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TERMINAL VALUE CALCULATION IN DCF VALUATION MODELS: AN EMPIRICAL VERIFICATION

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Abstract

The paper presents an empirical verification of the main assumptions underlying the calculation of terminal value in DCF valuation models. The test results suggest that the volatility of free cash flows and the dynamism of the operating environment do not allow us to make a reliable long-term forecast of value creation potential of the public companies in Poland. Regardless of their organic growth phase, the overwhelming majority of the sampled firms are evidenced to exhibit extreme year-on-year fluctuations of sales, investments and cash flows over the short- and medium-term observation windows. The variability of operating results and the probabilistic nature of company-level fundamentals may preclude the possibility of constructing a reliable cash flow forecast for the purposes of a DCF valuation. This methodological issue appears to pose a particular challenge during the calculation of terminal value, which is heavily dependent on highly subjective and uncertain steady-state fundamentals. Therefore, the predictive power of the deterministic DCF models may be reduced to a snapshot of the current market sentiment regarding a particular stock. The paper postulates that a further discussion on the tenets of terminal value calculation may be necessary in order to overcome the existing flaws and increase the accuracy of valuation models. We contribute to this discussion by outlining the principal methodological and theoretical issues which challenge the practicing valuators at the stage of terminal value calculation. Our conclusions may help to shed light on the problems of market short-termism, and high inconstancy of investment recommendations.

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Introduction

Along with discounted dividends (Gordon, 1959) and residual income models (Lundholm & O'Keefe, 2001), the discounted free cash flow (DCF) models constitute the most frequently applied tool of corporate valuation. Each of the enumerated types of valuation models relies on a set of rigorous simplifying assumptions, which despite facilitating the modelling process, may lead to significant distortions of the results.

The DCF models have considerably gained in popularity due to enhanced precision and flexibility (O'Brien, 2003). Estridge and Lougee (2007) explain the increased recurrence to DCF by the fact that free cash flows (FCF) are less susceptible to manipulation than earnings. Damodaran (1994) argues that the after-tax free cash flows generated by the company and distributable to both share- and debtholders represent the proper building blocks for corporate valuation models.

Despite its relative simplicity and wide acceptance, DCF valuation suffers from a number of methodological shortcomings. The issues of particular concern include the accuracy of corporate free cash flow forecasts (Blanc & Setzer, 2015; Jackowicz et al., 2017), the choice of an appropriate discount rate to calculate the present value of distant cash flows under conditions of uncertainty (Gollier & Weitzman, 2010; Mielcarz & Mlinarič, 2014), and the assumptions underlying the calculation of terminal value (Jennergren, 2008).

The paper presents an analysis of the algorithm of terminal value calculation with a particular focus on the steady-state forecast period. Relying on empirical evidence, we intend to verify whether the conventional assumptions underlying terminal value calculation are realistic and substantiated. Since the residual value frequently constitutes a major part of the total enterprise value, an empirical verification of the validity of essential inputs appears to be crucial for assuring the accuracy of DCF valuation models (Mielcarz & Osiichuk, 2017). Our empirical results challenge the conventional postulates of terminal value calculation and highlight the need for an in-depth discussion of possible built-up valuation models, which would allow us to incorporate the stochastic nature of the key valuation inputs and to accommodate market dynamics more accurately.

The paper is structured as follows: first, we provide a theoretical overview of the assumptions underlying terminal value calculation; thereafter, we present the findings of an empirical verification of the validity of those assumptions; finally, in order to contribute to the discussion on possible improvements to the DCF modeling process, we analyze each element of the residual value formula and present our suggestions regarding their appropriate incorporation within the valuation model; the paper concludes with a discussion of interrelations between the predictive power of DCF valuation models and investor short-termism on capital markets.

The Conventional Assumptions Underlying Terminal Value Calculation in DCF Valuation Models

Residual (terminal) value predominantly constitutes a major part of the total enterprise value, which makes the accuracy of its calculation an important factor of the overall reliability of a valuation model. The conventional wisdom presented in corporate finance textbooks (e.g., Copeland et al., 2010; Damodaran, 2010) formulated a set of restrictive assumptions, which, if applied correctly, should constitute a foundation of a sound and accurate valuation model. However, these assumptions appear to commonly derive from deductive reasoning rather than from statistical evidence. What is more, the authors have not found any research studies verifying the validity of these assumptions on empirical data. This paper represents an attempt to fill this gap.

