Kenth Skogsvik (Sweden), Stina Skogsvik (Sweden)

P/E-ratios in relative valuation – a mission impossible?

Abstract

P/E-ratio valuation still plays an important role among investment analysts and advisors. In an earnings-based valuation model of this kind, the value of owners' equity is commonly calculated as a function of an observed P/E-ratio for some peer company, or the mean/median P/E-ratio for some group of peer companies. The question being addressed in the article is concerned with the validity of a benchmark P/E-ratio being assessed in this way. Assuming that there is one peer company, the importance of differences (between the company being valued and its peer) with regard to the book return on owners' equity and the growth of owners' equity have been investigated. In the main, it is shown that relative P/E-ratio valuation will not be able to handle differences in the expected book return or growth of owners' equity. In an empirical context however, controlling for industry and the expected book return for next year, together with some modification of the valuation model itself, is likely to improve the accuracy of earnings-based relative valuation.

Keywords: equity valuation, financial statement analysis, P/E-ratio, relative valuation, valuation modeling.
JEL Classification: G12, M41.

Introduction

The challenge of using accounting numbers for valuation purposes has tempted researchers and practicians in accounting and finance over the years, resulting in a wide array of suggested valuation models. Several criteria can be used in partitioning these models, for example with regard to modeling complexity or the choice of some "value driver". A "free cash flow" model as specified in Koller et al. (2005) for example, can be viewed as a fairly complex model using company "free cash flow" as its underlying value driver. A *P/E*-ratio valuation model on the other hand, can be viewed as a technically simple model, with company earnings as its value driver. Another distinction can be based on the modelling logic as such, i.e. whether a model is deduced from the theory of capital value (in the sense of Fisher, 1906) or hinges on an empirically estimated association between the chosen value driver and stock market prices. In this respect, a "free cash flow" model would be an example of a deduced model, while a *P/E*-ratio model typically would be an empirically assessed model.

The purpose of this article is to investigate *P/E*-ratio valuation as a relative valuation approach[1]. More specifically, the idea is to investigate how similar the company being valued and its peer company have to be in order for relative *P/E*-ratio valuation to work. The stock market value of the peer company is not at stake in this analysis – as the idea of relative valuation implies, the analysis is conditioned on some market value of the peer company. If the peer company is a "perfect twin", relative *P/E*-ratio valuation will obviously be unproblematic. The analysis will, however, be concerned with the importance of differences pertaining to measures of profitability and capital growth, between the company being valued and its peer. Are such differences generically problematic? Or, when might such differences be valuation irrelevant?

The questions being addressed in the article are clearly important in practice – for example, in the pricing of initial public offerings (IPO's) or in fund portfolio management (cf. Liu et al., 2007; and Schreiner & Spremann, 2007). In a study by Goldman Sachs (Goldman Sachs, 1999), the *P/E*-ratio was found to be the primary valuation metric for about 50% of the surveyed US investment analysts. Sometimes the importance of *P/E*-ratios is downplayed, in favor of more "sophisticated" valuation models (typically based on forecasted free cash flows). The meaning of such statements is often dubious however – occasional observations of "buy-or-sell" recommendations in investor newsletters and the business press, indicate that *P/E*-ratios at least provide strong restrictions for what a "reasonable" stock market value should be.

The article is organized as follows. In section 1, the *P/E*-ratio valuation model and a deduced valuation model – based on expected future dividends – are specified, and a synthesis between the two models is made. Assuming a mean reversion process for the book return on owners' equity of the company being valued and its peer, the importance of differences with regard to the future profitability and growth of owners' equity are investigated in section 2. Empirical implications – including suggestions for the improvement of earnings-based relative valuation – are discussed in section 3. A summary and some concluding remarks are included in the last section of the paper.

[1] In the paper the concept of "relative valuation" is restricted to valuation models that are conditioned on knowing the stock market price for some peer company or group of peer companies. This type of valuation is referred to as "relative valuation – using comparables" in Damodaran (1994), pp. 15-16.

1. Relative *P/E*-ratio valuation and the PVED valuation model

A relative *P/E*-ratio valuation model is first specified in this section. The model hinges on a prediction of expected earnings for next year, as opposed to models based on reported earnings for last year. The specification is chosen as it in general appears to provide for lower valuation errors in previous empirical research (cf. Liu et al., 2002, and Schreiner & Spremann, 2007) and to be in line with a common practice among investment analysts. In order to interpret the P/E-ratio model, a dividend-based valuation model is also specified. This model coincides with the present value of future expected (net) dividends, henceforth referred to as the PVED ("present-value-of-expected-dividends") model.

The P/E-ratio model can be expressed as follows, where both $[P/E]_{j,t}$ and $E_t\left(\tilde{X}_{j,t+1}\right)$ are restricted to be non-negative numbers:

$$V_{j,t}^{(P/E)} = [P/E]_{j,t} \cdot E_t\left(\tilde{X}_{j,t+1}\right), \tag{1}$$

where $V_{j,t}^{(P/E)}$ is the value of owners' equity of company *j*, "ex dividend" at time *t* in *P/E*-ratio valuation; $[P/E]_{j,t}$ is the assessed *P/E*-ratio of company *j* at time *t*; $\tilde{X}_{j,t+1}$ represents accounting earnings of company *j* for period *t*+1; $E_t(\ldots)$ is an expectation operator, conditioned on the available information at time *t*.

The technical simplicity of the valuation model in (1) is obvious – you make a prediction of expected earnings for the coming year, multiply by an assessed *P/E*-ratio, and a value of owners' equity is obtained. The difficult task, however, is concerned with the value of $[P/E]_{j,t}$. In relative valuation this is handled through looking at other quoted companies. Presuming that there is only one peer company (company p) and that $E(\tilde{X}_{p,t+1}) > 0$ is known at time t,[1,2] $[P/E]_{j,t}$ in (1) would be assessed as:

$$[P/E]_{j,t} = (P/E)_{p,t} = \frac{Mv_{p,t}}{E_t\left(\tilde{X}_{p,t+1}\right)}, \tag{2}$$

where $(P/E)_{p,t}$ is the observed *P/E*-ratio of company *p* at time *t*; $Mv_{p,t}$ is the market value of owners' equity of company *p*, "ex dividend" at time *t*.

In setting $[P/E]_{j,t}$ equal to $(P/E)_{p,t}$ in (2) we assume that the value of owners' equity for company *j* in relation to its expected earnings next year, is the same as the corresponding market based ratio for the peer company. It is really this assumption that is crucial in the forthcoming analysis – i.e. when can a similarity of this kind be expected to hold?

Introducing the book value of owners' equity, $B_{j,t}\ (>0)$, the *P/E*-ratio for the peer company can trivially be rewritten as the ratio between two other well-known financial ratios:

$$(P/E)_{p,t} = \frac{Mv_{p,t}/B_{p,t}}{E_t\left(\tilde{X}_{p,t+1}\right)/B_{p,t}} = \frac{Mv_{p,t}/B_{p,t}}{E_t\left(R\tilde{O}E_{p,t+1}\right)}, \tag{3}$$

where $B_{p,t}$ is the book value of owners' equity of company *p*, "ex dividend" at time *t*; $R\tilde{O}E_{p,t} \equiv \tilde{X}_{p,t+1}/B_{p,t}$ represents book return on owners' equity of company *p* for period *t* + 1.

As (3) shows, an observed *P/E*-ratio can be reformulated as the "market-to-book" ratio at time *t* divided by the expected book return on owners' equity for period *t* + 1. In the forthcoming analysis, these numbers will play an important role in understanding the limitations of the *P/E*-ratio valuation model. However, it is first necessary to introduce the PVED model.

