Contents

Book Review

German Edition

Sandra Peterson/Richard C. Stapleton*

THE PRICING OF OPTIONS ON CREDIT-SENSITIVE BONDS

ABSTRACT

We build a three-factor term-structure of interest rates model and use it to price corporate bonds. The first two factors allow the risk-free term structure to shift and tilt. The third factor generates a stochastic credit-risk premium. To implement the model, we apply the *Peterson* and *Stapleton* (2002) diffusion approximation methodology. The method approximates a correlated and lagged-dependent lognormal diffusion processes. We then price options on credit-sensitive bonds. The recombining log-binomial tree methodology allows the rapid computation of bond and option prices for binomial trees with up to forty periods.

JEL-Classification: G12, G13.

Keywords: Credit Risk; Bonds; Options.

1 INTRODUCTION

The pricing of credit-sensitive bonds, that is, bonds which have a significant probability of default, is an issue of increasing academic and practical importance. The recent practice in financial markets has been to issue high yield corporate bonds that are a hybrid of equity and risk-free debt. Also, to an extent, most corporate bonds are credit-sensitive instruments, simply because of the limited liability of the issuing enterprise. In this paper, we suggest and implement a model for the pricing of options on credit-sensitive bonds. For example, the model can be used to price call provisions on bonds, options to issue bonds, and yield-spread options. From a modelling point of view, the problem is interesting because it involves at least three stochastic variables: at least two factors are required to capture shifts and tilts in the risk-free short-term interest rate. The third factor is the credit spread, or default premium. In this paper we model the risk-free term structure using the *Peterson*, *Stapleton* and *Subrahmanyam* (2002) [PSS] two-factor extension of the *Black* and *Karasinski* (1991) spot-rate model and add a correlated credit spread. To price the Bermudan- and Europeanstyle options efficiently, we need an approximation for the underlying diffusion processes for the risk-free rate, the term premium, and the credit spread. Here, we use the recombining binomial tree approach of *Nelson* and *Ramaswamy* (1990), extended to multiple variable diffusion processes by *Ho*, *Stapleton* and *Subrahmanyam* (1995) [HSS] and *Peterson* and *Stapleton* (2002).

* Dr. *Sandra Peterson*, Scottish Institute for Research in Investment and Finance, Strathclyde University, Glasgow, UK. Tel: (44)141-548-4958, e-mail: s.peterson@telinco.co.uk, Professor *Richard C. Stapleton*, Department of Accounting and Finance, Strathclyde University, Glasgow, UK and University of Melbourne, Australia. Tel: (44)1524-381172, Fax: (44)524-846 874, e-mail: dj@staplet.demon.co.uk.

There are two principal approaches to the modelling of credit-sensitive bond prices. *Merton* (1977)'s structural approach, recently re-examined by *Longstaff* and *Schwartz* (1995), prices corporate bonds as options, given the underlying stochastic process assumed for the value of the firm. On the other hand, the reduced form approach, used in recent work by *Duffie* and *Singleton* (1999) and *Jarrow, Lando* and *Turnbull* (1997), among others, assumes a stochastic process for the default event and an exogenous recovery rate. Our model is a reduced-form model that specifies the credit spread as an exogenous variable. Our approach follows the *Duffie* and *Singleton* "recovery of market value" (RMV) assumption. As *Duffie* and *Singleton* show, the assumption of a constant recovery rate on default, proportional to market value, justifies a constant period-by-period "risk-adjusted" discount rate. In our model, if there is no credit-spread volatility, we have the *Duffie* and *Singleton* RMV assumption as a special case.

A somewhat similar extension of the *Duffie* and *Singleton* approach to a stochastic credit spread has been suggested in *Das* and *Sundaram* (1999). They combine the credit-spread factor with a *Heath*, *Jarrow* and *Morton* (1992) type of forward-rate model for the dynamics of the risk-free rate. From a theoretical point of view, this approach is satisfactory, but it is difficult to implement for practical problems with multiple time intervals. *Das* and *Sundaram* only implement their model for an illustrative case of four time periods. In contrast, by using a recombining two-dimensional binomial lattice, we are able to efficiently compute bond and option prices for as many as forty time periods.

A possibly important influence on the price of credit-sensitive bonds is the correlation of the credit spread and the interest-rate process. To efficiently capture this dependence in a multiperiod model, we need to approximate a bivariate-diffusion process. Here, we assume that the interest rate and the credit spread are bivariate-lognormally distributed. In the binomial approximation, we use a modification and correction of the *Ho-Stapleton-Subrahmanyam* method, as suggested by *Peterson* and *Stapleton* (2002). The model provides a basis for more complex and realistic models, where yields on bonds could depend upon two interest rate factors plus a credit spread.

2 Rationale of the Model

We model the London Interbank Offer Rate (*LIBOR*), as a lognormal diffusion process under the risk-neutral measure. Then, as in PSS, the second factor generating the term structure is the premium of the futures *LIBOR* over the spot *LIBOR*. The second factor generating the premium is contemporaneously independent of the *LIBOR*. However, to guarantee that the no-arbitrage condition is satisfied, future outcomes of spot *LIBOR* are related to the current futures *LIBOR*. This relationship creates a lag-dependency between spot *LIBOR* and the second factor. In addition, we assume that the one-period credit-adjusted discount rate, appropriate for discounting credit-sensitive bonds, is given by the product of the oneperiod *LIBOR* and a correlated credit factor. We assume that since this credit factor is an adjustment to the short-term *LIBOR*, it is independent of the futures premium. This argument leads to the following set of equations. We let (x_t, y_t, z_t) be a joint stochastic process for three variables representing the logarithm of the spot *LIBOR*, the logarithm of the futures-premium factor, and the logarithm of the credit premium factor. We have:

$$dx_t = \mu(x, y, t)\,dt + \sigma_x(t)\,dW_{1,t} \tag{1}$$

$$dy_t = \mu(y, t)\,dt + \sigma_y(t)\,dW_{2,t} \tag{2}$$

$$dz_t = \mu(z, t)\,dt + \sigma_z(t)\,dW_{3,t} \tag{3}$$

where $E(dW_{1,t}dW_{3,t}) = \rho, E(dW_{1,t}dW_{2,t}) = 0, E(dW_{2,t}dW_{3,t}) = 0.\square$

Here, the drift of the x_t variable, in equation (1), depends on the level of x_t and also on the level of y_t, the futures premium variable. Clearly, if the current futures is above the spot, then we expect the spot to increase. Thus, the mean drift of x_t allows us to reflect both mean reversion of the spot and the dependence of the future spot on the futures rate. The drift of the y_t variable, in equation (2), also depends on the level of y_t, reflecting possible mean reversion in the futures premium factor. We note that equations (1) and (2) are identical to those in the two-factor risk-free bond model of *Peterson*, *Stapleton* and *Subrahmanyam* (2002). The additional equation, equation (3), allows us to model a meanreverting credit-risk factor. Also, the correlation between the innovations $dW_{1,t}$ and $dW_{3,t}$ enables us to reflect the possible correlation of the credit-risk premium and the short rate.

First, we assume, as in HSS, that x_t, y_t and z_t follow mean-reverting *Ornstein-Uhlenbeck* processes:

$$dx_t = \kappa_1(a_1 - x_t)dt + y_{t-1} + \sigma_x(t)dW_{1,t} \tag{4}$$

$$dy_t = \kappa_2(a_2 - y_t)dt + \sigma_y(t)dW_{2,t} \tag{5}$$

$$dz_t = \kappa_3(a_3 - z_t)dt + \sigma_z(t)dW_{3,t} \tag{6}$$

where $E(dW_{1,t}dW_{3,t}) = \rho dt$, $E(dW_{1,t}dW_{2,t}) = 0, E(dW_{2,t}dW_{3,t}) = 0$ and where the variables mean revert at rates κ_j to a_j, for $j = x, y, z$.

As in *Amin* (1995), we rewrite these correlated processes in the orthogonalized form:

$$dx_t = \kappa_1(a_1 - x_t)dt + y_{t-1} + \sigma_x(t)dW_{1,t} \tag{7}$$

$$dy_t = \kappa_2(a_2 - y_t)dt + \sigma_y(t)dW_{2,t} \tag{8}$$

$$dz_t = \kappa_3(a_3 - z_t)dt + p\sigma_z(t)dW_{1,t} + \sqrt{1-\rho^2}\sigma_z(t)dW_{4,t} \tag{9}$$

where $E(dW_{1,t}dW_{4,t}) = 0$. Then, rearranging and substituting for $dW_{1,t}$ in (9), we can write

$$dz_t = \kappa_3(a_3 - z_t)dt - \beta_{x,z}[\kappa_1(a_1 - x_t)]dt) + \beta_{x,z}dx_t + \sqrt{1-\rho^2}\sigma_z(t)dW_{4,t}.$$

In this trivariate system, y_t is an independent variable and x_t and z_t are dependent variables. The discrete form of the system can be written as follows:

$$x_t = \alpha_{x,t} + \beta_{x,t}x_{t-1} + y_{t-1} + \varepsilon_{x,t} \tag{10}$$

$$y_t = \alpha_{y,t} + \beta_{y,t}y_{t-1} + + \varepsilon_{y,t} \tag{11}$$

$$z_t = \alpha_{z,t} + \beta_{z,t}z_{t-1} + \gamma_{z,t}x_{t-1} + \delta_{z,t}x_t + \varepsilon_{z,t} \tag{12}$$

where

$$\alpha_{x,t} = \kappa_1 a_1 h$$

$$\alpha_{y,t} = \kappa_2 a_2 h$$

$$\alpha_{z,t} = [\kappa_3 a_3 - \beta_{x,z}\kappa_1 a_1]h$$

$$\beta_{x,t} = 1 - \kappa_1 h$$

$$\beta_{y,t} = 1 - \kappa_2 h$$

$$\beta_{z,t} = 1 - \kappa_3 h$$

$$\gamma_{z,t} = \beta_{z,z}(-1 + \kappa_1 h)$$

$$\delta_{z,t} = -\beta_{x,z}$$

$$\beta_{x,z} = \frac{\rho\sigma_z(t)}{\sigma_z(t)}.$$

Equations (10) – (12) can be used to approximate the joint process in (4) – (6).

Proposition 1 (Approximation of a Three-Factor Diffusion Process) *Suppose that X_t, Y_t, Z_t follows a joint-lognormal process where the logarithms of X_t, Y_t, and Z_t are given by*

$$x_t = \alpha_{x,y,t} + \beta_{x,t}x_{t-1} + y_{t-1} + \varepsilon_{x,t}$$

$$y_t = \alpha_{y,t} + \beta_{y,t}y_{t-1} + \varepsilon_{y,t}$$

$$z_t = \alpha_{z,t} + \beta_{z,t}z_{t-1} + \gamma_{z,t}x_{t-1} + \delta_{z,t}x_{t-1} + \varepsilon_{z,t}. \tag{13}$$

Let the conditional logarithmic standard deviation of J_t be $\sigma_j(t)$ for $J = (X, Y, Z)$, where $J = u_j^r d_j^{N-r} E(J)$. If J_t is approximated by a log-binomial distribution with binomial density $N = N_{t-1} + n_t$ and if the proportionate up and down movements, u_{j_t} and d_{j_t} are given by

$$d_{j_t} = \frac{2}{1 + \exp(2\sigma_j(t)\sqrt{\tau_t/n_t})}$$

$$u_{j_t} = 2 - d_{j_t}$$

and the conditional probability of an up-move at node r of the lattice is given by

$$q_{j_t} = \frac{E_{t-1}(j_t) - (N_{t-1} - r)\ln(u_{j_t}) - (n_t + r)\ln(d_{j_t})}{n_t[\ln(u_{j_t}) - \ln(d_{j_t})]}$$

then the unconditional mean and volatility of the approximated process approach their true values, i.e., $\hat{E}_0(J_t) \rightarrow E_0(J_t)$ *and* $\hat{\sigma}_{j_t} \rightarrow \sigma_{j_t}$ *as* $n \rightarrow \infty$.

Proof The result follows as a special case of HSS (1995), Theorem 1[1].□

In essence, the binomial approximation methodology of HSS captures both the mean reversion and the correlation of the processes by adjusting the conditional probability of movements up and down in the trees. We choose the conditional probabilities to reflect the conditional mean of the process at a time and node. The proposition establishes that the binomial approximated process converges to the true multivariate lognormal diffusion process.

In contrast to *Nelson* and *Ramaswamy*, the HSS methodology on which our approximation is based relies on the lognormal property of the variables. The linear property of the joint normal (logarithmic) variables enables the conditional mean to be fixed easily, using the conditional probabilities. In contrast, the lattice methods discussed, for example, in *Amin* (1995), fix the mean reversion and correlation of the variables by choosing probabilities on a node-by-node basis. Also, as pointed out in *Peterson* and *Stapleton* (2002), the HSS method fixes the unconditional mean of the variables exactly, whereas the logarithmic mean converges to its true value as $n \rightarrow \infty$. If we apply the *Nelson* and *Ramaswamy* method to the case of lognormally distributed variables, the mean of the variable converges to its true value. However, we note that in all these methods the approximation improves as the number of binomial stages increases. Hence, the choice between the various methods of approximation is essentially one of convenience.

3 The Price of a Credit-Sensitive Bond

Our model is a reduced form model that specifies the credit spread as an exogenous variable and then discounts the bond market value on a period-by-period basis. This approach is consistent with the *Duffie* and *Singleton* recovery of market value (RMV) assumption.

Duffie and *Singleton* show that the assumption of a constant recovery rate on default, proportional to market value, justifies a constant period by period "risk-adjusted" discount rate. In our model, if the credit spread volatility goes to zero, we have the *Duffie* and *Singleton* RMV assumption as a special case. In our stochastic model, we assume that the price of a credit-sensitive, zero-coupon, T-maturity bond at time t is given by the relation:

$$B_{t,T} = E_t(B_{t+1,T})\,\frac{1}{1 + r_t \pi_t h}, \tag{14}$$

1 See *Peterson* and *Stapleton* (2002) for details on the implementation of the binomial approximation.

with the condition, $B_{T,T} = 1$, in the event of no default prior to maturity. In (14), E_t is the expectation operator, where expectations are taken with respect to the risk-neutral measure, r_t is the risk-free, one-period rate of interest defined on a *LIBOR* basis, and $\pi_t > 1$ is the credit spread factor. The time period length, from t to $t+1$, is h. In this model, the value of a risk-free, zero-coupon bond is given by

$$b_{t,T} = E_t(b_{t+1,T}) \frac{1}{1 + r_t h}, \tag{15}$$

where $b_{T,T} = 1$ and, for the risk-free bond, $\pi_t = 1$. Equations (14) and (15) abstract from any consideration of the effects of risk aversion, whether to interest rate risk or default risk. We assume secondly, that the dynamics of the joint process of r_t, π_t are governed by the stochastic differential equations

$$d\ln(r_t) = \kappa_1[a_1 - \ln(r_t)]dt + \ln(\phi_t) + \sigma_r(t)dW_{1,t} \tag{16}$$

$$d\ln(\phi_t) = \kappa_2[a_2 - \ln(\phi_t)]dt + \sigma_\phi(t)dW_{2,t} \tag{17}$$

$$d\ln(\pi_t) = \kappa_3[a_3 - \ln(\pi_t)]dt\, \sigma_\pi(t)dW_{3,t} \tag{18}$$

with $E(dW_{1,t}dW_{2,t}) = \rho$. We note that the system of equations is the same as equations (7) – (9), with the definitions $x_t = \ln(r_t)$, $y_t = \ln(\phi_t)$, and $z_t = \ln(\pi_t)$. Hence, given (16) – (18), the spot *LIBOR*, r_t, and the credit spread, π_t, follow correlated, lognormal diffusion processes. Therefore, the processes can be approximated using the methodology described in Section 3. The stochastic model for the short-term risk-free rate follows the process in the PSS two-factor model. The short rate is lognormal and the logarithm of the rate follows a generalized *Ornstein-Uhlenbeck* process, under the risk-neutral measure. The process is generalized in the sense that the volatility, $\sigma_r(t)$, is time dependent. Hence, if required, the model for the risk-free rate can be calibrated to the prices of interest rate options observed in the market.

Recent research suggests that the credit spread is strongly mean reverting[2]. Also, there is evidence that the credit spread and the short rate are weakly correlated. Finally, although inconclusive, the evidence of *Chan et al.* (1992) suggests that lognormality of the short rate is a somewhat better assumption than the analytically more convenient assumption of the *Vasicek* and *Hull-White* model in which the short rate follows a Gaussian process. Hence, the model represented by equations (14), (16) and (18) has some empirical support.

One of the main problems that arises in constructing the model is calibrating the interest rate process (16) to the existing term structure of interest rates. This calibration is required to guarantee that the no-arbitrage condition is satisfied. In *Black* and *Karasinski* (1991), an iterative procedure is used, so that the prices in equation (15) match the given term structure. Here, we use the more direct approach of PSS, who use the fact that the futures *LIBOR* is the expected value, under the risk-neutral measure, of the future spot *LIBOR*. This result in turn follows from *Sundaresan* (1991) and PSS, Lemma 1. Building the two-factor interest

2 See *Tauren* (1999).

rate model (16) in this manner also guarantees that the no-arbitrage condition holds at each node, and at each future date.

To put the PSS method into effect, we take the discrete form of the short-rate process (16):

$$\ln(r_t) = \ln(r_{t-1}) + \kappa_1 a_1 h - \kappa_1 h \ln(r_{t-1}) + \ln(\phi_{t-1}) + \sigma_r(t)\sqrt{h}\varepsilon_{1,t}. \tag{19}$$

We then transform the process in (19) to have a unit mean by dividing by the futures *LIBOR* $f_{0.t}$. This gives

$$\ln = \left(\frac{r_t}{f_{0,t}}\right) = \alpha_r + (1-\kappa_1 h)\ln\left(\frac{r_{t-1}}{f_{0,t-1}}\right) + \ln(\phi_{t-1}) + \sigma_r(t)\sqrt{h}\varepsilon_{1,t}, \tag{20}$$

with

$$\alpha_r = \kappa_1 a_1 h - \ln(f_{0.t}) + (1-\kappa_1 h)\ln(f_{0.t-1}).$$

The process in (20) has unit mean, since $f_{0,t} = E(r_t)$, where the expectation is under the risk-neutral measure. As shown by *Sundaresan* (1991) and reiterated in PSS lemma 1, the futures *LIBOR* is traded as a price, and hence the *Cox*, *Ingersoll* and *Ross* (1981) expectation result holds for the *LIBOR*. Therefore, we build a model of the risk-free rate using the transformed process (20), and then calibrate the rates to the existing term structure of futures *LIBOR* prices by multiplying by $f_{0.t}$, for all t.

The credit spread, π_t, is also assumed to follow a lognormal process. We assume as given the expected value of π_t, for all t, where $E(\pi_t)$ is the expectation under the risk-neutral measure. In principle, these expectations could be estimated by calibrating the model to the existing term structure of credit-sensitive bond prices. However, we assume that one of the purposes of the model is to price credit-sensitive bonds at $t = 0$. Hence, these expected spreads are taken as exogenous. Taking the discrete form of (18), and transforming the process to a unit mean process, we have

$$\ln = \left(\frac{\pi_t}{E(\pi_t)}\right) = \alpha_\pi + (1-\kappa_2 h)\ln\left(\frac{\pi_{t-1}}{E(\pi_t - 1)}\right) + \sigma_\pi(t)\sqrt{h}\varepsilon_{2,t}, \tag{21}$$

with

$$\alpha_\pi = \kappa_2 a_2 h - \ln[E(\pi_t)] + (1-\kappa_2 h)\ln[E(\pi_{t-1})].$$

Assuming that the credit spread is lognormally distributed has advantages and disadvantages. One advantage is that the one-period credit-sensitive yield in the model $r_t \pi_t$ is also lognormal. This assumption provides consistency between the default-free and credit-sensitive yield distributions. However, we must take care that data input do not lead to π_t values of less than unity. In the implementation of the model, we truncate the distribution of π_t as a lower limit of 1.

4 Illustrative Output of the Model

In this section, we illustrate the model using a three-period example. Three periods are sufficient to show the structure of the model and the risk-free rates, risk-adjusted rates, and bond prices produced. For illustration, we assume a flat term structure of futures rates at $t = 0$. Each futures rate is 2.69%. We assume annual time intervals and flat caplet volatilities of 10% for 1-, 2-, and 3-year caplets. We assume that the spot *LIBOR* mean reverts at a rate of 30%. The PSS model requires an estimate of the futures premium volatility and mean reversion. We assume a volatility of 2% and a mean reversion of 10%. To implement the model, we require estimates of the credit risk premium and its volatility, mean reversion, and correlation with the *LIBOR*. In this example, we assume the current risk premium is 20%, i.e., $\pi_0 = 1.2$, its volatility is 12%, mean reversion 20% and its correlation with the short-term interest rate is $\rho = 0.2$.

To illustrate the output, we restrict the model to have a binomial density of $n = 1$ for each of the three variables. Therefore, the model, with $n = 1$, produces eight possible zero-coupon risky-bond prices at time $t = 1$, 27 prices at time $t = 2$, and in general $(t + 1)^3$ prices at time t. *Table 1* shows the outcome of the three variables in the model. r_t is the risk-free *LIBOR*. R_t is the risk-adjusted short-term rate. y_t is the term premium of the futures rate over the *LIBOR* and π_t is the credit premium. *Table 1* shows how the adapted PSS model recombines in three dimensions to produce a nonexploding tree of risk-adjusted interest rates. We note that there are two, three, and four different risk-free short rates at times 1, 2, and 3, respectively.

Table 1: LIBOR, Term-Premium, Credit-Premium and Risk-Adjusted Yields

row	r_1	π_1	R_1	ϕ_1	r_2	π_2	R_2	ϕ_2	r_3	π_3	R_3
1									0.040	1.534	0.061
2									0.040	1.212	0.048
3									0.040	0.958	0.038
4									0.040	0.757	0.030
5					0.034	1.373	0.046	1.040			
6					0.034	1.085	0.037	1.000	0.030	1.534	0.046
7	0.030	1.229	0.036	1.020	0.034	0.857	0.029	0.960	0.030	1.212	0.036
8	0.030	0.971	0.029	0.980					0.030	0.958	0.029
9					0.027	1.373	0.036	1.040	0.030	0.757	0.023
10					0.027	1.085	0.029	1.000			
11					0.027	0.857	0.023	0.960	0.023	1.534	0.035
12	0.024	1.229	0.030	1.020					0.023	1.212	0.028
13	0.024	0.971	0.024	0.980	0.021	1.373	0.029	1.040	0.023	0.958	0.022
14					0.021	1.085	0.023	1.000	0.023	0.757	0.017
15					0.021	0.857	0.018	0.960			
16									0.017	1.534	0.027
17									0.017	1.212	0.021
18									0.017	0.958	0.017
19									0.017	0.757	0.013

This table shows the outcome of the three primary variables: *LIBOR* (r_t), the credit spread factor (π_t), and the futures-premium factor (ϕ_t). In addition, the table shows the risk-adjusted one-period yield (R_t). There are $t + 1$ outcomes of each variable after t periods in the multidimensional recombining tree.

However, there are four, nine, and 16 different risk-adjusted rates at those dates. *Table 3* shows the bond price process for a four-period model, with the binomial density t = 1. *Table 2* shows the process for the risk-free bond price. Here, there are $(t+1)^2$ prices at time *t*.

Table 2: The Price Process for a 4-Year Risk-Free Bond

row	$b_{0,4}$	$b_{1,4}$	$b_{1,4}$	$b_{2,4}$	$b_{2,4}$	$b_{2,4}$	$b_{3,4}$
1							0.9615
2				0.9383	0.9383	0.9349	
3		0.9190	0.9208				0.9705
4	0.8988			0.9518	0.9518	0.9518	
5		0.9307	0.9327				0.9774
6				0.9591	0.9625	0.9625	
7							0.9828

The first column shows the price of the zero-coupon, risk-free bond at $t = 0$. The second and third columns show the price of the bond at $t = 1$, where the futures premium factors are high and low, respectively. Rows 2 and 3 show the bond prices when the *LIBOR* is high. Columns 4–6 show the bond prices at $t = 2$, when the futures premium factors are high, medium, and low, respectively. Row 1 shows the bond price at $t = 3$ when *LIBOR* is in the top state. Row 7 shows it in the bottom state.

Table 3: The Price Process for a 4-Year Risky Bond

row	$B_{0,4}$	$B_{1,4}$	$B_{1,4}$	$B_{2,4}$	$B_{2,4}$	$B_{2,4}$	$B_{3,4}$
1							0.9421
2							0.9537
3							0.9630
4							0.9706
5				0.9147	0.9166	0.9185	
6				0.9302	0.9318	0.9334	0.9554
7				0.9429	0.9443	0.9456	0.9644
8		0.8994	0.9032				0.9717
9		0.9159	0.9192	0.9298	0.9313	0.9327	0.9775
10	0.8885			0.9426	0.9438	0.9451	
11		0.9124	0.9156	0.9531	0.9542	0.9552	0.9658
12		0.9268	0.9296				0.9728
13				0.9431	0.9438	0.9449	0.9784
14				0.9536	0.9541	0.9550	0.9828
15				0.9621	0.9626	0.9634	
16							0.9738
17							0.9792
18							0.9835
19							0.9869

The first column shows the price of the zero-coupon, credit-risky bond at $t = 0$. The second and third columns show the price of the bond at $t = 1$, where the futures premium factors are high and low, respectively. Rows 8 and 9 show the bond prices when the *LIBOR* is high, and the credit premiums are high and low, respectively. Columns 4–6 show the bond prices at $t = 2$, when the futures premium factors are high, medium, and low, respectively. Rows 5–7 show the bond prices when the *LIBOR* is high and the credit premium factors are high, medium, and low, respectively. Rows 1–4 show the bond price at $t = 3$ when *LIBOR* is in the top state and the credit premium is at different levels.

5 Numerical Results: Bermudan Swaptions and Options on Coupon Bonds

To price options on defaultable bonds, we calibrate the model to the futures strip and the cap volatility curve on the 18th of July 2000, when the spot three-month *LIBOR* was approximately 7%. This calibration exercise gives a volatility of three-month *LIBOR* of 9.9% and a volatility of the first futures premium of 9.2%. The mean reversion of these variables is 170% per annum and 13% per annum, respectively. The multiperiod model is simulated in three-month intervals to reflect the innovations in the three-month *LIBOR* futures curve. PSS use data for the 18th of July 2000 for swaption calibration of their two- and three-factor interest rate models. (We refer the reader to that paper for details of the futures strip, cap volatility curve, and swaption prices on this date.) Both the expectations of the futures premium and the credit risk premium curve are equal to their current levels.

Table 4 shows European and Bermudan swaption prices for differing levels of moneyness and different levels of the credit-risk premium. The at-the-money level is assumed to be at a 7.5% strike. We price different swaptions using binomial densities of $n = 1$ and $n = 2$ and then use *Richardson* extrapolation to find the asymptotic price (denoted r/e in the tables). We assume that the volatility and mean reversion of the risk premium is 10% per annum and 20% per annum, respectively. The correlation between the short rate and the credit risk premium is 20%. Columns 4–8 show the prices of one-year options on one, two, three, four, and five year swaps, respectively. Column 9 shows the price of a Bermudan swaption that is exercisable annually for five years on a six-year underlying bond.

Tables 5 and *6* demonstrate the effect of varying the level and mean reversion of the credit-risk premium compared to the model prices reported in *Table 4*. *Table 5* shows the same calibrated model, but with a higher mean reversion of credit-risk premium of 50%. *Table 6* shows the calibrated model with higher volatility (20%) and mean reversion of 50%. All prices shown are in basis points.