Copeland et al. (2010) propose the following formula for terminal value calculation:

$$Terminal\,Value = \frac{NOPAT_{t+1}\left(1-\frac{g}{RONIC}\right)}{WACC-g} \quad (1)$$

where $NOPAT_{t+1}$ is the net operating profit after taxes in the first year of the post-horizon forecast period; g – the NOPAT growth rate held constant during the entire post-horizon forecast period; *RONIC* – the projected (implied) rate of return on new invested capital; *WACC* – the weighted average cost of capital.

The standard perpetuity formula for terminal value relies on FCF from the last period of the explicit cash flow forecast (Copeland et al., 2010):

$$Terminal\,Value = \frac{FCF_t(1+g)}{WACC-g} \quad (2)$$

where FCF_t – free cash flow in year t; other variables are defined above.

In order for the formulae 1 and 2 to yield the same result, the perpetuity growth rate (g) should equal:

$$g = RONIC\ x\ Reinvestment\ Rate \quad (3)$$

where *Reinvestment Rate* – the net investments as a percentage of NOPAT.

Copeland et al. (2010) note that since the terminal value formula relies on parameters which are explicitly assumed to be linearly evolving into perpetuity, it may be correctly applied (i.e., yield accurate results) only once the company has attained a steady-growth phase. The steady state is characterized by slow linear revenue growth, stable profit margins and, as a consequence, stable growth of earnings and cash flows. The stable-growth phase involves both internal and external stabilization. Internal dynamic equilibrium implies the maturity of the firm's business model, production cycle and product portfolio, which generate predictable cash flows. External stabilization includes a permanent repartition of the market between the principal participants, which technically leaves the overall market growth as a unique source of additional revenue. Hence, the external stabilization implies a general equilibrium in the company's operating environment and a linear growth of the economy. In the steady-growth phase, the gradual exhaustion of attractive investment opportunities causes the companies to slash investment expenditures to the point of sustaining the accumulated stock of fixed capital. As a result, the investment outlays, the reinvestment rate and the ratio of capital expenditures to depreciation reach a stationary point/static equilibrium.

Copeland et al. (2010) also provide detailed instructions regarding the derivation of each of the variables comprising the terminal value formula. According to these authors, WACC should be calculated relying on a sustainable capital structure with due consideration of the industry business risk. The NOPAT estimates in the residual period should imply sustainable values of RONIC and profit margins, while the forecast revenue should equal the average over the company's business cycle. In the majority of cases, RONIC should be set equal to WACC since competition is expected to erode the company's competitive advantage and eliminate abnormal economic profits. The latter translates into a decrease of return on new invested capital (RONIC) in the stable-growth period (Mielcarz & Osiichuk, 2017). In turn, a gradual decay of competitive advantage deprives the company of investment incentives thereby entailing a stabilization of the investment policy and a decrease of the reinvestment rate.

Despite their consistency and straightforwardness, the above presented assumptions underlying the residual value calculation may have some important conceptual shortcomings. For example, the strict criteria of steady growth may preclude the application of the conventional valuation algorithms by certain companies. The erosion of competitive advantage is yet another process which is difficult to anticipate and incorporate into the valuation model. The NOPAT growth rate, being a stochastic variable with a significant embedded volatility, has an inherent element of uncertainty, and exercises a considerable impact on the terminal value estimates.

Although the authors recommend comparing the obtained perpetual growth rate g with the average long-term inflation-adjusted growth of demand for the industry's products or services, it is evident that the application of either formula (3) or any other estimation method, which assumes steady FCF growth into perpetuity, relies on relatively simplistic assumptions of stationarity of RONIC and reinvestment rate. This paper verifies whether these assumptions accord with the empirical data.

The Steady-Growth Phase: An Empirical Test of FCF Stability Based on the Data from the Polish Stock Market

It is clear that the stable-growth assumptions underlying the terminal value calculation are simplified. But do they describe the development path of any of the actually existing companies? To put it simply, is there an explicitly observable pattern of a gradual transition towards the steady-growth phase? And what is the percentage of companies which meet the criteria of stable free cash flow growth? To answer these questions, we verify the assumptions underlying terminal value calculation against the empirical data from the Polish stock market.

Our dataset comprises 970 companies listed on the Warsaw Stock Exchange, NewConnect and over-the-counter (OTC) stock market administered by the company MTS-CeTO SA. We deliberately excluded banks and insurance companies from the research sample. The financial statements of the sampled companies for the period between 1997 and 2014 were retrieved from the Notoria database.

