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Option-Style Multi-Factor Comparable Company Valuation for Practical Use

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Non-Technical Summary

Comparable Company Valuation (CCV) is one of the most commonly used stock valuation methods. It is especially useful for external analysts who have no direct access to value relevant company data and it is a suitable approach in valuing companies with uncertain future cash-flow patterns. Additionally, CCV is a very powerful tool to test for plausibility of discounted cash flow-valuations in general and to determine market prices in initial public offerings or mergers & acquisitions-transactions.

One of the major shortcomings of the classical single-factor model (e.g. price-earnings ratio) is the non-applicability of negative values in the basis of reference which is not consistent with reality at capital markets. The quality of real capital markets (degree of market efficiency, number of comparable companies available) sometimes poses additional obstacles to the model: if applied correctly single-factor CCV requires comparable companies with at least identical profitability, cost of capital and long term growth rate of dividends. To account for market inefficiencies and balance minor under- or overvaluations of the peer group a certain amount of comparable companies is needed. However, the requirement of multiple appropriate comparable companies can not be fulfilled in several valuation cases at the German market because of the relatively small number of listed companies.

By providing a multi-factor CCV model based on certain accounting attributes we overcome these drawbacks: Firstly, because of the joint inclusion of substance and performance related factors the model is applicable for currently positively as well as for currently negatively performing companies. Secondly, the model waives profitability and long term growth of dividends as a peer group selection criterion by rather integrating them into the valuation process. For this approach a sufficient set of comparable companies is usually available.

An additional advantage of the multi-factor model is that it is in general more consistent with economic reality than single-factor models: To specify firm value assuming the company continues its current activities our model accounts for both book value of equity and earnings in the basis of reference because of their joint influence on stock prices. Using these two factors future growth perspectives of the target company can be depicted much more economically sound than in a common single-factor valuation model. Moreover, the phenomenon of positive stock prices under current negative earnings can be partially explained, too. To further improve valuation quality for current low-positive or negative earnings we additionally account for recent research, which indicates that the relationship between earnings and book value is non-linear. For this we take into consideration that the company has the possibility to adapt firm ressources to alternative uses or even to liquidate the company.

The proposed multi-factor model extends the existing tool box of company valuation. It is especially useful for valuing companies that have an expected RoE very different from its peer group and for companies with negative earnings. The study also aims to sharpen financial analysts‘ view of the actual relationship between earnings and stock prices and to highlight some of the problems of the classic single-factor valuation.

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Abstract:
Classical single-factor comparable company valuation (CCV) like e.g. valuation using the price-earnings ratio is associated with several shortcomings. The two most important are the non-applicability of negative values in the basis of reference and the high requirements to the qualitative characteristics of comparable companies. This paper develops a multi-factor CCV model based on substance and performance related accounting attributes that largely overcomes these drawbacks. Additionally, the model allows to depict expected future earnings development economically sounder than single-factor models. Furthermore, by accounting for management's option to adapt firm assets differently or to liquidate the company the model can conclusively assign positive stock prices to currently negatively performing companies.

JEL-Classifications: G12, G31, M21, M41

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1 Introduction

Comparable Company Valuation (CCV) is one of the most commonly used stock valuation methods (for Germany see e.g. Wichels 2000: 146,148). It has its origins in the basic principle of arbitrage that says: substitutes should sell for the same price. Thus, unlike the discounted cash flow (DCF)-method which values companies based directly on what they are expected to pay out in the future this approach determines the value or price of the target company based on how comparable companies (the so called peer group) are valued or priced.[1] Usually there are no two identical companies, so that appraisers have to rely on companies that exhibit a certain degree of similarity to the target company. To settle the remaining differences between both kinds of companies corporate values of the peer group are in a first step converted into a multiple of a certain accounting or non-accounting attribute. These attributes are called bases of reference. In a second step this multiple is applied to the respective basis of reference of the target company. A valuation model with only one basis of reference is called single-factor CCV, while the use of several bases leads to a multi-factor CCV model.

While in a world of forecast certainty DCF-valuation is a method that yields much more accurate valuation results, CCV becomes advantageous when future cash flows are not easily predictable. As a consequence, CCV is especially useful for external analysts who have no direct access to value relevant company data (i.e. no possibility to make a due dilligence), or in valuing companies with uncertain future cash-flow patterns. Additionally, CCV is a commonly used tool to test for plausibility of DCF-valuations in general and to determine market prices in IPOs or M&A-transactions.

The basic problem of CCV is to jointly select appropriate bases of reference as well as a suitable set of comparable companies so that the time series behaviour of discounted cash flows of the peer group can be projected onto the target company. However, many existing CCV models do not adequately account for the determinants of these time series properties. This problem becomes especially apparent when looking at classical single-factor CCV models like the model based on the price-earnings ratio (also called the price-earnings multiple): A major shortcoming of this ratio is the non-applicability of negative values in the basis of reference. Nonetheless, many companies have positive earnings after an initial period of loss and, consequently, many companies have positive stock prices under current negative earnings. Using sales instead of earnings in the basis of references might mitigate that problem but on the other hand decreases the value relevance of

[1] For the relationship between value and price see e.g. Casey (2000). The terms are used interchangeably below.

the multiple. It should be noticed that in case of positive bases of reference the difficulties with projecting the time series behaviour of future cash flows are not obvious at first glance but do exist, too. Additional problems with single-factor CCV arise because these models are usually not able to reflect management's option to apply firm assets differently (i.e. to reorganise). Therefore the valuation results are frequently misinterpretated.

We try to overcome these drawbacks by providing a multi-factor model that reflects both the actual capital market expectations of earnings' future development and earnings' persistence as well as the partial non-linearity in the functional relationship between earnings and stock prices due to management's option to reorganise the company. To specify firm value assuming the company continues its current activities (going concern value, recursion value) our model accounts for both book value of equity and earnings in the basis of reference because of their joint influence on stock prices (Penman 1992, Ohlson 1995, Barth/Kallapur 1996). Using these two factors future growth perspectives of the target company can be applied much more economically sound than in a common single-factor valuation model. Furthermore, using these two accounting figures the phenomenon of positive stock prices under current negative earnings can be partially explained. To improve valuation quality for companies with currently low-positive or negative earnings we additionally account for recent research, which indicates that the relationship between earnings and book value is non-linear (Hayn 1995, Berger/Ofek/Swary 1996, Burgstahler/Dichev 1997, Collins/Pincus/Xie 1999, Zhang 2000). For this we take into consideration that the company has the possibility to adapt firm resources to alternative uses (Burgstahler/Dichev 1997) or even to liquidate the company (Berger/Ofek/Swary 1996).

Even if our main focus is not on accounting related aspects of CCV – like how to normalise earnings and how to determine the real economic book value of equity – our paper also contributes to the large body of research about the value relevance of accounting attributes (for an overview see Holthausen/Watts 2001). Most of the previous studies deal with the general relationship between stock prices and balance sheet or income statement disclosures. However, almost none of them explores a valuation model that can be practically used under the realistic assumption of partial capital market inefficiencies and the limited availability of comparable companies. While our emphasis is also on the value relevance of accounting data for stock prices, we extend the existing literature by providing a concrete model that can determine values or prices of capital market oriented companies. Furthermore, the model should show how analysts can more accurately perform comparable company valuation and highlight the problems associated with classic single-factor CCV. Finally, we want to shed light on the fact, that CCV is not a simple in-and-out valuation method, but always has to be applied very carefully and well considered (Beckmann/Meister/Meitner 2003).

The remainder of this paper is organised as follows: section 2 describes the basic principles of classical single-factor CCV as it is broadly used in practical valuation settings. A critical assessment reveals why this approach to CCV might cause problems in its application and frequently delivers biased valuation results – especially when it is used in markets where the number of comparable companies is scarce. Section 3 presents the multi-factor CCV model. It is shown why book values and earnings have a joint influence on stock prices and what superior role the option to adapt firm resources plays in determining stock prices. Section 4 provides the summary, the conclusions and some implications for future research.

2 Single-factor comparable company valuation

2.1 Theoretical foundations

Valuation theory knows three general approaches to estimate the value of companies (Bhojraj/Lee 2002: 413-414, Damodaran 2002: 11). Via the first approach the equity value of the company is calculated directly on the basis of its expected cash flows. Sometimes cash flows are substituted by more easily predictable performance measures like dividends or earnings. Models used to apply the direct approach are the discounted cash flow (DCF) model, the dividend discount model (DDM) and the residual income model (RIM).

The second approach, the contingent claim approach, values assets that exhibit option characteristics. The value of these assets, so called real options, is calculated using option pricing models. If the high demands on the quality of the assets are met, appraisers can better account for management flexibility than with the direct approach. Consequently, this approach is sometimes used to supplement the direct approach (Trigeorgis 1996: 121-124). However, real option valuation prevalently faces massive measurement problems in practice.

The objective of the third approach is to value target companies based on how the market prices similar companies (relative valuation approach, valuation using multiples, CCV). In contrast to the direct approach no explicit cash flow forecasts for the target company are needed. However, accurately performing CCV necessitates relatively efficient markets and the existence of comparable companies. To put it differently, valuation quality depends crucially on capital market‘s quality. It is obvious, that in a world of high levels of forecast certainty DCF-valuation is a method that usually yields more accurate valuation results. Whereas CCV becomes advantageous when future cash flows are not easily predictable.