Table 4 demonstrates that the spread between the price difference of a 1/5 year payer swaption and its Bermudan counterpart reduces as the level of the credit-risk premium increases. Out-of-the-money spreads are reduced from 100% to 9%, whereas in-the-money spreads reduce from 6% to under 1%. *Table 5* shows the effect of increasing the mean reversion over the model in *Table 4*. The spread between the Bermudan swaption and the one-year option on the five-year swap decreases for out-of-the-money, in-the-money, and at-the-money swaptions. The at-the-money swaptions have a 27% spread for a credit premium level of 1.1, whereas *Table 4* shows a 30% spread for the same credit premium level. Other levels show a similiar decrease. *Table 6* shows the effect of increasing the volatility of the credit premium. As expected, the spread between the European- and Bermudan-style options widens. However, in some cases the raw prices are reduced. For example, *Table 6* shows an out-of-the-money 1/5 swaption r/e price of 560 basis points, and its corresponding Bermudan of 605 basis points. *Table 5* shows 582 and 617 basis points, respectively. This phenonemum is perhaps due to extrapolation error. In both the cases of a binomial density 2 and 3, the *Table 6*

Table 4: Swaptions: Low risk premium volatility and low mean reversion

strike	Premium Level	n	1/1	1/2	1/3	1/4	1/5	Bermudan
6.5%	1.1	2	135	261	378	487	589	626
		3	134	258	372	479	579	615
		r/e	132	255	366	470	569	604
	1.2	2	192	369	531	682	823	842
		3	191	365	525	675	814	832
		r/e	190	362	520	667	806	822
	1.4	2	310	588	839	1070	1282	1284
		3	308	584	834	1063	1273	1275
		r/e	306	580	829	1056	1264	1266
7.5%	1.1	2	70	139	200	256	306	382
		3	69	135	193	245	292	372
		r/e	67	130	186	234	278	361
	1.2	2	116	226	325	415	499	554
		3	115	222	318	405	486	542
		r/e	114	217	310	396	473	531
	1.4	2	226	429	613	781	935	953
		3	224	426	607	773	926	943
		r/e	223	422	601	765	916	933
8.5%	1.1	2	30	61	88	111	129	225
		3	28	58	82	102	117	217
		r/e	27	55	76	92	105	209
	1.2	2	60	119	172	217	256	346
		3	58	115	164	206	242	336
		r/e	57	111	156	194	227	325
	1.4	2	150	286	408	518	618	669
		3	148	282	401	508	605	657
		r/e	145	278	394	498	592	644

The table shows swaption prices for in-the-money (6.5%), at-the-money (7.5%), and out-of-the-money (8.5%) swaptions. Column 1 shows the strike rate of the swaption. Column 2 shows the spot level of the risk premium. The asymptotic price (r/e) is extrapolated from binomial densities, $n = 1$ and $n = 2$ using *Richardson* extrapolation. The model is calibrated to the futures strip and the cap volatility curve on 18 July 2000. From this calibration, we have the volatility of the three-month *LIBOR* of 9.9% and the volatility of the first futures premium of 9.2%, with mean reversions of 170% and 13%, respectively. The correlation between the short rate and the credit-risk premium is assumed to be 20%. The expected credit-risk premium curve is flat and equal to its spot. The volatility and mean reversion of the risk premiums are 10% per annum and 20%, respectively. Columns 4–8 show the one year option on one-, two-, three-, four-, and five-year swaps, respectively. Column 9 shows the price of a Bermudan swaption that is exercisable annually for five years on a six-year underlying swap. All prices are in basis points.

Table 5: Swaptions: Low risk premium volatility and high mean reversion

strike	Premium Level	n	1/1	1/2	1/3	1/4	1/5	Bermudan
6.5%	1.1	2	131	253	367	474	575	605
		3	133	256	370	477	579	611
		r/e	134	259	373	481	582	617
	1.2	2	190	363	523	673	814	827
		3	191	365	525	676	817	832
		r/e	192	367	528	679	821	836
	1.4	2	309	587	839	1071	1284	1285
		3	308	585	836	1066	1279	1280
		r/e	307	582	832	1062	1274	1275
7.5%	1.1	2	65	127	184	236	283	355
		3	67	131	188	239	286	362
		r/e	69	134	191	243	290	369
	1.2	2	112	215	310	398	480	529
		3	113	219	314	402	484	535
		r/e	115	222	318	406	488	542
	1.4	2	225	427	611	779	935	949
		3	224	425	607	775	930	944
		r/e	223	423	604	771	925	938
8.5%	1.1	2	24	51	73	92	107	199
		3	26	54	76	95	109	206
		r/e	28	57	80	97	112	212
	1.2	2	54	107	154	194	230	317
		3	56	111	158	199	234	324
		r/e	58	114	162	203	238	332
	1.4	2	148	282	402	512	612	657
		3	146	279	398	506	605	651
		r/e	145	277	394	500	597	645

The table shows swaption prices for in-the-money (6.5%), at-the-money (7.5%), and out-of-the-money (8.5%) swaptions. Column 1 shows the strike rate of the swaption. Column 2 shows the spot level of the risk premium. The asymptotic price (r/e) is extrapolated from binomial densities, $n = 1$ and $n = 2$ using *Richardson* extrapolation. The model is calibrated to the futures strip and the cap volatility curve on 18 July 2000. From this calibration, we have the volatility of three-month *LIBOR* of 9.9% and the volatility of the first futures premium of 9.2%, with mean reversion of 170% and 13%, respectively. The correlation between the short rate and the credit-risk premium is assumed to be 20%. The expected credit-risk premium curve is flat and equal to its spot. The volatility and mean reversion of the risk premium are 10% per annum and 50%, respectively. Columns 4–8 show the one-year option on one-, two-, three-, four-, and five-year swaps, respectively. Column 9 shows the price of a Bermudan swaption that is exercisable annually for five years on a six-year underlying swap. All prices are in basis points.

Table 6: Swaptions: High risk premium volatility and high mean reversion

strike	Premium Level	n	1/1	1/2	1/3	1/4	1/5	Bermudan
6.5%	1.1	2	141	267	382	488	588	635
		3	137	260	372	476	574	620
		r/e	134	253	362	464	560	605
	1.2	2	191	363	520	667	805	827
		3	192	365	523	670	808	832
		r/e	194	367	526	673	812	838
	1.4	2	310	587	837	1066	1277	1282
		3	307	581	829	1056	1265	1269
		r/e	304	575	820	1046	1253	1256
7.5%	1.1	2	79	148	208	261	308	396
		3	76	141	196	245	290	381
		r/e	73	134	185	230	271	366
	1.2	2	119	222	315	399	478	542
		3	120	226	319	403	482	549
		r/e	122	229	323	408	485	556
	1.4	2	229	432	613	779	931	957
		3	225	425	603	767	918	942
		r/e	222	417	594	755	905	927
8.5%	1.1	2	39	72	97	117	133	239
		3	36	65	87	104	117	227
		r/e	34	59	77	91	101	214
	1.2	2	65	119	164	203	236	338
		3	67	122	168	207	240	346
		r/e	69	126	172	211	244	353
	1.4	2	157	293	412	520	616	680
		3	153	285	401	504	599	663
		r/e	149	277	389	489	582	645

The table shows swaption prices for in-the-money (6.5%), at-the-money (7.5%), and out-of-the-money (8.5%) swaptions. Column 1 shows the strike rate of the swaption. Column 2 shows the spot level of the risk premium. The asymptotic price (r/e) is extrapolated from binomial densities, $n = 1$ and $n = 2$ using *Richardson* extrapolation. The model is calibrated to the futures strip and the cap volatility curve on 18 July 2000. From this calibration, we have the volatility of three-month *LIBOR* of 9.9% and the volatility of the first futures premium of 9.2%, with mean reversion of 170% and 13%, respectively. The correlation between the short rate and the credit-risk premium is assumed to be 20%. The expected credit-risk premium curve is flat and equal to its spot. The volatility and mean reversion of the risk premium are 20% per annum and 50%, respectively. Columns 4–8 show the one year option on one-, two-, three-, four-, and five-year swaps, respectively. Column 9 shows the price of a Bermudan swaption that is exercisable annually for five years on a six-year underlying swap. All prices are in basis points.

swaption prices are higher than the corresponding *Table 5* prices, i.e., 635 and 620 versus 605 and 611[3].

Tables 7 shows both European and Bermudan-style options on coupon bonds for differing levels of coupon-rate moneyness and credit-risk premium. *Table 8* prices the same options, but with a volatile credit-risk premium, with volatility of 10%, and mean reversion at 20% per annum. Both the models are calibrated to the same futures and caps as in the previous example. The correlation between the short rate and the credit-risk premium is 20%. The models are simulated for 12 periods, with resets at three-month intervals. The European coupon-bond option is exercisable at year one on a four-year underlying bond. The Bermudan coupon-bond option is exercisable yearly for three years on a four-year coupon bond. The strike price of a unit bond is $1. All prices shown are in basis points.

Table 7: European and Bermudan Options on Coupon Bonds: Risk-Free Credit Premium

Coupon Rate	n	Premium		Level			
		1.1		1.2		1.4	
		1/3	Bermudan	1/3	Bermudan	1/3	Bermudan
7%	2	23	47	6	24	0	6
	3	26	51	8	27	0	7
	r/e	29	54	10	29	0	9
8%	2	101	129	44	72	4	22
	3	103	133	46	76	6	24
	r/e	106	136	48	80	8	27
9%	2	248	268	138	167	30	59
	3	249	271	141	171	34	63
	r/e	250	274	144	175	38	67

The table shows prices for options on coupon bonds, for the coupon strike rates of 7%, 8%, and 9%. The asymptotic price (r/e) is extrapolated from binomial densities $n = 1$ and $n = 2$. The model is calibrated to the futures strip and the cap volatility curve on 18 July 2000. The volatility of three-month *LIBOR* of 9.9% and the volatility of the first futures premium of 9.2%, with mean reversion of 170% and 13% respectively. The correlation between the short rate and the credit-risk premium is 20%. The futures credit-risk premium curve is flat and equal to its spot. There is no volatility or mean reversion of the risk premium. The strike rate for a unit bond is $1. All prices shown are in basis points. Columns 3, 5, and 7 show the one-year option on a four-year underlying bond for initial credit-risk premium levels of 1.1, 1.2, and 1.4, respectively. Columns 4, 5, and 7 show the price of a Bermudan-style swaption that is exercisable annually for three years on the same four-year underlying bond.

Tables 7 and *8* show the effect of adding risk to the credit premium on European- and Bermudan-style options on coupon bonds. When the option is struck at-the-money, the effect on the price can be to produce an increase of as much as 44%. For example, when the credit premium level is at 1.4, the price of a Bermudan-style option increases from nine to 13 basis points. When the credit premium

3 To correct such an extrapolation error, we could similate prices with the binomial density 4 or 5 and continue the extrapolation from these figures.

Table 8: European- and Bermudan-Options on Coupon Bonds: Risky Credit Premium

Coupon Rate	*n*	Premium		Level			
		1.1		1.2		1.4	
		1/3	Bermudan	1/3	Bermudan	1/3	Bermudan
7%	2	32	60	11	33	1	10
	3	34	63	12	35	1	11
	r/e	35	66	14	38	1	13
8%	2	115	146	56	87	9	31
	3	117	150	57	91	10	33
	r/e	119	153	59	95	11	36
9%	2	262	286	155	186	41	74
	3	263	289	157	190	43	78
	r/e	265	291	159	194	45	82

The table shows prices for options on coupon bonds, for the coupon strike rates of 7%, 8%, and 9%. The asymptotic price (r/e) is extrapolated from binomial densities $n = 1$ and $n = 2$. The model is calibrated to the futures strip and the cap volatility curve on 18 July 2000. The volatility of three-month *LIBOR* is 9.9% and the volatility of the first futures premium is 9.2%, with mean reversion of 170% and 13%, respectively. The correlation between the short rate and the credit-risk premium is 20%. The expected credit-risk premium curve is flat and equal to its spot. The volatility and mean reversion of the risk premium is 20% per annum and 50%, respectively. The strike rate of a unit bond is $1. All prices shown are in basis points. Columns 3, 5, and 7 show the one-year option on a four-year underlying bond for initial credit-risk premium levels of 1.1, 1.2 and 1.4 respectively. Columns 4, 5, and 7 show the price of a Bermudan-style swaption which is exercisable annually for three years on the same four-year underlying bond.

is lower at 1.1, the prices of the options struck deep in-the-money, increase by a much lesser amount. For example, the European-style l-year option on the underlying four-year bond is priced at 250 basis points, and when risk is added to the premium, then the bond option is priced at 265 basis points, an increase of only 6%.

6 Conclusions

We have proposed and implemented a three-factor model for the pricing of options on credit-sensitive bonds. The first two factors represent movements in the risk-free interest rate, as in the two-factor version of the multifactor model of *Peterson*, *Stapleton* and *Subrahmanyam* (2002). The third factor is a credit spread factor that is correlated with the short-term interest rate. The model of the bond price process produces $(t + 1)^3$ risky bond prices after *t* periods. The computational efficiency of the model is achieved by using the recombining methodology outlined in *Peterson* and *Stapleton* (2002). This methodology allows us to capture the covariance of the credit spread and the *LIBOR*, as well as the two-factor risk-free rate process. European- and Bermudan-style options on bonds and on defaultable swaps are priced using the three-factor process. The results illustrate the sensitivity of these instruments to the level and volatility of the credit-risk premium.

Although we have been able to price options on defaultable coupon bonds for realistic cases, the three-factor model is obviously more computationally expensive than a two-factor model with a risk-free rate and a credit spread. The question arises as to whether the computational effort is worthwhile. The issue comes down to how volatile is the futures premium factor, and how long is the maturity of the coupon bonds. Evidence from PSS suggests that the volatility of the futures premium factor is high and has a significant effect on the pricing of swaptions. A similar conclusion is likely to hold for defaultable coupon-bond options. It follows that the three-factor model analysed in this article is a significant improvement on any simpler two-factor implementation.

References

Amin, Kaushik I. (1991), On the computation of continuous time option prices using discrete approximations, in: Journal of Financial and Quantitative Analysis, Vol. 26, pp. 447–495.

Amin, Kaushik I. (1995), Option Pricing Trees, in: Journal of Derivatives, Summer edition, pp. 34–46.

Amin, Kaushik I./Bodrutha, James N. (1995), Discrete-Time American Option Valuation with Stochastic Interest Rates, in: Review of Financial Studies, Vol. 8, pp. 193–234.

Black, Fischer/Karasinski, Piotr (1991), Bond and Option Pricing when Short Rates are Lognormal, in: Financial Analysts Journal, Vol. 47, pp. 52–59.

Chan, Kalok C./Karolyi, Andrew G./Longstaff, Francis A./Sanders, Anthony B. (1992), An Empirical Comparison of Alternative Models of the Short Term Interest Rate, in: Journal of Finance, Vol. 47, pp. 1209–1227.

Chung, San-Lin (1998), Generalised Geske-Johnson Technique for the Valuation of American Options with Stochastic Interest Rates, Ph.D. Thesis, Lancaster University.

Cox, John C./Ingersoll, Jonathan E./Ross, Stephen A. (1981), The Relationship between Forward Prices and Futures Prices, in: Journal of Financial Economics, Vol. 9, pp. 321–346.

Das, Sanjiv/Sundaram, Rangarajan (1999), A Discrete Time Approach to Arbitrage-Free Pricing of Credit Derivatives, working paper, NYU.

Duffie, Darrell/Singleton, Kenneth J. (1999), Modeling Term Structures of Defaultable Bonds, in: Review of Financial Studies, Vol. 12, pp. 687–720.

Hilliard, Jimmy E./Schwartz, Adam (1996), Binomial Option Pricing Under Stochastic Volatility and Correlated State Variables, in: Journal of Derivatives, Fall, pp. 55–75.

Ho, T. S./Stapleton, Richard C./Subrahmanyam, Marti G. (1995), Multivariate Binomial Approximations for Asset Prices with Non-Stationary Variance and Covariance Characteristics, in: Review of Financial Studies, Vol. 8, pp. 1125–1152.

Jarrow, Robert A./Lando, David/Turnbull, Stuart M. (1997), A Markov Model for the Term Structure of Credit Spreads, in: Review of Financial Studies, Vol. 10, pp. 481–523.

Longstaff, Francis/Schwartz, Eduardo (1995), A Simple Approach to Valuing Risky Fixed and Floating Rate Debt, in: Journal of Finance, Vol. 50, pp. 789–820.

Merton, Robert C. (1977), On the Pricing of Contingent Claims and the Modigliani-Miller Theorem, in: Journal of Financial Economics, Vol. 5, pp. 241–249.

Nelson, Daniel B./Ramaswamy, Krishna (1990), Simple Binomial Processes as Diffusion Approximations in Financial Models, in: Review of Financial Studies, Vol. 3, pp. 393–430.

Peterson, Sandra (1999), The Application of Binomial Trees to Calculate Complex Option Prices, Two-factor Stochastic Interest Rate Option Prices and Value-at-Risk, Ph.D Thesis, Lancaster University.

Peterson, Sandra/Stapleton, Richard C./Subrahmanyam Marti G. (2002), The Valuation of Bermudan-Style Swaptions in a Multi-Factor Spot-Rate Model, forthcoming, in: Journal of Financial and Quantitative Analysis.

Peterson, Sandra/Stapleton, Richard C. (2002), The Valuation of Bermudan-Style Options on Correlated Assets, in: Review of Derivatives Research, Vol. 5, pp. 127–151.

Sundaresan, Suresh M. (1991), Futures Prices on Yields, Forward Prices, and Implied Forward Prices from Term Structure, in: Journal of Financial and Quantitative Analysis, Vol. 26, pp. 409–424.

Tauren, Miikka (1999), A Comparison of Bond Pricing Models in the Pricing of Credit Risk, presented at European Financial Association conference, Helsinki.

Volker Herrmann/Frank Richter*

PRICING WITH PERFORMANCE-CONTROLLED MULTIPLES**

ABSTRACT

We test an approach for estimating the potential price of as yet untraded equity investments. The innovative aspect of our approach is that we use specific control factors, which we identify on the basis of a simplified valuation model. We investigate the accuracy of our approach by using a multi-year sample of American and European firms. The empirical results suggest that a selection of comparable assets based on control factors is superior to a selection based on SIC industry codes. Our study also offers some guidance on the reliability of different bases of reference and on diverse methods of estimating multiples from comparable sets.

JEL-Classification: G32, G12.

Keywords: Asset Pricing, Multiples, Discounted Cash-Flow, Key Performance Indicators.

1 INTRODUCTION

Despite the importance and widespread practical use of comparable methods for valuation/pricing purposes such as initial public offerings and corporate merger and acquisition transactions, the empirical properties of multiples remain largely unexplored. Only recently have a few studies emerged. These studies focus mainly on one of the three major implementation challenges to the methods of multiples, the selection method of comparable companies, the definition of a suitable basis of reference (such as earnings, sales, etc.), and the appropriate statistical estimation of relevant multiples from comparable samples.

One of the first investigations of this topic is offered by *Alford*[1], who tests different methods of selecting comparable firms based on SIC codes and different proxies for growth and risk. On the basis of nonparametrical statistical tests, he concludes that selecting comparable firms on the basis of 3-digit SIC codes is relatively efficient and that adding controls for firm size, return on equity, and expected earnings growth rates does not reduce prediction errors significantly.

* *Volker Herrmann* and *Frank Richter*, Institute for Mergers & Acquisitions; University Witten/Herdecke; e-mail: volker_herrmann@mckinsey.com; frank.richter@gs.com.

** We would like to thank two referees and the editor for their helpful and constructive comments. We would also like to thank the McKinsey Corporate Finance Knowledge Center for the assistance in the creation of the database used in this paper.

1 *Alford* (1992), pp. 94–108.

Boatsman/Baskin (1981) also address this issue but do not conduct formal tests of differences in valuation accuracy between different methods.

Kaplan and *Ruback* compare the accuracy of EBITDA-multiples relative to results based on a discounted cash-flow model ("DCF") in the context of market prices realized in leveraged transactions[2]. Their findings suggest that both the DCF and the comparable company approach add relevant information to the price forecast. However, DCF appears to produce slightly better results. As far as the accuracy of different multiple methods is concerned, a selection of comparable transactions in the same industry seems to yield better results than a similar public company approach. However, *Kaplan/Ruback* do not test the suitability of bases of reference other than EBITDA or further variations of the selection criteria for comparable companies beyond industry classification[3].

Kim and *Ritter* focus on the empirical pricing accuracy of multiples in initial public offerings ("IPO")[4]. For these companies, the performance of market multiples appears to be disappointing, which might be due to the high dispersion of multiples in the underlying sample of young firms as well as to the cyclical character of the IPO market in general.

Baker and *Ruback* concentrate on a largely unexplored implementation challenge, the statistical procedure of reducing the set of multiples of comparable firms to one relevant measure that can be applied to the target firm. Most empirical studies consider the median multiple as the best measure for eliminating possible outliers and at the same time accounting for the underlying skewness and kurtosis of the distribution[5]. The authors challenge this view by proposing the harmonic mean as an alternative estimator[6]. They base their recommendations on a specific Monte Carlo simulation, which draws random inverse multiples from a normal distribution[7].

In a related study, *Liu et al.* also test the accuracy of different multiple methods. Their emphasis is on the effects of varying the underlying basis of reference[8]. In apparent contradiction to the basic principles of valuation, they find that multiples based on forecasted earnings clearly outperform different kinds of cash flow multiples[9]. The worst predictions are produced by sales multiples. Neither *Kim/Ritter,*

2 See *Kaplan/Ruback* (1995), pp. 1059–1093; they use a method called "Compressed APV" which discounts after tax cash flow at the (pre-tax) weighted average cost of capital. See also *Kaplan/Ruback* (1996), pp. 45–60.

3 A related study, which leads to similar results concerning the prediction accuracy of EBITDA-multiples is offered by *Gilson/Hotchkiss/Ruback* (2000), pp. 43–74. The authors compare valuation estimates for firms emerging from bankruptcy with different valuation methods including multiples.

4 *Kim/Ritter* (1999), pp. 409–437.

5 *Baker/Ruback* (1999).

6 The harmonic mean of n multiples is defined as the inverse of the arithmetic mean of the inverse multiples and is mathematically always smaller than the arithmetic mean itself.

7 See *Baker/Ruback* (1999), p. 3.

8 *Liu/Nissim/Thomas* (2002), pp. 135–172.

9 See *Liu/Nissim/Thomas* (2002), pp. 152–161. This result is interesting because standard textbooks present cash flows as the dominant measure for valuation purposes. On the contrary, accounting related measures are criticized because they are susceptible to manipulation; see for example *Copeland/Koller/Murrin* (2000), part 1, pp. 73–87, *Rappaport* (2000), pp. 13–32.

Baker/Ruback, nor *Kaplan/Ruback* present further tests on an appropriate and theoretically sound method of selecting comparable assets that goes beyond the generally accepted definition of comparability vaguely defined by industry classification.

In a recent study, *Bhojraj* and *Lee* revive *Alford's* idea of selecting comparable companies on the basis of similar underlying economic variables instead of industry classification[10]. To do so, the authors use a multiple regression approach that predicts a theoretically correct multiple (justified by fundamental data) for each target company and then utilizes these "warranted" multiples in a second step as criteria for the choice of comparable assets. The relevant multiple for the target asset is then estimated as the harmonic mean of the multiples in the comparable set as suggested in *Baker/Ruback*[11].

A review of literature presents a fragmented picture of the theoretical analyses conducted so far, since each paper focuses on an isolated aspect of the multiples method. Our study examines all three implementation challenges, but emphasizes the appropriate design of the selection method of comparable companies on the basis of control factors determining the value of assets. We provide sound support for the factors used in our study and assume that these factors are also relevant for the pricing of assets.

To evaluate the accuracy of these performance-controlled multiples, we compare pricing results with observable market prices using the market capitalization as a proxy. We compare observed market prices (market capitalizations) with predicted market prices (with the use of multiples) to estimate prediction errors. Our approach is designed for companies for which no market prices are available. We ask what the potential market price would be if the company to be priced were to be traded in the same market and for the same time as the reference companies. We also think that this approach could be useful to gain insight into the relative prices of different traded assets. Single assets may or may not be subject to unsystematic pricing errors. Those can be identified by comparing a realized price with potential price based on the multiples of a set of (truly) comparable firms.

To some extent, our study builds on the work of *Alford,* but it provides a more theoretical backing for the choice of particular factors as selection criteria. We test different sets of control factors and compare such methods to traditional criteria guided by industry classification. We analyze the accuracy of our approach compared to other approaches presented earlier.

The paper is organized as follows: Section 2 discusses the theoretical foundation for our approach. We derive a simplified valuation model that is the basis for identifying specific factors which should be controlled for when selecting comparable firms. Section 3 presents the empirical test of our approach, beginning with a description of the study set-up. We analyze three key implementation aspects of our approach: What specific basis of reference, such as earnings, book equity or

10 *Bhojraj/Lee* (2001).
11 *Baker/Ruback* (1999).

some other accounting measure, should be selected? How does a selection method for comparable assets based on control factors perform in comparison to more common industry approaches? Which statistical measure should be used to aggregate the multiples of the comparable set? Section 4 concludes with a brief summary.

2 Identification of Control Factors

The control factors as selection criteria for comparable firms can be derived from valuation models. There are several studies that try to establish a theoretical link between the equity value of a company and fundamental accounting and cash-flow variables. For example, the *Gordon* growth model links the equity value of a firm to its earnings growth rate, cost of equity, and dividend pay out ratio[12].

More recent studies extend the residual income model that depicts a company's equity value as a function of the expected growth rate of earnings, the expected dividend pay-out ratio, the risk-free discount rate, and a risk adjustment factor that is determined by the underlying stochastic process of earnings and dividends[13]. In another recent study *Richter* asks which fundamental factors constitute valuation multiples, given certain stochastic properties of the future cash-flow stream. We use this model to identify the control factors.

2.1 The model

We assume that the future cash-flow stream follows a stochastic process of the martingale class. In its simplest version, future cash flows can either move up by a certain factor or down by the reciprocal of the upward factor. In this case, we have a recombining binomial model[14]:

$$C_t \in \{C_{t-1}u_t; C_{t-1}u_t^{-1}\} \quad \text{with: } t = 1,2,\ldots T, C_0 > 0, u_t \geq 1. \tag{1}$$

For our analysis we need to create more structure for the cash flow. Assume that C represents the cash flow of a firm that is financed with equity only. To be able to grow, the firm must retain a certain amount of its cash flow. This process can be accounted for as follows[15]:

$$C_t \in \{EBIT_{t-1}(1-\tau)(1-\theta)u_t; EBIT_{t-1}(1-\tau)(1-\theta)u_t^{-1}\} \tag{2}$$

12 See *Gordon/Shapiro* (1956), pp. 102–110; *Gordon* (1962), p. 45.
13 See *Ohlson* (1990), pp. 648–676; *Feltham/Ohlson* (1995), pp. 689–731.
14 See *Richter* (2001), pp. 175–196; *Richter* (2002), p. 2.
15 Equation (2) is identical to the numerator in the terminal value calculation on the basis of NOPLAT (Net operating profit less adjusted taxes) as suggested by *Copeland/Koller/Murrin* (1996), Appendix A, pp. 535–537.

with:
EBIT = earnings before interest and taxes,
τ = corporate tax rate,
θ = reinvestment rate.

