SFB 649 Discussion Paper 2008-069

Structural Dynamic Conditional Correlation

Enzo Weber*

* Freie Universität Berlin and Universität Mannheim

This research was supported by the Deutsche Forschungsgemeinschaft through the SFB 649 "Economic Risk".

http://sfb649.wiwi.hu-berlin.de
ISSN 1860-5664

SFB 649, Humboldt-Universität zu Berlin
Spandauer Straße 1, D-10178 Berlin

SFB 649 ECONOMIC RISK BERLIN

Structural Dynamic Conditional Correlation[1]

Enzo Weber

Freie Universität Berlin and Universität Mannheim
L 7, 3-5, D-68131 Mannheim, Germany
enweber@mail.uni-mannheim.de
phone: +49-621-181-1844 fax: +49-621-181-1931

First version: 12/2007
This version: 12/2008

Abstract

In the literature of identification through autoregressive conditional heteroscedasticity, Weber (2008) developed the structural constant conditional correlation (SCCC) model. Besides determining linear simultaneous influences between several variables, this model considers interaction in the structural innovations. Even though this allows for common fundamental driving forces, these cannot explain time variation in correlations of observed variables, which still have to rely on causal transmission effects. In this context, the present paper extends the analysis to structural *dynamic* conditional correlation (SDCC). The additional flexibility is shown to make an important contribution in the estimation of empirical real-data examples.

Keywords: Simultaneity, Identification, EGARCH, DCC
JEL classification: C32, G10

[1]This research was supported by the Deutsche Forschungsgemeinschaft through the CRC 649 "Economic Risk". I am grateful to Jürgen Wolters and Cordelia Thielitz for their help. Of course, all remaining errors are my own.

1 Introduction

Identifying structural models that feature simultaneous effects between several variables is one of the key tasks of econometrics. The conventional method solving identification problems in multivariate time series analysis works through parametric (zero) constraints, which allow recovering the structural model from the estimated reduced form. However, it is often difficult to justify these restrictions as they naturally imply a certain *a priori* determination of structure and direction of causalities.

For heteroscedastic series, a small strand of recent literature introduced methods that exploit non-constant variances for identifying simultaneous models "through heteroscedasticity" (see Rigobon 2003). A shift in the structural volatility, which yields more additional determining equations from the reduced-form covariance-matrix than unknown coefficients, describes the basic idea. Building on this logic, further research for example in Sentana and Fiorentini (2001), Rigobon (2002) and Weber (2007) proposed estimating ARCH-type processes as to coherently describe the necessary volatility movements.

While the previously mentioned models are successful in identifying simultaneous transmission effects, they neglect fundamental driving forces, which might equally underlie the development of all included variables. This problem has been recently addressed by Weber (2008), who introduced the so-called structural constant conditional correlation (SCCC) model. Thereby, he allowed for common third-party influences in a framework that upholds identifiability by restricting these influences to result in constant correlations of the innovations. However, in conventional reduced-form approaches, time variation has usually been found to be a common feature of correlations of observed financial variables. Just like the overall level of correlation, this time variation in conditional correlation can logically be triggered by direct spillovers or by common grounds in the disturbances. Consequently, the present paper allows for both of these sources instead of solely relying on the first one. This is achieved in a simultaneous equation system featuring structural *dynamic* conditional correlation (SDCC), extending the concept of Engle (2002) to the unobservable fundamental shocks. The proposed setup makes it possible to identify general causal structures, whose flexibility paves the way to realistic interpretations in terms of financial economics.

Building on the work of Weber (2008), the next section sets out the new methodological proceeding. Thereafter, section 3 discusses the usefulness of the econometric approach in a small empirical example with Dow Jones Industrial and Nasdaq Composite stock index returns. The last section concludes.