In order for the PVED model to be useful in the present context, it should include the book value of owners' equity and the book return on owners' equity as independent variables. Set *t* = 0 and let company indices *j* and *p* temporarily be suppressed, and we have[3]:

$$V_0^{(PVED)} = \sum_{\tau=1}^{\infty} \frac{E_0\left(\tilde{D}_\tau\right)}{(1+\rho)^\tau}, \tag{4}$$

where $\tilde{D}_\tau$ is the dividend (net of capital contributions) paid to the share-holders (of company *j* or *p*) at time (*t* +) τ; ρ is the required expected rate of return on owners' equity (for company *j* or *p*).

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[1] Restricting the expected value of company earnings next year to be positive is not likely to be a controversial issue in neither theory nor practice. Obviously, *P/E*-ratio valuation breaks down if $E_t(\tilde{X}_{j,t+1}) = 0$ (as then $V_{j,t}^{(P/E)} = 0$ for all values of $[P/E]_{j,t}$). If $E_t\left(\tilde{X}_{j,t+1}\right) < 0$, $[P/E]_{j,t}$ has to be negative in order for $V_{j,t}^{(P/E)} > 0$, in turn implying a peculiar relationship between company earnings and the value of owners' equity.

[2] In practice, $E_t(\tilde{X}_{p,t+1})$ is commonly calculated as an average or median of public earnings forecasts by financial analysts (often (mis-) labelled as a "consensus" forecast), or through some time series analysis of historical values of $\tilde{X}_{p,t}$.

[3] In order to simplify the analysis, the required rate of return on owners' equity (ρ) in (4) is assumed to be a constant. Issues concerning the assessment of ρ are not addressed in the article.

Defining the company payout ratio $\widetilde{pr}_\tau = \widetilde{D}_\tau / \widetilde{X}_\tau$, future dividends can be expressed as $\widetilde{D}_\tau = \widetilde{X}_\tau \cdot \widetilde{pr}_\tau$. Assuming that expected values of future dividends can be calculated as expected values of future earnings multiplied by a dividend policy payout ratio $\overline{pr}_\tau$, (4) can be rewritten as follows[1].

$$V_0^{(PVED)} = \sum_{\tau=1}^{\infty} \frac{E_0\left(\widetilde{X}_\tau\right) \cdot \overline{pr}_\tau}{(1+\rho)^\tau} = \sum_{\tau=1}^{\infty} \frac{E_0\left(\widetilde{B}_{\tau-1} \cdot R\widetilde{O}E_\tau\right) \cdot \overline{pr}_\tau}{(1+\rho)^\tau}. \quad (5)$$

Hence, we have a deduced valuation model including the book value of owners' equity ($\widetilde{B}_{\tau-1}$) and the book return on owners' equity ($R\widetilde{O}E_\tau$) as independent variables. Dividing $V_0^{(PVED)}$ with B_0, a "value-to-book" ratio is obtained:

$$\frac{V_0^{(PVED)}}{B_0} = \frac{1}{B_0} \cdot \sum_{\tau=1}^{\infty} \frac{E_0\left(\widetilde{B}_{\tau-1} \cdot R\widetilde{O}E_\tau\right) \cdot \overline{pr}_\tau}{(1+\rho)^\tau} = \sum_{\tau=1}^{\infty} \frac{E_0\left(\widetilde{G}_{\tau-1} \cdot R\widetilde{O}E_\tau\right) \cdot \overline{pr}_\tau}{(1+\rho)^\tau}, \quad (6)$$

where $\widetilde{G}_{\tau-1} \equiv \widetilde{B}_{\tau-1} / B_0$ is equal to one plus the relative growth of owners' equity over the period $t = 0$ to $(t +)\tau - 1$.

In the numerator of the RHS of (6) we have the expected value of the product of two random variables, $E_0\left(\widetilde{G}_{\tau-1} \cdot R\widetilde{O}E_\tau\right)$. However, in order to restrain the complexity of the analysis – and certainly in the spirit of the "dividend irrelevance proposition" of Miller & Modigliani (1961) – the following assumptions are now introduced:

(A.1) $E_0\left(\widetilde{G}_{\tau-1} \cdot R\widetilde{O}E_\tau\right) = E_0\left(\widetilde{G}_{\tau-1}\right) \cdot E_0\left(R\widetilde{O}E_\tau\right)$, i.e. the variables $\widetilde{G}_{\tau-1}$ and $R\widetilde{O}E_\tau$ (for company j and company ρ, respectively) are uncorrelated.

(A.2) In future periods the difference between dividends being paid and new issues of owners' equity will be managed in order to achieve a pre-specified (but otherwise unrestricted) growth of owners' equity, $G_{\tau-1}$, known to all market investors at time $t = 0$.

Reintroducing the company index j, the "value-to-book" ratio in (6) can be written as:

$$\frac{V_{j,0}^{PVED}}{B_{j,0}} = \sum_{\tau=1}^{\infty} \frac{G_{j,\tau-1} \cdot E_0\left(R\widetilde{O}E_{j,\tau}\right) \cdot \overline{pr}_{j,\tau}}{\left(1+\rho_j\right)^\tau}. \quad (7)$$

Given that stock market values are in alignment with the PVED model, the appropriate *P/E*-ratio for company j – $[P/E]_{j,0}^*$ – would be:

$$[P/E]_{j,0}^* = \frac{V_{j,0}^{(PVED)}/B_{j,0}}{E_0\left(R\widetilde{O}E_{j,1}\right)} = \frac{\sum_{\tau=1}^{\infty} G_{j,\tau-1} \cdot E_0\left(R\widetilde{O}E_{j,\tau}\right) \cdot \overline{pr}_{j,\tau} \cdot \left(1+\rho_j\right)^{-\tau}}{E_0\left(R\widetilde{O}E_{j,1}\right)}. \quad (8)$$

In the forthcoming analysis, $[P/E]_{j,0}^*$ will be viewed as the correct norm for the company being valued. Obviously, if $(P/E)_{p,0} = [P/E]_{j,0}^*$, relative *P/E*-ratio valuation works flawlessly. If $(P/E)_{p,0} \neq [P/E]_{j,0}^*$ however, the valuation approach will be (more or less) misleading.

2. Conditions for relative *P/E*-ratio valuation to work

The quality of relative *P/E*-ratio valuation obviously hinges on the similarity between the company being valued and its peer. In order not to discredit the valuation approach unnecessarily, assume now that the peer company is wisely selected on the basis of industry and risk characteristics in the following sense[2]:

(B.1) The business operations and the financial structure of companies j and p are the same at the valuation date and in future years, implying that the cost of equity capital is the same for both companies (= ρ).

(B.2) Companies j and p use the same accounting methods and are expected to have the same composition of operating assets and liabilities in future years.

A difference in risk between the company being valued and its peer would lead to a difference in the cost of capital between the two companies. In accordance with (B.1), this is henceforth ruled out. Also, as specified in (B.2), companies j and p use the same accounting methods and will have the same operating net asset composition in future years. This means that any conservative accounting bias is expected to affect the future book return on

[1] It is hence assumed that $Cov\left(\widetilde{X}_\tau, \widetilde{pr}_\tau\right) = 0$, an assumption which would be consistent with a company dividend policy implying a fixed goal for $\overline{pr}_\tau$, or a goal for $\overline{pr}_\tau$ being statistically unrelated to company earnings for period τ.

[2] Cf. Alford (1992), pp. 94-96 for the motivation of typical matching criteria in selecting peer companies.

owners' equity for the two companies in the same way (cf. Skogsvik, 1998).