θ represents the share of after-tax EBIT that is reinvested into the firm in excess of depreciation and other non-cash items.

In addition we have two equivalent probability measures, P and Q, which can be applied to the cash-flow process[16]. We define Q such that it transforms the conditional expected value of an uncertain cash flow in t (given the information available in t−1) into its economic value in t. If we apply P to the process, we get expected values. For example, the expected cash flow in time period 1 can be described as:

$$E_P[C_1] = pEBIT_0(1-\tau)(1-\theta)u_1 + (1-p)EBIT_0(1-\tau)(1-\theta)u_1^{-1}. \tag{3}$$

The unconditional expected growth rate is $1 + g_t = pu_t + (1-p)u_t^{-1}$. As we have already mentioned, we assume that growth stems from reinvestment, which can be expressed as:

$$g_t = \theta\, r_t \tag{4}$$

with: r_t = expected rate of return on net new investment.

Inserting this into (3) and collecting terms yields:

$$E_P[C_1] = EBIT_0(1-\tau)(1-g_1/r_1)(1+g_1) \tag{5}$$

If the probability q is used instead of p, the expected cash flow represents a certainty equivalent, which can be determined on the basis of the certainty equivalent growth rate $1 + g_t^* = qu_t + (1-q)u_t^{-1}$ and the certainty equivalent rate of return $r_t^* = g_t^*/\theta$[17]:

$$E_Q[C_1] = EBIT_0(1-\tau)(1-g_1^*/r_1^*)(1+g_1^*). \tag{6}$$

The risk-free rate is used to discount certainty equivalents that we obtain by applying the certainty equivalent probability q in quantifying the expectation:

$$V_0[C_1] = EBIT_0(1-\tau)(1-g_1^*/r_1^*)(1+g_1^*)(1+r_f)^{-1}. \tag{7}$$

The relation between p and q reflects the investors' degree of risk aversion. Investors who do not differentiate between p and q are risk neutral; for this group of investors, expected cash flows and certainty-equivalent cash flows are the

16 For an interpretation of the probability measures P and Q see *Richter* (2002), pp. 2–3.

17 For a detailed derivation of risk neutral probabilities and risk adjusted growth rates see *Richter* (2001), pp. 182–185. For more background on the theory see *Pliska* (1997).

same. Risk-averse investors assign a value to q that is lower than p. Without further specification of the relation between p and q, we can define the range of the possible values of the asset, given the process according to (1): The minimum value obtains with $q \to 0$, the maximum value is given with p = q. Knowing the range of attainable values is sufficient for the purpose of our analysis.

If certain factors such as the growth rate are constant, the valuation formula simplifies. First, we consider the case in which the growth rate of the unconditional expectation is constant, i.e., $u_t = u$ for all t. To also incorporate debt financing, we assume that the firm realizes a financing policy based on constant leverage ratios $l = D_t/V_t^{Ent} = const.$ We do not limit the life of the firm. Thus, we obtain a version of the constant growth model in which the entity value can be calculated as:

$$V_0^{Ent} = \frac{C_0(1+g^*)}{r_f(1-\tau l)-g^*} \quad \text{with: } C_0 = EBIT_0(1-\tau)(1-\theta). \tag{8}$$

This approach is the risk-neutralized WACC approach in which C_0 indicates the unlevered cash flow at time 0. The model can be transformed into the risk-neutralized total cash-flow approach and the risk-neutralized equity approach as follows (E = Earnings in the sense of Net Income)[18]:

$$V_0^{Ent} = \frac{TCF_0(1+g^*)}{r_f - g^*} \tag{9}$$

$$\text{with: } TCF_0 = EBIT_0(1-\tau)(1-\theta) + \tau r_f D_0$$

$$V_0^{Ent} = \frac{FTE_0(1+g^*)}{r_f - g^*} + D_0 \tag{10}$$

$$\text{with: } FTE_0 = EBIT_0(1-\tau)(1-\theta) - r_f D_0(1-\tau) + \frac{1+r_f}{1+g^*} g^* D_0.$$

Based on these enterprise values, equity values are given by $V_0^{Eq} = V_0^{Ent} - D_0$.

2.2 *Derivation of valuation multiples*

So far, we have shown the entity and equity values of firms as functions of different cash-flow measures, free cash flow (c) in (8), total cash flow (TCF) in (9), and flow to equity (FTE) in (10). Based on these models, we first derive the well-known price/earnings (P^{Eq}/E) multiple. Our argument is that the factors influencing the

18 For simplicity, we assume that interest will be paid based on the amount of debt at the end of the period. (8) is based on the more common assumption that interest is paid based on the amount of debt at the beginning of the period. (8), (9) and (10) yield identical results if the following discount rate is substituted into (8): $WACC = r_f (1 - \tau (1 + g^*) l)$.

P^{Eq}/E-multiple can be derived from the valuation multiple V^{Eq}/E[19]. Further factors may influence prices, but these are beyond the control of simple valuation models[20].

From (10) the V^{Eq}/E-multiple can be derived by using the following relation:

$$\frac{V_0^{Eq}}{E_0} = \frac{(1+g^*)(1-g^*/roe^*)}{r_f - g^*} \tag{11}$$

with:

$$\begin{aligned} FTE_0 &= EBIT_0(1-\tau)(1-\theta) - r_f D_0(1-\tau) + g^* D_0(1+r_f)/(1+g^*) \\ &= E_0 - EBIT_0(1-\tau)\theta + g^* D_0(1+r_f)/(1+g^*) \\ &= E_0(1-\varphi) \\ roe^* &= g^*/\varphi. \end{aligned}$$

In this model, cash flow to equity is defined on the basis of net income times one minus the retention rate φ. The retention rate itself is a function of the growth rate (g^*) and the certainty equivalent rate of return on the funds retained by the firm (roe^*). The amount of retained cash flow depends on that part of the reinvestment that must be financed with equity.

The derivation of an alternative multiple based on earnings before interest and after taxes (EBIAT) is analogous to the calculations expressed above.

$$\frac{V_0^{Ent}}{EBIAT_0} = \frac{(1+g^*)(1-g^*/roic^*)}{r_f - g^*} \tag{12}$$

with:

$$\begin{aligned} TCF_0 &= EBIT_0(1-\tau)(1-\theta) + \tau r_f D_0 \\ &= EBIAT_0 - EBIT_0(1-\tau)\theta \\ &= EBIAT_0(1-\vartheta) \\ roic^* &= g^*/\vartheta. \end{aligned}$$

19 In the following theoretical derivations the variables V^{Eq} and V^{Ent} are used instead of P^{Eq} and P^{Ent} to differentiate between valuation multiples (which are derived from valuation models) and pricing multiples (which can be observed in the market). This differentiation is necessary because value (V) is not necessarily identical to observed market price (P) when markets are incomplete, see for example *Shleifer/Vishny* (1997), pp. 35–55. This highlights the role of multiples as pricing instruments as opposed to valuation methods and explains their usage for the explanation of value-price-discounts as in IPOs, see *Purnanandam/Swaminathan* (2001), conglomerates, see *Berger/Ofek* (1995), pp. 39–65, or price comparisons between public and private companies, see *Koeplin/Sarin/Shapiro* (2000), pp. 94–101.

20 The derived factors, which determine value in the simplified models are not the only relevant drivers of market price. Other factors include asymmetric information, see for example *Rock* (1986), pp. 188–212, general demand/supply conditions or the specific market segment under observation (as will be shown later). For the purpose of this paper, however, it shall be assumed that factors determine both value and price.

The specifications of the V^{Eq}/E- and $V^{Ent}/EBIAT$-multiples can be extended to additional bases of reference. Assuming that the rates of return on net new investment are identical with the rates of return of the total firm, we can substitute the (after tax) profitability ratios roe = E/BE and roic = EBIAT/IC:

$$\frac{V_0^{Eq}}{BE_0} = \frac{roe\,(1+g^*) - g^*}{r_f - g^*} \tag{13}$$

$$\frac{V_0^{Ent}}{IC_0} = \frac{roic\,(1+g^*) - g^*}{r_f - g^*} \tag{14}$$

with:
BE: book equity
IC: total invested capital (book equity plus interest bearing debt).

Furthermore, a sales V^{Ent}/S-multiple can be derived from (12) by using the definitions of ros = EBIAT/S and cto = S/IC and the identity roic = ros · cto:

$$\frac{V_0^{Ent}}{S_0} = \frac{ros\,(1+g^*) - g^* / cto}{r_f - g^*}. \tag{15}$$

Analogous to multiples based on EBIDAAT (earnings before interest, depreciation, and amortization, after taxes) can be derived from the model in (12). Establishing the relation d = EBIAT/EBIDAAT and $roic_d$ = EBIDAAT/IC as a (depreciation-) adjusted return on invested capital after taxes, yields:

$$\frac{V_0^{Ent}}{EBIDAAT_0} = \frac{d(1+g^*)(1-g^* / roic_d)}{r_f - g^*}. \tag{16}$$

Thus, we have determined the factors that are relevant for our set of multiples.

We base the derivation of the control factors on the following simplifying assumptions: The model as defined in (2) describes the development of future cash flows. The risk-adjusted growth rate, the pay-out ratio, and the leverage ratio all are constant across time. Furthermore, the capital-based multiples (V^{Ent}/IC, V^{Eq}/BE) assume that there is no difference between the rate of return of the entire company and the rate of return on new investments. Those assumptions are only rarely fulfilled in reality and are therefore not suitable for practical valuation purposes. However, they are useful for demonstrating the theoretical link between valuation multiples and certain control factors. Under the assumption that those factors are not only relevant for value but also for market prices, controlling for them should significantly reduce prediction errors of market multiples[21].

21 We also note that the definition of terms like “EBIT” or “IC” does not solve the significant problem of estimating these variables properly, given differences in accounting standards and their application.

2.3 THEORETICAL AND EMPIRICAL RELEVANCE OF DIFFERENT CONTROL FACTORS

(a) CONTROL FOR GROWTH

The expected growth rate g has exponential impact on each multiple[22]. The models derived in this paper use the risk-adjusted growth rate g^* instead of g. This should not be of concern, because there is a deterministic relation between g and g^*. Based on our model, the expected growth rate without risk adjustment is $1 + g = pu + (1-p)/u$. With $p = 1/2$, and taking g from analyst forecasts or historical estimates, we can isolate u. Thus, the remaining factor to determine the risk-adjusted growth rate is q, given that $1 + g^* = qu + (1 - q)/u$:

$$1+g^* = q\left(1+g+\sqrt{(1+g)^2-1}\right)+(1-q)/\left(1+g+\sqrt{(1+g)^2-1}\right). \tag{17}$$

The theoretical and empirical relevance of growth rates for the variation of different multiples is widely accepted and has been demonstrated in numerous studies. For example, *Zarowin* shows a significant positive impact of long-term analyst growth forecasts on P^{Eq}/E multiples[23]. An analysis of the sample used in our study confirms the positive relation revealed in prior studies. *Table 1* shows how two different proxies for long-term earnings growth, i.e., long-term I/B/E/S forecasts as well as historic growth rates of sales, distinguish P^{Eq}/E multiples in the cross-section. We construct the multiples in *Table 1* by using the total market capitalization of U.S. and European firms[24] observable on the last trading day of March in the relevant year (1997, 1998, and 1999) and the preceding year's accounting measure. We estimate growth rates with two different proxies, the geometric mean of the historic sales growth rate of the preceeding four years (g^S) , and the I/B/E/S consensus of analysts forecasts for long-term growth (five years) of earnings per share (g^P)[25]. Therefore, the need to control for growth rates when selecting comparable firms should not be subject to much debate.

(b) CONTROL FOR PROFITABILITY

In addition to growth, we must control for profitability, so our main focus now turns to the role of current roe as a selection criteria for comparable firms.

22 See equations (8) – (16).

23 See *Zarowin* (1990), pp. 439–454; see also *Litzenberger/Rao* (1971), pp. 265–277; *Alford* (1992), pp. 103–104; *Lakonishok/Shleifer/Vishny* (1994), p. 1541 for similar results.

24 See section 3.1 (a) for a detailed description of the used sample.

25 Historical growth rates of sales are used because they show the smallest standard deviation through time relative to other measures, such as earnings or book equity, see *Lakonishok/Shleifer/Vishny* (1994), p. 1550.

Table 1: Empirical link between P^{Eq}/E and P^{Eq}/BE multiples with two different proxies for long-term earnings growth (historical sales growth (g^S) and I/B/E/S forecasts (g^P))[26]

g^S-Portfolio (Geometric mean of annual sales growth in preceding four years)	**Median P^{Eq} /E-Multiple**			**Median P^{Eq}/BE-Multiple**		
	1997	**1998**	**1999**	**1997**	**1998**	**1999**
g^S<5%	19.12	20.51	18.39	2.25	2.58	2.36
5%≤g^S<10%	17.72	20.66	18.53	2.36	2.81	2.69
10%≤g^S<15%	19.88	22.95	20.27	2.78	3.38	3.23
15%≤g^S<20%	20.20	23.80	21.02	3.03	3.43	2.78
20%≤g^S<25%	22.35	27.79	34.43	3.13	4.98	4.98
g^S≥25%	26.74	34.35	36.59	4.26	4.92	6.10
Correlation*	4%	13%	18%	7%	11%	13%
g^P-Portfolio (I/B/E/S long-term forecasts for annual eps growth rates)	**Median P^{Eq}/E-Multiple**			**Median P^{Eq}/BE-Multiple**		
	1997	**1998**	**1999**	**1997**	**1998**	**1999**
g^P<5%	15.50	18.85	14.43	1.70	2.14	1.66
5%≤g^P<10%	16.03	18.92	15.79	2.15	2.62	2.34
10%≤g^P<15%	18.40	22.52	18.90	2.66	3.46	2.95
15%≤g^P<20%	22.40	28.57	27.95	3.30	4.18	4.16
20%≤g^P<25%	25.79	35.01	32.48	4.50	5.05	5.19
g^P≥25%	34.24	37.99	43.30	4.95	5.29	7.22
Correlation*	17%	9%	39%	10%	10%	19%

* Calculated using a simple correlation coefficient (Bravais-Pearson) between growth rates and multiples taking into account each individual pair of data.

We take the V^{Eq}/BE-multiple as an example, since it is commonly interpreted as an indicator for future return on equity[27]. We refer to equation (13) and raise the issue regarding the quantification of roe.

$$\frac{V_0^{Eq}}{BE_0} = \frac{roe(1+g^*) - g^*}{r_f - g^*}. \tag{18}$$

26 Source: *Herrmann* (2002), pp. 135 and 138.
27 See for example *Beaver/Ryan* (1993), pp. 50–56.

As shown above, the term roe $(1 + g^*)$ represents the certainty equivalent return on equity for future periods, with roe = E_0/BE_0. If we control for the expected rate of return, $roe_1 = E_0(1 + g)/BE_0$, we basically control for current earnings, expected growth, and current book equity. Because we have already controlled for growth, we also consider only current earnings and current book equity. Thus, the current roe should be empirically relevant, as supported by the data in *Table 2*. Using the same sample as before we see that current roe sharply distinguishes current P/BE in the cross section. The current roe also underlines their critical importance as selection criteria for comparable firms when trying to estimate equity value with the use of P^{Eq}/BE multiples[28].

Table 2: Current P^{Eq}/BE multiples and return on equity[29]

	Median P^{Eq}/BE Multiple		
ROE-Portfolios	**1997**	**1998**	**1999**
ROE<0.05	1.64	1.70	1.66
0.05≤ROE<0.10	1.69	2.29	1.78
0.10≤ROE<0.15	2.06	2.48	2.13
0.15≤ROE<0.20	2.73	3.19	2.92
0.20≤ROE<0.25	3.60	4.35	3.46
ROE≥0.25	5.65	6.78	7.96
Correlation*	33%	24%	40%

* Calculated using a correlation coefficient (Bravais-Pearson) between growth rates and multiples, and taking into account each individual pair of data.

(c) Control for risk?

In summary, we are using current or expected growth rates g as proxies for g^* and current or expected rates of return, $roe_{t+1} = E_t(1 + g_{t+1})/BE_t$ and $roic_{t+1} = EBIAT_t(1 + g_t)/IC_t$, as proxies for roe^* and $roic^*$. The certainty equivalents are assumed to be deterministic functions of the expected variables, which is the key implication of the model presented in (1) and (2). The risk aversion of investors is taken into account on the basis of the certainty equivalent probability q. However, we do not need to control for q, since we can determine the interval of attainable values based on the minimum and the maximum growth rate[30]:

28 As above the simple theoretical and empirical relationship of current roe and P^{Eq}/BE can again be extended to the general case in which the operator of the multiple simultaneously represents the operator of the value relevant profitability ratio, such as in V^{Ent}/IC and roic; $V^{Ent}/EBIDAAT$ and d; as well as V^{Ent}/S and ros.

29 Source: *Herrmann* (2002), p. 142.

30 The minimum growth rate obtains for maximum risk aversion, i.e., the "up" probability q converging to zero, and the maximum growth rate obtains for risk neutrality, i.e., q = p.

$$
\begin{aligned}
g^*_{min} &= \left(1 + g + \sqrt{(1+g)^2 - 1}\right)^{-1} - 1 \le g^* \le g^*_{max} \\
roe^* &= g^* / \varphi \quad \text{resp.} \quad roe = g / \varphi \\
roic^* &= g^* / \vartheta \quad \text{resp.} \quad roic = g / \vartheta \\
r^* &= g^* / \theta \quad \text{resp.} \quad r = g / \theta.
\end{aligned} \tag{19}
$$

Empirical evidence supports our view. For instance, prior research has not confirmed a significant role for risk-adjusted costs of capital in the variation of different kinds of multiples and after controlling for different growth proxies. Most of the tested indicators for risk, such as beta[31], firm size[32], dispersion of earnings growth forecasts[33], or book leverage[34] show either zero or only very little statistical significance for the variation of P^{Eq}/E multiples in the cross-section.

3 Empirical analyses

3.1 *Analysis design*

(a) Sample description and descriptive statistics

To test the different implementation choices of the multiples method, we use a sample taken from the 524 largest (according to total market capitalization) U.S. corporations at the end of 1998 supplemented with the 830 large European companies[35]. Sample firms are drawn without exception from the nonfinancial services sector (excluding SIC industry codes 6000–6999), since measures like EBIAT or EBIDAAT do not have a meaningful economic interpretation for these firms.

Our sample companies must match the following criteria: The market capitalization is available in the Global Vantage file; all relevant items from the group accounts of the companies that are necessary for the calculation of earnings (E), earnings before interest (EBIAT), earnings before interest depreciation and amortization (EBIDAAT), book equity (BE), and invested capital (IC) are available in the Compustat North America and Compustat Global file and are positive; and that I/B/E/S analyst forecasts of long-term earnings growth are available. If a stock has listings on more than one stock exchange, we use only the market capitalization on the stock exchange of the company's home country. The final sample consists of 645 firms in 1997, 665 firms in 1998, and 664 firms in 1999[36].

31 See *Beaver/Morse* (1978), pp. 71–72; *Zarowin* (1990), pp. 446–453.
32 See *Alford* (1992), pp. 94–108
33 See *Bhojraj/Lee* (2001), pp. 17–18.
34 See *Bhojraj/Lee* (2001), pp. 17–18.
35 We focused on the largest companies assuming that the shares of these companies are most frequently traded. Furthermore, we concentrated on developed capital markets in Europe and in the US. The composition of the sample was also driven by the availability of complete data.
36 European companies were also selected on the basis of total market capitalization at year end 1998, namely the 550 largest companies from the countries above plus the 280 largest German corporations. The selection on the basis of market capitalization results in companies that are primarily from the EURO zone plus Switzerland, United Kingdom, Norway, Sweden, and Denmark. We

Multiples for these companies are constructed using the total market capitalization observable on the last trading day of March in the years 1997, 1998, and 1999 divided by the preceding year's accounting measure. Growth rates are estimated using historic sales growth rates (g^S) and I/B/E/S forecasts as described in section 2.3 (a). The descriptive statistics of the three yearly subsamples are contained in *Table 3*.

Table 3: Descriptive statistics of underlying sample in all three observation years (1997–1999)

	1999 (n=645)			1998 (n=665)			1997 (n=664)		
	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD
P^{Eq}/E	20.36	34.10	56.06	23.83	31.53	38.85	19.85	31.55	58.76
P^{Eq}/BE	2.91	3.93	3.31	3.67	5.58	9.22	3.16	5.93	9.25
P^{Ent}/S	1.49	2.04	1.94	1.68	2.46	2.66	1.57	2.36	2.43
P^{Ent}/ EBIDAAT	11.03	13.16	8.51	12.79	15.32	9.63	10.98	15.18	12.43
P^{Ent}/EBIAT	17.67	19.89	9.71	19.79	23.27	11.39	17.64	22.56	16.48
P^{Ent}/IC	2.23	2.96	2.42	2.50	3.86	6.26	2.24	4.05	6.07
roe	0.17	0.23	0.29	0.17	0.22	0.29	0.16	0.21	0.19
roic	0.15	0.17	0.11	0.15	0.18	0.15	0.14	0.18	0.16
$roic_d$	0.22	0.25	0.14	0.23	0.27	0.19	0.22	0.26	0.19
ros	0.08	0.10	0.08	0.08	0.10	0.08	0.08	0.11	0.09
cto	1.90	2.34	1.94	1.90	2.53	2.47	1.85	2.44	2.53
d	0.64	0.63	0.15	0.63	0.63	0.15	0.64	0.63	0.16
g^S	0.09	0.14	0.26	0.10	0.15	0.30	0.09	0.14	0.23
g^P	0.12	0.14	0.10	0.12	0.13	0.12	0.12	0.13	0.12

(b) Basis for the evaluation of different multiples methods

Before we can present the empirical results concerning the comparative advantages of individual multiple methods, we must choose which statistical basis comparisons between different implementation options of the multiple method we will conduct. To increase the reliability of the results, comparisons may be based on more than one statistical measure.

First, we calculate median absolute prediction errors for each year and then take the arithmetic mean of the three median errors in each of the three years. We cal-

use large companies since we expect higher trading volumes and therefore a higher information content in their observed market prices.

culate the absolute prediction error for an individual target company i in year t as follows[37]:

$$| E_{i,t} | = | \ln(\hat{P}_{i,t}) - \ln(P_{i,t}) | \qquad (20)$$

with:

$|E_{i,t}|$ = absolute prediction error for firm i in year t,

$\hat{P}_{i,t}$ = estimated market price on the last trading day of March of firm i in year t (1997, 1998, or 1999),

$P_{i,t}$ = observed market price on the last trading day of March of firm i in year t (1997, 1998, or 1999) of firm i in year t.

In addition to the average absolute prediction error over the three years, as a second basis of comparison we use the average percentage proportion of absolute prediction errors smaller than 15%. For the median absolute prediction errors, we average yearly measures over the three observation years 1997, 1998, and 1999.

As a third measure, we base assessments of individual multiple methods on the *Wilcoxon* rank sum test, a nonparametric test, which allows for a more thorough mutual comparison of two multiple methods. The advantage of this test is that it not only takes into account the number of better predictions of one method compared to an alternative method (for example, a simple sign test), but also evaluates the relative size of each deviation[38].

The three statistical measures briefly described above base assessments concerning the prediction accuracy of multiple methods on an ex post comparison of the estimated market price and the actual observable market price. Alternatively, comparisons between different methods might be based on an ex ante analysis of comparable sets. The smaller the dispersion of potential values resulting from comparable multiples, the more reliable should be a prediction that uses that particular comparable set. We assume that a lognormal distribution of multiples dispersion can be expressed in the form of a dispersion interval around the sample mean of, for example, one standard deviation as well as through a confidence interval around the true sample mean. Our way of calculating these dispersion measures is described in *Table 5*.

37 The index Eq is left out, because all errors, including those generated by entity multiples, are calculated on the basis of equity prices since equity price is the target of estimation. See for this method of calculating prediction errors, for example *Kaplan/Ruback* (1995); *Gilson/Hotchkiss/Ruback* (2000) or *Kim/Ritter* (1999). Log errors are taken because of their symmetrical properties in their positive and negative deviations. In addition we assume that prices have a lognormal distribution, which is consistent with the application of the binomial model. Furthermore, we had to choose the reference date of our valuation. We selected the last trading date in March of the respective year. The majority of accounting data refers to calendar years. Thus,we implicitly assume a time lag of three month for historic accounting data to be published and transformed into prices.

38 The *Wilcoxon* rank sum test is described in *Conover* (1980).

(c) Method of selecting comparable companies

We examine several competing methods of selecting comparable companies and test them on the basis of the statistical measures explained in the last section.

(1) **MARKET**: This method selects all companies from the underlying sample, but excludes the target company because its market price is unknown by definition. This selection method only serves as a benchmark method, and it should be improved on significantly by the four methods below. The results produced by MARKET work also as an indicator for the underlying dispersion of the total sample.

(2) **IND**: This method uses SIC industry codes as a classification for industry membership. As in other empirical studies, the search for comparable companies starts on the four-digit basis. Digits are successively reduced, if necessary down to a one-digit level. The search is continued until at least four comparable companies can be identified.

(3) **FUND**: This method ignores industry membership and selects comparable companies across all industries on the basis of similar fundamental factors. Factors are derived from the valuation models in section 2 and are presented for six different bases of reference. A company is considered a peer if both relevant fundamental factors deviate less than 30% from the target company's respective factors[39]. We estimate long-term growth rates by using the geometric mean of annual historic sales growth rates of the preceding four years as a proxy.

(4) **$\textbf{FUND}^{\textbf{P}}$**: This method is similar to FUND, except for the fact that long-term growth rates for the different bases of reference are uniformly estimated via I/B/E/S long-term growth forecasts for earnings per share.

(5) **$\textbf{FUNDIND}^{\textbf{P}}$**: This method represents a combination approach and therefore chooses the peer companies from the same industry as in IND. At the same time this method controls for underlying economics (with I/B/E/S forecasts as a proxy for long-term growth). To ensure identification of an appropriate number of comparable companies, the acceptable deviation interval is widened to 50%[40].

39 The definition of comparability based on a common percentage rate of 30 appears somewhat arbitrary. However, this approach ensures a flexible selection of comparables with varying numbers of firms in the individual comparable sets (e.g., relatively more comparables for firms with median factors and less comparables for firms with extreme factors). The alternative approach of using a predefined number of comparables as proposed by *Alford* (1992), pp. 98–99, yielded significantly higher pricing errors. Moreover, a variation of the tolerated deviation between 20% and 40% did not alter the overall empirical results relative to other selection methods.

40 I/B/E/S consensus analysts' long term growth forecasts for earnings per share are used for all companies. These growth predictions represent a median of observed forecasts of different financial analysts at the time of observation. These predicted growth rates do only serve as an empirical proxy for the growth rate in equations (11)–(16). They do not take into account possible differences in the calculation of earnings due to differences in national accounting practices.

3.2 EMPIRICAL RESULTS

(a) CHOICE OF BASIS OF REFERENCE

Table 4: Comparison of multiples based on different bases of reference[41]

Multiple	Absolute prediction errors*				
	MARKET	IND	FUND	$FUND^P$	$FUNDIND^P$
P^{Eq}/E	0.365	0.334	0.333	0.287	0.293
$P^{Ent}/EBIAT$	0.391	0.341	0.329	0.302	0.313
P^{Eq}/BE	0.487	0.432	0.347	0.317	0.322
$P^{Ent}/EBIDAAT$	0.462	0.372	0.351	0.324	0.329
P^{Ent}/IC	0.519	0.455	0.357	0.335	0.349
P^{Ent}/S	0.709	0.530	0.367	0.357	0.361

* Prediction errors are calculated as the arithmetic mean of the three median errors in the three observation years 1996-1998.

