

5.1 Table 3. Summary of results

<table>
<thead>
<tr>
<th>Model</th>
<th>Valuation period</th>
<th>Mean V/P</th>
<th>Mean PE</th>
<th>Median PE</th>
<th>STD PE</th>
<th>MAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDM</td>
<td>2009-2011</td>
<td>1.75</td>
<td>0.75</td>
<td>0.27</td>
<td>1.15</td>
<td>0.75</td>
</tr>
<tr>
<td>DDM</td>
<td>2009-2014</td>
<td>1.52</td>
<td>0.52</td>
<td>0.57</td>
<td>0.65</td>
<td>0.52</td>
</tr>
<tr>
<td>DCFM</td>
<td>2009-2011</td>
<td>1.77</td>
<td>0.77</td>
<td>-0.17</td>
<td>2.10</td>
<td>0.77</td>
</tr>
<tr>
<td>DCFM</td>
<td>2009-2014</td>
<td>2.01</td>
<td>1.01</td>
<td>0.72</td>
<td>2.50</td>
<td>1.01</td>
</tr>
<tr>
<td>RIVM</td>
<td>2009-2011</td>
<td>1.69</td>
<td>0.69</td>
<td>0.25</td>
<td>1.61</td>
<td>0.69</td>
</tr>
<tr>
<td>RIVM</td>
<td>2009-2014</td>
<td>1.82</td>
<td>0.82</td>
<td>0.56</td>
<td>1.65</td>
<td>0.82</td>
</tr>
<tr>
<td>AEGM</td>
<td>2009-2011</td>
<td>1.55</td>
<td>0.55</td>
<td>0.08</td>
<td>2.39</td>
<td>0.55</td>
</tr>
<tr>
<td>AEGM</td>
<td>2009-2014</td>
<td>1.18</td>
<td>0.18</td>
<td>0.29</td>
<td>2.00</td>
<td>0.18</td>
</tr>
</tbody>
</table>

In terms of accuracy, all models consistently overestimate stock price: AEGM being the most accurate, RIVM outperforms DDM, consequently finding itself in second place. In last place one finds DCFM. DDM also has a lower spread compared to all other models: RIVM, DCFM and AEGM show considerably higher variability.

Interestingly, and in line with previous studies (e.g. Penman & Sougiannis, 1998), DCFM has a median PE of -0.17, which implies that the measurement free cash flow is considerably more conservative compared to the other models.

5.2 Extended time horizon
The errors of DDM are significant over a shorter time horizon, but decline when extended from two to five years. In fact, every model except for RIVM and DCFM incline toward a higher degree of accuracy when extending the time period. The findings suggest that a decision to extend the horizon should be based on what input one uses. AEGM, inherently more speculative, benefits more greatly from an extension of the time period.
6. Analysis

6.1 Non-extended time horizon

Our research shows that AEGM is superior in terms of accuracy to the other models, albeit one can question its reliability and practical usefulness. Valuation models serve a purpose to guide practice: in this sense an accuracy metric alone is not sufficient to determine the overall utility of the model. Spread also has to be taken into account. What is more, by looking at the terminal value share of the overall intrinsic value one can determine how much of the value is based on assumptions or conversely on the actual realized payoffs. Altogether, this will enable an extensive analysis of the model accuracy and reliability.

Terminal values tell us where the value comes from – intrinsically from the anchor, or if it is based more on future assumptions. For, DDM and DCFM a majority of the value hinges on the terminal value\(^3\). RIVM and AEGM on the other hand, show that most of the value comes from the intrinsic value\(^4\). This is somewhat consistent with previous research (e.g. Penman 2005; Jorgensen, Lee, Yoo 2011; Bernard 1995), pointing out that there is some advantage in using RIVM that anchors on accounting data rather than on speculative assumptions about the future. As such, we did expect the terminal value to be predominant in AEGM. But surprisingly, most of the value in AEGM comes from the intrinsic value. In this regard, and in line with previous research (Penman 2005), capitalized next period earnings and dividends can potentially be seen as better value estimates compared to book value that RIVM anchors on.