Given the validity of the dividend discount model, in a world of uncertainty the company's equity is worth exactly the sum of its discounted expected future cash flows to equity[2]:

$$V_e = \lim_{n\to\infty} \sum_{t=1}^{n} \frac{E[CF_t]}{(1+k_e)^t} \tag{2.1}$$

with: V_e = Equity value of the company

CF_t = cash flow to equity at time t

k_e = cost of equity

The basic principle of arbitrage says, that all substitutes should sell for the same price. Thus, in an efficient market (i.e. Value (V_e) = market price of the company P) two companies are worth exactly the same, if they exhibit the same stream of expected cash flows and the same cost of equity. Since it is nearly impossible to find two companies with exactly the same characteristics, classical single-factor CCV allows for minor differences in the performance or the substance between the target company and the comparable company. Thus, with single-factor CCV models like those based e.g. on the PE ratio even companies that exhibit a different amount of earnings but have similar other characteristics can be compared directly.

The single-factor approach proceeds in two steps: In a first step the value of a comparable company or the average value of a set of comparable companies has to be expressed as a multiple of a certain (mostly accounting based) basis of reference (such as earnings, EBITDA, sales, etc.) in which the companies differ. In a second step this derived multiple is applied on the respective basis of reference of the target company:

$$P_{target,t} = \frac{P_{cc,t}}{Reference_{cc}} * Reference_{target} \tag{2.2}$$

where $P_{target,t}$ is the price of the target company at time t, $P_{cc,t}$ is the price of the comparable company at time t and $Reference_{target}$ and $Reference_{cc}$ are the bases of reference for the target company and the comparable company respectively. The fraction in this equation constitutes the multiple. This fraction is called a trailing multiple if these bases of reference are measured at time t. It is called a forward multiple if the bases illustrate expected future accounting attributes.

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[2] Cash flows to equity are cash flows that are available to be payed out to shareholders.

In practice more than one single comparable company should be included in the valuation process. The reasoning behind this is, that in real capital markets not every company is assumed to be priced correctly but companies are assumed to be on average priced correctly (Fama 1976: 144). In the case of several comparable companies the multiple is determined by averaging the multiples of every single peer group company (big peer groups) or by calculating the median (small peer groups). Sometimes even harmonic mean aggregation is proposed (Baker/Ruback 1999: 16, 20, Beatty/Riffe/Thompson 1999: 182).

Based on the framework provided by the Gordon-growth-model (Williams 1938, Gordon/Shapiro 1956) a derivation of theoretical valuation models for two of the most frequently used bases of reference is demonstrated below. In general, the set of all bases of reference can be divided into two classes: the performance oriented bases of reference and the substance oriented bases of reference. The one year forward price earnings (PE) ratio should be representative for all performance related multiples in this study. This ratio can be expressed by the following Gordon-Shapiro equation (Damodaran 2002, 471, Beaver/Morse 1978, 65):

$$\frac{P_t}{X_{t+1}} = \frac{(D_{t+1} / X_{t+1})}{k_e - g} \qquad (2.3)$$

where X_{t+1} is the expected earnings (normalised net income) at time t+1, D_{t+1} is the expected dividend at time t+1 and g is the long term growth rate for earnings and dividends.

The second multiple is the price-book (PB) ratio which should be representative for all substance oriented multiples. By substituting B_t*RoE_{t+1} (with B_t = book value of equity[3] at time t and RoE_{t+1} = expected return on equity at time t+1) for X_{t+1} the Gordon-Shapiro equation can be expressed as follows (Damodaran 2002: 515):

$$\frac{P_t}{B_t} = \frac{RoE_{t+1} * (D_{t+1} / X_{t+1})}{k_e - g} \qquad (2.4)$$

The expressions (2.3) and (2.4) show, which demands the comparable companies have to meet for each multiple valuation: Taking e.g. the PE ratio, we can see that it is a function of the payout ratio, the cost of equity and the growth rate of earnings. Accordingly, for accurate comparability the peer group companies have to exhibit similar future pay out ratios, similar cost of equity and similar growth rates. Under the further assumption of clean surplus accounting the importance of the dividend

[3] Alternatively shareholder funds, i.e. economic capital employed minus debt, can be used.

policy and therefore of the payout ratio can be reduced (Lundholm 1995: 752).[4] Thus, the comparable companies effectively only have to exhibit a similar cost of equity and a similar growth rate. All this correspondingly applies to the PB ratio with the only difference that the PB ratio additionally calls for the future RoE as a comparability criterion.

2.2 Critical assessment

One of the major methodical shortcomings of single-multiple CCV is its inability to produce reasonable company values on the basis of negative reference variables. This applies especially for earnings based valuation methods like the PE ratio. Real world observations at capital markets, however, reveal a lot of companies with negative current earnings and contemporaneous positive market values. If confronted with the problem of negative earnings in practice, analysts simply ascend the income statement until they find a positive position which they can use as a basis of reference – e.g. sales.[5] The problem of partial non-applicability of bases of reference is not that severe if sales serves as the basis of reference because sales figures are rarely zero and never negative. Moreover, in most cases it is economically sound that companies with zero sales have no value (with the exception of some young companies in the R&D stage). However, by substituting less performance related and less value relevant bases of references for more performance related and more value relevant bases of references, the CCV-model loses much of its valuation power.[6] Additionally, the comparable companies have to meet higher demands concerning the similarity to the target company (Moser/Auge-Dickhut 2003: 20, Herrmann 2002: 52 f., 99). As regards the accounting source of the multiples it is the CCV with performance related bases of reference that suffers mostly from this non-applicability of negative values. Multiples based on substance related bases of reference – like book value multiples – are not concerned that strongly.

The reason for this drawback stems from the implications of the valuation model. Based on the theoretical framework provided by the Gordon-growth-model, the

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4 The clean surplus relation means that only capital contributions, dividends and the profit or loss reported in the income statement can change the amount of owners‘ equity. To put it differently, all revenues and expenses have to be recorded on the income statement. For IAS, US-GAAP and German GAAP the clean surplus relation approximately holds. Consequently, all three accounting regimes slightly tolerate a „dirty“ surplus accounting. Thus, the payout ratio is not meaningless for the PE ratio. However, it can be assumed that its importance is low.

5 Another common method to avoid this problem is to average earnings over the last few years. Below, we do not go into the details of this method.

6 Regarding the value relevance of different bases of reference see Liu/Nissim/Thomas (2002).

sustainable growth rate of earnings or dividends should be the same for all peer group companies. This is implied by the assumed linear relationship between market value and the basis of reference with a null value at zero. Since this growth rate is a percentage number, the basis of growth (earnings or dividends) must be a positive figure to yield positive corporate values. From an economic point of view, however, corporate growth is seldom purely a function of earnings or dividends. Earnings are a suitable basis of growth if and only if companies exclusively have to rely on retained earnings to finance new investments and do not employ a significant amount of balance sheet assets during the value added process.[7] However, in a more general setting one should reasonably assume that it is rather sales or the ressources available to the firm which serve as a base for future corporate growth.

Recent research by Chan/Karceski/Lakonishok (2003) supports this theory of a limited usefulness of the application of earnings growth rates to company valuation in practice. In a broadly based empirical study they find that earnings growth rates exhibit a low predictability in general and, additionally, that there is mostly no persistence in long-term earnings growth rates. In the context of CCV that means that accounting for earnings growth rates in most cases rather seems to be an artifical construct to fulfill the methodical requirements of the Gordon-growth model than to be an economically justified operation.[8] This drawback of the valuation model is not only severe for companies with negative earnings but also for companies with low positive earnings, because in the latter case the economic growth rate might differ dramatically from the implied earnings growth rate. Consequently, it is also nonsensical to compare fundamentally underperforming companies with fundamentally outperforming companies.

The latter argument concerning the lack of comparability of companies with different profitabilities leads to a second important issue: along with the funds available the future profitability of a company is the most important determinant of corporate growth (Reilly/Brown 1997: 453). Thus, accounting for identical development of profitability is necessary to accurately perform single-factor CCV (see Alford 1992 for valuations using the PE ratio). However, selecting comparable companies based on profitability development in addition to other peer group criteria would often fail in practical settings because of the small number of then remaining

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7 All this will be explained in greater detail in section 3.1.1.

8 It should also be noticed that these considerations call the general applicability of the Gordon-growth-model into question. While methodically sound, it is economically doubtable that analysts can reliably determine the appropriate long term growth rate of earnings or dividends because of the discrepancy between the economic and the earnings' growth rate outlined above. This is getting even worse for companies with negative or zero earnings: the model is simply not able to calculate reasonable corporate values on these bases.

peer group companies (especially at non-US stock markets like the German market). The reason for this failure is that by aggregating the reference variables of several peer group companies individual over- and undervaluations can be balanced. Given the realistic settings of minor market inefficiencies along with the existence of individual mispricing of companies, it is obvious that single-factor CCV might easily result in biased valuation results if this balancing possibility does not exist, i.e. if CCV relies on an insufficient number of comparable companies.

Contrarily, analysts that perform single-factor CCV and do not accurately account for profitability development as a determinant of growth are also running danger to calculate biased corporate values. In this case the assumption of a linear relationship between market value and basis of reference not only poses problems if the target company exhibits negative reference variables but also if it exhibits a high level of profitability (Freeman/Ohlson/Penman 1982, Bernard 1994, Miller 1994: 33f.). The assumed linear relationship would only hold if companies can act totally independently of other industry forces (like competitors, suppliers and buyers). However, this does usually not conform with reality at capital markets.