Table 4 presents the absolute prediction errors and proportions in the 15% interval of the multiple method. The results are based on six different bases of reference, E, EBIAT, EBIDAAT, BE, IC, and S. P^{Ent}/EBIAT and P^{Ent}/EBIDAAT multiples are used in the empirical analysis instead of the more common V^{Ent}/EBIT and V^{Ent}/EBITDA multiples. Those after-tax multiples yield overall better prediction accuracy, presumably due to the additional information content of actually paid taxes (when taxes are not deferred). In addition, these after-tax entity multiples allow us to ignore leverage as a control variable. We select comparable companies on the basis of fundamental control factors regardless of industry membership ($FUND^P$). A company enters the comparable set if both its relevant growth rate (as estimated by the I/B/E/S consensus analyst forecast) and its relevant profitability ratio deviates less than 30% from that of the target company.

Following *Liu/Nissim/Thomas (2002),* multiples based on simple earnings lead to the smallest prediction errors and the highest proportion of "good" predictions.[42] By contrast, sales multiples yield the worst prediction accuracy. Therefore sales multiples reflect the low information content of sales even after controlling for profitability and growth. However, in comparison to the results of *Liu/Nissim/Thomas,* P^{Eq}/BE multiples produce much better pricings relative to other measures, such as EBIDAAT and EBIAT, when we select comparable companies on the basis of their ROEs and earnings growth instead of industry membership. This

41 Source: *Herrmann* (2002), p. 220.

42 See *Liu/Nissim/Thomas* (2002), pp. 152–161. Prediction results appear poor in comparison with similar analysis offered by *Alford* (1992), *Bhojraj/Lee* (2001), *Kaplan/Ruback* (1995), or *Liu/Nissim/Thomas* (2002). Results here, however, are largely distorted by the high prediction errors in 1999, which are primarily due to the stock market bubble of this year and a resulting high number of outliers. Moreover, merely current accounting variables are tested as performance indicators. The use of forecasted indicators should further improve valuation accuracy.

result mirrors the significant correlation of ROE and P^{Eq}/BE multiples. It also suggests that simple industry P^{Eq}/BE multiples will lead to erroneous conclusions about potential market prices.

(b) Selection of comparable companies

Next, we define our selection criteria for comparable companies. Despite the strong link between multiples and certain fundamental control factors, firms are often classified as comparable if these firms are from the same industry and need no prior adjustments for growth and profitability. This common practice implicitly assumes that firms within one industry tend to be roughly the same in their underlying economics.

Table 5 sheds doubt on this view. A simple cross-industry selection of comparable firms solely on the basis of similar earnings growth rates and return on equity yields both smaller absolute prediction errors and a lesser degree of dispersion in potential values within the selected comparable sets. This relation holds true if long-term earnings growth is estimated via a measure such as historic sales growth rates. The gap in pricing accuracy widens if we substitute sales growth with consensus analyst forecasts published by I/B/E/S. Even more important, a combination approach that controls for both industry membership and relevant fundamentals does not lead to a statistically significant improvement of prediction accuracy.

These results suggest that industry membership does not contain additional information beyond that already controlled for via the rates of return on capital and long-term growth forecasts.

A comparison based on nonparametric statistics offers the final evidence of a superior performance of performance-controlled multiples compared to industry multiples based on SIC codes. At the 95% significance level, the $FUND^{P}$ method produces significantly lower prediction errors than does IND, while $FUNDIND^{P}$ and $FUND^{P}$ appear statistically indistinguishable.

(c) Selection of an adequate estimator

Our third choice is on a suitable statistical measure that reduces the various multiples derived from comparable assets to a single estimator. This issue is often neglected; many researchers assume that they should use the arithmetic mean. However, due to the skewed multiple distribution, this measure does not lead to optimal results but instead to an overestimation of value.

To eliminate the distorting effect of outliers, most empirical analyses that use the multiple method utilize the median as an alternative estimator. As a third alternative estimator, the harmonic mean is suggested by *Baker/Ruback* and is based on the assumption of normally distributed inverse multiples[43].

43 See *Baker/Ruback* (1999).

Table 5: Evaluation of different selection methods of comparable firms using P/E multiples[44]

	MARKET	IND	FUND	$FUND^P$	$FUND\text{-}IND^P$	$FUND\text{-}IND^P$ (USA)
Absolute prediction error*	0.365	0.334	0.333	0.287	0.293	0.266
Proportion in 15%-range**	0.225	0.250	0.239	0.290	0.285	0.309
Dispersion interval (lower limit)***	-0.506	-0.428	-0.400	-0.388	-0.347	-0.343
Dispersion interval (upper limit)***	1.029	0.755	0.662	0.638	0.534	0.529
Confidence-interval (lower limit)****	-0.053	-0.292	-0.213	-0.124	-0.302	-0.121
Confidence-interval (upper limit)****	0.059	0.415	0.272	0.142	0.434	0.139

* Absolute prediction errors are calculated as the arithmetic mean of the three median errors in the three observation years 1996-1998.

** Calculated as the arithmetic mean of the annual proportions of absolute prediction errors not exceeding 15%.

*** Interval limits for individual companies i in year t are calculated as $\left[\frac{P_{i,t}^{u}-\overline{P}_{i,t}}{P_{i,t}};\frac{P_{i,t}^{o}-\overline{P}_{i,t}}{\overline{P}_{i,t}}\right]$ with $\overline{P}_{i,t}=e^{\overline{\mu}}\cdot I_{i,t}$; $P_{i,t}^{u}=e^{(\overline{\mu}-s)}\cdot I_{i,t}$ and $P_{i,t}^{o}=e^{(\overline{\mu}+s)}\cdot I_{i,t}$. and $\overline{\mu}$ represents the mean, s represents the standard deviation and n represents the number of logged multiples in the comparable set; $I_{i,t}$ is the respective basis of reference (Using entity multiples. the book value of debt $F_{i,t}$ has to be subtracted from the estimate). Annual median dispersions are separately calculated as medians lower and upper interval limits. Finally. the arithmetic mean of the three median dispersion is taken to yield the figures in the table (1996-1998).

**** Confidence interval limits for individual companies i in year t are calculated as $\left[\frac{P_{i,t}^{Konf,u}-\overline{P}_{i,t}}{\overline{P}_{i,t}};\frac{P_{i,t}^{Konf,o}-\overline{P}_{i,t}}{\overline{P}_{i,t}}\right]$ with $\overline{P}_{i,t}^{Konf,u}=e^{\left[\overline{\mu}-\frac{sc}{\sqrt{n}}\right]}\cdot I_{i,t}$; and $\overline{P}_{i,t}^{Konf,o}=e^{\left[\overline{\mu}+\frac{sc}{\sqrt{n}}\right]}\cdot I_{i,t}$. and $\overline{P}_{i,t}=e^{\overline{\mu}_{i,t}}\cdot I_{i,t}$ using $\overline{\mu}$ as the arithmetic mean, s as the standard deviation and n as the number of logged multiples in the comparable set of target company i. $I_{i,t}$ is the respective basis of reference (Using entity multiples. the book value of debt $F_{i,t}$ has to be subtracted from the estimate) and c represents the (1-α)-percentile of the t(n-1)-distribution. Annual median confidence intervals are separately calculated as medians of lower and upper interval limits. Finally, the arithmetic mean of the three median interval limits is taken to yield the figures in the table (1996-1998).

44 Source: *Herrmann* (2002), p. 217.

Table 6: Wilcoxon rank sum test for different selection methods of comparable firms (P^{Eq}/E multiples)[45]

	MARKET	IND	FUND	$FUND^P$	$FUNDIND^P$
Absolute prediction error*	0.365	0.334	0.333	0.287	0.293
	Wilcoxon values**				
IND	3.53				
FUND	7.27	0.21			
$FUND^P$	2.36	3.33	4.39		
$FUNDIND^P$	6.98	3.94	3.16	-0.33	

* Absolute prediction errors are calculated as the arithmetic mean of the three median errors in the three observation years 1996-1998.

** A positive (negative) number indicates that the method in the row (column) is superior to the method in the column (row). Numbers below 1,65 suggest comparable accuracy of both methods that is statistically indistinguishable on the 95% level.

Finally, we can calculate ln-mean as a fourth estimator by taking the natural logarithms of the comparable multiples, then taking the average of those transformed ratios and eventually retransforming the log average by using the exp function. Such a measure works reasonably well if a log-normal distribution is the appropriate assumption for the relevant multiples.

Table 7 summarizes the prediction results for these four different measures. As we expected, on average, the arithmetic mean leads to a significant overestimation of market price and also yields high absolute prediction errors. Surprisingly, just as disappointing as the arithmetic mean estimates are the results produced by the harmonic mean that demonstrate a regular underestimation of potential market price. The poor performance of the harmonic mean seems to contradict the results seen in *Baker/Ruback* and *Liu et al.* (2002)[46]. However, these authors perform their analysis in a sample in which they eliminate outliers prior to the analysis. A similar elimination of the 1% extreme values in multiples and relevant fundamentals at both ends of the respective distributions leads to a sharp improvement in pricing accuracy of the harmonic mean relative to the median. However, in a heterogeneous sample like the one presented here, the median represents by far the best estimator of potential market price.

Although the factors derived on the basis of the simplified models can serve as guidelines in the selection of comparable firms, they can nevertheless be used as independent variables in a linear regression approach, as suggested by *Damo-*

45 Source: *Herrmann* (2002), p. 219.

46 See *Baker/Ruback* (1999), p. 17; *Liu/Nissim/Thomas* (2002), pp. 156–160.

daran[47]. Although the comparable set approach is common practice in valuation settings, it may well be that a cross-market regression leads to superior prediction results.

For this reason, we also examine the regression method. The regression approach presumes both a linear relation between the control factors, such as earnings growth rate and roe and the respective multiple, as well as normally distributed regression residuals.

Table 7: Comparison of different estimators for P^{Eq}/E multiples (heterogeneous sample)

	Prediction error*	**Absolute prediction error****	**Proportion in 15% range*****
Median	-0.025	0.287	0.290
Ln-mean	-0.012	0.289	0.285
Harmonic mean	-0.153	0.321	0.266
Arithmetic mean	0.120	0.318	0.251

* Prediction errors are calculated as the arithmetic mean of the three median prediction errors in the three observation years 1996-1998.

** Absolute prediction errors are calculated as the arithmetic mean of the three median absolute prediction errors in the three observation years 1996-1998.

*** Calculated as the arithmetic mean of the annual proportions of absolute prediction errors not exceeding 15%.

To allow for nonlinearity, we study an alternative approach that uses logged multiples and fundamentals. We test the regression approach for two multiples of different bases of reference, E and BE, which lead to the following four equations:

$$\frac{P^{Eq}}{E} = \gamma_0 + \gamma_1 g^P + \gamma_2 roe + \varepsilon \tag{21}$$

$$\ln\left(\frac{P^{Eq}}{E}\right) = \beta_0 + \beta_1 \ln(g^P) + \beta_2 \ln(roe) + \varepsilon \tag{22}$$

$$\frac{P^{Eq}}{BE} = \gamma_0 + \gamma_1 g^P + \gamma_2 roe + \varepsilon \tag{23}$$

$$\ln\left(\frac{P^{Eq}}{BE}\right) = \beta_0 + \beta_1 \ln(g^P) + \beta_2 \ln(roe) + \varepsilon . \tag{24}$$

47 For practical valuation purposes the regression approach is presented in *Damodaran* (2001), pp. 251–352; (1997), pp. 648–656; (1996), p. 291–356; (1994), pp. 197–262; *Benninga/Sarig* (1997), pp. 326–328. Other studies use this approach to examine major determinants of multiples, such as *Beaver/Morse* (1978), pp. 71–72; *Zarowin* (1990), p. 439; *Litzenberger/Rao* (1971), pp. 265–277.

A cross-industry regression in the individual observation years leads to the parameters and *t*-statistics (in brackets) contained in *Table 8*.[48]

Table 8: Cross-industry regression of pEq/E and pEq/BE multiples (homogeneous sample)[49]

Year	$\frac{P^{Eq}}{E} = \gamma_0 + \gamma_1 g^P + \gamma_2 roe + \varepsilon$				$\ln(\frac{P^{Eq}}{E}) = \beta_0 + \beta_1 \ln(g^P) + \beta_2 \ln(roe) + \varepsilon$				
	γ_0	γ_1	γ_2	R^2	β_0	β_1	β_2	R^2	N
1996	16.3	134.9	-47.5	16%	3.4	0.5	-0.4	30%	581
	(6.7)	(8.9)	(-6.1)		(36.6)	(12.1)	(-11.3)		
1997	20.7	80.2	-18.2	10%	3.6	0.4	-0.2	19%	604
	(12.4)	(7.8)	(-3.7)		(40.9)	(10.1)	(-7.4)		
1998	12.9	154.9	-22.0	12%	3.6	0.4	-0.2	21%	598
	(4.3)	(8.5)	(-2.6)		(31.6)	(11.1)	(-5.6)		
Year	$\frac{P^{Eq}}{BE} = \gamma_0 + \gamma_1 g^P + \gamma_2 roe + \varepsilon$				$\ln(\frac{P^{Eq}}{BE}) = \beta_0 + \beta_1 \ln(g^P) + \beta_2 \ln(roe) + \varepsilon$				
	γ_0	γ_1	γ_2	R^2	β_0	β_1	β_2	R^2	N
1996	-0.7	11.2	14.5	61%	2.9	0.4	0.6	52%	581
	(-3.7)	(9.8)	(24.8)		(32.3)	(9.8)	(19.1)		
1997	-0.6	10.9	18.6	51%	3.1	0.3	0.7	52%	604
	(-2.3)	(6.3)	(22.8)		(34.6)	(8.0)	(22.3)		
1998	-1.2	19.6	17.5	32%	3.5	0.5	0.6	41%	598
	(-2.7)	(7.2)	(14.0)		(26.9)	(10.1)	(16.0)		

For each sample company, the regression result can now be utilized to estimate the company's potential market price. As in the previous section, the resulting estimates can then be compared with the observed market capitalization. *Table 9* presents absolute prediction errors and percentage proportions within the 15% error range, and makes a comparison with the benchmark method $FUND^P$.

Empirical results from the regression approach strongly suggest that this particular method of controlling for fundamentals is not effective. This result does not appear to be surprising, since the theoretical link between multiples and the

48 To reduce distortions of outliers in the regression results and to make results more comparable to prior studies, such as *Bhojraj/Lee* (2001) the 1% extreme values of P^{Eq}/E, P^{Eq}/BE, ROE, g, ros, and roic were eliminated from the sample, which explains the reduced number of observations and lower prediction errors for $FUND^P$ in *Table 8*.

49 Source: *Herrmann* (2002), p. 232.

Table 9: Comparison of the regression approach and the comparable set approach[50]

	P^{Eq}/E-Multiple		P^{Eq}/BE-Multiple	
	Absolute prediction error*	**Proportion in the 15% interval****	**Absolute prediction error***	**Proportion in the 15% interval****
$FUND^P$ Median estimator	0.263	0.313	0.278	0.304
Regression (g^P, ROE)	0.351	0.219	0.318	0.254
In-regression (g^P,ROE)	0.297	0.263	0.312	0.265

* Absolute Prediction errors are calculated as the arithmetic mean of the three median errors in the three observation years 1996-1998.

** Calculated as the arithmetic mean of the annual proportions of absolute prediction errors not exceeding 15%.

derived factors contradicts central assumptions of multifactor linear regressions, such as missing collinearity between individual regression parameters, a linear relation between the different factors and the corresponding multiple, and a normal distribution of regression residuals[51]. Although the log models in (22) and (24) lead to some improvement in prediction accuracy the resulting precision still clearly falls short of a simple comparable set approach on the basis of relevant fundamentals as represented by FUND.

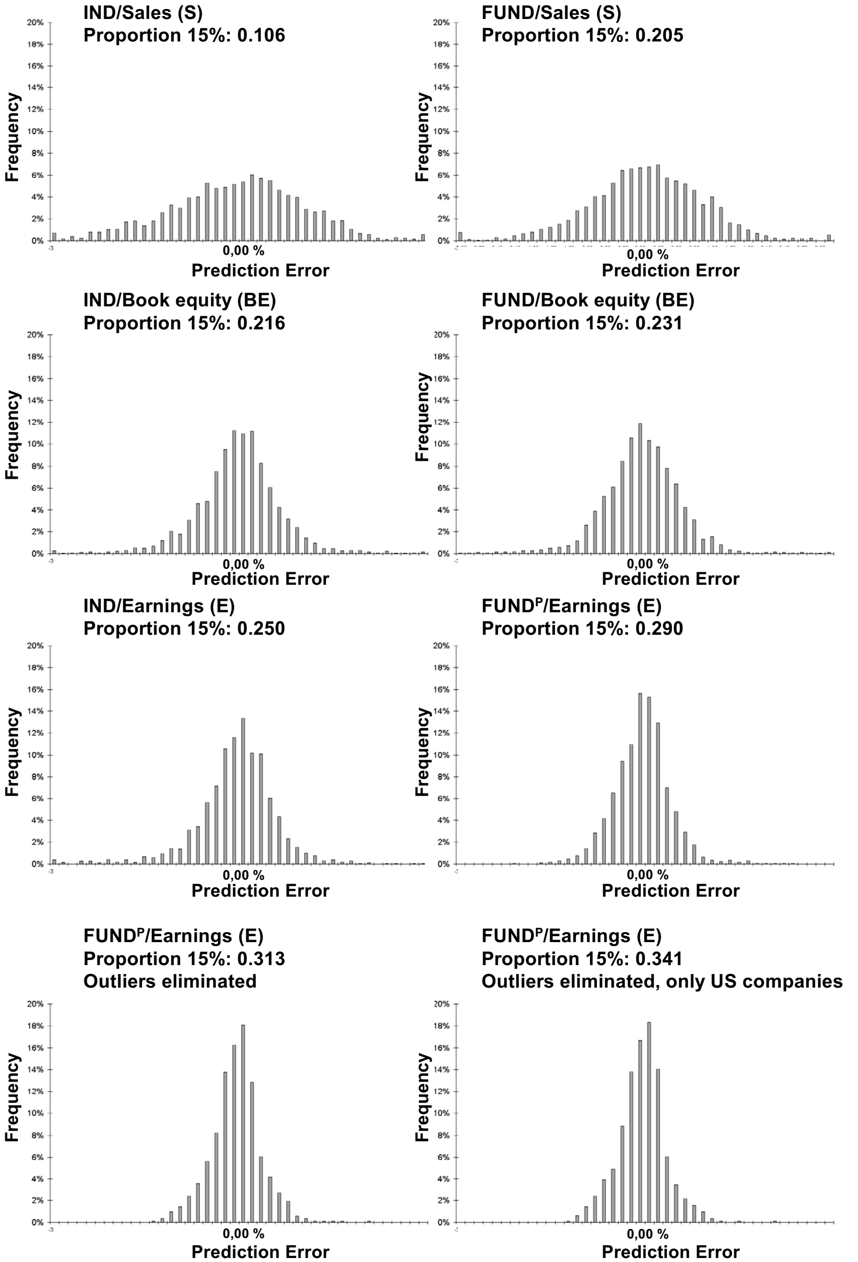
As a final summary *Figure 1* depicts how the pricing accuracy of multiples can be improved by choosing both the right basis of reference and an appropriate selection method (on the basis of control factors or of industry membership). Furthermore, the impact of an increasing homogeneity of the underlying sample becomes transparent. As explained above, average prediction errors decrease and the central tendency of the error distributions increases as the basis of reference moves further down in the income statement and relevant fundamentals are controlled for. As another interesting observation, the limitations in the U.S. capital market leads to some further improvement in pricing accuracy, an effect that cannot be observed if we limit the analysis to the German market. This observation might be due to either more efficient capital markets in the U.S., higher value relevance of U.S. accounting measures relative to their European counterparts, or a combination of both[52].

50 Source: *Herrmann* (2002), p. 233.

51 Within the context of the valuation models set out in this paper, the theoretical impact of g on the level of all multiples is exponential and therefore clearly contradicts the linear assumption. A linear relation can only be observed between roe and V^{Eq}/BE, as well as between roic and V^{Ent}/IC.

52 A higher value relevance of U.S. accounting measures, such as earnings and book equity, compared to their German counterparts is suggested in the empirical analysis of *Harris/Lang/Möller* (1994), pp. 187–209.

Figure 1: Distribution of prediction errors for different bases of reference, selection methods, and underlying samples (errors from −300 to 300 percent)[53]



53 Source: *Herrmann* (2002), p. 235.

4 Conclusion

This paper examines an appropriate use of market multiples. Based on a binomial process and the risk-neutral valuation approach, we show how multiples are linked with specific control factors. Empirical proxies for growth and profitability represent relevant criteria for the selection of comparable firms. On this basis, we empirically test different options for three major implementation challenges, namely the choice of an appropriate basis of reference, the selection method of comparable companies, and the choice of a suitable statistical multiple estimator.

The empirical results for the non-financial-services firms suggest the use of earnings as a highly aggregated performance measure. Book equity, invested capital, or sales multiples generally lead to much smaller pricing accuracy than earnings-based multiples, if relevant growth and profitability ratios are not controlled for. Sales multiples appear to be almost meaningless if comparisons are based on industry classification alone. After selecting comparable companies on the basis of control factors instead of industry classification, prediction accuracy increases, but is still lower than that produced by earnings multiples.

Despite the seemingly overwhelming importance of industry classification as a selection criteria for comparable companies, this study shows that predictions of considerably higher accuracy can be achieved if comparable firm selection is based on relevant fundamentals instead of SIC classifications. The relevant factors can be derived from valuation models. For example, median P^{Eq}/E multiples from cross-industry comparable sets selected exclusively on the basis of similar long-term I/B/E/S forecasts for earnings growth and roe lead to significantly smaller prediction errors than does a traditional industry approach based on SIC codes. Moreover, the additional control of industry membership does not increase the precision of cross-industry performance-controlled multiples. This observation suggests that industry classification (at least when using SIC codes as a proxy) does not contain superior information to that already controlled for by using the theoretically derived factors. The observation is robust against variations of industry, observation year, or basis of reference. The observtion even holds for less sophisticated proxies for earnings growth, such as historic sales growth rates. For the appropriate selection method based on fundamentals, the results in this paper strongly support the individual control for a limited number of truly relevant factors, rather than a highly aggregated measure such as a theoretical multiple.

Finally, in the choice of an appropriate statistical estimator, the empirical results outlined in this paper confirm the widely observed practice in empirical studies and practical valuation settings of using the median multiple of a limited comparable set as a capitalization factor. The retransformed mean of logged multiples represents a suitable alternative if the underlying sample shows a significant degree of skewness. In more homogeneous samples the harmonic mean leads to similar results, because the median and its prediction accuracy appears to be statistically indistinguishable.

As we expected, the arithmetic mean shows poor overall performance and constantly overestimates potential market price. The regression approach proposed by some authors is not an alternative to the approach using comparable sets. At least in the limited sample examined in this paper, a cross-industry regression of multiples as functions of a set of fundamental variables leads to significant higher estimation errors than does a “non-linear” comparable set method.

We suggest that future research in the area of performance-controlled multiples should address the following aspects: First, the sample of companies should be extended and differentiated by type of transaction, including IPOs and the merger market. In our study we covered only public market multiples. Second, we controlled for certain factors always and only in one point in time. We expect that accuracy of the pricing results can be further improved by controlling for transaction type and correlation of control factors over time. Third, we did not focus on the impact of different accounting standards and their application on market prices. However, this may also be reason for the obtained valuation errors.

References

Alford, Andrew W. (1992), The effect of the set of comparable firms on the accuracy of the price-earnings valuation method, in: Journal of Accounting Research, Vol. 30, pp. 94–108.

Baker, Malcom R./Ruback, Richard (1999), Estimating industry multiples, Working Paper, Harvard Business School, Boston.

Beaver, William H./Morse, Dale (1978), What determines price-earnings ratios? in: Financial Analysts Journal, July/August, pp. 65–76.

Beaver, William H./Ryan, Stephen G. (1993), Accounting fundamentals of the book to market ratio, in: Financial Analysts Journal, November/December, pp. 50–56.

Benninga, Simon Z./Sarig, Oded H. (1997), Corporate finance – a valuation approach, New York.

Berger, Philip/Ofek, Eli (1995), Diversification’s effect on firm value, in: Journal of Financial Economics, Vol. 37, pp. 39–65.

Bhojraj, Sanjeev/Lee, Charles M. C. (2001), Who is my peer? A valuation-based approach to the selection of comparable firms, forthcoming in: Journal of Accounting Research.

Boatsman, James R./Baskin, Elba F. (1981), Asset valuation with incomplete markets, in: The Accounting Review, Vol. 56, No. 1, pp. 38–53.

Copeland, Tom/Koller, Tim/Murrin, Jack (2000), Valuation, measuring and managing the value of companies, 3rd Edition.

Copeland, Tom/Koller, Tim/Murrin, Jack (1996), Valuation, measuring and managing the value of companies, 2nd Edition.

Conover, William, J. (1980), Practical nonparametric statistics, New York.

Cox, John C./Ross, Stephen A./Rubinstein, Mark (1979), Option pricing: a simplified approach, in: Journal of Financial Economics, Vol. 7, pp. 229–263.

Damodaran, Aswath (1994), Damodaran on valuation: Security analysis for investment and corporate finance.

Damodaran, Aswath (1996), Investment valuation, tools and techniques for determining the value of any asset.

Damodaran, Aswath (1997), Corporate finance – Theory and practice, New York.

Damodaran, Aswath (2001), The dark side of valuation, New York.

Feltham, Gerald A./Ohlson, James A. (1995), Valuation and clean surplus accounting for operating and financial activities, in: Contemporaray Accounting Research, Vol. 12, pp. 689–731.

Gilson, Stuart C./Hotchkiss, Edith S./Ruback, Richard S. (2000), Valuation of bankrupt firms, in: The Review of Financial Studies, Vol. 13, pp. 43–74.

Gordon, Myron J. (1962), The investment, financing, and valuation of the corporation, Illinois.

Gordon, M./Shapiro, E. (1956), Capital equipment analysis: The required rate of profit, in: Management Science, Vol. 3, pp. 102–110.