2 Methodology

To begin with, let us establish the key features of the SCCC model introduced by Weber (2008). Therein, contemporaneous transmission effects between the n endogenous variables contained in the vector y_t are specified as

$$Ay_t = \varepsilon_t \ . \tag{1}$$

Here, the coefficients representing instantaneous impacts are included in the $n \times n$ matrix A, in which the diagonal elements are normalised to one. ε_t is a n-dimensional vector of structural innovations with unrestricted correlation matrix.

Treating some notation in preparation for the ARCH modelling, denote the conditional variances of the elements in ε_t by

$$\text{Var}(\varepsilon_{jt}|I_{t-1}) = h_{jt}^2 \qquad j = 1, \ldots, n \ , \tag{2}$$

where I_{t-1} stands for the whole set of available information at time $t-1$.

Then, stack the conditional variances in the vector $H_t = \begin{pmatrix} h_{1t}^2 & \ldots & h_{nt}^2 \end{pmatrix}'$.

At last, denote the standardised white noise residuals by

$$\tilde{\varepsilon}_{jt} = \varepsilon_{jt}/h_{jt} \qquad j = 1, \ldots, n \ . \tag{3}$$

Then, the multivariate EGARCH(1,1)-process, as suggested by Weber (2007), is given by

$$\log H_t = C + G \log H_{t-1} + D|\tilde{\varepsilon}_{t-1}| + F\tilde{\varepsilon}_{t-1} \ , \tag{4}$$

where C is a n-dimensional vector of constants and G, D and F are $n \times n$ coefficient matrices. The absolute value operation is to be applied element by element and provides the pure magnitude of shocks.[2] In addition, the signed $\tilde{\varepsilon}_t$ introduce asymmetric volatility effects.

While the conditional variances are treated in (4), Weber (2008) recovers the *co*variances by the constant conditional correlation assumption as

$$\text{Cov}(\varepsilon_{it}, \varepsilon_{jt}|I_{t-1}) = h_{ijt} = \rho_{ij} h_{it} h_{jt} \qquad i \neq j \ , \tag{5}$$

[2]Note that in the original univariate formulation of Nelson (1991), the unsigned shock was corrected for its mean as in $(|\tilde{\varepsilon}_{t-1}| - E(|\tilde{\varepsilon}_{t-1}|))$. The present specification merges the term $-D \cdot E(|\tilde{\varepsilon}_{t-1}|)$ into the constants C, but is completely conformable to the original version. The advantage is that no distributional assumption has to be made for calculating the expectation.

where ρ_{ij} denotes the correlation between the ith and jth residual. At this point, the present paper introduces a considerably more flexible setup by adopting a DCC specification for the structural innovations: Building on Engle (2002), define the conditional correlation matrix R_t as

$$R_t = diag\{Q_t\}^{-1/2} Q_t \, diag\{Q_t\}^{-1/2} \; . \tag{6}$$

Therein, Q_t follows the process

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha \tilde{\varepsilon}_{t-1} \tilde{\varepsilon}'_{t-1} + \beta Q_{t-1} \; . \tag{7}$$

(7) corresponds to a standard GARCH(1,1) in that Q_t is driven by the cross product of the shocks and a persistence term. $\overline{Q}$ denotes the unconditional covariance matrix of the standardised residuals $\tilde{\varepsilon}_t$. Although α and β are defined as scalars for parsimony, more comprehensive solutions are possible, see Engle (2002).

With R_t at hand, the conditional covariance-matrix Ω_t of the structural disturbances ε_t is defined as

$$\Omega_t = diag\{H_t\}^{1/2} R_t \, diag\{H_t\}^{1/2} \; . \tag{8}$$

Accounting for the discussion in Engle (2002) and given positive variances from the log-linearised EGARCH, Ω_t is assured to be positive definite. This property carries over to the conditional covariance-matrix of the reduced-form residuals $A^{-1}\varepsilon_t$

$$\Sigma_t = A^{-1} \Omega_t (A^{-1})' \tag{9}$$

due to its quadratic form.