Provided that stock market values are consistent with the PVED model, the *P/E*-ratio of the peer company can now be written as (cf. (3) and (8) above):

$$(P/E)_{p,0} = \frac{Mv_{p,0}/B_{p,0}}{E_0\left(R\widetilde{O}E_{p,1}\right)} =$$

$$= \frac{\sum_{\tau=1}^{\infty} G_{p,\tau-1} \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right) \cdot \overline{pr}_{p,\tau} \cdot (1+\rho)^{-\tau}}{E_0\left(R\widetilde{O}E_{p,1}\right)}. \quad (9)$$

In order for $(P/E)^*_{j,0}$ in (8) to be equal to $(P/E)_{p,0}$, a trivial solution is for company *j* and company *p* to be "perfect twins"; i.e. a situation when $G_{j,\tau-1} = G_{p,\tau-1}$, $E_0\left(R\widetilde{O}E_{j,\tau}\right) = E_0\left(R\widetilde{O}E_{p,\tau}\right)$ and $\overline{pr}_{j,\tau} = \overline{pr}_{p,\tau}$ for $\tau = 1,2,\ldots\infty$. A solution of this kind is not very helpful, however, simply because of the fact that "perfect twins" typically are quite rare. Rather one would like to see solutions to $[P/E]^*_{j,0} = (P/E)_{p,0}$ permitting differences in the expected future book return on owners' equity and the expected future growth of owners' equity. We turn to these issues in the next two sub-sections.

2.1. Differences in expected book return on owner's equity. In order to simplify the analysis, we first make the following additional assumptions:

(A.3) The growth of owners' equity for company *j* and company *p* is the same in each future period; i.e. $G_{j,\tau-1} = G_{p,\tau-1} = G_{\tau-1}$ for $\tau = 2,3,\ldots\infty$.

(A.4) There are differences in the expected book return on owners' equity between company *j* and company *p*, but these differences will gradually vanish over time. Specifically, let $E_0\left(R\widetilde{O}E_{j,\tau}\right) = k_\tau \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right)$, with $k_1 > 0$ and $k_1 \neq 1$,[1] and $|k_\tau - 1|$ monotonically decreasing as τ increases and $(k_{T+1} - 1) = 0$ for some value of T, $1 \le T < \infty$.

(A.4) implies that the expected book return on owners' equity next year is either higher or lower for company *j* as compared to the peer company, but as τ increases the expected return for the two companies will converge. From year T + 1 and onwards both companies are forecasted to be in a "steady state equilibrium" and the expected book return will be the same[2].

Assumptions (A.3) and (A.4) can be incorporated in expressions (8) and (9):

$$[P/E]^*_{j,0} = \frac{\sum_{\tau=1}^{\infty} G_{\tau-1} \cdot k_\tau \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right) \cdot \overline{pr}_{j,\tau} \cdot (1+\rho)^{-\tau}}{k_1 \cdot E_0\left(R\widetilde{O}E_{p,1}\right)}, \quad (10)$$

$$(P/E)_{p,0} = \frac{\sum_{\tau=1}^{\infty} G_{\tau-1} \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right) \cdot \overline{pr}_{p,\tau} \cdot (1+\rho)^{-\tau}}{E_0\left(R\widetilde{O}E_{p,1}\right)}. \quad (11)$$

Given the "clean surplus relation" (cf. Ohlson, 1995), the payout ratios in (10) and (11) cannot be unrelated. As shown in Appendix A, partitioning $\overline{pr}_{j,\tau}$ into $\overline{pr}'_{j,\tau} = \mathrm{pr}_{p,\tau}$ for $E_0\left(R\widetilde{O}E_{p,\tau}\right)$ and $\overline{pr}''_{j,\tau}$ = 1,00 for $(k_\tau - 1) \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right)$, the dividends of company *j* can be linked to the payout ratio of company *p*. Making this transformation in (10) we get:

$$[P/E]^*_{j,0} = \frac{\sum_{\tau=1}^{\infty} G_{\tau-1} \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right) \cdot \overline{pr}_{p,\tau} \cdot (1+\rho)^{-\tau}}{k_1 \cdot E_0\left(R\widetilde{O}E_{p,1}\right)} +$$

$$+ \frac{\sum_{\tau=1}^{\infty} G_{\tau-1} \cdot (k_\tau - 1) \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right) \cdot (1+\rho)^{-\tau}}{k_1 \cdot E_0\left(R\widetilde{O}E_{p,1}\right)} =$$

$$= \frac{1}{k_1} \cdot (P/E)_{p,0} +$$

$$+ \frac{\sum_{\tau=1}^{\infty} G_{\tau-1} \cdot (k_\tau - 1) \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right) \cdot (1+\rho)^{-\tau}}{k_1 \cdot E_0\left(R\widetilde{O}E_{p,1}\right)}. \quad (12)$$

Focusing on the relationship between $[P/E]^*_{j,0}$ and $[P/E]_{p,0}$, we have:

$$\frac{[P/E]^*_{j,0}}{(P/E)_{p,0}} = \frac{1}{k_1} +$$

$$+ \frac{\sum_{\tau=1}^{\infty} G_{\tau-1}(k_\tau - 1) \cdot E_0\left(R\widetilde{O}E_{p,\tau}\right)(1+\rho)^{-\tau}}{k_1 \cdot E_0\left(R\widetilde{O}E_{p,1}\right)} \Big/ (P/E)_{p,0} =$$

[1] As it has previously been assumed that $E_0(R\widetilde{O}E_{p,1}) > 0$ and $E_0(R\widetilde{O}E_{j,1}) > 0$, k_1 has to be different from 0.

[2] As the two companies have the same cost of equity capital (assumption (B.1)), use the same accounting methods and are expected to have the same future asset composition (assumption (B.2)), the time series behavior of $E_0(R\widetilde{O}E_{j,\tau})$ is consistent with the discussion in Frankel & Lee (1998), pp. 286-287, and Skogsvik (1998), pp. 374-376.

$$=\frac{1}{k_1}\left[1+\frac{\sum_{\tau=1}^{\infty}G_{\tau-1}(k_\tau-1)\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)(1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty}G_{\tau-1}\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)\cdot \overline{pr}_{p,\tau}(1+\rho)^{-\tau}}\right]=$$

$$=\frac{1}{k_1}[1+Q]. \quad (13)$$

With Q being defined in (13), the relationship between $[P/E]^*_{j,0}$ and $(P/E)_{p,0}$ is as follows:

- If $(1+Q)/k_1 > 1{,}00$, $[P/E]^*_{j,0}$ is larger than $(P/E)_{p,0}$.
- If $(1+Q)/k_1 = 1{,}00$, $[P/E]^*_{j,0}$ is equal to $(P/E)_{p,0}$.
- If $(1+Q)/k_1 < 1{,}00$, $[P/E]^*_{j,0}$ is smaller than $(P/E)_{p,0}$.

$(1+Q)$ is equal to the "value-to-book" ratio of company j in relation to the "market-to-book" ratio of the peer company[1], and k_1 is equal to the expected book return on owners' equity next year for company j in relation to the expected book return for the peer company (assumption (A.4)). Hence Q can be viewed as the relative difference between $Mv_{p,0}/B_{p,0}$ and $V^{(PVED)}_{j,0}/B_{j,0}$ and (k_1-1) as the relative difference between $E_0(R\tilde{O}E_{p,1})$ and $E_0(R\tilde{O}E_{j,1})$. It is then easily acknowledged that $(1+Q)$ has to be equal to k_1 in order for $[P/E]^*_{j,0}$ to be equal to $(P/E)_{p,0}$.