Harris, Trevor/Lang, Mark H./Möller, Peter (1994), The value relevance of German accounting measures: An empirical analysis, in: Journal of Accounting Research, Vol. 32, pp. 187–209.
Herrmann, Volker (2002), Marktpreisschätzung mit kontrollierten Multiplikatoren, Köln.
Kaplan, Stephen N./Ruback, Richard S. (1995), The valuation of cash flow forecasts: An empirical analysis, in: The Journal of Finance, Vol. 50, pp. 1059–1093.
Kaplan, Stephen N./Ruback, Richard S. (1996), The market pricing of cash flow forecasts: Discounted cash flow vs. the method of "comparables", in: Journal of Applied Corporate Finance, Vol. 9, pp. 45–60.
Kim, Moonchul/Ritter, Jay R. (1999), Valuing IPOs, in: Journal of Financial Economics, Vol. 53, pp. 409–437.
Koeplin, John/Sarin, Atulya/Shapiro, Alan C. (2000), The private company discount, in: Journal of Applied Corporate Finance, Vol. 13, pp. 94–101.
Lakonishok, Josef/Shleifer, Andrei/Vishny, Robert W. (1994), Contrarian investment, extrapolation, and risk, in: The Journal of Finance, Vol. 49, pp. 1541–1578.
Litzenberger, Robert H./Rao, Cherukuri U. (1971), Estimates of the marginal rate of time preference and average risk aversion of investors in electric utility shares: 1960–66, in: The Bell Journal of Economics and Management Science, Vol. 2, pp. 265–277.
Liu, Jing/Nissim, Doron/Thomas, Jacob (2002), Equity valuation using multiples, in: Journal of Accounting Research, Vol. 40, pp. 135–172.
Ohlson, James A. (1990), A synthesis of security valuation theory and the role of dividends, cash flows, and earnings, in: Contemporary Accounting Research, Vol. 6, pp. 648–676.
Pliska, Stan (1997), Introduction to Mathematical Finance, Discrete Time Models, Massachusetts.
Purnanandam, Amiyatosh K./Swaminathan, Bhaskaran (2001), Are IPOs underpriced?, Working Paper, Cornell University.
Rappaport, Alfred (1998), Creating shareholder value, 2nd Edition.
Richter, Frank (2001), Simplified discounting rules in binomial models, in: sbr, Vol. 53, pp. 175–196.
Richter, Frank. (2002), Simplified discounting rules, variable growth, and leverage, in: sbr, Vol. 54, pp. 136–147.
Rock, Kevin (1986), Why new issues are underpriced, in: Journal of Financial economics, Vol. 15, pp. 188–212.
Shleifer, Andrei/Vishny, Robert W. (1997), The limits of arbitrage, in: The Journal of Finance, Vol. 52, pp. 35–55.
Zarowin, Paul (1990), What determines earnings-price ratios: Revisited, in: Journal of Accounting, Auditing & Finance, Vol. 5, pp. 439–454.

Schmalenbach Business Review ◆ Vol. 55 ◆ July 2003 ◆ pp. 220 – 241

Rudi K. F. Bresser/Klemens Millonig*

INSTITUTIONAL CAPITAL: COMPETITIVE ADVANTAGE IN LIGHT OF THE NEW INSTITUTIONALISM IN ORGANIZATION THEORY**

ABSTRACT

Neoinstitutional organization theory contains an important message for strategic management: A firm's existence and competitive advantage is strongly affected by its institutional environment. However, the strategic management literature disregards the role of the institutional environment when modeling competitive advantage. This paper develops an integrative model of competitive advantage that draws on prevailing concepts in strategic management and neoinstitutional theory. The model distinguishes three types of institutional capital: cognitive, normative, and regulative capital. The implications for generating and managing institutional capital are discussed.

JEL-Classification: A1, L1, M1.

Keywords: Competitive Advantage; Institutional Capital; Neoinstitutional Organization Theory; Strategic Management.

1 TOWARD AN INTEGRATIVE FRAMEWORK

Neoinstitutional organization theory has received increasing attention in strategic management research during the past decade. However, the theory's role in developing models of competitive advantage has been neglected. When explaining competitive advantage, the strategic management literature typically draws on industrial organization research and on the resource-based view. In contrast, neoinstitutional theory is used to address questions such as the institutionalization of organizational designs and practices[1], whether organizational isomorphism can increase organizational legitimacy[2], or, more generally, how legitimacy can be managed[3]. Only rarely is neoinstitutional theory used in the context of explaining competitive advantage[4].

* Univ.-Prof. Dr. *Rudi K. F. Bresser*/Dr. *Klemens Millonig*, Freie Universität Berlin, Fachbereich Wirtschaftswissenschaft, Institut für Management, Garystrasse 21, D-14195 Berlin, e-mail: bresser@wiwiss.fu-berlin.de, millo@zedat.fu-berlin.de.

** Helpful comments on earlier drafts of this paper from *Roger Dunbar* and an anonymous reviewer are gratefully acknowledged.

1 See, e.g., *Fligstein* (1985); *Haunschild* (1993); *Zajac/Westphal* (1995).
2 See *Deephouse* (1996; 1999).
3 See *Suchman* (1995).
4 See *Oliver* (1997).

The somewhat reluctant acceptance of neoinstitutional theory as a part of the theoretical mainstream in strategic management is due to some unresolved problems. For instance, central concepts such as the term "institution" itself are not clearly defined, because institutionalists vary in the emphasis they place on the macro and micro features of institutions[5]. The theory also has difficulties explaining institutional change[6], and depicts organizations and individuals as oversocialized[7]. A further reason for the slow integration is a paradigmatic difference between the two disciplines: Although most strategic management theorizing is based on a functionalist paradigm, neoinstitutional theory is conceived as an interpretive approach that rejects functional explanations[8]. Could a functionalist explanation also be an interpretation?

Despite this criticism, we believe that neoinstitutional theory can be integrated at the core of strategic management theory. This integration can be accomplished by using as the relevant framework the more moderate interpretations typical of recent neoinstitutional work. If, in fact, the generation and explanation of sustainable competitive advantage is the central task of strategic management[9], then it is essential to consider the institutional context, because a firm's competitive success and survival is strongly impacted by the institutional environment.

This paper develops a comprehensive model of sustainable competitive advantage by considering neoinstitutional arguments and those arguments typical of the mainstream strategic management literature side by side. The paper begins by distinguishing between different institutions and institutional theories. We then provide a brief account of the new institutionalism in organization theory. We describe how prevailing strategic management models explain competitive advantage and then present institutional explanations. This analysis leads to the development of an integrated model and a detailed discussion of the institutional elements contained in this model.

2 Institutions and Institutional Theories

Generally speaking, institutions can be defined as behavioral expectations that can be sanctioned if violated[10]. It is further possible to distinguish two broad types of institutions, fundamental and secondary (deduced) institutions[11].

Fundamental institutions represent generally accepted norms and values that have evolved at a societal level, for example, human rights or professional ethics.

5 See, e.g., *DiMaggio/Powell* (1991b); *Walgenbach* (2002).
6 This problem has been addressed by a recent special issue of the Academy of Management Journal. See *Dacin et al.* (2002).
7 See *Granovetter* (1985); *Bresser* (1998), pp. 341–345; *Walgenbach* (2002).
8 See *Gioia/Pitre* (1990); *Walgenbach* (2002); *Müller-Jentsch* (2002). It is noteworthy that in spite of this paradigmatic difference, there are also epistemological similarities. Both, neoinstitutional and strategic management studies are based on qualitative as well as quantitative research designs.
9 See, e.g., *Bresser* (1998), p. 4; *Welge/Al-Laham* (2001), p. 6; *Wheelen/Hunger* (2002), p. 2.
10 See *Dietl* (1993), pp. 35–39, and similarly *Jepperson* (1991), p. 145.
11 See *Dietl* (1993), pp. 67–84; *Picot et al.* (2002), pp. 10–25.

They are adhered to largely at a subconscious level, because individuals have internalized the respective norms and values and often cannot even conceive of alternatives. Fundamental institutions are taken for granted and are difficult to change through purposive design.

Secondary institutions are deduced from fundamental institutions to regulate specific societal problems. They include laws, contracts, organizations, and organizational rules and procedures. Thus, secondary institutions are much more amenable to conscious design than are fundamental institutions. Although many norms and values represented by secondary institutions are consciously perceived, they too can become internalized and taken for granted. For instance, organization members internalize the values constituting an organization's culture over time and then take them for granted.

Although there may be as many new institutional theories as there are social science disciplines[12], only two are relevant for the development of strategic management theory: neoinstitutional economics and neoinstitutional organization theory. Arguably, neoinstitutional economics has had a more pronounced impact on the development of strategic management thinking than has neoinstitutional organization theory[13].

There are several similarities and differences between the two neoinstitutionalisms. The two most important similarities are that both theories assume that human actors are constrained by bounded rationality, and that both theories hold that organizations are important institutions. However, there are also important differences between the two approaches. For example, in contrast to neoinstitutional organization theory, neoinstitutional economics embraces the functionalist paradigm.

We believe that a more important difference concerns the two types of institutions distinguished. Neoinstitutional economics is primarily concerned with the design and adaptation of efficient secondary institutions such as governance structures[14], but neoinstitutional organization theory focuses on the effects that internalized norms and values, represented by fundamental and secondary institutions, have on individuals, organizations, and organizational fields. Assumptions that are taken for granted lead to behaviors that are based on habit and convenience. Such behaviors complicate the search for efficient solutions[15]. Recent work suggests a

12 See *DiMaggio/Powell* (1991b), p. 1.

13 For accounts of the pervasiveness of neoinstitutional economics in strategic management see, e.g., the special issue of the Strategic Management Journal, Vol. 12, *Winter* (1991) or *Mahoney/Pandian* (1992).

14 Modern institutional economics considers "adaptation" as "the central problem of economic organization", *Williamson* (1999), p. 1101; similarly *Dietl* (1993).

15 Thus, the two institutionalisms place a different emphasis on the way institutions contribute to bounded rationality. Both theories acknowledge that rationality is bounded because of an individual's incomplete information and limited information processing capacity *and* because of the constraining effects arising from institutional environments. However, institutional economists do not believe the institutional environment to be as constraining on organizational choice as do institutional organization theorists. For institutional economists conscious choice remains possible (see,

possible integration of the two neoinstitutionalist approaches[16]. Although this line of thinking is fascinating, it is beyond the scope of this paper, where the focus is on the role of neoinstitutional organization theory for strategic management.

3 Basics of Neoinstitutional Organization Theory

We note that for the balance of this paper, the terms (neo)institutional theory, institutionalist(s), and institutionalism will refer to the new institutionalism in organization theory.

Central to neoinstitutional theory is the assumption that organizational behavior, routines, and structures are more often determined by cultural norms and values than by efficiency considerations. Within each society there are fundamental institutions embodying expectations that specify why organizations may be useful, what purposes they should fulfill, and how they should be designed[17]. To attain legitimacy and resources, organizations must adapt to these pressures from their institutional environment. The result is that organizations constituting an "organizational field"[18] become institutionally isomorphic over time, i.e., they resemble each other more and more in their behaviors and structures.

Neoinstitutionalism is characterized by two complementary research traditions, a macro- and a microlevel approach[19]. Macroinstitutionalism considers the sources of institutionalization as being located within the external environment of organizations. Microinstitutionalism assumes that these sources are internal to organizations. Both approaches can help to explain an organization's ability to obtain and dispose of resources, and thus are relevant for understanding economic success.

Macroinstitutionalists establish a direct link between adaptation and resource management capabilities: by adopting structures and processes that are considered institutionally desirable, organizations adapting to *external institutional pressures*

e.g., *Williamson* (1991); *Dietl* (1993), pp. 71–76; *Picot et al.* (2002), p. 15, 54), while the traditional institutional organization theorists reject the possibility of rational choice because taken-for-granted assumptions allow for habitual behavior only (see, e.g., *DiMaggio/Powell* (1983); *Zucker* (1977)). However, more moderate institutional organization theorists allow for choice within institutional constraints (see, e.g., *Oliver* (1991); *Powell* (1991)).

16 See, e.g., *Eisenhardt* (1988); *Roberts/Greenwood* (1997); *North* (1998). According to the constrained-efficiency framework proposed by *Roberts/Greenwood* (1997) an integration seems possible, if efficiency-seeking economic actors are modeled as being biased towards current governance structures and those that are legitimated within their institutional contexts.

17 See, e.g., *Lawrence* (1999); *Scott/Meyer* (1994); *Walgenbach* (1999; 2002).

18 "By organizational field we mean those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products" (*DiMaggio/Powell* (1983), p. 148). Since the organizational field is an organization's relevant external environment, the term is similar to the sum of the "task environment" and the "societal environment", two concepts commonly used in strategic management (see, e.g., *Wheelen/Hunger* (2002), p. 11).

19 For detailed accounts of these approaches, see, e.g., *Scott* (1987); *Hasse/Krücken* (1999); *Millonig* (2002).

can attain legitimacy[20]. Since legitimacy is necessary for organizations to obtain and dispose of resources, only institutionally legitimated organizations can persist. Thus, legitimacy is more important for survival than efficiency. Organizations that resist institutional pressures face legal, economic, and social sanctions that threaten not just their profitability, but their very existence. Thus traditional macroinstitutionalists portray organizations as passive entities dominated by institutional pressures[21].

Microinstitutionalists argue that an organization's ability to manage resource flows depends largely on its ability to accommodate *internal institutional pressures*[22]. The more organizational structures and processes become institutionalized, the more they become taken for granted, and the more they will persist and dominate behavior[23]. High levels of institutionalization prevent organizational actors from acting intentionally and reflecting on their behavior. Instead, behavior is institutionally determined, routinized, and legitimated.

Institutional reasoning has direct consequences for the strategic management of firms because internal and external institutional environments have a profound impact on organizational success and survival. However, the arguments put forth in classical neoinstitutionalist analyses[24] are too restrictive for strategic management theorizing. Institutional environments are depicted as overly constraining, which does not square with the strategic choice perspective[25] favored in strategic management. There must be ways for organizations to manage their institutional environments[26]. Alternative interpretations are needed for an integration of the two perspectives. Such alternatives are, in fact, provided in more recent neoinstitutionalist publications. However, before we can develop an institutional model of competitive advantage in light of these recent contributions, we must summarize the major concepts of competitive advantage as they are described in the field of strategic management.

4 Models of Competitive Advantage Within Strategic Management

Three approaches to explain competitive advantage prevail in the field of strategic management: the market-based view, the resource-based view, and the "Austrian" school[27].

20 See *Meyer/Rowan* (1991); *DiMaggio/Powell* (1991a).

21 An exception to these restrictive assumptions among early institutionalists are *Meyer/Rowan* (1977), who advocated a "decoupling", i.e., a ceremonial adaptation to institutional pressures at the structural level of organizations but not at the operative level of ongoing activities.

22 See *Zucker* (1977; 1987; 1988).

23 See *Berger/Luckmann* (1972), p. 64; *Zucker* (1977).

24 See, e.g., *DiMaggio/Powell* (1983); *Zucker* (1977).

25 See, e.g., *Child* (1972); *Zajac/Kraatz* (1993).

26 The problem with accepting the classical argument that institutionalization elicits habitual, unvarying behavior is to assume that organizations cannot recognize that their practices may have become obsolete because the competitive environment has changed to favor more efficient alternatives. Taken to the extreme, these forms of institutionalization represent a "paradigm stasis" (see *Kondra/Hinings* (1998); *Oliver* (1996)), threatening organizational survival.

27 See, e.g., *Collis* (1994); *Bresser* (1998); *Jacobson* (1992).

Within *Porter*'s *market-based view*[28], competitive advantage results from a firm's *superior position* in an industry, which a firm can attain by pursuing a generic strategy. Firms with a superior position generate monopoly rents because they succeed in restraining productive output[29].

Advocates of the *resource-based view* do not deny the importance of industry characteristics, but they consider resource heterogeneity to be the primary driver of competitive advantage[30]. They argue that *firm-specific* bundles of *resources and capabilities* that are valuable, rare, difficult to imitate, non-substitutable and imperfectly mobile are the sources of sustained competitive advantage. Firms with such superior resources realize Ricardian rents, because they succeed in restraining the competition for inputs[31].

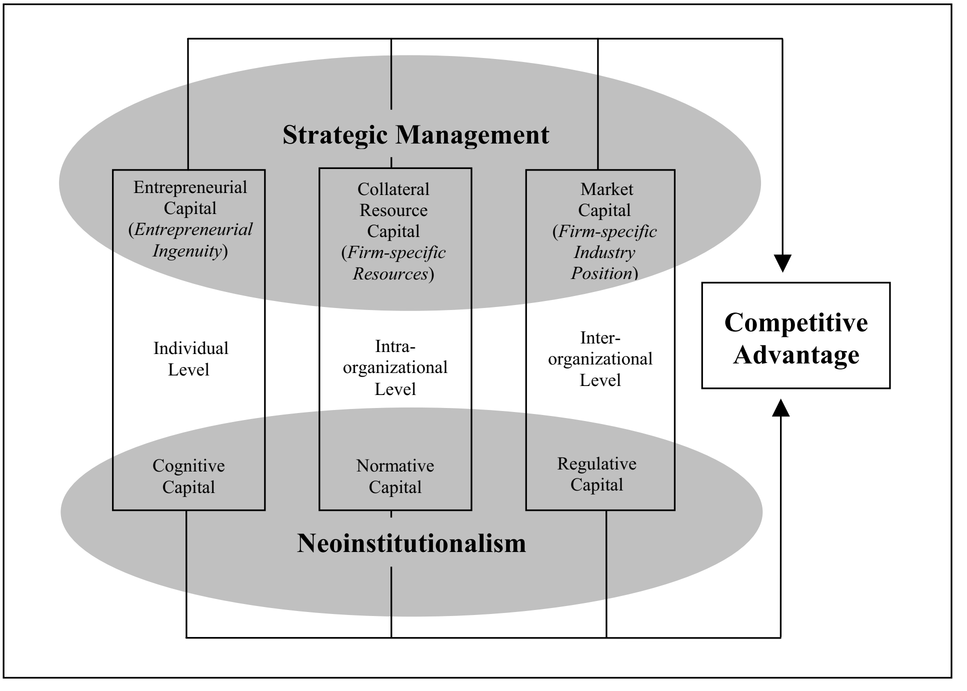
Both the market- and the resource-based views explain competitive advantage under the assumption of relatively stable competitive conditions. The "Austrian" logic highlights the dynamic and evolutionary features of competitive advantage[32]. The idea of "sustainability" is increasingly questioned and replaced by notions of "temporary" competitive advantage. Creatively destructive entrepreneurs[33] attain *Schumpeterian* rents by risk-taking and entrepreneurial insight in dynamic and complex environments. Due to the dynamics of entrepreneurial activity, any competitive advantage and the associated rents can only be temporary.

The upper part of *Figure 1* illustrates how competitive advantage can be explained in terms of three levels. First, at the level of the individual and based on "Austrian" economics, competitive advantage can be explained in terms of *entrepreneurial ingenuity*. Second, at the intraorganizational level and drawing on the resource-based view, competitive advantage can be explained in terms of *firm-specific resources*. And third, at the interorganizational level and based on the market-based view, competitive advantage can be explained in terms of *firm-specific industry positions*.

It is useful to cast the above advantages in a resource-based logic. Firms with ingenious entre- or intrapreneurs[34] own a specific nonmaterial resource that can be labeled *entrepreneurial capital*. Similarly, firms with a superior industry position control a special nonmaterial resource that can be called *market capital*. When firms possess additional firm-specific resources and capabilities that meet the resource-based view's desiderata (e.g., preferable locations, superior R&D, or marketing know-how), these can be called *collateral resource capital*.

28 See *Porter* (1980; 1985).
29 See, e.g., *Conner* (1991); *Mahoney/Pandian* (1992).
30 See, e.g., *Amit/Schoemaker* (1993); *Barney* (1991); *Peteraf* (1993).
31 See *Mahoney/Pandian* (1992).
32 See *Jacobson* (1992); *Mahoney/Pandian* (1992); *Rühli* (1998).
33 See *Schumpeter* (1912).
34 See *Burgelman* (1983).

Figure 1: An Integrative Explanation Of Competitive Advantage Based On Neoinstitutional And Strategic Management Theory



5 A Neoinstitutional Model Of Competitive Advantage

The classical neoinstitutionalists' assumptions are too restrictive for the strategic management field because they depict individuals and organizations as "oversocialized" actors who can only passively accept the dictates of their institutional environments. This simplified view has been criticized and corrected in recent neoinstitutionalist writings[35]. An important clarifying contribution has been provided by *Scott*, who suggests that an institution is best understood in terms of three interacting components or pillars: regulative, normative, and cognitive. These components define each institution in varying degrees[36], and impact the actors within an institutional field differently[37]:

Regulative Component: This component focuses on formal and informal rules that are monitored and sanctioned in case of violation. The threat of sanctions, for example, when laws are violated, encourages conformity. The *fear of potential sanctions* lets actors realize that it is in their own best interests to avoid violations

35 See, e.g., *Powell*, (1991); *Oliver* (1991); *Roberts/Greenwood* (1997).
36 This holds regardless of the type of institution (fundamental or secondary).
37 See *Scott* (1995), pp. 33–42.

or, at least, to maintain the semblance of behaving in conformity with rules[38]. In this sense, the regulative component of an institution exercises *coercive pressures.*

Normative Component: The normative component comprises norms and values that define the types of behaviors that are considered desirable, appropriate, and correct. Values and norms provide individuals and organizations with standards to evaluate, compare, and guide behavior. In contrast to the regulative component, compliance is not the result of coercive pressures. Rather, the basis of compliance is *acceptance of and conformity with* the norms and values[39]. Compliance is considered a moral obligation. The pressures emanating from this component of institutions are called *normative pressures.*

Cognitive Component: This component of institutions relates to the ways in which individuals perceive and interpret reality, a reality that is always a social construction. The cognitive component can be defined as the sum of all internalized values and norms, i.e., all aspects of institutions that are *taken for granted* and which determine how individuals react to environmental stimuli[40]. Taken-for-grantedness defines an individual's actions as well as his/her interests at a subconscious level. Thus, compared to the normative component, the cognitive component emphasizes subjective taken-for-granted assumptions and exercises *cognitive pressures.*

The institutional context of an organization is a multidimensional phenomenon, not only because of the many different institutions exerting pressures, but also because each institution can be characterized by the three different components[41]. In line with the two complementary neoinstitutionalisms, it is useful to distinguish between the internal and external institutional context. When using the macroinstitutionalist frame of reference as a basis for analyzing the context, several issues become apparent. First, the existence of normative and regulative components implies that organizations can respond to external institutional pressures. Organizational actors can consciously decide to act in conformity with external rules and norms either because they fear sanctions or because they consider certain norms and values as appropriate.

Second, the sources of the institutions and their three components are external to an organization. The three components specify types of influence that define socially acceptable behavior in an organizational field. Thus, the *external institutional context* can be defined as socially legitimated behavior that affects an organization in the form of regulative, normative, and cognitive pressures. Pressures emanate from external institutional actors such as the government, regulatory agencies, professions, or other societal interest groups.

When adopting a microinstitutionalist's perspective, the relevant institutional context is the organization itself, with its structures and activities that have been insti-

38 See *Walgenbach* (2000), p. 53.
39 See *Scott* (1995), pp. 37–39.
40 See *D'Andrade* (1984), p. 88.
41 See *Scott* (1995), p. 35.

tutionalized over time[42]. *Zucker* established the importance of *intraorganizational* norms, values, and taken-for-granted assumptions[43]. She argues that due to an organization's unique history, different institutional elements like norms, values, structures, and routines evolve. These internally sourced institutions govern the behavior of an organization and its members. When defining the internal institutional context, the regulative component of institutions is excluded, because it is inconsistent with the logic of microinstitutionalism[44]. In contrast to macroinstitutionalism, microinstitutionalism assigns much greater weight to the cognitive internalization of institutions and explains such internalization in the context of intraorganizational processes. Thus, the *internal institutional context* is defined as socially legitimated behavior that operates within organizations in the form of normative and cognitive pressures. Although the internal institutional context can be just as persistent (resistant to change) as the external institutional context, the normative and cognitive pressures emanating from the two contexts do not have to be identical.

The strategic management literature has rarely addressed the question of whether a firm's institutional contexts can be managed to gain competitive advantage. A notable exception is *Oliver*'s analysis[45]. *Oliver* combines the resource-based view with neoinstitutional thinking. *Oliver* contends that the institutional context[46] exerts an important influence on an organization's *resource selection processes*, and thus on firm heterogeneity and sustainable competitive advantage. Because of the institutional context, organizations acquire different resources and evolve in idiosyncratic ways. Thus, resource heterogeneity is not just a function of incomplete factor markets, i.e., the inability to obtain resources, but also of an institutional context, which may prompt unwillingness among organizations to obtain certain resources. *Oliver* concludes that if the institutional context allows for the acquisition and development of superior resource bundles, then organizations may possess not just resource capital, but also *institutional capital*.

This paper extends *Oliver*'s ideas by analyzing more generally how the institutional context may be a source of competitive advantage, not just as it pertains to resource acquisition processes. Thus, we distinguish three types of institutional capital at three levels. The model is shown in *Figure 2*.

Figure 2 superimposes the three components of institutions on the three levels where competitive advantage may accrue, i.e., the individual, intraorganizational, and interorganizational levels. What results are three intersections that indicate where organizations can generate institutional capital that can lead to institution-

42 "Institutional elements commonly arise from within the organization itself […], not from power or coercive processes located in the state or elsewhere." (*Zucker* (1987), p. 446).

43 See *Zucker* (1977; 1988; 1991).

44 "[coercive pressure is] central […] in the environment-as-institution approach, but it is explicitly considered deinstitutionalizing in the organization-as-institution approach, since any use of sanctions indicates that other attractive alternatives exist." (*Zucker* (1987), p. 446).

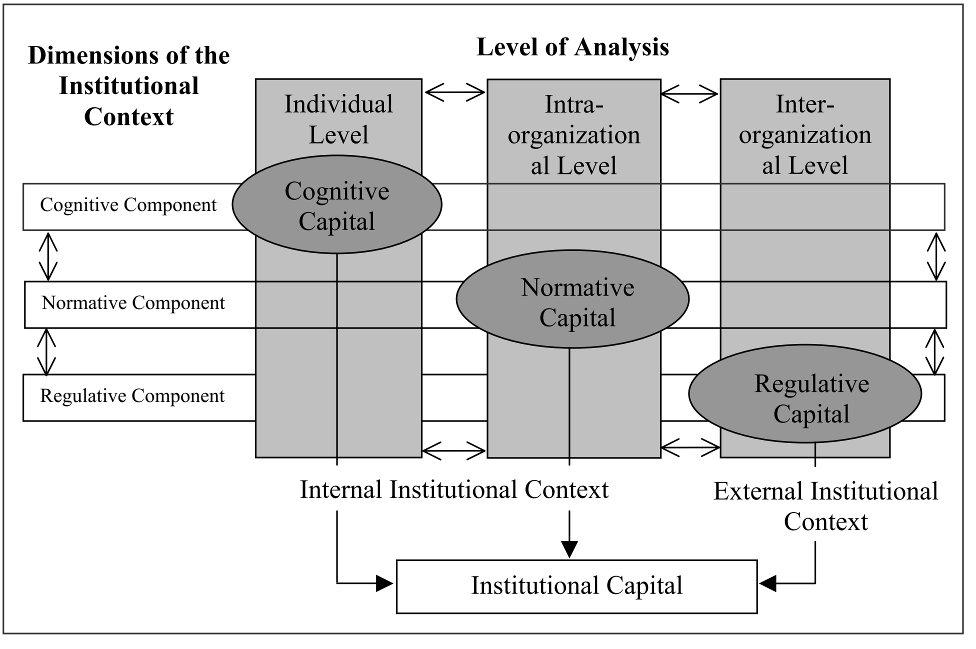
45 See *Oliver* (1997).

46 The institutional context is defined by *Oliver* (1997), p. 697, as a combination of internal and external aspects that include a firm's "internal culture as well as broader influences from the state, society, and interfirm relations that define socially acceptable economic behavior."

ally based competitive advantage. We define *institutional capital*, in general terms, as the specific conditions in an organization's internal and external institutional context that allow the formation of competitive advantage.

The internal institutional context is associated with competitive advantage that originates at the individual and intraorganizational levels, because the internal context is relevant for both the organization and its individual members[47]. The intersection between the cognitive component of institutions and the individual level relates to competitive advantage resting on the interpretive schemes of an organization's decision makers. Consequently, decision makers' cognitive abilities represent the *cognitive capital* of an organization.