We check the year-on-year fluctuations of the following variables (separately and in combinations) underlying the terminal value formula: 1) revenue; 2) ratio of capital expenditures to depreciation; 3) free cash flow for firm (FCFF).

The stationarity of the studied variables is subject to verification over varying observation windows, namely over 3-, 4- and 5-year time intervals, which is why we choose a time series as a unit of observation. By combining 7531 firm-year observations into 3-, 4- and 5-year time series, we obtain 5403 3-year time series; 4433 4-year time series and 3598 5-year time series.

In accordance with the assumptions underlying terminal value calculation, the revenue growth rate is expected to stabilize in the residual period at the level close to the rate of economic growth or the rate of consumption growth in the industry. The ratio of capital expenditures to depreciation, the elements of which are used as inputs to the calculation of the reinvestment rate, is also expected to stabilize at the level close to unity as the company matures, delimitates its share on the market and runs out of investment projects generating positive NPV. FCFF is expected to grow linearly without being subject to excessive volatility.

The revenue stability criterion implies that during the entire observation period (3, 4 or 5 years) the company's revenue does not fluctuate by more than r % year-on-year. The verification of the second stability criterion aims at identifying the companies for which the ratio of capital expenditures to depreciation does not fluctuate by more than d % year-on-year through the observation period. Finally, the FCFF stability criterion verifies whether for the sampled companies, FCFF changes by more than f % year-on-year during the observation period; additionally, we require that FCFF be positive in the first year of the observation window.

The testing algorithm is organized as follows: first, we determine the possible range of fluctuation for the studied variable; thereafter, we calculate the number of observations, for which the studied variables are found to remain within the specified range; finally, we determine the proportion of observations satisfying the initial test criterion in the research sample.

Table 1 summarizes the results of the revenue growth stability tests. Assuming that revenue is recognized as stable under condition of fluctuating by no more than 4% year-over-year during the entire observation period, the table demonstrates that only 2,83% of the 3-year time series, 1,06% of 4-year time series, and only 0,47% of 5-year time series satisfy the stability criterion. Revenues of the majority of firms in the sample demonstrate significant volatility with the mode fluctuation range for the 3-year observation span r∈[-14%; 14%]. An increase of revenue variability range to r∈[-10%; 10%] yields 12,94% of 3-year time series, 6,59% of 4-year time series and only 3,72% of 5-year time series satisfying the criterion. The empirically observable volatility of revenue growth rate is clearly at odds with the simplified assumptions underlying terminal value calculation.

Table 2 presents the empirical results for the ratio of capital expenditures to depreciation. Assuming that the ratio of capital expenditures to depreciation is recognized as stable under condition of fluctuating by no more than 10% year-on-year during the pre-defined observation period, we can observe that only 0,93% of 3-year time series, 0,16% of 4-year time series, and only 0,03% of 5-year time series potentially satisfy the mentioned stability criterion. By widening the fluctuation range to d∈[-30%; 30%] we obtain 8,31% of 3-year observations, 3,65% of 4-year observations and 1,80% of 5-year observations meeting the criterion. The ratio of capital expenditures to depreciation is evidenced to be highly volatile with the mode fluctuation range d∈[45%; 50%]. The high variability of the capex-to-depreciation ratio translates into high fluctuations and, as a consequence, low reliability of the g estimate, while the linearization of the residual-period growth rate may appear overly simplistic.

Table 3 highlights the extreme volatility of FCFF exhibited by Polish companies. Only once over the entire research period one company maintained yearly FCFF fluctuations below 10% for 3 consecutive years. For 6,39% of observations, the year-on-year FCFF fluctuations were below 100% during the entire observation interval. The remaining observations manifested higher levels of FCFF volatility.

Table 4 offers an overview of different combinations of the analyzed stability criteria. As demonstrated in the table even considerably broad fluctuation corridors contain a modest share of observations. For example, for the year-on-year FCFF changes contained within the fluctuation range [-100%; 100%], YoY revenue changes ranging between [-20%;20%], capex-to-depreciation yearly changes ranging between [-50%; 50], the percentages of valid observations are as follows: 0,52% of 3-year time series, 0,09% of 4-year time series, and only 0,09% of 5-year time series. The three observations appearing in the first three columns of Table 4 belong to Energa SA and Wawel SA. Both companies can be described as stable-growth mature companies operating in utilities and consumer staples segments respectively, with fixed product portfolios and established market shares. Yet, both firms invest heavily and have volatile FCFF fluctuating by more than 50% yearly.