A necessary and sufficient condition for the *P/E*-ratio valuation model to be correct is thus that $(1+Q)/k_1 = 1{,}00$, or equivalently (as $k_1 \neq 1$), that $Q/(k_1-1) = 1{,}00$. The latter condition can be analyzed as follows:

(C.1) $$\frac{Q}{k_1-1} = \frac{\sum_{\tau=1}^{\infty}G_{\tau-1}\cdot\left(\frac{k_\tau-1}{k_1-1}\right)\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)(1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty}G_{\tau-1}\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)\cdot \overline{pr}_{p,\tau}(1+\rho)^{-\tau}} = 1{,}00.$$

[1] Recognizing that $V^{(PVED)}_{j,0}/B_{j,0} = \sum_\tau G_{\tau-1}\cdot k_\tau\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)\cdot\overline{pr}_{j,\tau}(1+\rho)^{-\tau} = \left[\sum_\tau G_{\tau-1}\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)\cdot\overline{pr}_{p,\tau}(1+\rho)^{-\tau} + \sum_\tau G_{\tau-1}\cdot(k_\tau-1)\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)\cdot(1+\rho)^{-\tau}\right]$ and that $Mv_{p,0}/B_{p,0} = \sum_\tau G_{\tau-1}\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)\cdot\overline{pr}_{p,\tau}(1+\rho)^{-\tau}$, this interpretation is obvious (cf. the derivation of (13)).

Condition (C.1) implies that $Q/(k_1-1)=1{,}00$ if $(k_\tau-1)/(k_1-1)=\overline{pr}_{p,\tau}$ in all future years. Obviously $(k_\tau-1)/(k_1-1) = 1{,}00$ for $\tau=1$ and ratio decreases over time and is equal to 0 for $\tau \geq \mathrm{T}+1$. Requiring that $(k_\tau-1)/(k_1-1)=\overline{pr}_{p,\tau}$ would hence imply a very peculiar dividend policy for the peer company – a full payout of earnings next year, but no dividends at all in the company "steady state". Clearly, this is not a reasonable solution.

Going back to (C.1), both the numerator and denominator of $Q/(k_1-1)$ can be viewed as a weighted sum of $G_{\tau-1}\cdot E_0\left(R\tilde{O}E_{p,\tau}\right)\cdot(1+\rho)^{-\tau}$, $\tau=1,2,\ldots\infty$, with $(k_\tau-1)/(k_1-1)$ as weights in the numerator and $\overline{pr}_{p,\tau}$ as weights in the denominator. As noted, $(k_\tau-1)/(k_1-1)=1{,}00$ for $\tau=1$ and will subsequently decrease towards 0. On the other hand, the payout ratio of the peer company can be expected to be in the interval $0 < \overline{pr}_{p,\tau} \leq 1{,}00$ in future years. However, without any additional restrictions on $G_{\tau-1}$ and/or $E_0(R\tilde{O}E_{p,\tau})$, one cannot preclude that $Q/(k_1-1)$ can be equal to 1,00 for some delicately chosen values of k_τ and $\overline{pr}_{\tau,p}$, $\tau=1,2\ldots\infty$. One can hardly put faith in a solution of this kind though – there are simply too many *ad hoc* coincidences that would have to work out.

How is then the analysis affected if we introduce more restrictions on $G_{\tau-1}$ and/or $E_0(R\tilde{O}E_{p,\tau})$? An interesting benchmark situation is to simplify the specification of $\frac{Q}{(k-1)}$ as follows:

(A.5) The growth of owners' equity is the same for each future year, i.e. $G_{\tau-1}=(1+g)^{\tau-1}$, with $-1{,}00 < g < \rho$.

(A.6) The time series behavior of $E_0(R\tilde{O}E_{j,\tau})$ is "well-behaved" in the sense that $\left(\frac{k_\tau-1}{k_1-1}\right)=\omega^{\tau-1}$, where $0<\omega<1{,}00$.

(A.7) The expected book return on owners' equity for the peer company is constant over time, i.e. $E_0\left(R\tilde{O}E_{p,\tau}\right)=E_0\left(R\tilde{O}E_p\right)$. Thus $\overline{pr}_{p,\tau}$ is also expected to be constant (as $g=E_0\left(R\tilde{O}E_p\right)\left(1-\overline{pr}_{p,\tau}\right)$).

Incorporating assumptions (A.5), (A.6) and (A.7) in the previous condition for $[P/E]^*_{j,0} = (\mathrm{P/E})_{\mathrm{p},0}$, we get (C.2):

(C.2) $\dfrac{Q}{(k_1-1)} =$

$$= \frac{\sum_{\tau=1}^{\infty}(1+g)^{\tau-1}\cdot\omega^{\tau-1}\cdot E_0\left(R\tilde{O}E_p\right)(1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty}(1+g)^{\tau-1}\cdot E_0\left(R\tilde{O}E_p\right)\cdot\overline{pr}_p(1+\rho)^{-\tau}} = $$

$$= \frac{\dfrac{1}{(1+\rho)-(1+g)\omega}}{\overline{pr}_p\left(\dfrac{1}{\rho-g}\right)} =$$

$$\frac{\rho-g}{\overline{pr}_p\left[(1+\rho)-(1+g)\omega\right]} = 1{,}00\,.$$

(C.2) can be solved for the "required" value of the payout ratio of the peer company, $\overline{pr}_p^*$:

$$\overline{pr}_p^* = \frac{(1+\rho)-(1+g)}{(1+\rho)-(1+g)\omega}\,. \qquad (14)$$

As ρ is a non-negative number and $-1{,}00 < g < \rho$, the numerator on the RHS of (14) is positive. Furthermore, as $(1+\rho)>(1+g)>0$ and $0 < \omega < 1{,}00$, the denominator is positive and larger than the numerator, and consequently $0<\overline{pr}_p^*<1{,}00$. Thus $\overline{pr}_p^*$ is the elusive payout ratio of the peer company which – in this benchmark situation – would justify the *P/E*-ratio model. If, for example, ρ = 10%, g = 5% and ω = 0,5, $\overline{pr}_p^*$ is equal to 0,0870. If the difference between $E_0\left(R\tilde{O}E_{j,\tau}\right)$ and $E_0(R\tilde{O}E_p)$ is more persistent in future years – implying that ω increases – the value of $\overline{pr}_p^*$ will increase, and *vice versa*[1].

Another interesting benchmark situation is a plain "no growth scenario", implying that $G_{\tau-1} = 1{,}00$ and $\overline{pr}_{p,\tau} = 1{,}00$ for $\tau = 1,2,...\infty$. If assumptions (A.6) and (A.7) are maintained, the following condition is then obtained:

(C.3) $\dfrac{Q}{(k_1-1)} = \dfrac{\sum_{\tau=1}^{\infty}\omega^{\tau-1}(1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty}(1+\rho)^{-\tau}} =$

$$= \frac{\rho}{\rho-(\omega-1)} = 1{,}00\,.$$

Since $0 < \omega < 1{,}00$, (C.3) cannot hold. The crucial hitch is here the assumed time series behavior of $E_0\left(R\tilde{O}E_{j,\tau}\right)$ – setting ω = 1,00 the condition would trivially hold. However, as $\omega = (k_\tau - 1)/(k_1 - 1)$, ω = 1,00 means that the difference between $E_0(R\tilde{O}E_{j,1})$ and $E_0(R\tilde{O}E_p)$ would persist forever, contradicting the time series dynamics of $E_0\left(R\tilde{O}E_{j,\tau}\right)$ in assumption (A.4).

2.2. Differences in expected growth of owners' equity. In the previous sub-section the importance of differences in the book return on owners' equity between the company being valued and its peer was investigated. In this section, the importance of differences in the future growth of owners' equity will be analyzed, assuming that the book return on owners' equity is the same for both companies.