Figure 2: Institutional Capital



Normative capital is generated at the intraorganizational level, and denotes competitive advantage resulting from an organization's institutionalized norms, values, structures and routines. *Figure 2* indicates normative capital at the intersection between the intraorganizational level and the normative component[48].

Finally, *regulative capital* results from the specific conditions of an organization's external institutional context. It denotes competitive advantage that organizations

47 "It holds that organizations and the individuals who populate them are suspended in a web of values, norms, rules, beliefs, and taken-for-granted assumptions." (*Barley/Tolbert* (1997), p. 93).

48 Since the regulative component is irrelevant for the definition of an internal institutional context (*Zucker* (1987), p. 444), it is not superimposed on the individual and intraorganizational levels in *Figure 2*.

generate when dealing with the formal and informal demands of external institutional actors. *Figure 2* indicates regulative capital at the intersection between the interorganizational level and the regulative component. The following section provides more detailed definitions of the three types of institutional capital, along with a more precise delineation of how competitive advantage can be understood on the basis of neoinstitutional theory.

6 Institutional Capital

6.1 Internal Institutional Capital

Internal institutional capital appears at both the individual and intraorganizational levels. The associated cognitive and normative institutional components operate differently in different organizations, and thus help to explain why organizations are dissimilar (heterogeneous) and why isomorphic tendencies within organizational fields are limited[49].

6.1.1 Individual Level

The importance of top-level decision makers for a firm's strategies and overall success has been addressed by several strategic management research traditions[50]. These approaches base their arguments on the assumption that decision makers are economically rational within the cognitive constraints of bounded rationality. In contrast, neoinstitutional theorists are critical of rational-actor models[51] and suggest that decision makers are not so much constrained by incomplete information and limited information processing capacities as by their institutional context. If a decision to improve an organization's efficiency or effectiveness might violate institutionalized norms, values, structures, or routines, management abandons it in favor of an institutionally more acceptable alternative. Institutionalized structures and routines are 'cognitive sunk costs' and persist. Cognitive sunk costs, such as the fear of change or a preference for traditions, are social and psychological barriers that prevent individuals from relinquishing established habits and routines in favor of economically more beneficial alternatives[52].

It is important to note that the rejection of economically rational alternatives in favor of those that are institutionally acceptable can be either a conscious or a

49 "While regulative influences may apply uniformly within an industry, thereby inducing isomorphism among firms, normative and cognitive influences, because they often vary from firm to firm are perhaps more apt to engender interfirm differences." (*Miller* (1996), p. 287).

50 In line with "Austrian" economics, some authors have highlighted the role of the entrepreneur (see, e.g., *Jacobson* (1992); *Young* (1995)) or the intrapreneur (see *Burgelman* (1983)). A second influential stream of research is based on the "upper echelons" perspective initiated by *Hambrick/Mason* (1984).

51 Traditionalists reject the possibility of rational choice altogether, while moderates allow for economically rational choices within institutional constraints. See footnote 15.

52 Since cognitive sunk costs rise with an increasing insititutionalization of structures and processes, it holds that higher degrees of insitutionalization via higher cognitive sunk costs increase the probability of economically inferior decisions (see *DiMaggio/Powell* (1991a); *Powell* (1991); *Oliver* (1997)).

subconscious process. On the one hand, decision makers can consciously realize and, for example, discard decisions that might violate institutional norms and habits. In such instances, cognitive sunk costs lead to a conscious rejection of alternatives. On the other hand, such a rejection may also occur at a subconscious level, when taken-for-granted assumptions prevent decision makers from even realizing that other, e.g., more efficient, alternatives exist[53]. What follows is that an organization may gain competitive advantage relative to its competitors, as its decision makers have comparatively lower levels of cognitive sunk costs and taken-for-granted assumptions. Thus, they are less opposed to economically rational alternatives. Decision makers who manage to overcome institutional barriers to change and implement economically beneficial solutions may develop competitive advantages for a firm. Since such firm competitive advantage is based on the cognitive capacities of its decision makers, cognitive capital can be defined as follows: An organization possesses *cognitive capital* to the extent that its decision makers have comparatively low levels of cognitive sunk costs and taken-for-granted assumptions, so that the potential for economically inferior decisions is low.

6.1.2 Intraorganizational Level

The intraorganizational level is dominated by the normative component of institutions, which is relevant for an organization in two ways: First, a normative component exerts external pressures on an organization by specifying institutionally desirable behavior. Typically, an organization voluntarily adheres to and adopts such norms. Second, a normative component is also considered to be organizationally internalized to the extent that it is reflected in an organization's structures, strategies, and routines[54].

The organizations' idiosyncratic internal institutional contexts elicit varying responses to influences from the external environment[55]. A case in point is the demand to adopt modern information technology. While some organizations embrace this opportunity, others with a 'low-tech-culture' resist it because modern technologies infringe on their internal system of norms and values. Such resistance is similar to the resource-based concept of an 'isolating mechanism.' The unwillingness to acquire an otherwise accessible resource because it fails to fit with prevailing cultural norms can be called an *institutional isolating mechanism*[56].

Institutional isolating mechanisms do not operate only with regard to resource acquisition decisions. They are relevant for all types of organizational decisions. An 'institutional filter' determines to what extent specific environmental demands are compatible with an organization's system of norms and values and should therefore be adopted. Thus, just like in the case of individual decision makers, decisions favored by organizations are not always governed by efficiency considerations. If efficiency-enhancing decisions are not compatible with an organiza-

53 See *Oliver* (1997), p. 700.

54 *Scott* (1995), p. 40, acknowledges this duality by stating that values and norms "…are both internalized and imposed by others."

55 See *Zucker* (1991); *Tolbert* (1988); *Miller* (1996).

56 See *Oliver* (1997), pp. 704–705.

tion's norms and values, they will either not be adopted or they will be adopted only in modified forms. This reasoning leads to the conclusion that competitive advantage at the intraorganizational level results from the ability of an organization to attain a dynamic strategic fit[57] between efficiency considerations and the demands emanating from its internal institutional context. An organization possesses *normative capital* if its internal system of norms and values allows for an easy modification of its structures, routines, and resources.

6.2 External Institutional Capital

The interorganizational level is where external institutional actors exert pressure by threatening punishment in cases of noncompliance. Central to these external pressures is the regulative component of institutions, i.e., the formal and informal *"rules of the game"*[58].

The most important external institutional actor is the state, with its regulative processes of rule setting, monitoring, and sanctioning. Since a violation of laws and government regulations can lead to harsh economic and social sanctions, the state and its agencies are very powerful drivers of institutional isomorphism[59]. However, the state can also be a source of firm heterogeneity if its actions protect firms and at least temporarily bestow a competitive advantage on them. For example, if the state intensifies its environmental regulations, a firm with high environmental protection standards may realize a temporary competitive advantage because it will not have to upgrade its facilities.

Apart from the state, there are many other institutional actors that can exert coercive pressures on organizations, e.g., clients, banks, unions, the media, and consumer protection agencies. These other institutional actors do not just constrain a focal organization; they can also be sources of competitive advantage. By developing stable and trusting relationships with members of the institutional environment, organizations can secure an early access to privileged information and influence the behavior of these critical actors. Thus, an organization possesses *regulative capital* if it can gain support from relevant institutional actors for its goals and actions, and if it can influence formal and informal rules to its advantage.

7 The Management Of The Institutional Context

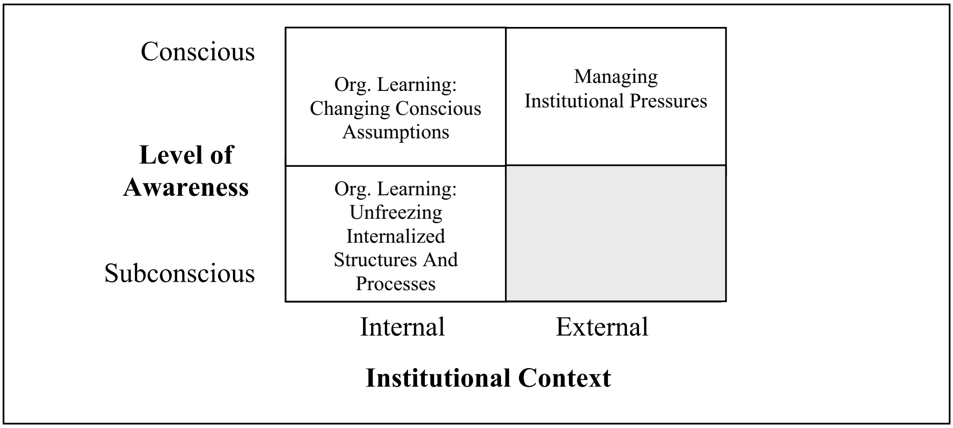
The previous section established that in order to generate institutional capital one must distinguish between internal and external institutional contexts. Additionally, and so far as the internal institutional context is concerned, we must distinguish between conscious and subconscious institutional influences. These distinctions provide three possibilities for managing an organization's institutional context, which are summarized in *Figure 3*:

57 See *Zajac et al.* (2000).

58 *Scott* (1994), p. 63.

59 See, e.g., *DiMaggio/Powell* (1991a); *Miller* (1996), p. 284.

Figure 3: Starting Points For Generating Institutional Capital



Managing the internal institutional context aims at reducing the effects of internalized norms, values, structures, and routines on organizational members, particularly the decision makers. Thus, management avoids being overtaken by paradigm stasis, but instead succeeds by "*maintaining a cool detachment from institutional norms*"[60]. The processes for managing the internal institutional context are described by theories of organizational learning. Such theories are relevant at the individual and intraorganizational levels of analysis and as they affect the conscious and subconscious levels of awareness.

The management of the external institutional context deals with attempts to change the nature of the institutional environment by proactively influencing institutional actors. To this end, and contrary to the assumptions of traditional macro-institutionalists, an organization can utilize several promising strategies[61].

7.1 Managing The Internal Institutional Context

Considering the concept of organizational learning in the context of neoinstitutional theory may appear at first to be a paradox, because neoinstitutionalism focuses on enduring qualities in organizational fields[62], while organizational learning often explains changes in organizations. But in these different foci lies precisely the value of an integrated analysis: Organizational learning can be used to overcome the conceptual one-way-street of neoinstitutional theory, i.e., the assumption that the institutionalization of values, norms, structures, and routines

60 *Kondra/Hinings* (1998), p. 758.

61 We do not consider the subconscious external institutional context here, because it cannot be subjected to a proactive management by individual organizations. Institutional pressures that remain subconscious at the level of the organizational field, or even larger organizational aggregations, are institutionalized to the extent that nobody will be able to perceive them consciously.

62 See *Wiegand* (1996), p. 112.

creates only a circular self-reinforcing situation. The learning theory developed by *Argyris* and *Schön*[63] is particularly useful to this end, because it connects the individual and the intraorganizational levels of analysis, and because it offers a concept and technique for unfreezing consciously and subconsciously institutionalized assumptions and behaviors. This concept is called "double-loop-learning", and it "involves surfacing and challenging deep-rooted assumptions and norms of an organization that have previously been inaccessible, either because they were unknown or known but undiscussable"[64].

According to *Argyris* and *Schön*, the most effective tool for "double-loop-learning" is a comprehensive intervention that is facilitated by an external change agent who helps individuals and organizations to detect, unfreeze, and change institutionalized assumptions and behaviors. However, it is not necessary to rely on massive change programs to facilitate organizational learning[65].

Organizations can also resort to more specific methods to enhance their reflective capacities. For example, human resource management practices, such as training programs or creativity enhancing techniques (e.g., cognitive mapping, scenario analysis), can facilitate the planned disruption of institutionalized behavior[66]. Similar effects may also obtain as a result of interorganizational cooperation, because cooperative ventures confront partners with different routines and institutional contexts that challenge the prevailing structures and routines of firms. In this way, cooperative experiences can reveal new behavioral options to a firm[67].

Measures to enhance organizational learning help organizations to generate cognitive and normative capital. At the level of the individual, organizational learning can improve the reflective abilities of decision makers by challenging taken-for-granted-assumptions and eliminating cognitive sunk costs (cognitive capital). At the intraorganizational level, organizational learning helps to uncover institutionalized behavior that is dysfunctional and thus increases an organization's abilities to modify its structures, routines, and resources (normative capital). The ability of individuals and organizations to conceive of and implement alternatives that go beyond existing institutional constraints is a prerequisite for managing the external institutional context.

7.2 Managing The External Institutional Context

According to the traditional macroinstitutional line of reasoning, the options for managing an external institutional context are restricted to one alternative: either full adherence to institutional demands or a decoupling of structural features of

63 See *Argyris/Schön* (1974); *Hennemann* (1997); *Wiegand* (1996).
64 *Kim* (1993), p. 45.
65 See, e.g., *Argyris* (1985), p. 340.
66 See, e.g., *Bresser* (1987); *Oliver* (1997).
67 See, e.g., *Borys/Jemison* (1989); *Frost* (2001). In fact, the participation of the Japanese in strategic alliances with Western partners has been attributed repeatedly to such learning processes, e.g., by *Hamel et al.* (1989).

the organization from ongoing activities[68]. However, since these options generally preclude a proactive manipulation of the institutional environment, they are not suitable for creating regulative capital. However, recent contributions by neoinstitutionalists allow for more proactive options.

For example, *Scott* suggests that organizations should be "expected to exercise 'strategic choice' in relating to their institutional environments"[69]. *Oliver* is more specific. She distinguishes five strategic responses to institutional pressures: acquiescence, compromise, avoidance, defiance, and manipulation[70]. While these responses vary in their degree of active resistance to institutional demands, only one, manipulation, can generate regulative capital. Because manipulation aims at changing and controlling the demands of institutional actors, it is the only strategy that facilitates proactive management attempts.

Oliver provides an insightful typology of responses to institutional pressures, but she has not detached herself from the environmental determinism that is typical of traditional neoinstitutional writings. This limitation is most apparent in her discussion of the contextual conditions that give rise to the various responses. The more active options, most notably the manipulation tactics, are recommended only for environments with low levels of institutional pressure. Organizations should embrace more passive responses as they are located in high pressure environments[71].

We challenge this assumption, and we propose an extended typology of five manipulative strategies, namely lobbying, co-optation, membership, standardization, and influence (see *Table 1*). Each of these strategies can be applied in environments of high institutional pressure to generate regulative capital.

Table 1: Manipulative Strategies And Illustrative Examples Of Their Use

Strategy Type	**Illustrative Examples**
Lobbying	Deutsche Telekom AG
Co-optation	Politicians on Boards of Directors
Membership	Neuland
Standardization	Microsoft
Influence	Duales System

68 See *Meyer/Rowan* (1977; 1991) and footnote 22.
69 *Scott* (1991), p. 170.
70 See *Oliver* (1991).
71 See *Oliver* (1991), pp. 159–172.

Proactive, manipulative strategies appear to be particularly important in high-pressure institutional environments because they can provide organizations with more discretion in pursuing efficiency enhancing strategies. *Lobbying* is a case in point, and its effectiveness in creating a favorable institutional environment has been widely acknowledged[72]. A recent German example is Deutsche Telekom. The information technology giant is threatened by deregulation. To ward off some of the deregulation decisions in this high pressure environment that would unfavorably affect their firm, Deutsche Telekom's top management wrote personal letters to individual members of the German government, asking for political interventions to curtail deregulation[73]. So far, the efforts have been successful, as the German government has slowed down the deregulation process.

Similarly, *Co-optation* is a useful technique for neutralizing institutional opposition. This technique is evidenced by the numbers of politicians who have been invited to serve as outside directors on many corporate boards[74]. Co-opting politicians can elicit formidable competitive advantages for individual firms, not just in terms of improved conditions for lobbying legislative bodies, but also in terms of being awarded lucrative government contracts and attaining legitimacy[75]. This realization has led the *Verein Deutscher Ingenieure*, the association of German engineers, to recommend that its members actively invite politicians to join their boards[76].

Membership and *standardization* also are very effective in producing regulative capital, but are not as widely discussed[77]. A *membership* strategy attempts to define the importance of a particular institution within an organizational field by establishing the rules of membership and their meaning. Typically, this strategy restricts the membership of an institution, because economic advantages and legitimacy are positively related to the exclusivity of an elite[78]. Maintaining an exclusive image also requires strict controls and sanctions. Thus, a membership strategy contains institutional pressures by shaping a new, elitist institution. A telling example is *Neuland*, a German meat-processing and marketing association. This association caters to the ecologically conscious consumer who also embraces animal rights. The association purchases meat from its members and distributes it to retailers and wholesalers. Only those farmers who adhere to strict rules with regard to how they keep and feed their animals can be members. The objective of these rules is to distinguish *Neuland* members from large, mass-production farms. The association is very successful and charges premium prices[79].

72 The effectiveness of lobbying as well as co-optation are a central concern of resource dependence theory (see, e.g., *Pfeffer/Salancik* (1978); *Oliver* (1991)).

73 See *Berliner Morgenpost* (2001), p. 9.

74 About half of the members of the *Deutsche Bundestag* serve on boards of directors or similar advisory bodies (see *Darmstäder Echo* (2000), p. 48).

75 See *Oliver* (1991).

76 See VDI-Nachrichten online (2001), p. 2.

77 See, e.g., *Lawrence* (1999); *Garud/Kumaraswamy* (1993).

78 See *Lawrence* (1999), p. 171.

79 See *Neuland Online* (2001).

The strategy of *standardization* uses the institutionalization of standards to establish what is 'normal' for a product, service, or practice[80]. Again, this strategy creates a secondary institution to manage the institutional context. The objective of a standardization strategy is not necessarily to institutionalize the most efficient solution from the consumer's point of view, but a solution that favors the organization(s) setting the standard. Organizations seek to set standards on which they already excel.

Standardization strategies are typically based on interfirm cooperation or on lobbying regulatory agencies. Often, successful standardization requires that a powerful organization takes the lead. A classic example is *Microsoft*'s dominance in the software industry. At a time of high technical and market uncertainties, *Microsoft* managed to establish MS DOS as an industry standard for personal computers. Subsequently, *Microsoft* used cooperative ventures and an 'open standard' to institutionalize Windows as a software standard that favored its own position and capabilities[81]. The success of *Microsoft*'s standardization strategy is beyond dispute: Since the introduction of Windows, *Microsoft*'s market share has risen to approximately 90%[82].

Influence is the manipulative strategy comprising the most encompassing effects. It attempts to manipulate values, belief systems, and acceptable practices, and thus institutionalization processes, at the societal level[83]. Influence strategies are used by individual and cooperating organizations, and are based on the use of public relations, advertising, or publications. Often, they are pursued in combination with the other four manipulative strategies. Trade associations are a good example, because much of their work attempts to influence public perceptions of industries. A prominent German example of this strategy is the *Duales System Deutschland AG*. This company is a privately owned umbrella organization for the recycling of sales packaging. The *Dual System* fulfills the legal recycling obligations of German industry and trade, and so cooperates with more than 400 waste management firms. This organization's effectiveness depends crucially on the extent to which recycling is considered a legitimate societal norm, because the perceived legitimacy of recycling will influence consumers' willingness to collect and recycle used sales packaging. The *Dual System* uses various forms of consumer communication to heighten awareness of recycling and environmental protection issues. Although it is not easy to assess the impact the *Dual System* has had on societal norms and values, the figures suggest it has been successful because German consumers have recycled more and more packaging over the years[84].

From the above discussion it is apparent that organizations have more active strategies at their disposal to deal with the demands of their institutional environments than compliance. The examples have shown that even under conditions of high institutional pressure, it is possible for organizations to rely on five proactive

80 See *Lawrence* (1999), p. 177.
81 See *Lawrence* (1999), p. 179.
82 See *Computerchannel.de* (2001).
83 See *Oliver* (1991), p. 158.
84 See *Der Verbraucherschutz Newsletter* (1999).

strategies to gain the support of institutional actors, and to establish competitive advantage based on regulative capital.

8 Conclusion

The new institutionalism in organization theory makes an important contribution to the understanding of competitive advantage and thus, also, to a central research topic in strategic management. To appreciate these potential contributions to the strategic management field, it is necessary to question many traditional assumptions of neoinstitutional theory, such as the ideas of overly constraining institutional environments and oversocialized organizations[85].

This paper offers two main conclusions:

1. *An organization's institutional context is a major driver of competitive advantage.*

2. *Organizations can develop a competitive advantage by proactively managing both their internal and external institutional contexts.*

We suggest that institutionally embedded competitive advantage is possible at three levels: (1) at the individual level as *cognitive capital*, (2) at the intraorganizational level as *normative capital*, and (3) at the interorganizational level as *regulative capital*. This line of reasoning is fully compatible with strategic management thinking, where competitive advantage is discussed at the same three levels (see *Figure 1)*.

It is also possible to interpret the three types of institutional capital from a resource-based perspective as special types of nonmaterial resources. Thus, the resource-based view can be used as an integrative framework for future empirical work. The six types of resource capital distinguished in this paper are latent constructs, amenable to structural equation analysis[86]. Although much progress has been made in measurement issues typical of the resource-based view, the development of indicators for the three constructs that represent institutional capital is just beginning[87].

References

Amit, Raphael/Schoemaker, Paul (1993), Strategic Assets and Organizational Rents, in: Strategic Management Journal, Vol. 14, pp. 33–46.

Argyris, Chris/Schön, Donald (1974), Theory in Practice.

Argyris, Chris (1985), Strategy, Change and Defensive Routines.

Barley, Stephen/Tolbert, Pamela (1997), Institutionalization and Structuration: Studying the Links between Action and Institution, in: Organization Studies, Vol. 18, pp. 93–117.

85 See *Scott* (1991); *Oliver* (1991; 1997); *Powell* (1991).
86 See *Godfrey/Hill* (1995).
87 See *Powell* (1996); *Millonig* (2002).

Barney, Jay (1991), Firm Resources and Sustained Competitive Advantage, in: Journal of Management, Vol. 17 (1), pp. 99–120.
Berger, Peter/Luckmann, Thomas (1972), Die soziale Konstruktion der Wirklichkeit, 3rd ed.
Berliner Morgenpost (2001), Telekom bittet Regierung um Hilfe, March 30, 2001, p. 9.
Borys, Bryan/Jemison, David (1989), Hybrid Arrangements as Strategic Alliances: Theoretical issues in organizational combinations, in: Academy of Management Review, Vol. 14, pp. 234–249.
Bresser, Rudi (1987), Unternehmerische Innovationen durch Teufelskreise, in: *Dichtl, Erwin/Gerke, Wolfgang/Kieser, Alfred* (eds.), Innovation und Wettbewerbsfähigkeit, pp. 33–51.
Bresser, Rudi (1998), Strategische Managementtheorie.
Burgelman, Robert (1983), A model of the interaction of strategic behavior, corporate context, and the concept of strategy, in: Academy of Management Review, Vol. 8, pp. 61–70.
Child, John (1972), Organizational Structure, Environment and Performance: The Role of Strategic Choice, in: Sociology, Vol. 6, pp. 1–22.
Collis, David (1994), How Valuable are Organizational Capabilities?, in: Strategic Management Journal, Vol. 15, pp. 143–152.
Computerchannel.de (2001), Microsoft will Servergeschäft in Deutschland ankurbeln, (http://www.computerchannel.de/newpp.phtml?newsid=11669).
Conner, Kathleen (1991), A Historical Comparison of Resource-Based Theory and Five Schools of Thought within Industrial Organization Economics: Do We Have a New Theory of the Firm?, in: Journal of Management, Vol. 17, pp. 121–154.
Dacin, Tina/Goodstein, Jerry/Scott, Richard (2002), Institutional Theory and Institutional Change: Introduction to the Special Research Forum, in: Academy of Management Journal, Vol. 45, pp. 45–57.
D'Andrade, Roy (1984), Cultural Meaning System, in: *Schweder, Richard/LeVine, Robert* (eds.), Culture Theory: Essays on Mind, Self, and Emotion, pp. 88–119.
Darmstädter Echo (2000), Der staatsmonopolistische Kapitalismus in der BRD, February 8, 2000, p. 48.
Deephouse, David (1996), Does Isomorphism Legitimate?, in: Academy of Management Review, Vol. 39, pp. 1024–1039.
Deephouse, David (1999), To Be Different or to Be the Same? It's a Question (and Theory) of Strategic Balance, in: Strategic Management Journal, Vol. 20, pp. 147–166.
Der Verbraucherschutz Newsletter (1999), Bundesbürger ökologisch vorbildlich: Sammeln und Recycling weiter im Trend. Duales System legt Mengenstromnachweis 1998 vor, May 14, 1999.
Dietl, Helmut (1993), Institutionen und Zeit.
DiMaggio, Paul/Powell, Walter (1983), The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields, in: American Sociological Review, Vol. 48, pp. 147–160.
DiMaggio, Paul/Powell, Walter (1991a), The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields, in: *Powell, Walter/DiMaggio, Paul* (eds.), The New Institutionalism in Organizational Analysis, pp. 63–82.
DiMaggio, Paul/Powell, Walter (1991b), Introduction, in: *Powell, Walter/DiMaggio, Paul* (eds.), The New Institutionalism in Organizational Analysis, pp. 1–38.
Eisenhardt, Kathleen (1988), Agency- And Institutional-Theory Explanations: The Case Of Retail Sales Compensation, in: Academy of Management Journal, Vol. 31, pp. 488–511.
Fligstein, Neil (1985), The Spread of the Multidivisional Form Among Large Firms, 1919–1979, in: American Sociological Review, Vol. 50, pp. 377–391.
Frost, Tony (2001), The Geographic Sources of Foreign Subsidiaries' Innovations, in: Strategic Management Journal, Vol. 22, pp. 101–123.
Garud, Raghu/Kumaraswamy, Arun (1993), Changing Competitive Dynamics in Network Industries: An Exploration of Sun Microsystems' Open System Strategy, in: Strategic Management Journal, Vol. 14, pp. 351–369.
Gioia, Dennis/Pitre, Evelyn (1990), Multiparadigm Perspectives on Theory Building, in: Academy of Management Revue, Vol. 15, pp. 584–602.
Godfrey, Paul/Hill, Charles (1995), The Problem of Unobservables in Strategic Management Research, in: Strategic Management Journal, Vol. 16, pp. 519–533.
Granovetter, Mark (1985), Economic Action and Social Structure: The Problem of Embeddedness, in: American Journal of Sociology, Vol. 91, pp. 481–510.

Hambrick, Donald/Mason, Phyllis (1984), Upper Echelons: The Organization as a Reflection of Its Top Managers, in: Academy of Management Review, Vol. 9, pp. 193–206.

Hamel, Gary/Doz, Yves/Prahalad, C.K. (1989), Collaborate with your Competitors – and win, in: Harvard Business Review, Vol. 67 (1), pp. 133–139.

Hasse, Raimund/Krücken, Georg (1999), Neo-Institutionalismus.

Haunschild, Pamela (1993), Interorganizational Imitation: The Impact of Interlocks on Corporate Acquisition Activity, in: Administrative Science Quarterly, Vol. 38, pp. 554–592.

Hennemann, Carola (1997), Organisationales Lernen und die lernende Organisation: Entwicklung eines praxisorientierten Gestaltungsvorschlages aus ressourcenorientierter Sicht.

Jacobson, Robert (1992), The "Austrian" School of Strategy, in: Academy of Management Review, Vol. 17, pp. 782–807.

Jepperson, Ronald (1991), Institutions, Institutional Effects, and Institutionalism, in: *Powell, Walter/DiMaggio, Paul* (eds.), The New Institutionalism in Organizational Analysis, pp. 143–163.