The empirical data from the Polish stock market prove that the assumptions underlying the terminal value calculation in DCF valuation models represent an unrealistic simplification. The stable-growth phase in the company's organic development represents a theoretical microeconomic construct, which is rarely encountered in practice. Long-term dynamic equilibrium appears to be impossible to attain due to extremely high volatility of the operational environment and fierce competition on the product markets.

The results of the empirical tests call for a discussion of possible ways to improve the conventional DCF models in order to incorporate realistic prognoses of FCF dynamics as well as to account for the high variability of investment policies. The assumption of linear growth during the steady-state period cannot accurately describe the actual transition path of a company towards a dynamic equilibrium, which by itself appears to be an overly simplified theoretical notion.

Table 1: The Results of Empirical Tests of Revenue Fluctuations

Yearly change in revenue over the observation interval, r	2,00%	4,00%	6,00%	8,00%	10,00%	12,00%	14,00%	16,00%	18,00%	20,00%
Observation interval (n)	Number of observations for which the year-on-year changes in revenues are found to remain within the specified range [-r;+r] during the entire observation period									
3 years	38	153	317	506	699	926	1164	1380	1594	1775
4 years	6	47	116	196	292	414	575	738	897	1043
5 years	1	17	52	88	134	200	304	414	525	643
Observation interval (n)	Share of observations meeting the study criterion in the complete research sample									
3 years	0,703%	2,832%	5,867%	9,365%	12,937%	17,139%	21,544%	25,541%	29,502%	32,852%
4 years	0,135%	1,060%	2,617%	4,421%	6,587%	9,339%	12,971%	16,648%	20,235%	23,528%
5 years	0,028%	0,472%	1,445%	2,446%	3,724%	5,559%	8,449%	11,506%	14,591%	17,871%

Source: own elaboration

Table 2: The Results of Empirical Tests of Stability of the Ratio of Capital Expenditures to Depreciation

Yearly change in CAPEX/Depreciation ratio over the observation interval, d	5,0%	10,0%	15,0%	20,0%	25,0%	30,0%	35,0%	40,0%	45,0%	50,0%
Observation interval (n)	Number of observations for which the year-on-year changes in CAPEX/Depreciation ratio are found to remain within the specified range [-d;+d] during the entire observation period									
3 years	13	50	122	208	325	449	595	755	923	1092
4 years	0	7	22	52	113	162	233	330	430	545
5 years	0	1	7	17	40	65	100	157	214	290
Observation interval (n)	Share of observations meeting the study criterion in the complete research sample									
3 years	0,241%	0,925%	2,258%	3,850%	6,015%	8,310%	11,012%	13,974%	17,083%	20,211%
4 years	0,000%	0,158%	0,496%	1,173%	2,549%	3,654%	5,256%	7,444%	9,700%	12,294%
5 years	0,000%	0,028%	0,195%	0,472%	1,112%	1,807%	2,779%	4,364%	5,948%	8,060%

Source: own elaboration

Table 3: The Results of Empirical Tests of FCFF Stability

Yearly change in FCFF over the observation interval, f	10,0%	20,0%	30,0%	40,0%	50,0%	60,0%	70,0%	80,0%	90,0%	100,0%
Observation interval (n)	Number of observations for which the year-on-year FCFF fluctuations are found to remain within the specified range [-f;+f] during the entire observation period									
3 years	1	11	25	47	94	131	184	241	296	345
4 years	0	1	2	4	17	26	43	55	70	83
5 years	0	0	0	0	1	1	3	6	9	14
Observation interval (n)	Share of observations meeting the study criterion in the complete research sample									
3 years	0,019%	0,204%	0,463%	0,870%	1,740%	2,425%	3,406%	4,460%	5,478%	6,385%
4 years	0,000%	0,023%	0,045%	0,090%	0,383%	0,587%	0,970%	1,241%	1,579%	1,872%
5 years	0,000%	0,000%	0,000%	0,000%	0,028%	0,028%	0,083%	0,167%	0,250%	0,389%

Source: own elaboration

Table 4: A Summary Table for Pre-Specified Combinations of the Studied Stability Criteria