The third methodical shortcoming is that the model does not take into consideration management's option to adapt firm resources to alternative uses or to liquidate the company (Berger/Ofek/Swary 1996, Burgstahler/Dichev 1997). This flexibility is especially value relevant if the performance related reference variable has negative or low positive values because in this case the probability of future corporate reorganisation is high. Even if analysts account for profitability the selection of suitable comparable companies is difficult because additional criteria like the amount of assets available to reorganise or to sell off have to be considered. Including this amount of assets would presumably lead to an even lower number of comparable companies available. Controversely, if analysts do not explicitly use profitability as a peer group selection criterion this option leads to a partially convex functional relationship between market value and profitability (in analogy to the typical shape of the function of financial options). This convex shape is not considered in common single-factor CCV models.

Even if analysts succeed in selecting a sufficient number of peer group companies based on the appropriate selection criteria and therefore perform single-factor CCV theoretically sound, there remains a last problem: If the basis of reference is only weakly relevant for stock prices there is a high risk of calculating biased company values; i.e. even if the basis of reference has the same value relevance for both the peer group companies and the target company, this does not automatically mean that the valuation process yields accurate results. In fact, it is also necessary that the basis of reference exhibits a high degree of value relevance. How analysts can determine the value relevance of certain bases of reference is discussed in section 3.1.1.

To conclude: existing theoretical work is not totally consistent with economic reality at capital markets. Especially the non-applicability of negative values in the basis of reference, the unresolved role of corporate profitability, the non-consideration of the reorganisation option and a potential lack of value relevance of the basis of reference might lead to problems in practical valuation settings.

3 Multi-factor comparable company valuation

3.1 Key elements

3.1.1 Corporate growth perspectives assuming the company continues its current business activities

While in DCF-analysis growth perspectives of a company are forcasted taking into consideration all possible growth drivers, classic single-multiple CCV relies on limiting assumptions. Taking the PE model, one strange characteristic becomes apparent: Current dividends (and implicitly current earnings) are the basis of future growth. That means that growth is assumed to be a percentage of earnings. It also implies that if earnings are zero no growth is possible. (Reilly/Brown 1997, p. 453-454). In contrast, taking the PB ratio, current book value is assumed to be the basis of growth. Thus, only the amount of firm ressources available determines the development of future earnings. In this latter case the current performance of the company is assumed to be not relevant for the future performance.

For analysts there are certain indicators that determine which of the two categories of ratios – substance oriented or performance oriented ratios – is supposed to deliver more accurate results in a practical valuation setting, i.e. which of the two categories is more value relevant. These indicators can be divided into three dimensions.

The first dimension is the availability of capital. Usually there are two possibilities of financing new investments: Either by internal capital sources (retained earnings) or by external capital sources (debt). If a company has no access to the debt market, corporate growth is possible only if current and future investments are profitable, i.e. if current and future earnings are positive. Consequently, the amount of current earnings well-defines future growth possibilities. In this case the PE ratio applies and the growth rate of current earnings g can be expressed as follows (Reilly/Brown 1997: 453):

$$g = \left[1 - (D_{t+1} / X_{t+1})\right] * RoE_t \tag{3.1}$$

That means that the growth rate directly depends on the retention rate and the return on equity.[9]

In contrast, current earnings are not necessarily a good indicator for future performance if a company also relies on external finance. In this case the growth rate still depends crucially on the return on equity on future investments but no longer exclusively on the retention rate and therefore no longer exclusively on current earnings. However, it is not clear whether the PB ratio leads to more accurate valuation results than the PE ratio because access to external finance usually depends on the performance of a company and therefore on its amount of earnings. As a consequence it is not clear whether the growth rate should be based on economic activity (e.g. book value or sales) or on earnings.[10] It can only be stated that from a financing perspective there are some reasons to consider the PB ratio as not-irrelevant for the valuation of companies

The second dimension is the value added process of the company (i.e. the depth of production, the production intensity). At one extreme of this dimension we find a group of companies that does not employ a significant amount of balance sheet assets during the value added process or that does not have a high proportion of variable assets, like the services industry. Future cash flows of these companies do not depend crucially on the book value of equity. In this case current performance (e.g. current earnings) is a good indicator of future performance. Thus, it is the PE ratio that should apply.

On the other extreme we find a group of companies that employs a high proportion of balance sheet assets during the value added process (asset heavy companies) or that has a great amount of variable assets compared to total assets. Examples for these companies are utilities and banks. For those companies the income earned is on average in close relationship to the book value (McCarter/Aschwald 1992: 153). In general, it is also desirable that the book value is a good indicator for the amount of firm resources (Peemöller/Meister/Beckmann 2002: 207).[11] If all this applies, using the PB ratio is a suitable CCV approach.

The third dimension is the state of the industry. The degree of competition in an industry determines the level of profitability of companies and the possibilities to

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[9] It is important to consider that on the one hand a higher retention rate increases the growth rate, but on the other hand it decreases the numerator in equation 1 on page xx. Therefore, it is not clear how a change of the dividend policy eventually affects the PE ratio.

[10] Following this reasoning earnings should at the moment be more value relevant than in the late 1990s, because of the worse access to external funds.

[11] This is especially a problem for companies with a high proportion of intangibles.

earn abnormal earnings in the long term. In pure competition markets (price taker markets) economic profits approach zero in the long run – i.e. companies earn a normal rate of return (Gwartney/Stroup 1997: 515). However, in most industries the assumption of pure competition is not satisfied. Porter provided a framework which points out the different forces that influence the real degree of competition of an industry (Porter 1980: 3-29, Porter 1998: 21-34). These five forces are: the rivalry among companies, the buyer power, the supplier power, the barriers to entry and the threat of subsitutes.

In industries that are only weakly influenced by these industry forces (with the exception of the barriers to entry, which are assumed to be high[12]) companies within these industries can earn longterm abnormal profits. A low rivalry permits to make strategic moves like changing prices or differentiating products. In industries with low degrees of buyer and supplier power[13] companies have the power themselves to improve their benefit-cost relationship and therefore their margins. When barriers to entry are high the degree of rivalry will stay low. Thus, companies can keep or even increase their abnormal profits. Finally, a low number of substitute products or the non-existence of close substitute products raise the ability of companies to increase prices. To conclude, for companies that do business under these circumstances the current performance (current earnings) is a good indicator for future performance. Outperformer can keep their strategic advantages because of their power while underperformer do not have the possibility to defend against the outperformer. Thus, the PE ratio (or any performance based multiple) should lead to accurate valuation results.

If, however, these five forces heavily influence the industry, long term economic profits are driven to zero[14] or at least profitability becomes equal for all companies. Given that profitability can be expressed as a certain percentage of book value the PB ratio is a suitable valuation approach in this case.

Figure 1 visualises the determinants of the value relevance of book value and earnings. It combines all three dimensions and shows recapitulatorily when to use substance oriented multiples like the PB ratio and when to use performance related multiples like the PE ratio. It should be noticed that this economic approach to

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[12] If below the influence of industry forces is called „weak“, barriers to entry are always assumed to be high and vice versa.

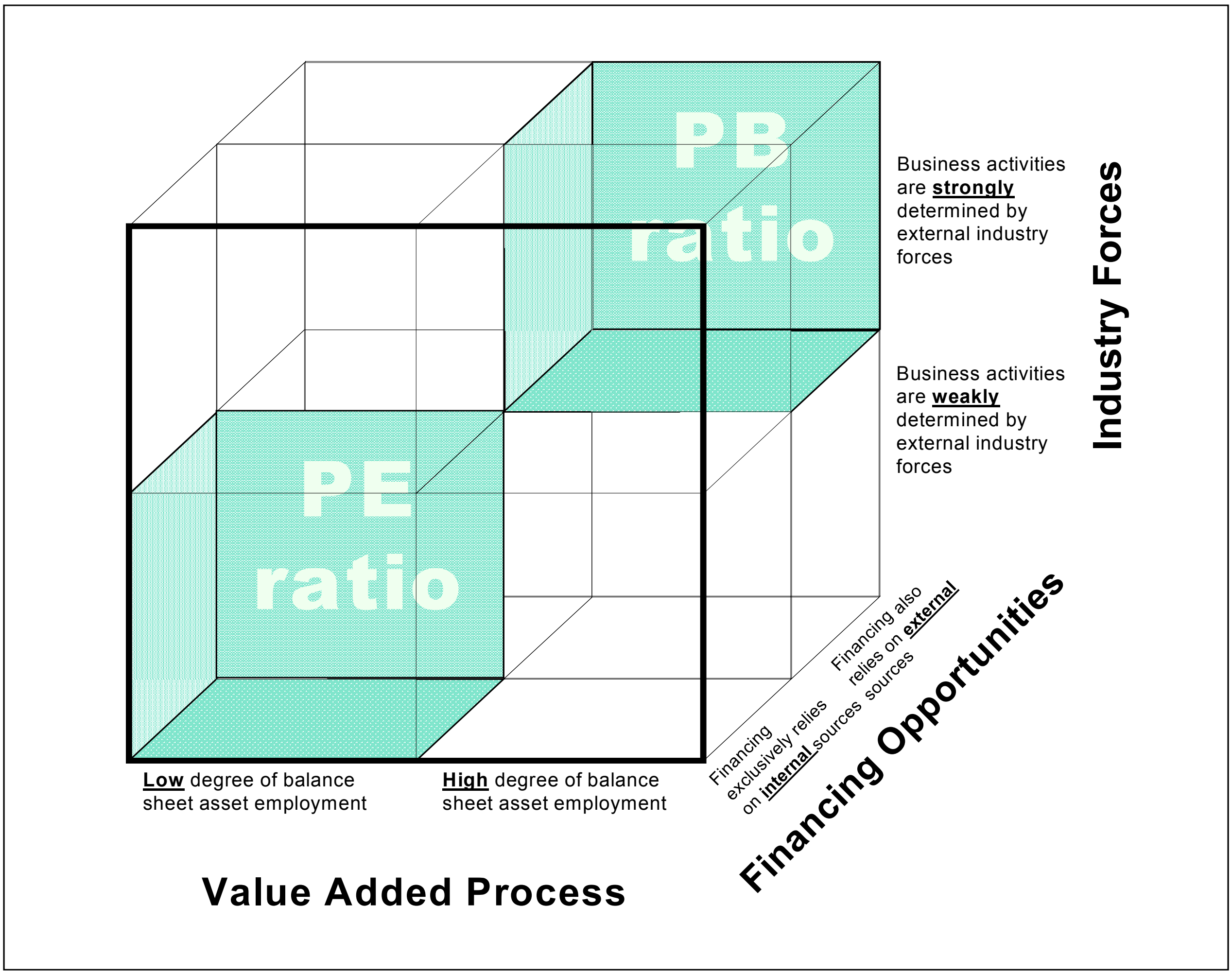
[13] A high intensity of production (high depth of production) typically leads to a low dependence of suppliers and therefore to a low supplier power. Thus, the second and the third dimension are not totally independent.