Kim, Daniel (1993), The Link between Individual and Organizational Learning, in: Sloan Management Review, Vol. 35 (1), pp. 37–50.

Kondra, Alex/Hinings, Christopher (1998), Organizational Diversity and Change in Institutional Theory, in: Organization Studies, Vol. 19, pp. 743–767.

Lawrence, Thomas (1999), Institutional Strategy, in: Journal of Management, Vol. 25(2), pp. 161–188.

Mahoney, Joseph/Pandian, Rajedran (1992), The Resource-Based View Within the Conversation of Strategic Management, in: Strategic Management Journal, Vol. 13, pp. 363–380.

Meyer, John/Rowan, Brian (1977), Institutionalized Organizations: Formal Structure as Myth and Ceremony, in: American Journal of Sociology, Vol. 83, pp. 340–363.

Meyer, John/Rowan, Brian (1991), Institutionalized Organizations: Formal Structure as Myth and Ceremony, in: *Powell, Walter/DiMaggio, Paul* (eds.), The New Institutionalism in Organizational Analysis, pp. 41–62.

Miller, Danny (1996), Commentary: The Embeddedness of Corporate Strategy: Isomorphism vs. Differentiation, in: Advances in Strategic Management, Vol. 13, pp. 283–291.

Millonig, Klemens (2002), Wettbewerbsvorteile durch das Management des institutionalen Kontextes: Eine integrative Betrachtung von Institutionalismus und Strategischem Management.

Müller-Jentsch, Walther (2002), Organisationales Handeln zwischen institutioneller Normierung und strategischem Kalkül, in: *Schreyögg, Georg/Conrad, Peter* (eds.), Managementforschung 12: Theorien des Managements, pp. 203–209.

Neuland Online (2001), Richtlinien – Haltung und Fütterung, (http://www.neuland-fleisch.de/richtlin/index.php3?id=2).

North, Douglass (1998), Economic Performance through Time, in: *Brinton, Mary/Nee, Victor* (eds.), The New Institutionalism in Sociology, pp. 247–257.

Oliver, Christine (1991), Strategic Responses to Institutional Processes, in: Academy of Management Review, Vol. 16, pp. 145–179.

Oliver, Christine (1996), The Institutional Embeddedness of Economic Activity, in: Advances in Strategic Management, Vol. 13, pp. 163–186.

Oliver, Christine (1997), Sustainable Competitive Advantage: Combining Institutional and Resource-Based Views, in: Strategic Management Journal, Vol. 18, pp. 697–713.

Peteraf, Margaret (1993), The Cornerstones of Competitive Advantage: A Resource-Based View, in: Strategic Management Journal, Vol. 14, pp. 179–191.

Pfeffer, Jeffrey/Salancik, Gerald (1978), The External Control of Organizations: A Resource Dependence Perspective.

Picot, Arnold/Dietl, Helmut/Franck, Egon (2002), Organisation – Eine ökonomische Perspektive, 3rd ed.

Porter, Michael (1980), Industry Structure and Competitive Strategy: Keys to Profitability, in: Financial Analysis Journal, Vol. 34, pp. 30–42.

Porter, Michael (1985), Wettbewerbsvorteile: Spitzenleistungen erreichen und behaupten.

Powell, Walter (1991), Expanding the Scope of Institutional Analysis, in: *Powell, Walter/DiMaggio, Paul* (eds.), The New Institutionalism in Organizational Analysis, pp. 183–203.

Powell, Walter (1996), On the nature of Institutional Embeddedness, in: Advances in Strategic Management, Vol. 13, pp. 293–300.

Roberts, Peter/Greenwood, Royston (1997), Integrating Transaction Cost and Institutional Theories: Toward a Constrained-Efficiency Framework for Understanding Organizational Design Adoption, in: Academy of Management Review, Vol. 22, pp. 346–373.

Rühli, Edwin (1998), Strategie ist tot – es lebe das Strategische Management, in: *Handlbauer, Gernot et al.* (eds.), Perspektiven im Strategischen Management, pp. 239–257.

Schumpeter, Joseph (1912), Theorie der wirtschaftlichen Entwicklung.

Scott, Richard (1987), The Adolescence of Institutional Theory, in: Administrative Science Quarterly, Vol. 32, pp. 493–511.

Scott, Richard (1991), Unpacking Institutional Arguments, in: *Powell, Walter/DiMaggio, Paul* (eds.), The New Institutionalism in Organizational Analysis, pp. 164–182.

Scott, Richard (1994), Institutions and Organizations. Toward a Theoretical Synthesis, in: *Scott, Richard/Meyer, John* (eds.), Institutional Environments and Organization. Structural Complexity and Individualism, pp. 55–80.

Scott, Richard (1995), Institutions and Organizations.

Scott, Richard/Meyer, John (1994), Developments in Institutional Theory, in: *Scott, Richard/Meyer, John* (eds.), Institutional Environments and Organizations. Structural Complexity and Individualism, pp. 1–8.

Suchman, Mark (1995), Managing Legitimacy: Strategic and Institutional Approaches, in: Academy of Management Review, Vol. 20, pp. 571–610.

Tolbert, Pamela (1988), Institutional Sources of Organizational Culture in Major Law Firms, in: *Zucker, Lynne* (ed.), Institutional Patterns and Organizations.

VDI-Nachrichten online (2001), Wie sich Gründer und Investoren zusammenraufen, (http://www.vdi-nachrichten.com/agenturservice/factsfigures/vc-panel/vc4.asp).

Walgenbach, Peter (1999), Institutionalistische Ansätze in der Organisationstheorie, in: *Kieser, Alfred* (ed.), Organisationstheorie, 3rd ed., pp. 319–353.

Walgenbach, Peter (2000), Die normgerechte Organisation. Eine Studie über die Entstehung, Verbreitung und Nutzung der DIN EN ISO 9000er Normreihe.

Walgenbach, Peter (2002), Neoinstitutionalistische Organisationstheorie – State of the Art und Entwicklungslinien, in: *Schreyögg, Georg/Conrad, Peter* (eds.), Managementforschung 12: Theorien des Managements, pp. 155–202.

Welge, Martin/Al-Laham, Andreas (2001), Strategisches Management, 3rd ed.

Wheelen, Thomas/Hunger, David (2002), Strategic Management and Business Policy, 8th ed.

Wiegand, Martin (1996), Prozesse Organisationalen Lernens.

Williamson, Oliver (1991), Comparative Economic Organization: The Analysis of Discrete Structural Alternatives, in: Administrative Science Quarterly, Vol . 36, pp. 269–296.

Williamson, Oliver (1999), Strategy Research: Governance And Competence Perspectives, in: Strategic Management Journal, Vol. 20, pp. 1087–1108.

Young, Gregory (1995), Comment: The Resource-Based View of the Firm and 'Austrian' Economics, in: Journal of Management Inquiry, Vol. 4, pp. 333–340.

Zajac, Edward/Kraatz, Matthew (1993), A diametric forces model of strategic change: Assessing the antecedents and consequences of restructuring in the higher education industry, in: Strategic Management Journal, Special Issue, Vol. 14, pp. 83–102.

Zajac, Edward/Westphal, James (1995), Accounting for the explanations of CEO compensation, in: Administrative Science Quarterly, Vol. 45, pp. 283–308.

Zajac, Edward/Kraatz, Matthew/Bresser, Rudi (2000), Modeling the Dynamics of Strategic Fit: A Normative Approach to Strategic Change, in: Strategic Management Journal, Vol. 21, pp. 429–453.

Zucker, Lynne (1977), The Role of Institutionalization in Cultural Persistence, in: American Sociological Review, Vol. 42, pp. 726–743.

Zucker, Lynne (1987), Institutional Theories of Organizations, in: Annual Review of Sociology, Vol. 13, pp. 443–464.

Zucker, Lynne (1988), Where Do Institutional Patterns Come From? Organizations as Actors in Social Systems, in: *Zucker, Lynne* (ed.), Institutional Patterns and Organizations, pp. 23–52.

Zucker, Lynne (1991), The Role of Institutionalization in Cultural Persistence, in: *Powell, Walter/DiMaggio, Paul* (eds.), The New Institutionalism in Organizational Analysis, pp. 83–107.

Schmalenbach Business Review ◆ Vol. 55 ◆ July 2003 ◆ pp. 242–256

Bernhard Baumgartner*

MEASURING CHANGES IN BRAND CHOICE BEHAVIOR

ABSTRACT

The multinomial logit model is frequently used in marketing research to explain consumers' brand choice decisions. In almost all applications of this model, the parameters of the consumers' utility function are assumed to be constant across time. In contrast to this assumption, both marketing theory and statements from marketing practitioners suggest the possibility of short-term fluctuations and long-term changes in consumers' brand choice behavior. In this paper, nonparametric brand-specific time-variable functions replace the brand-specific constants usually found in brand choice models. I estimate the model for panel data from two product categories and derive management implications.

JEL-Classification: C25, M31.

Keywords: Brand Choice Model; Generalized Additive Model; Multinomial Logit.

1 INTRODUCTION

In the last two decades the multinomial logit model has been frequently used by both academics and market researchers to explain consumers' brand choice decisions. Today, the multinomial logit model is counted among standard methods of marketing-research[1].

The multinomial logit model has been applied to assess the impact of prices and promotions on consumers' brand choice. In most studies, brand-specific constants are included in addition to prices for different brands as observed by the buyer at the point of purchase. In many cases the models also incorporate dummy variables that describe the use of non-price promotions.

A brand's constant is usually interpreted as representing the influences on consumers' brand choice decisions that are not reflected by other predictors, such as brand awareness or consumer perceptions of brand quality. Furthermore, methods were introduced to consider brand loyalty or consumer heterogeneity. A detailed review and comparison of these methods can be found in *Ailawadi et al.* (1999)[2]. Several researchers have applied the multinomial logit model to verify theories on

* Dr. *Bernhard Baumgartner*, Department of Marketing, University of Regensburg, Universitätsstraße 31, 93053 Regensburg, Phone: +49941/9432275,
e-mail: bernhard.baumgartner@wiwi.uni-regensburg.de.

1 See, e.g., *McFadden* (1980); *Guadagni/Little* (1983); *Ailawadi et al.* (1999).

2 See *Ailawadi et al.* (1999), pp. 178ff.

brand choice behavior, such as variety seeking[3] or the role of reference-prices[4] in consumers' perception of prices.

Data from consumer panels or scanner panels on purchases by a large number of households for a certain period are regularly used to estimate brand choice models. Parameters constant across time are generally estimated. When we are given typical observation periods of six months or a year, for which a brand-choice model is estimated, we can easily assume changes in brand choice behavior during this time interval. An advertising campaign may improve brand awareness or the brand's perceived quality. Such effects can be obtained by substituting brand-specific constants by brand-specific time-variable terms.

Advertising may further influence price sensitivity. In this case, a model specification that allows for a time-changeable price parameter appears to be appropriate.

Usage situation is frequently mentioned as affecting consumer behavior[5]. Market researchers state that within several product categories (e.g., coffee or chocolate) the market shares of (generally high-valued) brands increase before holidays such as Easter or Christmas[6]. Therefore, the model specification should also account for such temporal changes in brand choice behavior.

Very few studies deal with the possibility of changes of parameters of brand choice models. *Mela et al.* (1998) split the period into discrete intervals and estimate separated models for each time interval. Using this approach, the effect of a long-term advertising campaign may result in an increasing alternative-specific constant or decreasing price sensitivity for the advertised brand[7]. *Papatla* and *Krishnamurthi* (1996) formulate price- and promotion-parameters that depend on past marketing effort. Though this approach enables the modelling of advertising effects on consumers' price sensitivity, temporal changes in brand choice behavior (e.g. changes expected prior to holidays within some product categories) cannot be considered by either of these approaches.

In this paper, I apply a method proposed by *Abe* (1998; 1999) for consideration of nonparametric functions of explanatory variables within the framework of the multinomial logit model. I use this method to estimate time-dependent functions, as opposed to constant parameters. This approach allows for representation of temporal fluctuations as well as long-term changes in brand choice behavior.

Subsection 2.1 briefly outlines the multinomial logit model and Subsection 2.2 reviews the usage of nonparametric functions within the multinomial logit model's utility function. A model specification allowing for the estimation of time-variable parameters is introduced in Subsection 2.3. Section 3 contains the results of an empirical application of the proposed model to two product categories and outlines management implications.

3 See, e.g., *Lattin* (1987).
4 See, e.g., *Kalyanaram/Little* (1994); *Abe* (1998); *Kalwani* (1990); *Hruschka et al.* (2002).
5 See, e.g., *Wilkie* (1986), pp. 277–281.
6 The idea for this study arose during a discussion with Dr. Wildner and Mr. Dietrich, GfK Nuremberg. They remarked that this effect is usually not considered in brand choice modelling.
7 *Mela et al.* (1998) apply this model to estimate long-term impact of promotions.

2 A Brand Choice Model with Time-variable Parameters

2.1 The Brand Choice Model

When applying the multinomial logit model to represent brand choice decisions, consumer i's probability $Prob_{ij'K_i}$ of choosing brand j' from the available brands $j = 1 \ldots J$ in the K_i-th act of purchase is

$$Prob_{ij'K_i} = \frac{\exp\left(V_{ij'K_i}\right)}{\sum_{j=1}^{J} \exp\left(V_{ijK_i}\right)}. \tag{1}$$

The deterministic part of the utility V_{ijK_i} for purchasing brand j is usually assumed to be a linear additive function of predictors x_{ijmK_i}, $m = 1 \ldots M$:

$$V_{ijK_i} = \beta_{j0} + \sum_{m=1}^{M} \beta_m \cdot x_{ijmK_i}. \tag{2}$$

Parameter β_{j0} denotes the alternative specific constant for brand j[8]. Moreover, the model incorporates considerations of prices, promotions, and consumers' loyalties for the available brands.

An approach introduced by *Guadagni* and *Little* (1983), which accounts for brand loyalty in the multinomial logit model, has proved its suitability in a number of applications[9] and is therefore used in this paper. Loyalty Loy_{ijK_i} of household i for brand j prior to the K-th buying occasion of this household K_i is determined by an exponentially weighted average of past purchases of the same brand:

$$\begin{aligned} & Loy_{ijK_i} = \gamma_{Loy} \cdot Loy_{ijK_i-1} + \left(1 - \gamma_{Loy}\right) \cdot y_{ijK_i-1} \\ & 0 \le \gamma_{Loy} \le 1 \\ & y_{ijK_i} = \begin{cases} 1 & \text{if household } i \text{ buys brand } j \text{ in occasion } K_i \\ 0 & \text{elsewhere.} \end{cases} \end{aligned} \tag{3}$$

The carryover constant γ_{Loy} indicates how fast loyalty grows for a chosen brand and declines for brands not chosen in the purchase occasion.

Both marketing theory and empirical research[10] suggest the presence of nonlinearities in consumers' price response. Adaptation Level theory[11] states that reaction to

8 Because choice probabilities do not change if a constant value is added to each brand's utility, alternative specific constants can be estimated only for J-1 brands. Therefore, a brand's constant term must be interpreted in relation to the reference brand (whose constant is equal to zero).

9 See, e.g., *Ailawadi et al.* (1999) for empirical comparisions of several measures of brand loyalty and/or consumer heterogeneity.

10 See, e.g., *Kalyanaram/Little* (1994); *Lattin/Bucklin* (1989); *Abe* (1998); *Wedel/Leeflang* (1998).

11 See *Helson* (1964).

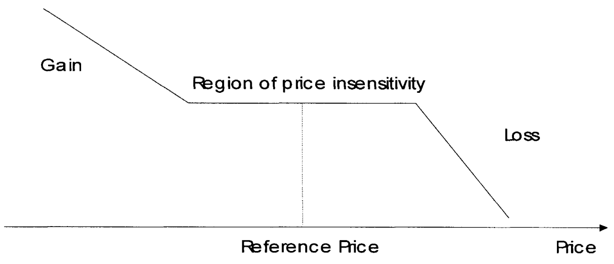
a stimulus depends on its relation to an internal reference value, which is built through experience. Therefore, consumers may compare observed prices to internal reference prices. In empirical applications, reference prices *RP* have frequently been built from prices *P* observed in the past by an adaptive process[12]:

$$RP_{ijK_i} = \gamma_{Ref} \cdot RP_{ijK_i-1} + \left(1-\gamma_{Ref}\right) \cdot P_{ijK_i-1}. \tag{4}$$

When comparing five reference price models, *Briesch et al.* (1997) found that this approach outperformed alternative models. The deterministic utility V_{ijK_i} is influenced by reference prices and differences between these reference prices and observed prices.

Assimilation-contrast theory[13] predicts a region of price insensitivity (latitude of acceptance) surrounding the reference price. Due to prospect theory[14] a consumer's response to price increases (losses) is stronger than response to price decreases (gains). The consumer's price response curve that results from these theories is shown in *Figure 1*.

Figure 1: Price response



2.2 Estimation of Nonparametric Utility Functions in the Multinomial Logit model

Due to the closed form solution of the first and second derivatives of the log likelihood, the parameters of a multinomial logit model with linear utility function can be determined by maximum likelihood estimation[15]. Indeed, there are reasons to presume the presence of nonlinearities in consumer response. The occurrence of a nonlinear response to prices has been mentioned above. If indicators for brand quality or brand characteristics are included in the model, saturation effects may occure. *Abe* (1998; 1999); has investigated nonlinear influence of brand loyalty.

12 See, e.g., *Kalyanaram/Little* (1994); *Lattin/Bucklin* (1989); *Abe* (1998); *Mazumdar/Papatla* (1995).
13 See *Sherif/Hovland* (1961).
14 *Kahneman/Tversky* (1979).
15 See, e.g., *Ben Akiva/Lerman* (1985) p. 188; *Fader et al.* (1992).

Applying nonlinear transformations of predictors provides a way to overcome the linearity assumption[16]. *Wedel* and *Leeflang* (1998), *Ben Akiva* and *Lerman* (1985), *Kalwani et al.* (1990) and *Kalyanaram* and *Little* (1994) estimate piecewise linear utility functions. In these approaches, the utility function is still linear in parameters. Therefore, well-known methods can be used for estimation.

A remaining problem on the transformations of the original predictors is that the functional form is predetermined. When piecewise linear functions are considered, boundaries between linear pieces[17] must either be fixed prior to estimation or determined by an expensive search procedure[18]. In *Wedel* and *Leeflang*'s (1998) approach, the knots represent psychologically odd prices like $4.99 or $99.95. *Kalyanaram* and *Little* (1994) use sensitivity analysis to determine the width of the latitude of price acceptance.

Nonparametric methods offer the opportunity to overcome the linear in parameters' assumptions[19]. In Generalized Additive Models, a dependent variable y is assumed to be a sum of onedimensional nonparametric functions $f(\cdot)$ of covariates x: $E(y|X) = \Sigma_m f(x_m)$. Several methods, including kernels, cubic smoothing splines, or local smoothers, can be applied to model the so-called smooth functions $f(\cdot)$. Generalized Additive Models are counted among semiparametric methods, because they model the influence of covariates in a nonparametric fashion while assuming a parametric distribution for the models' random component.

Marketing literature contains only very few studies on semiparametric estimation. In a pioneering work, *Rust* (1988) applied nonparametric kernel regression to estimate the influence of ethnic identification and income on usage of Spanish language media by Hispanic consumers. *Rust* also estimates the dependency between profitability and salaries of marketing executives. Using spline regression, *Kalyanam* and *Shiveley* (1998) uncover irregular pricing effects. *Van Heerde et al.* (2001) uses local polynomial and kernel estimators to examine the relation between prices and sales. Recently, *Hruschka* (2000; 2002) has applied semiparametric methods to corroborate Gutenberg's kinked demand curve and to uncover utility functions in Attraction Models.

A method introduced by *Abe* (1998; 1999) allows the use of generalized additive utility functions within the multinomial logit model. In *Abe*'s approach, the brand utility is specified to be a sum of nonparametric functions f_m of predictors of brand choice:

$$V_{ijK_i} = \beta_{j0} + \sum_{m=1}^{M} f_m\left(x_{ijmK_i}\right). \tag{5}$$

The brand utilities V_{ijK_i} and choice probabilities $Prob_{ijK_i}$ are initially estimated for a multinomial logit model with linear utility function shown in equation (2). Subse-

16 See, e.g., *Krishnamurthi/Raj* (1988); *Tellis* (1988).

17 The knots in terms of linear splines.

18 See, e.g., *Kalyanaram/Little* (1994) *Kooperberg et al.* (1995).

19 See, e.g., *Härdle* (1990); *Härdle* (1991); *Hastie/Tibshirani* (1990).

quently, adjusted values for the deterministic utilities $\tilde{V}_{ijK_i}$ and weights w_{ijK_i} are calculated:

$$\tilde{V}_{ijK_i} = V_{ijK_i} + \frac{y_{ijK_i} - Prob_{ijK_i}}{Prob_{ijK_i} \cdot \left(1 - Prob_{ijK_i}\right)} \tag{6}$$

$$w_{ijK_i} = Prob_{ijK_i} \cdot \left(1 - Prob_{ijK_i}\right). \tag{7}$$

The functions $f_m(x_{ijmK_u})$ are obtained by nonparametric regression of $\tilde{V}_{ijK_i}$ on x_{ijmK_i} with weights w_{ijK_i}. Using these nonparametric functions $f_m(x_{ijmK_i})$ the V_{ijK_i} and choice probabilities, $Prob_{ijK_i}$ are recalculated and the iteration continues with equations (6) and (7). The procedure stops when a convergence criterion for an increase of the log likelihood function is satisfied[20].

In this paper, I apply cubic smoothing splines in the weighted nonparametric regression of $\tilde{V}_{ijK_i}$ on x_{ijmK_i}. Therefore, I estimate the functions f_m to maximize the penalized log likelihood criterion *PLL*

$$PLL = LL_V - \frac{1}{2} \sum_{m=1}^{M} \lambda_m \int f''_m (r)^2 \, dr \tag{8}$$

LL_V: log likelihood of nonparametric regression.

The term $\lambda_m \int f^{n}_m(r)^2 \; dr$ in equation (8) penalizes the curvature of the smoothed function f_m. The penalty factors λ_m, $m = 1 \ldots M$ must be determined prior to estimation. For large values of λ_m, a relatively smooth function results, while smaller values produce more flexible functions. In empirical applications, degrees of freedoms df_m for the functions f_m are usually specified instead of penalty factors[21]. The smoothed functions f_m that maximize the penalized log likelihood (8) are determined by a backfitting algorithm[22].

2.3 Time-variable Terms in Utility Function

Abe uses the methodology to estimate nonlinear consumer response to prices, differences between prices and reference prices, and loyalty. In this paper I apply *Abe*'s methodology to allow not only for nonlinear responses to these covariates, but also to consider variations in consumers' brand choices over time.

20 Derivation of the algorithm is shown in *Abe* (1998), p. 565, and *Abe* (1999), p. 282.

21 *Hastie/Tibshirani* (1990), pp. 52–55 and pp. 305–306 discuss the coherency between penalty factor and degrees of freedom as well as benefits of using degrees of freedom in detail.

22 A detailed introduction to Generalized Additive Models including the estimation of cubic smoothing splines by backfitting is proposed by *Hastie/Tibshirani* (1990) and *Green/Silverman* (1994); see also *Abe* (1999), p. 282.

Alternative-specific constants β_{j0} can be interpreted as reflecting influences that are not appropriately included in the model's utility functions[23]. In the context of a brand choice model, a brand-specific constant covers the "goodwill" that has accrued to this brand. This goodwill has been built by past marketing efforts. An increase or decrease in a brand's goodwill due to an advertising campaign, newspaper article, or word-of-mouth communication can be considered by applying time-variable (nonparametric), brand-specific functions that replace brand-specific constants. A temporal increase in consumer preference for a certain brand, for example a brand with high perceived quality prior to holidays, can also be modelled by this kind of function. To keep terminology simple, below I denote the nonparametric time-variable brand-specific functions by (time-variable) goodwill. The multinomial logit model's utility function for brand *j*, including a time-variable goodwill, is:

$$V_{ijK_i} = f_j\left(t_{K_i}\right) + \sum_{m=1}^{M} f_m\left(x_{ijmK_i}\right) \tag{10}$$

t_{K_i}: time index (e.g. number of week) of the *K*-th purchase of household *i*

$f_j(t_{K_i})$: cubic smoothing spline for brand *j*'s goodwill.

To ensure parameter identification, the goodwill for one brand is set to zero for all points in time.

In addition to time-variable goodwill, time-variable consumer responses to marketing instruments, such as price and promotion or brand characteristics, are also conceivable. If researchers expect time-variable price sensitivity, the influence of price could be modelled by a function $f_P(t_{K_i}) \cdot P$. Moreover, brand specific functions are appropriate if researchers expect a decrease in price sensitivity for a certain brand due to an advertising campaign for this brand. Indeed, a multinomial logit model with a utility function that includes the above-mentioned term cannot be estimated using the method proposed by *Abe,* because the utility function is no longer an additive function. It is possible to estimate the influence of an interaction term $f_P(t_{K_i} \cdot P)$ but an interpretation of the resulting function would become extremely difficult.

Moreover, a change in goodwill for brand *j* also changes the choice probability $Prob_{ijK_i}$. Therefore, applying utility function (10) also allows for changing price elasticity ε_{ijK_i}, which is defined as $\varepsilon_{ijK_i} = \beta_P \cdot P_{ijK_i} \cdot (1 - Prob_{ijK_i})$ in the multinomial logit model. This argument also applies to time-varying responses to loyalty or other predictors of brand choice.

Of course, if the researcher has a distinct hypothesis concerning temporal changes in brand choice, she may try to verify this hypothesis by estimating a brand choice model that includes the appropriate variables. If, for example, an increase in a certain brand's choice probability prior to Easter is expected, a dummy variable can

23 See *Maier/Weiss* (1990), p. 171.

be considered and if a brand is preferred in summer to winter, a variable such as temperature may be used[24].

3 Empirical Applications

3.1 *Data and Estimation*

In the empirical study, I use panel data for two product categories. One of these data sets includes purchases of coffee from the German consumer panel acquired by the "Gesellschaft für Konsumforschung (GfK)" in Nuremberg, Germany. The data were provided subject to the condition that publications allow no inference on the brand names that are included. The product category of coffee was chosen because temporal changes in brand choice, for example an increased preference for some brands prior to holidays, could be expected.

The second data set contains purchases within the product category of ketchup. These data come from the GfK ConsumerScan Panel[25]. In this product category, temporal changes are also conceivable, if, for example, different brands are preferred for barbecues in summer to those for other dishes in winter. In both data sets, I use six brands accounting for 54% of coffee sales and 59% of ketchup sales[26]. A calibration sample and a validation sample were drawn randomly from each data set. I use three purchase acts by each household to initialize brand loyalties and reference prices.

First, I estimate the parameters of a multinomial logit model with linear utility function, including brand-specific constants, brand loyalty (*Loy*), reference prices (*RefPrice*) and differences between reference prices and observed prices (*DiffPrice*). Below, I refer to this linear model as "M1." To ensure that computational effort remains sufficiently small, I fix the carry-over constants γ_{Loy} and γ_{Ref} at the values (γ_{Loy} = 0,74 for coffee data and 0,65 for ketchup data; γ_{Ref} = 0,51 for coffee data and 0,88 for ketchup data). These values are estimated in this step and not recalculated for the estimation of the models described below.