Yearly change in FCFF over the observation interval, [-f;+f]	40,00%	50,00%	60,00%	70,00%	80,00%	90,00%	100,00%
Yearly change in revenue over the observation interval, [-r;+r]	8,00%	10,00%	12,00%	14,00%	16,00%	18,00%	20,00%
Yearly change in CAPEX/Depreciation ratio over the observation interval, [-d;+d]	20,00%	25,00%	30,00%	35,00%	40,00%	45,00%	50,00%
Observation interval (n)	Number of observations for which the yearly fluctuations of the studied variables are found to remain within the specified fluctuation ranges during the entire observation interval						
3 years	0	3	3	5	11	17	28
4 years	0	1	1	1	1	1	4
5 years	0	0	0	0	0	0	1
Observation interval (n)	Share of observations meeting the study criteria in the complete research sample						
3 years	0,00%	0,06%	0,056%	0,093%	0,204%	0,315%	0,518%
4 years	0,00%	0,02%	0,023%	0,023%	0,023%	0,023%	0,090%
5 years	0,00%	0,00%	0,000%	0,000%	0,000%	0,000%	0,028%

Source: own elaboration

Directions for Potential Improvements in Terminal Value Modeling

The Sustainability of Competitive Advantage: RONIC in Terminal Value Calculation

Despite having its foundation in economic theory, the assumption of a gradual erosion of the firm's competitive advantage and, as a consequence, a decrease of RONIC, which is embedded within the terminal value modelling algorithm might seem logically flawed and overly simplified. Copeland et al. (2010) provide convincing evidence of ROIC sustainability for 5000 US-based non-financial companies over the 1963-2008 period. If it were the case that all companies gradually accomplished transition to the steady-growth phase, then in a foreseeable time perspective there would be no companies outperforming the economy or actively investing to generate economic value-added, since RONIC would be gradually approaching the WACC. The corporate sector would attain a dynamic equilibrium.

In practice, however, a multitude of scenarios may be observed. Some companies strengthen their competitive advantage and manage to increase their value creation potential; others go bankrupt; yet others reach stabilization, which, however, does not necessarily imply a linear cash flow growth.

The conclusion is as follows: an accurate anticipation of erosion of the firm's competitive advantage and, as a consequence, of ROIC decay is a challenging task which necessitates an in-depth analysis of the company's fundamentals, its operating and institutional environments. Terminal value provides a generalized conservative forecast of the firm's organic growth based on a set of rigorous simplifying assumptions, which reduce the company's long-term strategy to a linear stable-growth function. The static character of DCF valuation models, which ignores the firm's ability to adapt to the operational environment in order to conserve or build upon its competitive advantage, constitutes their main weakness. The modeling of medium- and long-term ROIC dynamics may require a complex econometric analysis of the key leading explanatory variables, which may help prepare a projection of the company's value creation potential and distinguish between firms which are likely to preserve and build upon their competitive advantage and those which are expected to gradually decay. Subsequently, the results of prognostic models may be successfully incorporated within the terminal value estimates.

A particular role in the analysis of the company's competitive position belongs to the instruments and paradigms of strategic management which attempt to define the source of a sustainable competitive advantage. Being one of the cornerstones of the theory of industrial organization, Porter's (1980) 'five forces' model concentrates on interactions between the company and its environment and offers guidance regarding the elaboration of defensive strategies aimed at preserving competitive advantage. The primary focus of the competitive forces model is the creation of conditions necessary for market dominance. Shapiro (1989) analyzes the possibilities to apply the toolkit of oligopolistic game theory to strategic decision making and concludes that the static character of most of the game-theory models constitutes their principal weakness. According to Shapiro (1989), game theories forego the entrepreneurial aspect of the competition process, whereby management's primary task is not to plan a sequence of steps in the game, but rather to persistently build a non-replicable competitive advantage. However, the idea of formulating strategic responses to competitor actions relying on the tenets of game theory had enormous repercussions for strategic management paradigms.

The resource-based view (RBV) analyzes a company's abilities to sustain its competitive advantage from the standpoint of its resource endowment (Learned et al., 1969). Barney (1991) identified four key factors determining the resources' ability to contribute to the company's competitive advantage: 1) value; 2) rareness; 3) imitability; 4) substitutability. Amit and Shoemaker (1993) elaborate on the foundation of RBV and analyze the circumstances and conditions, which help companies to procure economic rents, e.g.: 1) heterogeneous distribution of resources between companies; 2) resource-market imperfections; 3) bounded rationality of management responsible for making decisions regarding resource usage and development under conditions of uncertainty, process complexity and organizational conflicts. Further developing the RBV, Grant (1991) stresses the importance of the resource and capability management as the key success factor for sustaining competitive advantages and identifies the following factors of sustainability: barriers to entry (patents, brands, retaliatory capability); monopoly and bargaining power; cost advantage (access to specific resources or unique technologies); differentiation advantage (marketing and quality management).