[14] If economic profits are zero the company earns its cost of capital which can be assumed to be approximately equal for all the companies within the industry.

selecting valuation ratios basically applies on the enterprise level (i.e. valuation of the whole company, valuations of equity and debt). To be valid on the equity level, too, companies of the peer group must all exhibit the same capital structure.

Regarding the financing dimension we can identify a scenario that definitely requires the PE ratio. That is if companies have no access to external capital. However, if companies do not exclusively rely on internal finance sources no estimation can be made concerning the advantageness of one of the two ratios. Regarding the other two dimensions it seems to be economically sounder to assume settings in which the PE ratio should be favoured in the majority of the cases. This leads to the conjecture that in practical settings of corporate valuation on average the PE ratio is slightly more useful than the PB ratio. Empirical studies concerning valuation accuracy (Cheng/McNamara 2000) and concerning the use of these ratios in practical valuation settings (Wichels 2002: 146-154, Fernandez 2002) support this hypothesis.

Figure 1: The PE/PB ratio application cube



Source: ZEW

In economic reality, however, none of the scenarios, which definitely recommend the application of one of the two ratios, is satisfied. Thus, the position of a company usually can be interpreted as an intermediate point between the two extremes of each dimension. Firstly, companies generally have the possibility to raise a certain amount of debt capital to finance new projects even though the amount of funds that can be raised varies over time because of changes in corporate liability management or in conditions at capital markets. Secondly, regarding the production process of a company, usually neither the total amount of balance sheet assets nor none of the assets are employed in the value added process. Companies rather exhibit a certain degree of asset employment. Additionally, balance sheet assets are a more or less good proxy for the amount of firm resources[15], but do not correspond perfectly. Thirdly, there is a certain degree of competition in every industry. However, pure competition industries are scarce. Even if some of Porter's industry forces strongly influence corporate behavior, there is hardly a situation in which the entirety of forces controls the industry.

To put it differently, using the PE/PB ratio application cube may demonstrate tendencies which ratio to prefer to the other. However, in reality both ratios have a certain explanatory power. But even if we assume that both book value and earnings are important in CCV, there remains a major problem: In fact, it is not clear which relative weightings should be assigned to the PE ratio and to the PB ratio. Analysts usually perform CCV on the basis of both kinds of ratios – those with substance oriented and those with performance oriented bases of reference – and then subjectively weight them. However, this is not necessarily consistent with economic reality.

To better understand how the asset base and the performance jointly affect the market value of companies, it is necessary to have a closer look at some theoretical models. The basic model that proceeds on the joint value relevance of book value and earnings is the residual income valuation (RIV) model. Starting from the assumption of the clean surplus relation it can be shown that the market value of equity equals the sum of the current book value and the present value of future residual earnings (Preinreich 1938: 240, Lo/Lys 2000):

$$P_t = B_t + \lim_{x \to \infty} \sum_{n=1}^{x} \frac{X_{t+n} - k_e B_{t+n-1}}{(1+k_e)^{t+n}} \tag{3.2}$$

where X_{t+n} are the earnings at time t+n and $X_{t+n}–k_eB_{t+n-1}$ are the residual earnings (residual income RI) at time t+n. In this model book value serves as a proxy for expected future normal earnings (Penman 1992). However, the model is stated very

15 This heavily depends on the applied accounting standard, too.

generally. Thus, no explicit market value forecasts can be made solely on the basis of current accounting data.

Ohlson (1995) extended the RIV-model by introducing a system of linear information dynamics, which postulates a certain time series behaviour of residual earnings. More precisely, the market value of equity is expressed as a function of residual earnings, information not yet captured by accounting ν – both following an AR(1) process, i.e. a certain autoregressive process – and current book value (Ohlson 1995: 670/671):

$$P_t = (1-k)B_t + k(\varphi X_t - D_t) + \lambda \nu_t \qquad (3.3)$$

with $k = \omega r / (1 + r - \omega)$

$\varphi = (1+r)/r$ and

$\lambda = (1+r)/\left[(1+r-\omega)(1+r-\gamma)\right]$

where r = risk free rate of interest, ϖ and γ are persistence parameters with $0 \le \omega, \gamma \le 1$.

The major achievement of the Ohlson model is the demonstration of the formal linkage between value and the two accounting numbers book value and earnings (Lo/Lys 2000, Lundholm 1995: 761). Empirical studies that rely on the Ohlson model mostly show its superiority to other (classical) accounting based valuation models.

Some of the existing empirical work about CCV has already taken into consideration this idea of the joint value relevance of book value and earnings in CCV. However, the proceeding applied in the present paper widely differs from the approaches used in these studies. In contrast to the Cheng/McNamara (2000) approach we do not assume that PE and PB ratios are equally weighted. We do not assume that companies which earn their cost of capital have necessarily a market value equal to book value or shareholder funds (as similarly assumed in the Merrill Lynch (1998) approach). Assuming the equality of market value and shareholder funds would not be consistent with the reasonable and frequently observable situation of near term earnings growth of companies with currently zero economic profit. We rather assume that the market value is a function of regressional weighted book values and earnings (comparable with the concept of one of the models in Beatty/Riffe/Thompson 1999).

Our model is also built on the concepts provided by the RIV and Ohlson model. However, we try to adapt our model to real capital market settings and therefore we rearrange some of the limiting assumptions of the Ohlson model for our purposes. A major advantage of our model is that fewer theoretical requirements are needed because we can draw persistence parameter and discount factors directly and in an aggregated form from the comparable companies' and capital market's data.[16] Additionally we extend the framework provided by Ohlson in allowing for transient or even lasting growth of earnings.

Our approach is in line with the theoretical framework provided by the Ohlson model. Starting from equation (3.3), we firstly neglect the information not yet captured by the accounting system. This is reasonable because this information can totally be incorporated into the weights if we assume that the comparable companies are subject to the same kind of information (Penman 1997). However, to account for the possibility that some firm specific short term information exists which is incorporated in near term future earnings, we rather use expected next period earnings than current earnings. Consequently, we substitute the term $k(\varphi X_t - D_t)$ with $\beta E(X_{t+1})$. Future dividends do not affect the market value of equity because of the clean surplus relation. In doing this substitution we can also avoid the problem of not accounting for information released after the disclosure of current earnings. This is especially important because the date of valuation rarely equals the date of financial statement disclosure.

In contrast to the Ohlson model we are weighting earnings but not discounted earnings. Thus, the earnings‘ weighting factor needs not necessarily be in the range between 0 and 1. The book value's weighting factor may also differ from values between 0 and 1 because of conservative accounting and the possibility of short term earnings growth attributed to the size of the firm's assets. Consequently, the weights of book value and earnings are not constrained to sum to one.

It should be noticed that from an economic point of view even negative weights for the book value of equity might be reasonable. In this case, certain underperforming companies have a negative recursion value even if they have positive earnings and ceteris paribus their absolute recursion value is indirectly related to book value. This phenomenon can occur e.g. in an industry that tends to a natural monopoly and where earnings can be viewed as a proxy for market share. All other things equal, underperforming companies are exposed to the situation that the higher the book value of equity the higher is the amount of absolute earnings increase that is

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16 In empirical tests of the Ohlson-model, persistence parameters are not drawn from comparable companies but from historical data of the target company. Ohlson himself assumes the persistence parameter to be constant over time (Ohlson 1995: 686, Ohlson 2001: 110) However, from an analyst's point of view this approach seems to be highly debateable, because of quick changing market conditions and industry characteristics.

necessary to earn its cost of capital and therefore the lesser is the chance that these companies will ever earn the normal rate of return. In contrast, negative weights for expected earnings do not make any economic sense. This would rather be a sign for bad comparable company selection.

Finally, there is a methodical advantage of using this regressional weighted approach: we can easily attune this model of CCV under continuing business activities to the below outlined option to liquidate or to adapt by changing the strategy in the case of bad current expectations of business activities. Incidentally, the inclusion of this option is casual for the selected equity value approach of our model (in contrast to the enterprise value approach of Merrill Lynch 1998) as can be seen in section 3.1.2.