Note that growth is concerned with growth in book values of owners' equity here, not growth in earnings as might be more common in previous research (cf. Herrmann & Richter, 2003). However, provided that the "clean surplus relation" holds in future financial statements, growth in earnings is a function of the book return on owners' equity and growth in owners' equity[2].

In addition to assumptions (A.1), (A.2), (B.1) and (B.2) above, it is now postulated:

(A.3') The expected book returns on owners' equity for company *j* and company *p* are the same in each future period; i.e. $E_0\left(R\tilde{O}E_{j,\tau}\right) = E_0\left(R\tilde{O}E_{p,\tau}\right) = E_0\left(R\tilde{O}E_\tau\right)$ for $\tau = 1,2,...\infty$.

(A.4') There are differences between company *j* and company *p* with regard to the growth of owners' equity in future periods, in the sense that $G_{j,\tau} \neq G_{p,\tau}$ for some subset of future periods $\tau = 1,2,...\infty$.

[1] If ω = 0,99 (0,01), with ρ = 10% and g = 5%, the "required" payout ratio $\overline{pr}_p^*$ is equal to 0,8264 (0,0459).

[2] Assuming that the "clean surplus relation" holds and there are no new issues of owners' equity, the relative growth in earnings period τ assessed in the beginning of period τ, $g(\tilde{X}_\tau)$, can be derived as follows (company indices suppressed):

$$g(\tilde{X}_\tau) = (\tilde{X}_\tau - X_{\tau-1})/X_{\tau-1} = (B_{\tau-1}\cdot R\tilde{O}E_\tau - B_{\tau-2}\cdot ROE_{\tau-1})/B_{\tau-2}\cdot ROE_{\tau-1} =$$

$$= \frac{B_{\tau-2}\left[1+ROE_{\tau-1}(1-pr_{\tau-1})\right]\cdot R\tilde{O}E_\tau - B_{\tau-2}\cdot ROE_{\tau-1}}{B_{\tau-2}\cdot ROE_{\tau-1}} =$$

$$= \frac{R\tilde{O}E_\tau}{ROE_{\tau-1}}\cdot\left[1+ROE_{\tau-1}(1-pr_{\tau-1})\right]-1.$$

The factor $\left[1+ROE_{\tau-1}(1-pr_{\tau-1})\right]$ is equal to one plus the relative growth in owners' equity during the previous period, and hence earnings growth is equal to $ROE_{\tau-1}(1-pr_{\tau-1})$ if $R\tilde{O}E_\tau = ROE_{\tau-1}$. Also note that for the case of a full payout of earnings, the relative growth in earnings is equal to $R\tilde{O}E_\tau / ROE_{\tau-1} - 1$.

Incorporating assumptions (A.3') and (A.4') in the expressions for $\left[P/E\right]^{*}_{j,0}$ ((8) above) and $\left(P/E\right)_{p,0}$ ((9) above)), we get:

$$\left[P/E\right]^{*}_{j,0} = \frac{\sum_{\tau=1}^{\infty} G_{j,\tau-1} \cdot E_0\left(R\widetilde{O}E_\tau\right) \cdot \overline{pr}_{j,\tau} \cdot (1+\rho)^{-\tau}}{E_0\left(R\widetilde{O}E_1\right)}. \quad (15)$$

$$(P/E)_{p,0} = \frac{\sum_{\tau=1}^{\infty} G_{p,\tau-1} \cdot E_0(R\widetilde{O}E_\tau) \cdot \overline{pr}_{p,\tau} \cdot (1+\rho)^{-\tau}}{E_0(R\widetilde{O}E_1)}. \quad (16)$$

In order for $\left[P/E\right]^{*}_{j,0} = \left(P/E\right)_{p,0}$, it is thus required that:

(C.4)

$$\frac{\left[P/E\right]^{*}_{j,0}}{\left(P/E\right)_{p,0}} = \frac{\sum_{\tau=1}^{\infty} G_{j,\tau-1} \cdot E_0\left(R\widetilde{O}E_\tau\right) \cdot \overline{pr}_{j,\tau}(1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty} G_{p,\tau-1} \cdot E_0\left(R\widetilde{O}E_\tau\right) \cdot \overline{pr}_{p,\tau}(1+\rho)^{-\tau}} = 1{,}00.$$

A tempting solution for (C.4) is now easily specified – setting $G_{j,\tau-1} \cdot \overline{pr}_{j,\tau} = G_{p,\tau-1} \cdot \overline{pr}_{p,\tau}$ for periods $\tau = 1,2,..\infty$, $\left[P/E\right]^{*}_{j,0}$ will be equal to $\left(P/E\right)_{p,0}$. However, as $G_{j,0} = G_{p,0} = 1{,}00$, this would imply that $\overline{pr}_{j,1} = \overline{pr}_{p,1} = \overline{pr}_1$. In accordance with the "clean surplus relation", the expected growth of owners' equity next year would then be equal to $E_0(R\widetilde{O}E_1)(1-\overline{pr}_1)$ for both companies. Hence $G_{j,1}$ would be equal to $G_{p,1}$, in turn implying that $\overline{pr}_{j,2} = \overline{pr}_{p,2} = \overline{pr}_2$ and $G_{j,2} = G_{p,2}$. Going forward, it is easily recognized that $G_{j,\tau} = G_{p,\tau}$ for all future periods, a result that contradicts (A.4'). Consequently this cannot be a permissible solution for condition (C.4) when there are differences in the future growth of owners' equity between company *j* and its peer.

The RHS of (C.4) implies that both the numerator and the denominator can be viewed as a weighted sum of $E_0(R\widetilde{O}E_\tau) \cdot (1+\rho)^{-\tau}$, with $G_{j,\tau-1} \cdot \overline{pr}_{j,\tau}$ as weights in the numerator and $G_{p,\tau-1} \cdot \overline{pr}_{p,\tau}$ as weights in the denominator. Allowing $G_{j,\tau-1} \cdot \overline{pr}_{j,\tau} \neq G_{p,\tau-1} \cdot \overline{pr}_{p,\tau}$ for some subset of future periods, there might exist combinations of $G_{j,\tau-1} \cdot \overline{pr}_{j,\tau}$ and $G_{p,\tau-1} \cdot \overline{pr}_{p,\tau}$ that are permissible in (C.4). The validity of such solutions is dubious, however, as it is hard to see any reasonable argument for such an interdependence between the company being valued and its peer.

In order to reduce the complexity of (C.4), the following simplifications can be introduced:

(A.5') The payout ratios for companies *j* and *p* are constant over time; i.e. $\overline{pr}_{j,\tau} = \overline{pr}_j$ and $\overline{pr}_{p,\tau} = \overline{pr}_p$ for $\tau = 1,2,...\infty$.

(A.6') The expected return on owners' equity is constant over time; i.e. $E_0\left(R\widetilde{O}E_\tau\right) = E_0\left(R\widetilde{O}E\right)$ for $\tau = 1,2,...\infty$. Also, assume that $E_0\left(R\widetilde{O}E\right)\left(1-\overline{pr}_j\right) < \rho$ and $E_0\left(R\widetilde{O}E\right)\left(1-\overline{pr}_p\right) < \rho$.

Assumptions (A.5') and (A.6'), together with the "clean surplus relation", imply that the growth variables $G_{j,\tau-1}$ and $G_{p,\tau-1}$ can be expressed as:

$$G_{j,\tau-1} = \left(1 + E_0\left(R\widetilde{O}E\right) \cdot \overline{b}_j\right)^{\tau-1}, \quad (17.a)$$

where $\overline{b}_j \equiv \left(1-\overline{pr}_j\right)$ is the earnings retention ratio for company *j*, and

$$G_{p,\tau-1} = \left(1 + E_0\left(R\widetilde{O}E\right) \cdot \overline{b}_p\right)^{\tau-1}, \quad (17.b)$$

where $\overline{b}_p \equiv \left(1-\overline{pr}_p\right)$ is the earnings retention ratio for company *p*.