Although earnings and dividends seem to weigh up for the more speculative aspects of AEGM one has to take spread into consideration to determine its reliability. As so, when looking at the high standard deviation of AEGM one can question how reliable it is to anchor on future expectations. Not only are next period earnings ($\text{EPS}_{t+1}$) speculative, EPS per se could be anything to satisfy the equation (e.g. ebit, ebitda, sales or cash flow). In other words, the model is not only based on expectations but also dependent on the analyst. Taking this into account, one can from practical standpoint and in terms of efficiency question its utility. This is in line with Jorgensen, Lee and Yoo (2011). Furthermore, AEGM is dependent on growth in abnormal earnings and not abnormal earnings per se, mathematically meaning that a constant growth or decline in earnings has an exponential effect on the value.

Thus, contrary to previous research (Penman, 2005; Francis, Olsson & Oswald, 2000; Francis, Jorgensen, Lee & Yoo, 2011) the superiority of AEGM in our results could likely be explained by our homogenous and relatively small sample.

Similar to Penman and Sougiannis (1998), our study finds DDM’s accuracy errors to be high. As the model assumes dividends to be stable over time, fluctuations resulting in different growth rates is problematic and could likely explain the accuracy errors. In particular, a change in payout the last year of the valuation period has a significant effect on the terminal value. Consequently, DDM’s extensive hinge on the terminal value results in higher accuracy errors if the final year dividend growth rate is not associated with changes in market value. In this regard, finite horizon calculations make it difficult to apply DDM, which in turn serves as a justification for the use of accounting-based models.

\[^3\] DDM 80 %, DCFM 77 % (Median)

\[^4\] 31 % for RIVM, 10 % for AEGM (Median)
DCFM’s high accuracy errors are connected to the extensive dependency on the terminal value. In line with previous studies (e.g. Penman & Sougiannis, 1998), a shorter horizon does not likely represent the maturity effects of investments. Thus, investments are treated as a direct reduction in value when calculating FCF. In other words, investments have a negative effect on FCF while investment lifespan likely extends beyond the valuation period. Consequently, a negative payoff may not be associated with movements in market value, resulting in accuracy problems.

Further, the high spread signals that there are problems connected to estimating a fair discount factor, much due to the sensitivity of the WACC, where a small increase (decrease) results in major decrease (increase) in intrinsic value. This particularly applies to the terminal value. Our study contains, apart from a fluctuating risk free rate, some years were the debt to equity ratio is generally high while stock prices were low. As a result, the period for our research computes a low WACC. In this regard, the technical limitations causing the low accuracy and reliability of DCFM supports Imam, Barker and Clubb (2008) findings that an increased use of unsophisticated methods in valuing equity might be warranted.

6.2 Extended time horizon

In line with previous studies (Jorgensen, Lee Yoo 2011; Penman & Sougiannis 1998), extending the time horizon seems to benefit AEGM and DDM especially, compared to RIVM. In other words, the accuracy is dependent on the payoff one decides to choose. Naturally, models that are inherently more speculative will see more dramatic changes when extending the time horizon compared to a model that uses accounting data. The reason for this is because much of the value, in a model like RIVM, is derived from data that is already known.

AEGM’s improvements in accuracy when extending the horizon can possibly be explained by the reduced effect that negative transitory items \(^5\) have on short-term earnings growth. This is in line with previous studies (Penman, 2005; Jorgensen, Lee Yoo 2011). Consequently, it becomes less problematic to forecast abnormal earnings growth that is likely to include transitory items, when extending the horizon. Taking this into consideration, one can question the utility of the model as our findings further stress the importance of analysts’ ability to make accurate predictions.