Eventually, in response to the increasing pace of changes in operational environment, the focus in strategic management studies shifted towards the dynamic capabilities framework. Dynamic capabilities are defined as difficult-to-imitate company abilities to create, enhance and deploy internal and external competences in order to build new competitive advantage in a rapidly changing business environment (Teece et al., 1997). Teece et al. argue that competitive advantage is created through interaction of managerial and organizational processes, i.e., coordination, learning and reconfiguration, with the company's resources and specific assets (technological, reputational, financial, etc.).

The principal merit of the dynamic capabilities framework consists in shifting the focus of strategic decision making to the choice of the path of capabilities creation and development, which in turn determines the firm's investment strategy (Pisano, 2015). Pisano argues that companies face not only direct market competition in terms of product quality, technology, production capacities, but also indirect competition of effectiveness of capability creating strategies, which constitute the source of a deep-seated competitive advantage.

The discussion of strategic management theories conveys an important message: erosion of a competitive advantage cannot be perceived as an inevitable fatality facing the company in the long-term perspective. Despite theoretical elegance, the assumption of a gradual transition to the stable-growth phase with RONIC approaching WACC cannot and should not become a rule of thumb, for it completely ignores the company's adaptation capabilities. As a consequence, its application may lead to a distorted picture of the company's value creation potential and to the wrong bottom line of the valuation model. Copeland et al. (2010) state that in the case of companies with an ingrained competitive advantage, e.g., protected by patents, licenses or barriers to entry, RONIC should be assumed to equal ROIC observed during the high-growth period. However, the examples of Xerox, Kodak, Nokia, Canon, Renault, and many others demonstrate that this rule should be applied with prudence.

These conceptual issues of terminal value calculation prompt a debate over possible improvements to the modelling process. When it comes to ROIC forecasts, the 'one size fits all' approach clearly does not reflect the observed market dynamics, for it assumes a unique development scenario which may not be applicable to some companies (in particular those, which have valuable growth options and are expected to sustain their competitive position).

One of the possible alternative approaches to terminal value calculation is to use the multiples technique. The basic assumption is that in the residual period, the company's value is equal to a multiple of its earnings or book value. Usually, current industry price-to-earnings or price-to-book-value ratios are taken as inputs for calculations. Copeland et al. (2010) criticize this approach since at the end of the explicit-forecast period, the multiples are likely to change in response to changes in the firm's fundamentals. In fact, the multiples approach and DCF models share the same weakness, i.e., they are static by their nature and therefore may fail to adequately reflect the uncertainty surrounding the firm's prospects.

WACC in the Calculation of Terminal Value

The existing approaches to terminal value calculation do not provide unambiguous guidance regarding the appropriate discount rate to be applied. Gollier and Weitzman (2010) argue that distant and uncertain cash flows should be discounted using the discount rate which declines over time to its minimal possible value. Damodaran (2010) and Copeland et al. (2010) argue that the applicable discount rate should derive from a sustainable or targeted capital structure. We refine these statements by suggesting the use of industry average leverage ratios for WACC calculation as the best proxy for an optimal level of indebtedness for the valued company.

Empirical literature supports our suggestion to use the industry benchmarks to estimate WACC for the purposes of terminal value calculation. Graham and Harvey (2001) conducted a survey among 392 CFOs of American companies representing diverse industries and sizes: the majority of respondents stated that their company had a strict or rather strict target capital structure influenced by the leverage ratio prevailing in the industry. Among the factors determining the choice of the leverage ratio, CFOs of the investment-grade companies highlighted financial flexibility and target credit ratings. Similar conclusions were presented by Lemmon et al.

(2008): capital structures were found to be relatively stable; significant deviations from the long-run industry averages were found to be followed by gradual return to the steady states.