To summarize: The market value of equity of the company at time t assuming that it continues its current business activities (recursion value, $V_{rec,t}$) can be expressed as follows:

$$V_{rec,t} = \alpha B_t + \beta E\left[X_{t+1}\right] \tag{3.4}$$

where α, β are the respective regressional weights for the expected earnings and the current book value. Since the term $(\varphi X_t - D_t)$ from equation (3.3) approximately equals $k_e^{-1} E\left[X_{t+1}\right]$ in our settings[17], the following statements can be made regarding the development of future earnings: If $\beta k_e > 1$, future earnings are expected to grow perpetually. If $\beta k_e = 1$, earnings remain constant over time and if $\beta k_e < 1$, future earnings approach a certain RoE. This RoE asymptotically equals $(\beta k_e + \alpha) k_e$ since $\left(V_{rec,t} / B_t\right)_{E[RoE_t]=k_e} = \beta k_e + \alpha$. In this context it should be noticed that the term $(\beta k_e + \alpha) B_t$ does not necessarily equal shareholder funds because sometimes earnings approach a certain RoE>k_e in the long run, depending on the degree of competition in the respective industry. In such industries (e.g. price searcher markets with high entry barriers like the automobile or steel industry) companies can infinitely earn abnormal profits (Gwartney/Stroup 1997: 554-561).

Obviously, companies with the same position in the PE/PB ratio application cube should have the same weightings for book value and earnings. Consequently, the factors determining the position in the application cube should be the base of the selection of comparable companies. Thus, comparability is given if companies have the same financing possibilities and restrictions, are affected by the same industry

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[17] While the Ohlson model assumes risk neutrality of all investors our model also works in the more realistic settings of investor's risk aversion.

forces and employ the same amount of assets during the value added process. It can be assumed that all companies of one industry generally meet these requirements on the enterprise level – i.e. they have the same weightings of total assets and operating profit. To make this enterprise level model valid on the equity level, too, companies should additionally exhibit similar capital structures and hence similar cost of capital. Our approach is largely consistent with the empirical findings of Cheng/McNamara (2000) who showed that the selection criterion „same industry sector“ is the only characteristic needed to select the comparable companies when using both book value and earnings in the basis of reference (they did not include leverage as a selection criterion into their analyses). One major perception of our approach is that corporate growth perspectives are not explicitly a criterion of peer group selection because growth (and persistence) is thoroughly included into the three dimensions of the cube.[18]

Penman (1996, 1997) finds that market value is not a linear function of book value and earnings. However, we assume in a first step that recursion value is indeed a linear function of book value and earnings. This assumption seems reasonable because peer group companies selected on industry classification and gearing are affected by the same factors of the PE/PB ratio application cube, independently of their actual RoE. Nonetheless, one should consider that well performing companies probably have more power within the industry than poor performing companies. Regarding the PE/PB ratio application cube, this could lead to a higher value relevance of earnings along with a lower value relevance of book value for these companies as compared to low RoE companies. Analysts should take this into account when composing the peer group.

Since the model sometimes assigns positive recursion values to companies with current negative earnings, the linear relationship only holds if the market discounts negative earnings with the same rate as it discounts positive earnings. This use of a unique discount rate is sometimes supported (Ariel 1998) and sometimes challenged in theoretical studies (Berry/Dyson 1980, Booth 1982).

3.1.2 The option to adapt firm resources to alternative uses

The amount of assets available does not only play a major role in determining future earnings assuming the company continues its current business activities but also in

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[18] It should be noticed that companies selected on the basis of the cube all have the same corporate development perspective, but not necessarily the same earnings growth perspectives because the latters are not only a function of the cube dimensions but also crucially depend on the actual level of return on equity of the company. That is why some empirical studies find that short term earnings growth is a criterion for selecting comparable companies when exclusively using the PE or PB ratio (e.g. Richter/Herrmann 2002).

determining the company's value in case of abandonment or change of current business activities (Leuner 2002) . In the most simple case of abandonment and sale of assets the company is worth exactly what it is expected to get for the sold net firm resources – its liquidation value. In this context, abandonment can be understood as total abandonment of the whole firm but also as a partial asset sell-off, like spin-offs or equity carve outs. In the more complex settings of strategy change and employment of assets in alternative uses within the firm, the value of the company depends on the specific use to which firm resources should be adapted.[19]

Since liquidation or adaptation takes place at any future point in time, these exit values are generally unobservable. Particularly external analysts have no direct access to data with which they can determine the real values so that they have to rely on publicly available accounting figures that are close to these values. Even if neither liquidation value nor the value of firm resources adapted to some superior use necessarily conform with book value (Sieben/Maltry 2002: 397) the differences can be assumed to be typically small. This is obvious for the liquidation value because both values imply that the company is not viable as a going concern (Berger/Ofek/Swary 1996, Barth/Beaver/Landsman 1998), but it also holds approximately for the adaptation value: Adaptation value is an unknown figure not only for external analysts but also for company insiders because though management knows that it has to adapt firm resources there is some initial uncertainty concerning the specific use these assets should be adapted to. Balancing the benefits of a possible superior use of assets with the cost of adaptation, book value is a prudent estimate of adaptation value.

It should be noticed that even if it seems reasonable to proxy in a first step the amount of assets available to sell or to adapt by book value, this might be inappropriate dependent on the level of information: If in a specific valuation setting the analyst knows the real reorganisation value – which by definition includes both factual adaptation and sale of assets – or a better proxy, this new value should be substituted for book value.

We use book value of equity (and not book value of total assets) because it is the accounting figure relevant for shareholders. This is consistent with the proceeding of

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[19] As in the abandoment case adaptation does not neccessary mean full and immediate change of current activities, neither. It can also mean, to change the current form of business activities bit by bit or even to change only a part of current activities. A well-known example for that is the metamorphosis of the German Mannesmann AG in the late 1990s (before the merger with Vodafone). The company changed its business focus from pipe producing to coal, iron and steel manufacturing to finally become a pure play telecommunication company. Annother example for gradual adaptation is the conversion of the German industry group Preussag AG into the tourist company TUI.

the empirical study of Barth/Beaver/Landsman (1998) and allows us to better account for the senior position of debt in case of bankruptcy. To make this reorganisation value comparable to the recursion value we use expected next period book value assuming the company pays no dividends. Thus, the reorganisation value of the company at time t ($V_{reo,t}$) can be expressed as follows:

$$V_{reo,t} = B_t + E\left[X_{t+1}\right] \qquad (3.5)$$

The assumption that reorganisation value depends on expected next period's earnings is not only important to reach consistency with recursion value, it is also economically plausible since the process of adaptation does not start immediately but probably at any time in the future. Even if the process starts soon after the date of valuation, it will usually last several months, so that next period's earnings affect stockholders equity and therefore directly change the amount of available resources.

This function of reorganisation value has a null value for $E[X_{t+1}] = -B_t$, indicating that the company has no assets left when it loses all its equity through next years negative earnings.

The relevance of the reorganisation value in business valuation is especially high if the company is very likely to adapt firm resources. The probability of adaptation is in turn dependent on the current operating performance and efficiency of the company: If a company's business is flourishing and current earnings are high relative to book value, it is very unlikely that the management gives up its current operations. In this case reorganisation value is obviously of little significance compared to recursion value. Contrary, if a company's current activities are not satisfyingly successful, the probability of abandonment or strategy change is higher. In the latter case the reorganisation value plays a major role in determining the company's market value.

The threshold of change to adaptation is reached when a company can get more out of an asset or a certain group of assets by selling it or adapting it than by continuously applying it to its current use, i.e. when net present values in case of adaptation exceed net present values in case of continued use. In the present case of multi-factor CCV management reorganises firm resources if $V_{reo} > V_{rec}$.

However, since we live in a world of uncertainty and information asymmetry and thus especially reorganisation value can not be determined exactly, the real position of the threshold of reorganisation is ex ante indeterminable. Whether firm assets will be liquidated in the future depends on the probability of default (externally induced liquidation) or on management's discretion (internally induced liquidation). Similar uncertainties hold for adaptation: Whether firm assets are adapted to a different use depends on management discretion based on management's estimates about the future of current business activities and about the success of adaptation.

In fact, there is always a certain probability of business reorganisation – this probability is high if current earnings are low and it is low if current earnings are high. Thus, the fair value of a company is a function of both recursion value and reorganisation value because management has an ongoing option to either continue its present operating activities or to adapt its resources to different uses (Berger/Ofek/Swary 1996, Burgstahler/Dichev 1997, Collins/Pincus/Xie 1999). Consequently, not only recursion value but also the value of the option to reorganise current business activities (American style long put) should be reflected in the market value of the company. Not accounting for this option would mostly understate the value of companies with very low or even negative earnings.

3.2 The model

To derive a model for the target company's market value of equity having regard to the existence of recursion value as well as the option to switch to reorganisation value we first restate equations (3.4) and (3.5):

$$V_{rec,t} = \alpha \cdot B_t + \beta \cdot E[X_{t+1}]$$

$$\frac{V_{rec,t}}{B_t} = \alpha + \beta \cdot RoE_{t+1} \tag{3.6}$$

and

$$V_{reo,t} = B_t + E[X_{t+1}]$$

$$\frac{V_{reo,t}}{B_t} = 1 + RoE_{t+1} + \varepsilon \tag{3.7}$$

where RoE_{t+1} is short for $E[X_{t+1}]/B_t$, denoting the expected return on equity of period 1 and ε is the normally distributed additive error with expectation value $E[\varepsilon]=0$ and standard deviation $\sigma[\varepsilon]=\sigma_{reo}$ ($\varepsilon \sim N(0,\sigma_{reo})$). This error term is necessary since we do not exactly know the real reorganisation value.[20]

[20] There is no error term in the recursion value formula because it is assumed that earnings and book value are satisfyingly value relevant if applied jointly.