If the simplifying assumptions are incorporated in (C.4), the requirement for $\left[P/E\right]^{*}_{j,0} = \left(P/E\right)_{p,0}$ can be rewritten:

(C.5) $$\frac{\left[P/E\right]^{*}_{j,0}}{\left(P/E\right)_{p,0}} = \frac{\sum_{\tau=1}^{\infty}\left(1 + E_0\left(R\widetilde{O}E\right)\overline{b}_j\right)^{\tau-1} \cdot E_0\left(R\widetilde{O}E\right) \cdot \overline{pr}_j \cdot (1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty}\left(1 + E_0\left(R\widetilde{O}E\right)\overline{b}_p\right)^{\tau-1} \cdot E_0\left(R\widetilde{O}E\right) \cdot \overline{pr}_p \cdot (1+\rho)^{-\tau}} = \frac{\dfrac{\overline{pr}_j}{\rho - E_0\left(R\widetilde{O}E\right) \cdot \overline{b}_j}}{\dfrac{\overline{pr}_p}{\rho - E_0\left(R\widetilde{O}E\right) \cdot \overline{b}_p}} = 1{,}00.$$

Recognizing the definitions of $\overline{b}_j$ and $\overline{b}_p$, and simplifying (C.5) somewhat, one gets:

(C.5')

$$\left(1/\overline{pr}_j\right)\left(E_0(R\widetilde{O}E) - \rho\right) = \left(1/\overline{pr}_p\right)\left(E_0\left(R\widetilde{O}E\right) - \rho\right).$$

If $E_0\left(R\widetilde{O}E\right) - \rho \neq 0$, the only solution to (C.5') is $\overline{pr}_j = \overline{pr}_p$, a solution which is not permissible as it would contradict assumption (A.4'). However, if $E_0\left(R\widetilde{O}E\right) - \rho = 0$, (C.5') holds for all values of $\overline{pr}_j$

and $\overline{pr}_p$. This is not a surprising result – if the book return is equal to the cost of equity capital, it is well-known that the value of owners' equity is independent of the payout ratio[1]. Trivially this means that the value of owners' equity will be independent of future growth[2].

3. Empirical implications for relative *P/E*-ratio valuation

In the spirit of the idea that "market prices are right", the stock market value of the peer company is typically not at stake in relative *P/E*-ratio valuation. However, the quality of a relative valuation hinges on the information efficiency of the stock market, as well as the choice of an appropriate peer company. Having made this reservation, the discussion in this section will focus on some important characteristics of a good peer in relative *P/E*-ratio valuation.

In previous research (Beaver & Morse, 1978; and Alford, 1992) there are three company characteristics that have been put forth as being important in *P/E*-ratio valuation – investment risk, earnings growth and accounting measurement principles. In this article, the investment risk and accounting measurement biases have been assumed to be the same for the company being valued and its peer. However, in the specification of the PVED model, the concept of "earnings growth"[3] has been replaced by the book return on owners' equity $\left(R\widetilde{O}E_{j,\tau}\right)$and growth in owners' equity $\left(\widetilde{G}_{j,\tau}\right)$. The analysis in sub-section 2.1 showed that even when the relative growth of owners' equity is the same for the company being valued and its peer, setting $\left[P/E\right]^{*}_{j,0} = \left(P/E\right)_{p,0}$ is unlikely to be correct if there are differences in the expected book return for next year between the two companies. The same type of result was obtained in sub-section 2.2 with regard to differences in the relative growth of owners' equity in future years.

There is consequently a good reason to try to control for the expected book return on owners' equity for next year and the future growth in owners' equity in relative *P/E*-ratio valuation. Controlling for the book return on owners' equity is supported by empirical results in the seminal article by Alford (Alford, 1992) – in testing the accuracy of relative *P/E*-ratio valuation, the lowest prediction errors were obtained for peer companies belonging to the same industry and having about the same book return on owners' equity as the company being valued[4]. Controlling for the combination of next year's book return on owners' equity and future relative growth in owners' equity – and hence implicitly controlling for future earnings growth – is also in line with empirical results reported in Zarowin (1990), Bhojraj & Lee (2002), Lie & Lie (2002), and in particular, Herrmann & Richter (2003).

A peer company should hence be as similar as possible to the company being valued with regard to investment risk, accounting measurement principles, expected next year book return on owners' equity and expected future growth in owners' equity. As the number of available peer companies typically is limited, this is a formidable task. There is no obvious solution to this "matching conundrum". A common approach among professional investment analysts appears to be to select a number of approximative peers and to use an average *P/E*-ratio as the valuation norm. However, it is far from clear that a procedure of this kind will improve the quality of relative *P/E*-ratio valuation. As illustrated in a numerical example in Appendix B, even when the average characteristics of such a sample of peer companies are equal to the characteristics of the company being valued, the average *P/E*-ratio of the peers will not be correct[5]. This reservation is also corroborated by empirical results in Herrmann & Richter (2003).

Another methodological issue is concerned with the functional form of the chosen valuation model. The *P/E*-ratio model in the article hinges on a proportional relationship between the value of owners' equity and expected earnings next year. Or, equivalently, the relationship between the market-to-book value and the expected book return on owners' equity next year is presumed to be proportional. It is not hard to see that this might be a weakness of the model. As the book returns on owners' equity for the company being valued and its peer are expected to converge over time, a relative difference in book returns for next year should rather be associated with a less pronounced relative difference in market-to-book-values.

A non-proportional relationship between the value of owners' equity and expected earnings next year

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[1] Cf. for example Johansson (1998), pp. 13-17.

[2] With assumptions (A.1), (A.2), (A.4'), (A.5') and (A.6'), (8) and (9) can be simplified to $\left[P/E\right]^{*}_{j,0} = \left(P/E\right)_{p,0} = 1/\rho$. Obviously, the future growth of owners' equity has no bearing on $1/\rho$ and condition (C.5) is always fulfilled.

[3] It appears that the importance of earnings growth in P/E-ratio valuation emanates from a simple reformulation of Gordon's growth model – cf. Beaver & Morse (1978).

[4] It was the book return on owners' equity for the previous year – not the expected return for next year – that was controlled for in Alford (1992). Also, Alford viewed the return measure as an indicator of earnings growth.

[5] The cost of equity capital, the future relative growth in owners' equity and the "steady state equilibrium" conditions are the same for all companies in the numerical example – only the expected book return on owners' equity varies among the companies. Hence, the example could be expected to work in favor of an "average P/E-ratio approach".

might better be captured in a linear function with an intercept, i.e.:

$$V_{j,0} = \beta_0 + \beta_1 \cdot E_0\left(\widetilde{X}_{j,1}\right). \tag{18}$$

Having a sample of peer companies, β_0 and β_1 in (18) could be estimated in standard regression analysis. In order to mitigate statistical problems (mainly heteroscedasticity), it might also be helpful to deflate $V_{j,0}$ and $E_0\left(\widetilde{X}_{j,1}\right)$ in (18). Using the book value of owners' equity as a deflator, one gets the following value-to-book model:

$$\frac{V_{j,0}}{B_{j,0}} = \beta_0' + \beta_1' \cdot E_0\left(R\widetilde{O}E_{j,1}\right). \tag{19}$$

Allowing for an intercept in relative P/E-ratio valuation is supported by empirical results reported in Burgstahler (1998) and Liu et al. (2002). In the former article[1], graphs of the association between the market-to-book ratio and the book return on owners' equity clearly indicate the existence of a positive intercept. In the latter report, it is shown that allowing for an intercept in a valuation model such as (19) strongly reduces the valuation errors of the model.