Another interesting dilemma is whether to make adjustments to the equity beta in the stable-growth period for the purposes of terminal value calculation. Damodaran (2010) maintains that in the long-run the company's risk profile gradually approaches that of the market, which technically implies the beta's long-term convergence to unity. However, Fabry and Van Grembergen (1978) studied the stationarity of beta coefficients and documented a reasonable stability of betas over time. Similar conclusions were presented by Baele and Londono (2013), who investigated the dynamics of market betas of 30 US industry portfolios between 1970 and 2009. Koutmos et al. (1994) stated that betas exhibited persistent volatility levels. Overall, the empirical evidence suggests that the problem of beta forecasting remains a debatable issue. Making reliable predictions of the beta's dynamics is a challenging task, for it is influenced by multiple factors including the general economic conjuncture, stock market dynamics, changes to the company's business model, etc. Taking into consideration the inherently static character of DCF valuation models, leaving beta unchanged for the purposes of terminal value calculation might be a sound decision.

The Fair Value Considerations in Terminal Value Calculation: The 'Highest and Best Use' Assumption and Adjustments for Operational Inefficiencies

DCF valuation models may be utilized to estimate the fair value of an asset. In accordance with the International Valuation Standards (IVS, 2017), fair value is defined as 'the estimated price for the transfer of an asset or liability between identified knowledgeable and willing parties that reflects the respective interests of those parties'. Calculation of fair value within the DCF framework imposes additional assumptions on the valuation model.

The concept of fair value assumes complete symmetry of information between the transacting parties, i.e., between buyers and sellers. It implies that if the company is being run inefficiently, the negative impact of the identified inefficiencies should be eliminated from the long-term cash flow forecast (Mielcarz & Wnuczak, 2011). Such inefficiencies may include: an excessive stock of cash and non-operating assets; cost inefficiencies; suboptimal financing and capital structure decisions; flawed dividend policy and excessive management perquisites, etc. A cash flow projection for the fair value calculation should be based on the 'Highest and Best Use' (HBU) assumption presented in IFRS 13 (IASB, 2011). In accordance with the HBU assumption, management is assumed to use all available assets in the best possible way in order to fulfill the fiduciary duty towards shareholders. The corporate finance theory postulates that if managers fail to deliver the optimal operating results, inefficient decisions may be penalized by means of a management replacement or a corporate takeover.

In the case of terminal value calculation, the HBU assumption implies that the operating results underlying the FCF forecast should be adjusted for all existing inefficiencies (Mielcarz & Wnuczak, 2011). The company's growth rate should reflect the long-term prospects of its business model, and not exclusively the current performance record. WACC should be assumed to converge towards its optimal level.

Conclusions

The paper analyzes the assumptions underlying terminal value calculation in DCF valuation models. Relying on a critical review of empirical literature and data from the Polish stock market, we conclude that the residual value estimates may present only a static picture of the currently available information on the company's fundamentals, which substantially limits its predictive power. Empirical data demonstrate that the terminal value assumptions may not match the observable market dynamics and may not describe the actual development path of the valued companies. Steady-state growth assumptions do not find confirmation in practice with the majority of quoted Polish companies exhibiting high volatility of revenues, cash flows and investment ratios. Results of the empirical tests point to the methodological shortcomings underlying the assumptions of terminal value calculation and highlight the importance of further developments of DCF modeling techniques in order to improve their accuracy.

The simplifying assumptions and the highly probabilistic nature of DCF models impede their application in building long-term investment strategies. Being static in nature, a DCF forecast is based only upon the publicly available information. An inflow of new information is followed by price adjustment accompanied with revisions to the terminal value estimates and, as a consequence, to the bottom line of the valuation model (Yezegel, 2015). The latter implies that DCF models may necessitate frequent adjustment in response to inflows of information in order to remain an accurate reflection of the firms' fundamentals. Low accuracy of the modeling process may possibly contribute to the short-termism of investment decisions and high inconstancy of investment recommendations.

Due to heavy reliance on financial prognoses, DCF models are vulnerable to the influence of behavioral factors. The choice of the inputs to the model remains at the sole discretion of the analyst and may not always be objective. Terminal value is particularly sensitive to changes in the underlying assumptions and, therefore, requires special attention on the part of valuators.

Any company represents a complex system consisting of multiple divisions, departments and investment projects with each of them exhibiting particular development and growth patterns. Summarizing the performance records of all constitutive parts into one static figure may present an overly simplistic view of the company's development prospects. More complicated and detailed models may be necessary in order to come up with reliable and realistic value estimates. The conclusions presented in the paper question current market conventions in the domain of corporate valuation and suggest undertaking an in-depth discussion of possible improvements to the existing valuation toolkit.

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