The restatement facilitates a graphical visualisation of the relation between earnings, book value and market value in a two-dimensional space. For this illustration we plot V/B_t (i.e. the PB ratio) on the ordinate and RoE_{t+1} on the abscissa (see figure 2).

To determine the recursion value weights α and β of equation (3.6) we linearly regress the RoE on the PB ratio. In doing this we can illustrate the relative value relevance of the accounting attributes book value and earnings and, implicitly, the expected earnings future development and persistence for an average peer group company.

The approach of determining recursion value by regression analysis helps us to achieve our objectives of determining a value line dependent on the level of expected next period RoE. Additionally, this regressional approach is largely consistent with the theory of capital market efficiency. In an efficient market not every company must necessarily be priced correctly but companies are on average priced correctly (Fama 1976: 144). In this context the regressional line serves as an adjustment line for individual company over- or undervaluations. The regressional technique is also useful in balancing minor differences in the nature of the peer group companies – granted that these differences are equally distributed. Since at real capital markets there are phenomenons which must be considered as inconsistent with market efficiency[21] analysts should eliminate all companies from the peer group that are expected to be priced inefficiently.

Unfortunately the regressional analysis suffers from a major problem: In general, stock prices are influenced by interdependencies between recursion and reorganisation. Thus, to identify pure recursion value we need companies whose stock prices are largely unaffected by the abandonment or adaptation option. Consequently, for our regression we only use data of companies with an expected RoE exceeding the cost of equity or at least close to its cost of equity.[22] That implies that we expect the earnings/stock price relationship to be linear only if a company earns at least a certain return on equity. Obviously, a sufficent set of profitable companies is needed to run this regression accurately.

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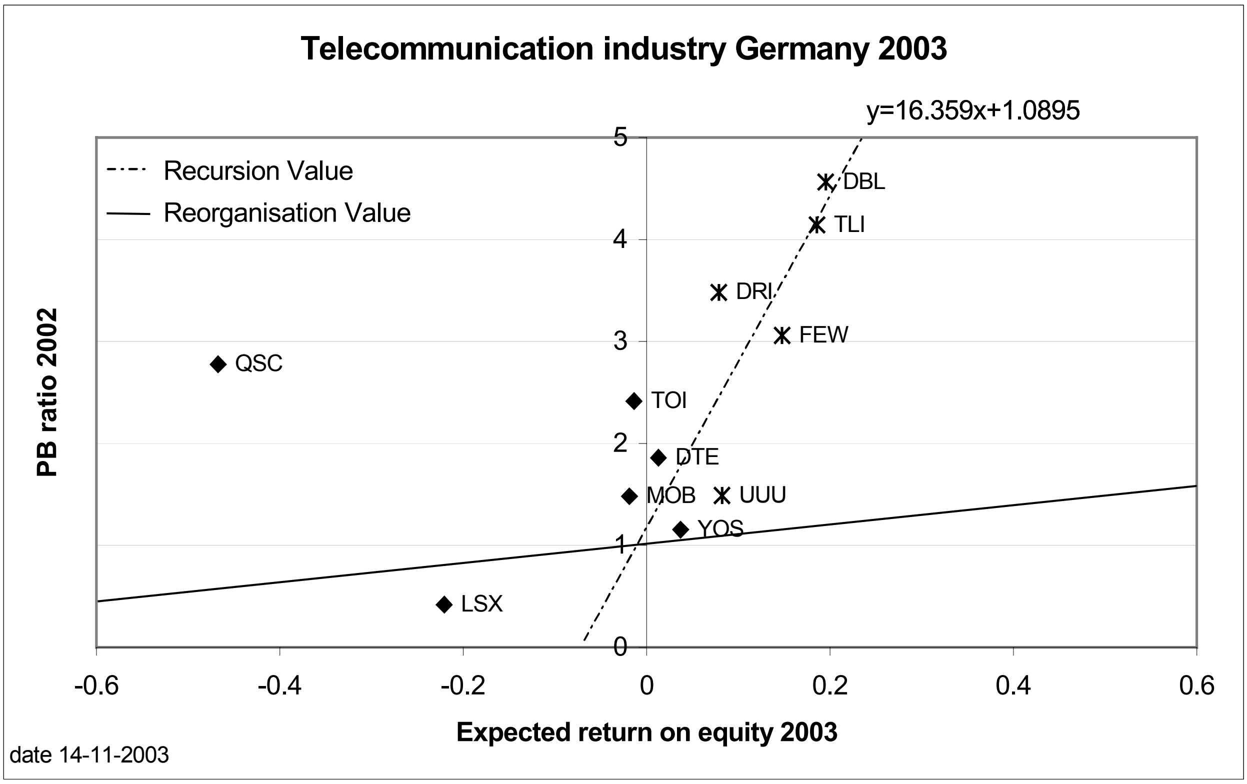
[21] At the German market these phenomenons apply e.g. to the pricing of newly listed companies (Mager 2001) or of companies that are likely to enter or leave a stock-index (Gerke/Arneth/Fleischer 2001).

[22] the respective threshold effectively depends upon the slope of the recursion value line, the moments of ε and the point of intersection between $E[V_{reo}]$ and V_{rec}. That is why in certain low reorganisation value industry sectors sometimes even for firms with negative earnings the abandonment option is irrelevant. This was the case e.g. in the IT-sector in the late 1990s.

A steep slope of the regression line indicates a high persistence and value relevance of current earnings. In this case, the regression line resembles the PE ratio-line. If, in contrast, the regression line is very flat and its course is almost parallel to the RoE-axis then current abnormal earnings are a bad indicator of future cash flows: future earnings are rather expected to converge to the industry level RoE. In this case, current book value of equity significantly influences the market value of equity. As a consequence, the regression line resembles the PB ratio-line.

Figure 2 exemplifies recursion value and reorganisation value for an average company of the German telecommunication industry (date: 14-11-2003). Expected RoEs are calculated with I/B/E/S earnings forecasts 2003 drawn from Bloomberg. Therefore we only included companies with an I/B/E/S forecast available. Each data point in the figure represents a peer group company. The squares (♦) denote companies with an expected RoE less than 7.5 percent and the stars (*) stand for companies with an expected RoE greater than 7.5 percent.[23] The dashed recursion value line is the result of a regression run with the star-shaped data points while the thin continuous line represents reorganisation value.

Figure 2: Recursion value and reorganisation value



Source: ZEW, Bloomberg

[23] As we will see later, for the selected σ_{reo} all companies with a RoE bigger than 7.5 percent are nearly unaffected by the reorganisation option.

To finally establish the functional relationship between the PB ratio and the expected future return on equity we compute the expected maximum of the reorganisation value and the recursion value (based on the idea of Trigeorgis 1996: 12, and Burgstahler/Dichev 1997). In doing so, not only recursion is considered but also the ongoing option to switch from recursion to reorganisation can be incorporated into the model:

$$PB = E\left[\max\left(V_{reo}, V_{rec}\right)\right] \tag{3.8}$$

By solving this maximisation problem we get a function for PB which is practically applicable, i.e. a model where all the necessary parameters can be drawn from previous calculations or directly from the capital market:

$$PB = E\left[V_{reo}\right] + c \cdot \Phi\left(\frac{c}{\sigma_{reo}}\right) + \sigma_{reo} \cdot \varphi\left(\frac{c}{\sigma_{reo}}\right) \tag{3.9}$$

with

$E\left[V_{reo}\right] = 1 + RoE_{t+1}$,

$c \equiv V_{rec} - E\left[V_{reo}\right] = \alpha - 1 + \left(\beta - 1\right) RoE_{t+1}$,