When extending the horizon, DDM’s accuracy errors decrease. This is in line with the findings of Penman and Sougiannis (1998). When increasing the valuation period, the calculation will include more dividends, which will result in fewer errors. Contrary to previous research, DDM is superior to RIVM both in terms of spread and accuracy. Presumably, this can be explained by our sample, which contain firms that are to some extent ideal to DDM. In general, a majority of the firms on OMX30 are large and gives out stable dividends over time.

Finally, DCFM’s significantly large accuracy error when extending the time period is to some extent surprising. This further highlight the problems regarding the negative effect investments have on FCF when maturity of investments stretches further than the valuation period. Therefore, the variety of investments maturities seem to make it difficult, if not impossible, in choosing a fair time horizon.

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\(^5\) i.e. non-recurring accounting items affecting income statement such as write-downs.
7. Conclusion

A review of the previous literature gives the reader an understanding of and insights into contemporary and more seasoned valuation models used today. In addition, it also shows how unsophisticated valuation tools as well as the discounted cash flow model are becoming more popular in equity valuation. Our study set out to examine whether this tendency, from a theoretical and empirical perspective, is rational by looking at each model’s accuracy. Accordingly, we first delved into the theoretical underpinnings of each model and what constitutes their relative strengths and weaknesses. This step was followed by an investigation of what performance-enhancing effects an extension of the time horizon might have on the results.

Our non-extended study shows that AEGM is the most accurate model; RIVM comes in second place, followed by DDM and finally DCFM. When extending the horizon, in an extended study, we can conclude that AEGM continues to be the most accurate, followed by DDM, RIVM and lastly, lagging behind considerably, DCFM. RIVM, anchoring on accounting data, or things that are “real”, benefits less from an extension of the horizon compared to the other models. This can be attributed to the terminal values, where most of the value resides in DCFM and DDM (77%, 80%). We argue that the reason why AEGM remains the most accurate model is because of the fact that abnormal earnings growth, as a measurement, fits this particular sample well and weights up for the more speculative aspects of the model.

By the same token, we also looked at spread, where DDM showed the lowest variation, followed by RIVM, DCFM and AEGM. We followed the same exercise as we did for accuracy and assessed if extending the horizon would have any performance-enhancing effects on spread and concluded that DDM has the least spread, RIVM comes in second, AEGM third and finally in last place, DCFM. In terms of reliability, we deemed RIVM to be the most practical. Although AEGM is the most accurate its results fluctuate too much to be considered useful from a practical standpoint. The same can be said about DCFM. As for any model, DCFM is highly dependent on the denominator to discount future cash flows. The WACC discount factor is more speculative than CAPM; it takes into account variables such as tax, debt and equity, subsequently making it hard to come to any decisive conclusions. In other words, the results might vary depending on the user and on whether or not one employs an ex post (based on realized payoffs) or ex ante (based on forecasted analyst estimates) research methodology.

In regards to the above, our paper adds to the current literature by looking at the Swedish stock market, and from a practical standpoint offers several alternatives to DCFM that are inherently more accurate and reliable in terms of spread.

As a concluding remark, it is worth recalling the discussion between Lundholm, O’Keefe and Penman (2001), where Penman states that it is imperative that valuation practice be consistent with theory but that in the end, usefulness is the final decider. Ultimately, all models are restricted to the same underlying problem: finite value calculations. Thus, the juxtaposition between practical usefulness and theoretical soundness will always exist.

For future research, we see an opportunity to continue down the same road and look closer at growth rates and discount factors and how good analysts are at determining these. As shown in our study, it ultimately comes down to how skilled or unskilled the investor is in practice.
What is more, one could also look at transitory items and how an exclusion of these could affect the results. Our study has raised some important questions and staked out a path for future research, we look forward to see where this might lead.
8. Bibliography


7. Appendix

7.1 Appendix: Sample list

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<thead>
<tr>
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<td>GETINGE AB</td>
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Listed on OMX30, though not included in the sample:

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