There are hence good reasons for questioning the functional form of the *P/E*-ratio model as suggested by practice – neither the PVED model nor empirical observations appear to support a proportional relationship between $V_{j,0}$ and $E_0\left(\widetilde{X}_{j,1}\right)$ (or, equivalently, between $V_{j,0} / B_{j,0}$ and $E_0\left(R\widetilde{O}E_{j,1}\right)$). Obviously some of the simplicity of the model is lost when allowing for a non-zero intercept, especially with regard to the need for regression analysis in order to estimate β_0 and β_1 in (18), or β_0' and β_1' in (19). On the other hand, it hardly makes sense to continue using an erroneous functional form whose main virtue might only be its non-technical appearance.

Summary and concluding remarks

Occasional as well as more systematic observations indicate that relative *P/E*-ratio valuation plays an important role among investment analysts and advisors. An advantage of a model of this kind is mainly its apparent simplicity – you make a prediction of company earnings, multiply by an appropriate *P/E*-ratio, and a value of owners' equity is obtained. Observed *P/E*-ratios for peer companies are commonly used to determine the "appropriate" *P/E*-ratio. The main question being addressed in the article is concerned with the validity of a valuation approach of this kind.

The analysis hinges on stock prices being determined in accordance with the PVED ("present-value-of-expected-dividends") model. Including accounting measures in this model, a simple expression for the *P/E*-ratio ((8) in section 1) has been deduced. The expression shows that the *P/E*-ratio is a function of four company characteristics – the expected book return on owners' equity, future growth in owners' equity, the dividend payout ratio, and the cost of equity capital.

Assuming that there is one peer company, the importance of differences with regard to the future book return on owners' equity and the future growth in owners' equity have been investigated. Looking at differences in the expected book return on owners' equity for next year and assuming that the book return for the company being valued and its peer will converge at some future point in time, it was found that:

- In order for the *P/E*-ratios of the company being valued ($[P/E]^*_{j,0}$) and the peer company ($P/E_{p,0}$) to be the same, the dividend policy of the peer company has to be circumscribed in an unrealistic or *ad hoc* fashion.
- Assuming that the future relative growth in owners' equity and the expected book return for the peer company are constant (≠0) over time, $[P/E]^*_{j,0} = (P/E)_{p,0}$ for a specific dividend payout ratio of the peer company. However, if there is zero growth in owners' equity, the *P/E*-ratio model is not applicable.

As there is no reason to believe that the dividend payout ratio(-s) for the peer company should lead to $(P/E)_{p,0}$ being equal to $[P/E]^*_{j,0}$, the above results imply that the *P/E*-ratio of the peer is unlikely to be correct when there are differences in the expected book return on owners' equity.

If future book returns are the same for the two companies, but there are differences with regard to the future growth in owners' equity, it was found that:

- $[P/E]^*_{j,0}$ can be equal to $(P/E)_{p,0}$ for *ad hoc* combinations of future growth of owners' equity and dividend payout ratios for the two companies.
- Assuming that the dividend payout ratios for the company being valued and its peer and the expected book returns on owners' equity are constants, $[P/E]^*_{j,0} = (P/E)_{p,0}$ only when the expected book returns are equal to the cost of equity capital.

[1] Cf. figure 4, p. 339, in Burgstahler (1998).

These results also imply that the *P/E*-ratio of the peer company is unlikely to be correct in the *P/E*-ratio model.

As the implications of the analyses are predominantly negative for relative *P/E*-ratio valuation, one might ask whether there is anything that can be done in order to mitigate the problems. There is one obvious piece of advice – the peer company (or group of peer companies) should really be as similar as possible to the company being valued with regard to investment risk, accounting principles, expected future book return on owners' equity, and future growth in owners' equity. Controlling for industry, accounting principles, and the expected book return next year can be viewed as a reasonable first step. Furthermore, introducing an intercept in the valuation model is recommended. It is also likely to be worthwhile to deflate the value of owners' equity and expected earnings next year by the book value of owners' equity; i.e. to write the market-to-book ratio as a linear function of the expected next year's book return on owners' equity.

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Appendix A. Dividend payout ratios of companies *j* and *p* with a common growth rate of owners' equity

In accordance with assumption (A.3) in sub-section 3.1, the future growth of owners' equity is assumed to be the same for companies *j* and *p,* i.e. $G_{j,\tau} = G_{p,\tau} = G_\tau$ for $\tau = 1,2,...\infty$. As G_τ is equal to one plus the relative growth of owners' equity at the end of period $(t+)\tau$, we have:

$$\text{(I.1)} \qquad G_\tau = \prod_{s=1}^{\tau}(1+g_s)\,,$$

where g_s is the relative growth of owners' equity in period *s*.

Given the "clean surplus relation", g_s can be written as $E_0(\widetilde{ROE}_{j,s})(1-\overline{pr}_{j,s})$ for company j and $E_0\left(\widetilde{ROE}_{p,s}\right)\left(1-\overline{pr}_{p,s}\right)$ for company p. As $E_0\left(\widetilde{ROE}_{j,s}\right) = k_s \cdot E_0\left(\widetilde{ROE}_{p,s}\right)$, a common value of the growth in owners' equity implies that:

(I.2) $$k_s \cdot E_0\left(\widetilde{ROE}_{p,s}\right)\left(1-\overline{pr}_{j,s}\right) = E_0\left(\widetilde{ROE}_{p,s}\right)\left(1-\overline{pr}_{p,s}\right),$$

$k_s \cdot E_0\left(\widetilde{ROE}_{p,s}\right)$ in (I.2) can be rewritten as $E_0\left(\widetilde{ROE}_{p,s}\right) + (k_s - 1)\cdot E_0\left(\widetilde{ROE}_{p,s}\right)$, and the LHS of the expression can then be divided into two parts:

(I.3) $$E_0\left(\widetilde{ROE}_{p,s}\right)\left(1-\overline{pr}'_{j,s}\right) + (k_s - 1)\cdot E_0\left(\widetilde{ROE}_{p,s}\right)\left(1-\overline{pr}''_{j,s}\right) = E_0\left(\widetilde{ROE}_{p,s}\right)\left(1-\overline{pr}_{p,s}\right).$$

The LHS of (I.3) and (I.2) are identical if $\overline{pr}'_{j,s} = \overline{pr}''_{j,s} = \overline{pr}_{j,s}$. This is not, however, necessary for (I.3) to hold – it is easy to imagine several combinations $0 \le \overline{pr}'_{j,s} \le 1{,}00$ and $0 \le \overline{pr}''_{j,s} \le 1{,}00$ where $\overline{pr}'_{j,s} \ne \overline{pr}''_{j,s}$ but (I.3) still holds. One such combination is to set $\overline{pr}'_{j,s} = \overline{pr}_{p,s}$ and $\overline{pr}''_{j,s} = 1{,}00$, meaning that company j applies the same payout ratio as company p for a return corresponding to $E_0(\widetilde{ROE}_{p,s})$, but a full payout ratio for any difference between $E_0\left(\widetilde{ROE}_{j,s}\right)$ and $E_0\left(\widetilde{ROE}_{p,s}\right)$. Total dividends in relation to the opening book value of owners' equity for company j will then be equal to $\left[E_0\left(\widetilde{ROE}_{p,s}\right)\cdot \overline{pr}_{p,s} + (k_s-1)\cdot E_0\left(\widetilde{ROE}_{p,s}\right)\right]$, i.e.:

(I.4) $$k_s \cdot E_0\left(\widetilde{ROE}_{p,s}\right)\cdot \overline{pr}_{j,s} = E_0\left(\widetilde{ROE}_{p,s}\right)\cdot \overline{pr}_{p,s} + (k_s - 1)\cdot E_0\left(\widetilde{ROE}_{p,s}\right).$$

Solving (I.4) for $\overline{pr}_{j,s}$, one gets:

(I.5) $$\overline{pr}_{j,s} = 1 - \frac{\left(1-\overline{pr}_{p,s}\right)}{k_s}.$$

Granted that the growth in owners' equity is the same for both companies, the payout ratio of company j can thus be written as a function of the payout ratio of company p $\left(\overline{pr}_{p,s}\right)$ and the ratio between the book return on owners' equity for the two companies (k_s).