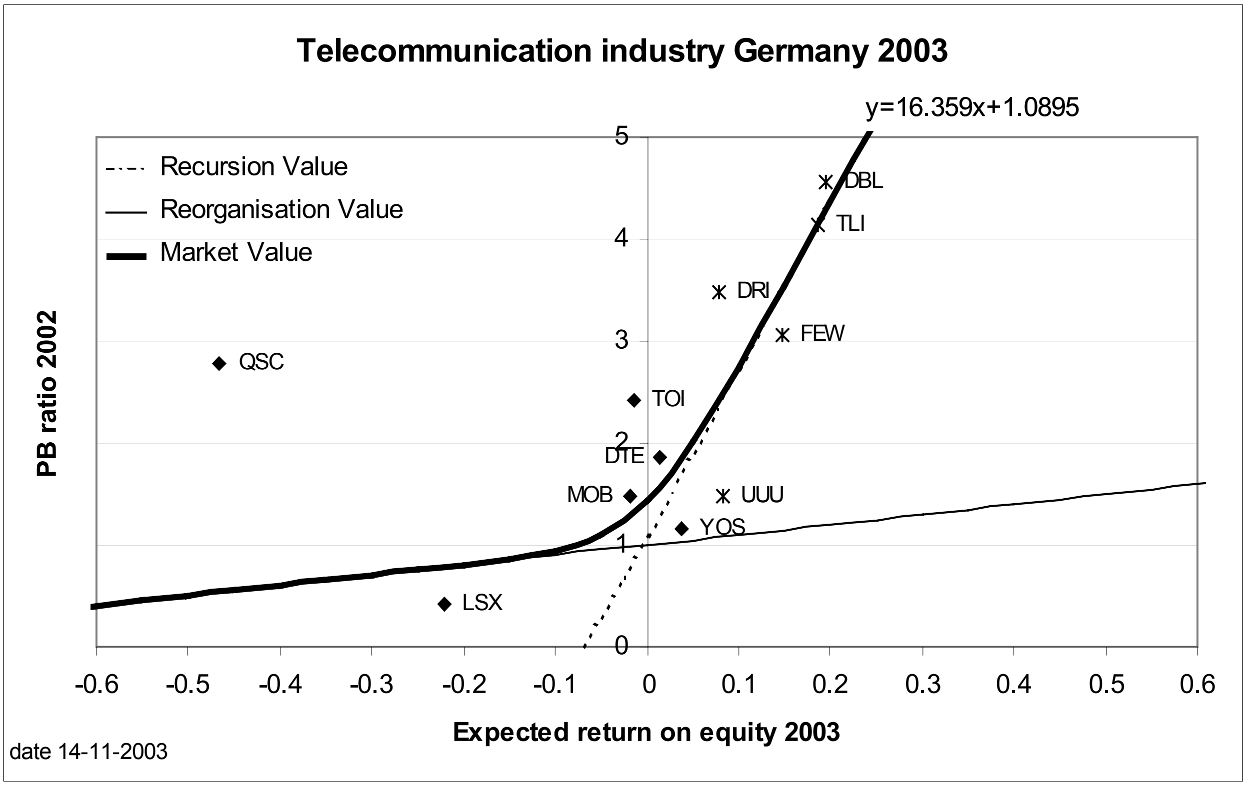
$\varphi(x)$ denoting the standard normal distribution of x and

$\Phi(x)$ denoting the cumulative standard normal distribution of x.

A detailed calculation of the PB function can be found in the appendix at the end of this paper.

High importance should be attached to the standard deviation of the reorganisation value error term σ_{reo}. Since it is ex ante not clear to what specific use the firm assets should be adapted it seems to be reasonable that we proxy this standard deviation by the volatility of a broad market index (e.g. the German DAX). To determine the period up to expiry of the reorganisation option is obviously more difficult: certainly, management will always have the possibility to reorganise, but it is not economically sound to use an infinite time horizon for valuation due to timely limited forecast periods of market participants. More concrete, we think that the market prices this option with a time to expiration equal to the period for which analysts usually perform detailed future cash flow forecasts in common DCF-valuation models; i.e. up to 5 years (Copeland/Koller/Murrin 2000: 234). However, just as in the case of the determination of the reorganisation value, if analysts can better predict the parameters of this option they might use a deviant time to expiration here, too.

Figure 3: The multi-factor comparable company valuation model



Source: ZEW, Bloomberg

Figure 3 exhibits the multi-factor CCV model. The thick curve represents the target company's PB ratio dependent on expected next year RoE. The parameters α (1.0895) and β (16.359) equal the weights of the regressional determination of the recursion value, σ_{reo} denotes the historical 5 year volatility of the DAX, which is 67,84 percent.[24] It can be seen that the data points of underperforming companies like the Deutsche Telekom AG (DTE), the Mobilcom AG (MOB) and the LS Telcom AG (LSX) are not far away from the red curve. However, the results might lead to the supposition that the reorganisation value of the LS Telcom AG is overstated in our model, i.e. that it is smaller than book value in reality. Even worse, the model obviously fails to accurately value the QSC AG (QSC). Nevertheless, the problems associated with these inaccuracies can probably be mitigated by a more detailed analysis of the respective companies (i.e. more thorough determination of the reorganisation value of LS Telcom and clear identification of the reasons for the relatively high PB ratio of QSC).

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[24] The historical volatility of the DAX was calculated based on daily prices for the last 5 years.

4 Conclusion

In this paper we developed a multi-factor CCV model that largely avoids the three major shortcomings of classical single multiple valuation: the non-applicability of negative bases of reference, the problems with accounting for corporate profitability within the valuation process and the non-consideration of management's option to reorganise the company.

Our model is based on the two accounting attributes "book value of equity" and "earnings". It consists of the recursion value (the going concern value) and the option to reorganise the company (break-up or adaptation). Therefore all three groups of companies can suitably be valued: Operatingly outperforming companies which are most likely to continue current business activities, operatingly underperforming companies which are expected to change their strategy or even liquidate firm assets and, finally, operatingly normal-performing companies for which it is not clear ex ante whether they continue as hitherto or whether they change their focus of business activities. Compared to previous CCV models the presented multi-factor model is theoretically advantageous in valuing companies that have an expected RoE much higher than the peer group average but also in valuing companies with low or negative earnings.

However, the model is associated with certain caveats. Firstly, the real reorganisation value is difficult to determine. While, to simplify matters, liquidation value can be proxied by book value of equity, the adaptation value can be part of a wide range of values and might therefore noticeably deviate from book value. Secondly, the time to expiration of the option to reorganise the company is hardly predictable. We proxied it by 5 years but can not rule out that any other time period is more appropriate. Additionally, as in most asset pricing and option pricing models, the assumption of constant volatility might lead to biased valuation results. If possible, using rather expected future volatility than historical volatility might improve valuation accuracy. Unfortunately, in most cases a detailed examination of the sources that drive volatility to be time varying (for the German market see Edelmann 2000) is necessary to predict future volatility for longer time periods.

Further development of multi-factor CCV research should especially address the following questions:

- How can the time to expiration of the reorganisation option better be determined?
- How can analysts identify the real value of assets adapted to a superior use?
- What results can be drawn from an empirical analysis of the valuation accuracy of multi-factor CCV compared to that of single-factor CCV?

Appendix

To establish the functional relationship between the price scaled by book value of equity (PB) and the expected future return on equity (RoE) we compute the expected maximum of the reorganisation value and the recursion value.

$$PB = E\left[\max\left(V_{reo}, V_{rec}\right)\right]$$

$$PB = E\left[\max\left\{1 + RoE + \varepsilon, \alpha + \beta RoE\right\}\right]$$

$$PB = \int_{-\infty}^{+\infty} \max\left\{1 + RoE + \varepsilon, \alpha + \beta RoE\right\} f_\varepsilon(\varepsilon) d\varepsilon$$

where ε is the normally distributed additive error with expectation value E[ε]=0 and standard deviation $\sigma[\varepsilon]=\sigma_{reo}$ ($\varepsilon \sim N(0, \sigma_{reo})$) and $f_\varepsilon(\varepsilon)$ denotes its probability density function.

$$PB = \int_{-\infty}^{\infty} \left[\left(\alpha + \beta RoE\right) \cdot 1_{[-\infty, c]}\left(\varepsilon\right) + \left(1 + RoE + \varepsilon\right) \cdot 1_{[c, +\infty]}\left(\varepsilon\right)\right] \cdot f_\varepsilon(\varepsilon) d\varepsilon$$

where $1_{[a,b]}\left(\varepsilon\right) := \begin{cases} 1, \text{ if } \varepsilon \in \left[a, b\right] \\ 0, \text{ if } \varepsilon \notin \left[a, b\right] \end{cases}$

and the parameter c is defined as the realisation of ε which leads to investors' indifference between recursion value and reorganisation value. It is obtained by setting V_{reo} equal to V_{rec} and solving for ε which yields $c \equiv V_{rec} - E\left[V_{reo}\right] = \alpha - 1 + \left(\beta - 1\right) RoE$

$$PB = \int_{-\infty}^{c} \left(\alpha + \beta RoE\right) f_\varepsilon(\varepsilon) d\varepsilon + \int_{c}^{+\infty} \left(1 + RoE + \varepsilon\right) f_\varepsilon(\varepsilon) d\varepsilon$$

$$PB = \left(\alpha + \beta RoE\right) \int_{-\infty}^{c} f_\varepsilon(\varepsilon) d\varepsilon + \left(1 + RoE\right) \int_{c}^{+\infty} f_\varepsilon(\varepsilon) d\varepsilon + \int_{c}^{+\infty} \varepsilon f_\varepsilon(\varepsilon) d\varepsilon$$

$$PB = \left(\alpha + \beta RoE\right) \int_{-\infty}^{c} f_\varepsilon\left(\varepsilon\right) d\varepsilon + \left(1 + RoE\right)\left(1 - \int_{-\infty}^{c} f_\varepsilon\left(\varepsilon\right) d\varepsilon\right) + \int_{c}^{+\infty} \varepsilon f_\varepsilon\left(\varepsilon\right) d\varepsilon$$

$$PB = \left(1 + RoE\right) + \left(\alpha - 1 + \left(\beta - 1\right) RoE\right) \int_{-\infty}^{c} f_\varepsilon\left(\varepsilon\right) d\varepsilon + \int_{c}^{+\infty} \varepsilon f_\varepsilon\left(\varepsilon\right) d\varepsilon$$

$$PB = \left(1 + RoE\right) + \left(\alpha - 1 + \left(\beta - 1\right) RoE\right) \int_{-\infty}^{c} f_\varepsilon\left(\varepsilon\right) d\varepsilon + \left[-\frac{1}{\sqrt{2\pi}} \sigma_{reo} \exp\left\{-\frac{\varepsilon^2}{2\sigma^2}\right\}\right]_{c}^{+\infty}$$

$$PB = E\left[V_{reo}\right] + \left(V_{rec} - E\left[V_{reo}\right]\right) \int_{-\infty}^{c} f_\varepsilon\left(\varepsilon\right) d\varepsilon + \frac{\sigma_{reo}}{\sqrt{2\pi}} \exp\left\{-\frac{c^2}{2\sigma_{reo}^2}\right\}$$