Second, I determine the appropriate degrees of freedom for nonparametric functions f(*Loy*), f(*RefPrice*) and f(*DiffPrice*) by using a stepwise procedure. Beginning with the linear model M1, one additional degree of freedom is added successively to each covariate's smooth function. The trial obtaining the largest improvement in the fit to the holdout sample is accepted. The procedure stops if no more improvement is achieved. Below, I label the model resulting from this procedure as "M2."

Stepwise procedures similar to this are also applied to enable the decision on the use of dummies for holidays and degrees of freedom for temperature in model

24 The author thanks an unknown reviewer for this suggestions.

25 These data are based on the dataset including a sample of the ConsumerScan household panel 1995 provided to ZUMA by the GfK Nuremberg. For a description of the data see *Papastefanou et al.* (2001).

26 Each of the remaining brands have less then 4% market share.

"M3", and to obtain the degrees of freedom in the model "M4", which considers time-variable goodwill proposed in Subsection 2.2.

3.2 Model fit

Table 1 presents log likelihood values for the models M1 – M4, applied to coffee and ketchup data. The degrees of freedom for the smooth functions appear in brackets in the description of each model.

Table 1: Log Likelihood

	description	2.1 Calibration sample	Holdout sample
		log likelihood	log likelihood
	Coffee Data		
M1	Loy + RefPrice +Diffprice (linear)	-5629.9512	-5324.2689
M2	f(Loy,df=3) + f(RefPrice,df=1) +f(Diffprice,df=8)	-5490.4554	-5205.5789
M3	M2+f(Temp,3)+Dummy(Mothers Day)+Dummy(Pentecost)	-5453.2491	-5177.0014
M4	M2 + f(time,22)	-5324.8082	-5151.5906
	Ketchup Data		
M1	Loy + RefPrice +Diffprice (linear)	-2056.5372	-2121.5621
M2	f(Loy,df=4) + f(RefPrice,df=1) +f(Diffprice,df=3)	-2026.4092	-2074.6705
M3	M2 + Temp	-2024.6228	-2072.8106
M4	M2 + f(time,2)	-2020.6826	-2073.3244

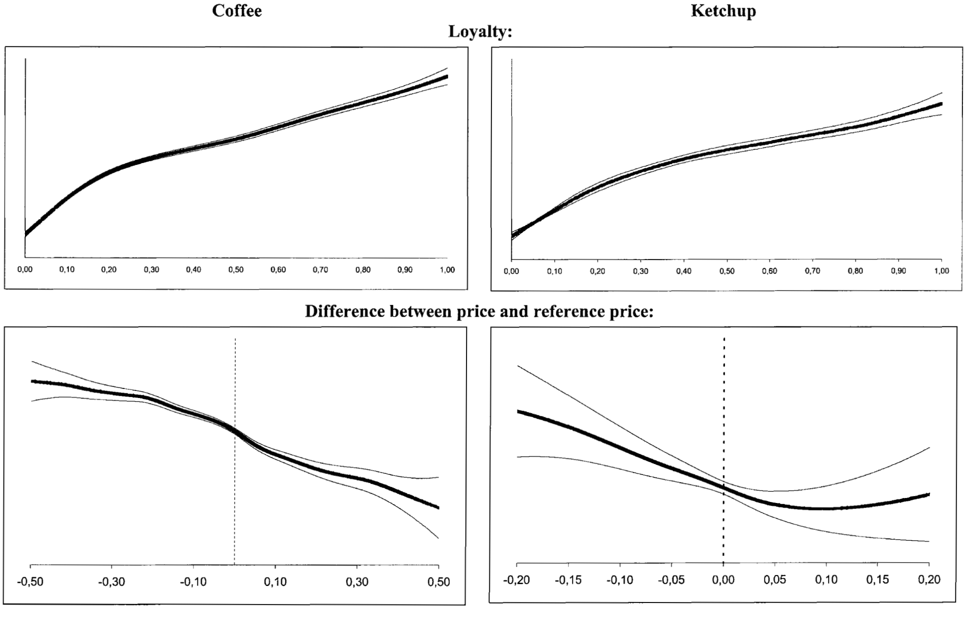
Allowing for nonlinearities in the slope parameters (M2) increases the fit in calibration and holdout samples of both product categories. Incorporating dummies for two holidays and a nonlinear influence of temperature with three degrees of freedom clearly improves the fit in the coffee data set, but in the ketchup data set it is only temperature that has a slight (linear) influence.

When considering time-variable goodwill, Model M4 outperforms model M3 in the coffee data set. Furthermore, the high number of degrees of freedom indicates the high relevance of short-term influences. In the ketchup data set, M4 achieves improvement in fit only in the calibration sample.

3.3 *Influence of Covariates*

Although the influence of reference price is still linear, we can observe nonlinear slope parameters for the difference between price and reference price, as well as for loyalty. *Figure 2* illustrates these functions and 95% confidence bands.

Figure 2: Nonparametric functions of covariates



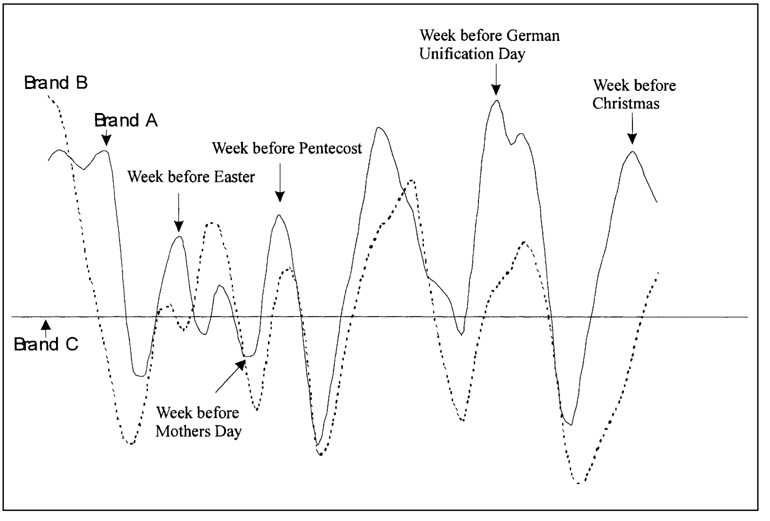
In both data sets, an increase in loyalty improves utility to a greater extent if the level of loyalty is small. It is plausible that purchasing an unfamiliar brand can raise the probability of further purchases of this brand to a relatively large extent.

The influence of price difference seen here does not support theories described in Subsection 2.1. There is neither a larger influence of losses compared to gains, nor a region of price insensitivity for small price differences. Gains observed for coffee brands larger then 0.2 have negligible effects on brand utility and losses of more than 0.05 have no influence on the utility of brands in the ketchup market. Although both observations may suggest that consumers use price as a quality indicator, there is little relative data within these regions, resulting in wider confidence bands.

3.4 *Changes in Goodwill*

The high number of 22 degrees of freedom for the smoothed goodwill functions in the coffee market can be understood by viewing the appropriate curves. *Figure 3* shows the resulting goodwill functions for three brands named brand A, B, and C. Brand C is the reference brand whose brand specific goodwill is fixed at zero across time.

Figure 3: Time-variable Goodwill for two Brands of Coffee Market

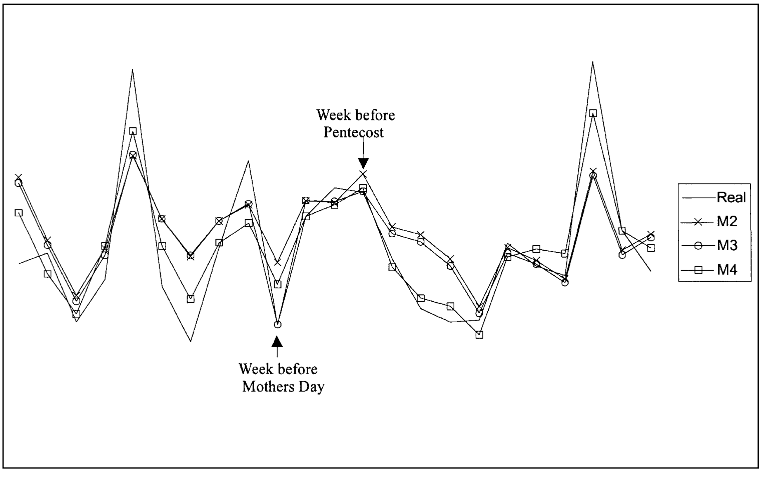


The goodwill for brand A is almost always higher than the goodwill for brand B. The highest values for brand A's goodwill are observed in the weeks prior to holidays such as Easter, Pentecost, German Unification Day, and Christmas, while goodwill for brand B is low especially in the weeks before Easter and Christmas. This observation indicates that consumers perceive brand A as being particularly suitable for celebrating holidays. Because we observe a higher price level for brand A, the goodwill functions shown in *Figure 3* may also result from lower price sensitivity before holidays. In this case, the low price sensitivity initiates increasing preferences for brands that are rated as offering high quality, but too expensive for everyday life. An argument for this interpretation is that for other brands with high price levels, goodwill functions similar to that of brand A can be observed.

The decrease in brand A's function in the weeks after the holidays is probably attributable to remaining stocks, because a pound of coffee can hardly be consumed within a few days. There are also increases and decreases in goodwill that cannot be explained by the occurrence of holidays. These changes in goodwill may be due to advertising campaigns or other reasons not evident from the data.

Figure 4 compares the market share forecasts for brand A that are provided by the model that does not consider temporal changes (M2), the model that includes dummies for holidays and temperature (M3), and the model with time-variable goodwill functions (M4) to real market shares. To keep the representation concise, the market shares are illustrated only for an interval of 23 weeks.

Figure 4: Market share for Brand A



Market share forecasts proposed by model M3 are, for most of this time, very close to the market shares proposed by model M2. As expected, model M3 precisely forecasts the real market share in the weeks before Mothers Day and Pentecost, because dummies for these weeks are included in the model. With the exception of these weeks, model M4 forecasts real market shares more accurately.

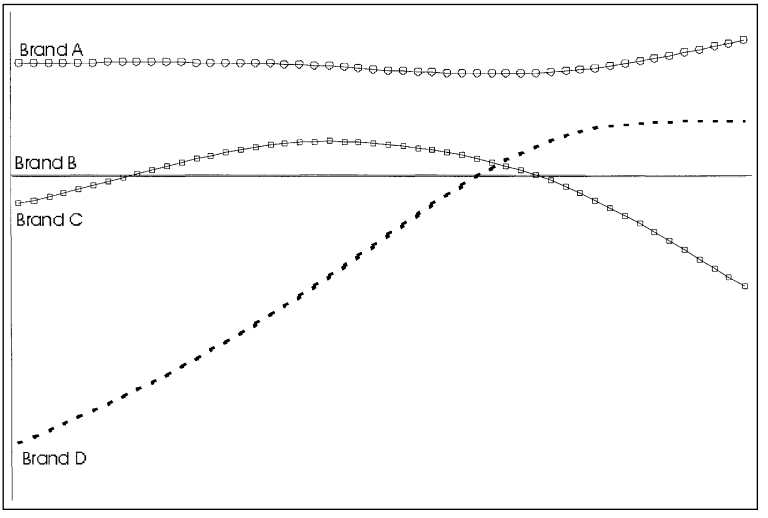
Contrary to the product category coffee, there is no short-term fluctuation in the goodwill for brands within the product category of ketchup. Therefore, no brand has the image of being convenient for holidays. *Figure 5* presents the resulting goodwill functions for four brands.

Although brand A consistently achieves the highest goodwill, there is only a slight increase at the end of the year. Preference for brand D is very low at the beginning of the year but increases steadily. This increase may be due either to an advertising campaign or the increased availability of this brand. Contrary to brand B, brand C's goodwill achieves an increase in summer, but in autumn and winter the goodwill decreases. This effect is also observed in model M3, where brand C's choice probability strongly increases along with temperature. Although this observation may again be explained by advertising or availability, there can also be a seasonal effect for brand C, which is perceived to be especially suitable for barbecues or picnics in summer.

3.5 Managerial Implications

The proposed time-varying goodwill functions suggest some implications for marketing management. For example, the managers responsible for brand B in the coffee market receive some alerts. The brand is perceived to be unsuitable for festive occasions and a slightly decreasing trend in the brand's goodwill is observed. A comparison of the marketing policy in periods of increasing goodwill with the

Figure 5: Time-variable goodwill for brands of ketchup market



marketing policy in periods of decreasing goodwill may be a source of suggestions for improvement. The managers of brand A in the coffee market may be interested in reasons for the unexpected decrease in goodwill in the weeks before Mother's Day, which contrast with the brand's goodwill trend prior to other holidays. Moreover, simulations can be used to determine the best date for promotions.

The high preference for ketchup brand A should not cause management to become overconfident, because brand D may be turning into a real threat. The lack of short-term variations in goodwill may motivate management to develop an advertising campaign that presents the brand as being highly suitable for special purposes.

Of course, knowledge about marketing actions not included in the data but accessible to marketing management may lead to further interpretations of goodwill functions. Furthermore, analysis of the development of a brand's goodwill is only one of many sources for management implications. Insights from other marketing research studies and the management's knowledge about market structure, as well as objectives regarding brand positioning and superior business objectives, will influence decisions fairly.

4 Summary and Conclusions

In almost all applications of the multinomial logit model to brand choice, the parameters of the utility function, and therefore consumers' brand choice behavior, are assumed to be constant across time. In contrast to this assumption, marketing theory as well as statements by practitioners imply the possibility of temporal fluctuations and long-term variations in brand choice behavior.

In this paper, to replace the commonly used alternative specific constant terms by nonparametric time-dependent alternative specific functions I apply an algorithm introduced by *Abe* (1998) for the estimation of nonparametric terms within a multinomial logit model's utility function. These functions can be interpreted as the brand's time-variable goodwill.

The results of the empirical study imply considerable fluctuations in the goodwill of brands on the coffee market. The resulting goodwill functions suggest that consumers perceive some brands to be especially suitable for festive occasions, such as Easter, Pentecost, or Christmas. In the ketchup product category, only long-term trends, but no short-term fluctuations of goodwill functions, are observed. In both applications, the model that examines time-variable goodwill outperforms a model that includes brand-specific constants. Moreover, an analysis of the resulting goodwill functions allows management implications that are not readily available by other brand choice models.

In general, the main advantage of applying nonparametric methods is that the researcher is not required to predetermine a parametric function that may not represent the true relationships. Furthermore, the results can suggest appropriate parametric functions. Because there are several possible short- and long-term influences, these arguments are especially valid for models that study changes in brand choice behavior. In this paper, a model incorporating nonparametric time-variable goodwill outperforms a parametric model that includes dummy variables representing holidays and temperature in one data set. Moreover, the resulting goodwill functions suggest temporal fluctuations that would usually not be expected a priori, and therefore would not have been considered in a parametric model.

References

Abe, Makoto (1998), Measuring Consumer Nonlinear Brand Choice Response to Price, in: Journal of Retailing, Vol. 74, pp. 541–568.

Abe, Makoto (1999), A Generalized Additive Model for Discrete Choice Data, in: Journal of Business & Economic Statistics, Vol. 17, pp. 271–284.

Ailawadi, Kusum L./Gedenk, Karen/Neslin, Scott A. (1999), Heterogeniety and Purchase Event feedback in Choice Models: An empirical analysis with implications for model building, in: International Journal of Research in Marketing, Vol. 16, pp. 177–198.

Ben-Akiva, Moshe/Lerman, Steven R. (1985), Discrete Choice Analysis: Theory and Application to Travel Demand.

Briesch, Richard A./Krishnamurthi, Lakshman/Mzumdar, Tribid/Raj, S. P. (1997), A Comparative Analysis of Reference Price Models, in: Journal of Consumer Research, Vol. 24, pp. 202–214.

Fader, Peter/Lattin, James M./Little, John D. C. (1992), Estimating nonlinear Parameters in the Multinomial Logit Model, in: Marketing Science, Vol. 11, pp. 372–385.

Green, P. J./Silverman, Bernard W. (1994), Nonparametric Regression and Generalized Linear Models.

Guadagni, Peter M./Little, John D. C. (1983), A Logit Model of Brand Choice Calibrated on Scanner Data, in: Marketing Science, Vol. 2, pp. 203–238.

Hastie, Trevor J./Tibshirani, Robert J. (1990), Generalized Additive Models.

Hruschka, Harald (2000), Specification, Estimation and Empirical Corroboration of Gutenberg's Kinked Demand Curve, in: *Albach, Horst/Brockhoff, Klaus/Eymann, E./Jungen, P./Steven, M./Luhmer, A.* (eds.), Theory of the firm. Erich Gutenberg's Foundations and Further Developments, pp. 153–168.
Hruschka, Harald (2002), Market Share Analysis Using Semi-Parametric Attraction Models, in: European Journal of Operational Research, Vol. 138, pp. 212–225.
Kalwani, Manohar U./Yim, Chi K./Rinne, Heikki J./Sugita Yoshi (1990), A Price Expectations Model of Customer Brand Choice, in: Journal of Marketing Research, Vol. 27, pp. 251–262.
Kalyanam, Kirthi/Shively, Thomas S. (1998), Estimating Irregular Pricing Effects: A Stochastic Spline Regression Approach, in: Journal of Marketing Research, Vol. 35, pp. 16–29.
Kalyanaram, Gurumurthy/Little, John D. C. (1994), An Empirical Analysis of Latitude of Price Acceptance in Consumer Package Goods, in: Journal of Consumer Research, Vol. 21, pp. 408–418.
Kooperberg, Charles/Stone, Charles J./Truong, Young K. (1995), Hazard Regression, in: Journal of the American Statistical Association, Vol. 90, pp. 78–94.
Krishnamurthi, Lakshman/Raj, S. P. (1988), A Model of Brand Choice and Purchase Quantity Price Sensitivities, in: Marketing Science, Vol. 7, pp. 1–20.
Lattin, James M. (1987), A Model of Balanced Choice Behavior, in: Marketing Science, Vol. 6, pp. 48–65.
Lattin, James M./Bucklin, Randolph E. (1989), Reference Effects of Price and Promotion on Brand Choice Behavior, in: Journal of Marketing Research, Vol. 16, pp. 299–310.
Maier, Gunther/Weiss, Peter (1990), Modelle diskreter Entscheidungen.
Mazumdar, Tridib/Papatla, Purushottam (1995), Loyalty Differences in the Use of Internal and External Reference Prices, in: Marketing Letters, Vol. 6, pp. 111–122.
McFadden, Daniel (1980), Econometric Models for Probabilistic Choice among Products, in: Journal of Business, Vol. 53, pp. s13–s34.
Mela, Carl F./Gupta, Sunil/Jedidi, Kamel (1998), Assessing long-term promotional influences on market structure, in: International Journal of Research in Marketing, Vol. 15, pp. 89–107.
Papastefanou, Georgious/Schmidt, Peter/Börsch-Supan, Axel/ Lüdtke, Hartmut/Otersdorf Ulrich (eds.) (2001), Social and Economic Analysis of Consumer Panel Data.
Rust, Roland T. (1988), Flexible Regression, in: Journal of Marketing Research, Vol. 25, pp. 10–24.
Tellis, Gerard J. (1988), Advertising Exposure, Loyalty and Brand Purchase: A Two-Stage Model of Choice, in: Journal of Marketing Research, Vol. 25, pp. 134–144.
Wedel, Michel/Leeflang, Peter S. H. (1998), A Model for the Effects of Psychological Pricing in Gabor-Granger Price studies, in: Journal of Economic Psychology, Vol. 19, pp. 237–260.
Wilkie, William L. (1986), Consumer Behavior, John Wiley & Sons.

Endres, Dieter/Möller, Marius, Unternehmensbesteuerung in Deutschland/Corporate Taxation in Germany, IDW-Verlag GmbH, Düsseldorf 2001, 732 pp., € 49,90 (bilingual in German and English).

The overall economic framework of doing business has changed significantly during the last decade. Global economic and technological developments are still ongoing and are particularly strong within integrated regions, like the EU, the NAFTA and others. While barriers to international trade and investment are more and more eliminated and capital markets are characterised by full mobility of capital, tax impediments to cross-border activities are becoming increasingly important. Therefore, EU Member States as well as other countries have started to play a rather active part in European and global tax competition matters, especially to attract inbound investments, but are also forced to safeguard their tax revenues. Insofar, the EU Member States have to exercise their fiscal sovereignty in accordance with the non-legally binding Code of Conduct as well as the fundamental freedoms and the state aid rules that are contained in the EC Treaty and enforced by the European Court of Justice and the European Commission, respectively.

In 2000, Germany has significantly improved its tax climate for foreign (inbound) business investment by adopting the revolutionary Tax Reduction Act, which became effective January 1, 2001. The reform was especially supposed to reduce the overall tax burden on business activities, to bring the provisions of German tax law into line with European efforts, to equalize the tax treatment of different legal forms of business entities and to simplify the tax system. In effect, only the first two aims could be reached in order to enhance the competitiveness of Germany as a location for business investment and therefore to increase employment. Knowledge of the fundamentally revised provisions is therefore essential for both, domestic and foreign investors. Thus, as the authors, *Dieter Endres* and *Marius Möller*, note in their preface, especially with regard to inbound investors, "the new edition seeks to briefly and succinctly present the main feature of the current (tax; M.W.) system, relevant to foreign businesses with German business activities (Part 1). The translations of and comments on the more important Acts (Part 2) and Decrees (Part 3) will, it is hoped, serve the interests of those foreign businesses planning an actual investment in Germany." To address the mentioned objectives, the experienced authors, supported by *Andrew Miles*, who are all with PriceWaterhouseCoopers in Frankfurt, give the reader in the first part of the book the opportunity to get a comprehensive and up to date overview about the German Corporate Tax System (pp. 15–73); the extensive collection of German tax acts with individual notes in the second part (pp. 73–204) and administrative principles and opinions in the third (pp. 205 –361) comprehensively support those readers that are familiar with the law of taxation.

In the first chapter (pp.15–28), the authors give a broad introduction about the basic principles of corporate taxation in Germany. The referred principles of legislation describe the legal and economic characteristics, but also the nature of the administration of Germany as a country with a federal structure, having a complex tax system. Moreover, the most important taxes and their amount of revenue, they individually account for, as well as the network of countries with which Germany has concluded a Double Tax Treaty are mentioned. Special emphasis is put on the increasing influence by European developments to the tax climate for business investment in Germany. Furthermore, the most important taxes of the German tax system, the taxes on income (individual income tax, corporation tax, trade tax and surcharges on income and corporation tax), capital taxes (land tax, inheritance and gift tax) and transaction and consumption taxes (Value Added Tax and real estate transfer tax) are explained as well as an overview with regard to the taxation procedures in Germany is given.

In the second chapter (pp. 28–50), the main features of the fundamental German tax reform, based on the Tax Reduction Act, are illustrated in great detail and with special emphasis to inbound investors. First, the general concept of the reform is described. Second, the introduction of a flat-rate classical system of corporation tax with shareholder relief is extensively explained: It replaces the split-rate full imputation system by a uniform corporation tax rate of 25% for all profits, whether retained or distributed, that is applicable for both, resident and non-resident companies with regard to earnings derived through a German permanent establishment or partnership. The withholding tax rate on domestic dividends is reduced to 20%, but remains fully creditable for resident individual or corporate shareholders. Moreover, domestic and foreign dividends are both partially or even entirely tax exempt at the individual (50%: half-income method) or corporate shareholder level (100%: dividend-received exemption), irrespective of the percentage shareholding or the holding period. However, these dividend exemption privileges also apply to capital gains on the disposition of shares in domestic or foreign companies. Half of the respective capital gains are subject to income tax if the disposed shares are part of the business assets of a partnership or a sole proprietorship, if the individual shareholder holds at least 1% of the respective shares, or if the disposal takes place during the speculation period of one year. Capital gains realised on the disposal of shares through other private transactions are still not subject to income tax in Germany. Corporate shareholders are generally tax exempt concerning the respective capital gains, irrespective of the percentage shareholding or the holding period. Furthermore, to equalize the tax treatment of different legal forms of business entities, no check-the-box option permitting unincorporated businesses to elect taxation as companies was enacted; however, for individual sole proprietors and partners deriving business income, a standardised credit against their personal income tax liability for trade tax was introduced.

In the third chapter (pp. 51–67) the authors itemise further important tax aspects for inbound investors. Insofar, a comparison of the tax burden of a German subsidiary and a German permanent establishment (branch or partnership) is also given as the effects of funding German business entities by way of equity or debt is explained. Special emphasis is put on the considerably tightened thin capitalisation provisions, which may still be contrary to the freedom of establishment, laid down in the EC Treaty. Moreover, the attractiveness of Germany as a location for holding companies is briefly illustrated on a case by case basis. In the fourth chapter (pp. 67–71) the impact of the German tax reform on mergers, acquisitions and reorganisations as well as joint ventures and international mergers is explained and the possibilities to structure an acquisition in Germany are discussed. The explanatory part of the book finishes with a statement in the fifth chapter (pp. 71–72) about the tax climate for foreign investors in Germany.

In short, Corporate Taxation in Germany is a brilliant introduction to the complex German law of national and international business taxation from both, an economic and a legal perspective, especially with regard to inbound investments. Together with the huge collection of statutory provisions and authoritative regulations, the entirely bilingual written publication is a fascinating source for executives of multinational enterprises and their (German) tax advisers as well as for researchers and scholars dealing with international business relationships. For them, the book of *Endres* and *Möller* is most valuable and therefore more than welcome and highly recommended.

Dr. Martin Wenz, Munich

August 2003

Bruhn, Manfred/Michalski, Silke

Analysis of Relationship Ending

Analyse von Kundenabwanderungen – Forschungsstand, Erklärungsansätze, Implikationen

Achtenhagen, Leona/Müller, Jörg/ zu Knyphausen-Aufseß, Dodo

The Open Source Dilemma: Open Source Software between Free Availability and Commercialisation

Das Open Source-Dilemma: Open Source-Software-Entwicklung zwischen organisatorischer Optimierung und notwendiger Kommerzialisierung

Borcherding, Malte/ Grund, Christian

Wage Agreements, Human Capital Investments, and Performance Evaluation – an Empirical Study

Tariforientierung, Humankapital-investitionen und subjektive Leistungs-bewertung – eine empirische Studie

Arbeitskreis "Finanzierung" der Schmalenbach-Gesellschaft für Betriebswirtschaft e.V.:

Subsidiary IPOs – Recommendations Developed by the Schmalenbach Working Group 'Finance'

Börsengänge von Konzerneinheiten – Handlungsempfehlungen des Arbeitskreises "Finanzierung" auf Basis einer empirischen Untersuchung deutscher Equity Carve-Outs und Spin-offs (1997 – 2000)

September 2003

Gründl, Helmut/Stehle, Richard/Waldow, Thorsten

Endowment Life Insurance Policies versus Investment Portfolios with Similar Pay-Off Structures – a Performance Comparison from the Perspective of an Investor

Zur Vorteilhaftigkeit von Kapitallebensversicherungen gegenüber alternativen Anlageformen – Eine Analyse aus Anlegersicht

Schremper, Ralf

Capital Market Relevance of German Share Repurchase Programs

Kapitalmarktrelevanz deutscher Aktienrückkaufprogramme

Seitz, Bernhard

Direct Search and the Protection of Corporate Rights: Economic Arguments for a Legal Debate

Die Direktansprache und der Schutz unternehmerischer Rechte: Ökonomische Argumente für eine rechtliche Problematik

Gerpott, Torsten J.

Convergence Strategies of Mobile and Fixed Network Service Providers

Konvergenzstrategien von Mobilfunk- und Festnetzdiensteanbietern