Appendix B. On the accuracy of an average *P/E*-ratio for a sample of peer companies

In order to illustrate the virtue of a sample of approximative peer companies, assume that there are four peer companies (p = 1, p = 2, p = 3 and p = 4) which all have the same cost of equity capital (ρ = 10%) as company j. Also, assume that the future growth in owners' equity is the same for all companies, and that any differences with regard to the expected book return on owners' equity gradually diminish over time. Furthermore, all companies have the same expected book return in a future "steady state equilibrium", equal to $E_0(\widetilde{ROE}_{ss}) = 12\%$.

The time series behavior of $E_0(\widetilde{ROE}_{j,\tau})$ and $E_0(\widetilde{ROE}_{p,\tau})$ are assumed to be "well-behaved" in the sense that the ratios $k'_{j,\tau} = \dfrac{E_0\left(\widetilde{ROE}_{j,\tau}\right)}{E_0\left(\widetilde{ROE}_{ss}\right)}$ and $k'_{p,\tau} = \dfrac{E_0\left(\widetilde{ROE}_{p,\tau}\right)}{E_0\left(\widetilde{ROE}_{ss}\right)}$ monotonically approach a value of 1,00 over time. Specifically, it is assumed that $(k'_{j,\tau}-1)/(k'_{j,1}-1) = \omega_{\mathrm{j}}^{\tau\text{-}1}$ and $(k'_{p,\tau}-1)/(\mathrm{k}'_{\mathrm{p},1}-1) = \omega_{\mathrm{p}}^{\tau\text{-}1}$, where $\omega_j = \omega_{\mathrm{p}} = 0{,}5$. In the "steady state equilibrium" all companies have a dividend payout ratio $\overline{pr}_{ss} = 0{,}5$ (and hence an expected constant annual growth in owners' equity of $g_{ss} = g$ = 12%(1–0,5) = 6%).

The expected book return on owners' equity for τ=1 and $k'_{p,1}$ for the peer companies are as follows:

Company	$E^{(0)}(\widetilde{ROE}_{p,1})$	$k'_{p,1}$
p = 1	10%	0,8333
p = 2	6%	0,5000
p = 3	24%	2,0000
p = 4	16%	1,3333

In order for an average of the characteristics of the peer companies be representative for the company being valued, $E_0(R\tilde{O}E_{j,1})$ is set to be equal $(10\% + 6\% + 24\% + 16\%)/4 = 14\%$. Hence, $k'_{j,1} = 14\%/12\% = 1{,}1667$, equal to the average of $k'_{p,1}$ for the peer companies ((0,8333 + 0,5000 + 2,0000 + 1,3333)/4).

In assessing the *P/E*-ratios of the peer companies, it is helpful to first calculate the *P/E*-ratio for the "steady state equilibrium", $[P/E]^*_{ss,0}$. With reference to expression (8) in the main text, this is:

$$\text{(II.6)} \quad [P/E]^*_{ss,0} = \frac{\sum_{\tau=1}^{\infty} \overline{G}_{ss,\tau-1} \cdot E_0\left(R\tilde{O}E_{ss,\tau}\right) \cdot \overline{pr}_{ss,\tau} \cdot (1+\rho)^{-\tau}}{E_0\left(R\tilde{O}E_{ss,1}\right)} =$$

$$= \frac{\sum_{\tau=1}^{\infty} (1+g)^{\tau-1} \cdot E_0\left(R\tilde{O}E_{ss}\right) \cdot \overline{pr}_{ss} (1+\rho)^{-\tau}}{E_0\left(R\tilde{O}E_{ss}\right)} =$$

$$= \frac{\overline{pr}_{ss}}{\rho - g} = \frac{0{,}5}{0{,}10 - 0{,}06} = 12{,}5\ .$$

Following the derivation of (13) and (C.2) in the main text, the *P/E*-ratio of each peer company in relation to $[P/E]^*_{ss,0}$ can be expressed as in (II.7).

$$\text{(II.7)} \quad \frac{(P/E)_{p,0}}{[P/E]^*_{ss,0}} = \frac{1}{k'_{p,1}} \left[1 + \frac{\sum_{\tau=1}^{\infty} (1+g)^{\tau-1} \cdot \left(k'_{p,\tau} - 1\right) \cdot E_0\left(R\tilde{O}E_{ss}\right) \cdot (1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty} (1+g)^{\tau-1} \cdot E_0\left(R\tilde{O}E_{ss}\right) \cdot \overline{pr}_{ss} \cdot (1+\rho)^{-\tau}} \right] =$$

$$= \frac{k'_{p,1} - 1}{k'_{p,1}} \left[\frac{1}{k'_{p,1} - 1} + \frac{\sum_{\tau=1}^{\infty} (1+g)^{\tau-1} \cdot \frac{(k'_{p,\tau} - 1)}{(k'_{p,1} - 1)} \cdot (1+\rho)^{-\tau}}{\sum_{\tau=1}^{\infty} (1+g)^{\tau-1} \cdot \overline{pr}_{ss} \cdot (1+\rho)^{-\tau}} \right] = \frac{k'_{p,1} - 1}{k'_{p,1}} \left[\frac{1}{k'_{p,1} - 1} + \frac{\rho - g}{\overline{pr}_{ss}\left[(1+\rho) - (1+g)\omega_p\right]} \right].$$

With numerical values for the peer companies as given above, *P/E*-ratios for these companies can now be calculated:

Company	$(P/E)_{p,0} / [P/E]^*_{ss,0}$	$(P/E)_{p,0}$
$p = 1$	1,1719	14,65
$p = 2$	1,8596	23,25
$p = 3$	0,5702	7,13
$p = 4$	0,7851	9,81

The average *P/E*-ratio for the peer companies is (14,65 + 23,25 + 7,13 + 9,81)/4 = 13,71. The question is then whether this value would work for company *j*.

The correct *P/E*-ratio for company *j*, $[P/E]^*_{j,0}$, is calculated in the same manner as the values of $(P/E)_{p,0}$ above:

$$\text{(II.8)} \quad \frac{[P/E]^*_{j,0}}{[P/E]^*_{ss,0}} = \frac{k'_{j,1} - 1}{k'_{j,1}} \left[\frac{1}{k'_{j,1} - 1} + \frac{\rho - g}{\overline{pr}_{ss}\left[(1+\rho) - (1+g)\omega_j\right]} \right] = \frac{0{,}1667}{1{,}1667} \left[\frac{1}{0{,}1667} + \frac{0{,}04}{0{,}5(1{,}1 - 1{,}06 \cdot 0{,}5)} \right] = 0{,}8770.$$

Hence $[P/E]^*_{j,0}$ = 0,8770·12,5 = 10,96 – a value which clearly differs from the average of the *P/E*-ratios for the peer companies. In fact, $(P/E)_{p,0}$ for p = 4 is closer to $[P/E]^*_{j,0}$ than this average. This indicates that it can be more worthwhile to find one "very similar" peer company than to calculate an average *P/E*-ratio for a sample of miscellaneous companies (even when the average characteristics of these companies coincide with the characteristics of the company being valued).