Since

$$\int_{-\infty}^{c} f_x(x)\,dx = \frac{1}{\sqrt{2\pi}\sigma}\int_{-\infty}^{c}\exp\left\{-\frac{x^2}{2\sigma^2}\right\}dx = P(X \le c) = P\left(\frac{X}{\sigma} \le \frac{c}{\sigma}\right) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{c/\sigma}\exp\left\{-\frac{t^2}{2}\right\}dt = \Phi\left(\frac{c}{\sigma}\right)$$

where $T = \frac{X}{\sigma} \sim N(0,1)$ as $X \sim N(0,\sigma)$

and

$$\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{x^2}{2\sigma^2}\right\} = P(X = c) = P\left(\frac{X}{\sigma} = \frac{c}{\sigma}\right) = \varphi\left(\frac{c}{\sigma}\right)$$

we get

$$PB = E\left[V_{reo}\right] + c \cdot \Phi\left(\frac{c}{\sigma_{reo}}\right) + \sigma_{reo} \cdot \varphi\left(\frac{c}{\sigma_{reo}}\right)$$

with $\varphi(x)$ denoting the standard normal distribution of x and $\Phi(x)$ denoting the cumulative standard normal distribution of x.

References

Alford, A. (1992), The effect of the Set of Comparable Firms on the Accuracy of the Price-Earnings Valuation Method, Journal of Accounting Research, 30 (1), 94-108.

Ariel, R., (1998), Risk Adjusted Discount Rates and the Present Value of Risky Costs, The Financial Review 33, 17-30.

Baker, M./Ruback, S. (1999), Estimating Industry Multiples, Working Paper, Harvard University.

Barth, M./Beaver, W./Landsman, W. (1998), Relative valuation roles of equity book value and net income as a function of financial health, Journal of Accounting and Economics 25, 1-34.

Barth, M./Kallapur, S. (1996), The effects of cross-sectional scale differences on regression results in empirical accounting research, Contemporary Accounting Review 13, 527-567.

Beatty, R./Riffe, S./Thompson, R. (1999), The method of comparables and tax court valuations of private firms: an empirical investigation, Accounting Horizons 13, 177-199.

Beaver, W./Morse, D. (1978), What determines Price-Earnings Ratios? Financial Analyst Journal, 65-78.

Beckmann, C./ Meister, J.M./ Meitner, M. (2003), Das Multiplikatorverfahren in der kapitalmarktorientierten Unternehmensbewertungspraxis, Finanz-Betrieb 02/2003, 103- 105.

Berger, P.G./Ofek, E./Swary, I.(1996), Investor valuation of the abandonment option, in: Journal of Financial Economics 42, 257-287.

Bernard V. (1994), Accounting based valuation methods, determinants of market-to-book ratios, and implications for financial statement analysis, Working Paper, University of Michigan.

Berry, R.H., and R.G. Dyson, (1980), On the Negative Risk Premium for Risk Adjusted Discount Rates, Journal of Business Finance and Accounting, 7(3), 427-436.

Bhojraj, S./Lee, C. (2002), Who Is My Peer? A Valuation-Based Approach to the Selection of Comparable Firms, Journal of Accounting Research 40(2), 407-439.

Booth, L., (1982), Correct Procedures for the Evaluation of Risky Cash Outflows, Journal of Financial and Quantitative Analysis, 17(2), 287-300.

Burgstahler, D./Dichev (1997), Earnings, adaptation, and equity value, The Accounting Review 72, 187-215.

Casey, C. (2000), Unternehmensbewertung und Marktpreisfindung, Wiesbaden.

Chan, L./Karceski, J./Lakonishok, J. (2003), The level and persistence of growth rates, in: The Journal of Finance 58(2), 643-684.

Cheng, A./McNamara, R. (2000), The Valuation Accuracy of the Price-Earnings and Price-Book Benchmark Valuation Methods, Review of Quantitative Finance and Accounting 15, 349-370.

Collins, D./Pincus, M./Xie, H., (1999), Equity Valuation and Negative Earnings: The Role of Book Value of Equity, The Accounting Review, January, 29-61.

Copeland, T./ Koller, T./Murrin, J. (2000), Valuation, 3rd ed., New York.

Damodaran, A. (2002), Investment Valuation, New York.

Edelmann, R. (2000), Volatility of the German Stock Market: evidence from 1960-1994, Bern.

Fama, E. F. (1976), Foundations of Finance, New York.

Fernandez, P. (2002), Valuation using multiples: How do analysts reach their conclusions, Working Paper No. 450, University of Navarra.

Freeman, R./Ohlson, J.A./Penman, S. (1982), Book Rate-of-Return and Prediction of Earnings Changes: An Empirical Investigation, Journal of Accounting Research 20 (2), 639-653.

Gerke, W./ Arneth, S./ Fleischer, J. (2001), Kursgewinne bei Aufnahmen in den DAX 100, Verluste bei Entnahmen: Indexeffekt am deutschen Kapitalmarkt, Zeitschrift für Betriebswirtschaft 71(1), 45-66.

Gordon, M/Shapiro, E. (1956), Capital Equipment Analysis: The Required Rate of Profit, Management Science 3, 102-110.

Gwartney, J./Stroup, R. (1997), Economics, Private and Public Choice, 8th ed., Fort Worth.

Hayn, C. (1995), The Information Content of Losses, Journal of Accounting and Economics, 125-153.

Herrmann, V. (2002), Marktpreisschätzung mit kontrollierten Multiplikatoren.

Holthausen, R./Watts, R. (2001), The relevance of the value relevance literature for financial acounting standard setting, Journal of Accounting and Economics 31, 3-75.

Leuner, R. (2002), Bewertung ertragsschwacher Unternehmen (Sanierung), in: Peemoeller, V.H. (Hrsg.), Praxishandbuch der Unternehmensbewertung, 649-670, Herne/Berlin.

Liu, J/Nissim, D./Thomas, J (2002), Equity Valuation Using Multiples, Journal of Accounting Research 40(1), 135-172..

Lo, K./Lys, T. (2000), The Ohlson Model: Contribution to Valuation Theory, Limitations, and Empirical Applications, Working Paper.

Lundholm, R. (1995), A Tutorial on the Ohlson and Feltham/Ohlson Models: Answers to some Frequently Asked Questions, Contemporary Accounting Research, 749-761.

Mager, F. (2001), Die Performance von Unternehmen vor und nach dem Börsengang – eine empirische Studie, Wiesbaden.

McCarter, M./Aschwald, K. (1992), The Market Comparable Approach Using Public Market Data, in: West, T./Jones, J. (ed.), Handbook of Business Valuation, New York.

Merrill Lynch (1998), European Capital Goods: ´99 Yearbook, London.

Miller, M. (1994), Is American Corporate Governance Fatally Flawed?, Journal of Applied Corporate Finance 6(4), 32-39.

Moser, U./Auge-Dickhut, S. (2003), Der Informationsgehalt von Marktpreisabschätzungen auf Basis von Vergleichsverfahren, in: Finanz-Betrieb 01/2003, 10-22.

Ohlson, J.A. (1995), Earnings, Book Values, and Dividends in Equity Valuation, Contemporary Accounting Research, 661-687.

Ohlson, J.A. (2001), Earnings, Book Values, and Dividends in Equity Valuation: An Empirical Perspective, in: Contemporary Accounting Research, 107-120.

Peemoeller, V./Meister, J./Beckmann, C. (2002), Der Multiplikatoransatz als eigenständiges Verfahren in der Unternehmensbewertung, Finanz-Betrieb 04/2002, 197-208.

Penman, S. (1992), Return to Fundamentals, Journal of Accounting, Auditing & Finance 7, 465-483.

Penman, S. (1996), The Articulation of Price-Earnings Ratios and Market-to-Book Ratios and the evaluation of growth, Journal of Accounting Research 34 (2), 235-259.

Penman, S. (1997), Combining Earnings and Book Value in Equity Valuation, Working Paper.

Porter, M. (1980), Competitive Strategy, New York.

Porter, M. (1998), On Competition, Boston.

Preinreich, G. (1938), Annual Survey of Economic Theory: The Theory of Depreciation, Econometrica 6, 219-241.

Reilly, F.K./Brown, K.C.(1997), Investment Analysis and Portfolio Management, 5th edition, Fort Worth.

Richter, F./Herrmann, V. (2002), Pricing with Performance Controlled Multiples, Working Paper, Universtität Witten/Herdecke.

Sieben, G./Maltry, H. (2002), Der Substanzwert der Unternehmung, in: Peemoeller, V.H. (Hrsg.), Praxishandbuch der Unternehmensbewertung, 375-399, Herne/Berlin.

Trigeorgis, L. (1996), Real Options - managerial flexibility and strategy in resource allocation, Cambridge.

Wichels, D. (2000), Gestaltung der Finanzmarktkommunikation mit Finanzanalysten, Wiesbaden.

Williams, J, (1938), The Theory of Investment Value, Cambridge.

Zhang, X. (2000), Conservative Accounting and Equity Valuation, Working Paper.