Identifiability can now be discussed as in Weber (2008), without loss of generality focusing on the bivariate case. The structural variance process (4) contains two parameters in C and four each in G, D and F. Together with the two parameters from the structural matrix A and one each from α, β and $\overline{Q}$, the sum adds up to 19 coefficients. This can be compared to the number arising from the reduced-form process for $vech(\Sigma_t)$, where the $vech$ operator stacks the lower triangular portion of a matrix into a column vector. For the given example, this vector includes two variances and one covariance. Thus, in a general MGARCH, the equivalent of C has dimension 3×1 and those of G, D and F are 3×3. Consequently, the number of parameters arrives at a total of $3 + 3\,(3 \cdot 3) = 30$, which exceeds 19 and hence satisfies the necessary summing-up constraint. In addition, a sufficient condition is given by linear independence of the conditional variances (as in Sentana and Fiorentini 2001), which should normally be met by ARCH-type processes.

The estimation can be done by Maximum Likelihood. For this purpose, the log-likelihood for a sample of T observations (complemented by an adequate number of pre-sample observations) under the assumption of conditional normality is constructed as

$$L(\theta) = -\frac{1}{2}\sum_{t=1}^{T}(n \log 2\pi + \log |\Sigma_t| + y_t' \Sigma_t^{-1} y_t) \ , \tag{10}$$

where the vector θ stacks all free parameters from C, G, D, F, A, α, β and $\overline{Q}$. That is, maximisation of (10) yields estimates of both the EGARCH parameters and the structural coefficients governing spillovers and fundamental correlations. As the assumption of conditional normality is often problematic for financial markets data, the estimation relies on Quasi-Maximum-Likelihood (QML, see Bollerslev and Wooldridge 1992). This ensures consistency of the estimation, while standard errors are corrected for possible non-normality. Numerical likelihood optimisation is performed using the BHHH algorithm (Berndt et al. 1974).

3 Once again: Blue Chip vs. High Tech

Weber (2008) applies his SCCC model to the Dow Jones Industrial Average and Nasdaq Composite daily returns for the long sample from 2/5/1971 until 10/31/2007. For ρ, the constant conditional correlation coefficient, he finds an estimate of roughly 20%. Given the considerable proximity of the two stock segments, he argues that one might have expected a much higher coherence of shocks. Indeed, cutting the sample at the end of 1996 raises ρ to 42%. Weber (2008) ascribes this effect to the CCC assumption, which obviously fails to adequately describe the correlation structure through the whole sample including the extremely volatile period around the year 2000.

This discussion suggests that the SDCC model should be able to compensate for the depicted shortcoming: Namely, under an SCCC assumption, the time-varying part of the total correlation logically has to be picked up exclusively by the mutual transmission effects. Logically, above all in times of economic turbulences, the estimation might easily understate the influence of third-party common factors. In view of this problem, the SDCC model is likely to provide a more appropriate impression of the underlying financial processes.

As in Weber (2008), in a first step the returns are regressed on a constant and four day-of-the-week dummies, but no autoregressive lags. Starting values for the optimisation of the likelihood (10) were obtained as follows: The EGARCH parameters were estimated in univariate models, whereas the off-diagonal elements were set to zero. The variance processes were started at the sample moments. A was initialised as the identity matrix, so that the off-diagonal element from $\overline{Q}$ equalled the unconditional return correlation. However, putting more weight on A and less on $\overline{Q}$ had no relevant impact on the outcome of the QML procedure. Starting values for α and β, which govern the development of the structural conditional correlation, were taken from a conventional reduced-form DCC model. The estimations were carried out in a Gauss programme employing the CML module.

Equations (11), (12) and (13) display the estimation outcome. The variable names denote close-to-close returns at time t, q_t is the off-diagonal element from Q_t, and QML standard errors are in parentheses.

$$\begin{aligned} \text{DJIA}_t &= \underset{(0.036)}{0.326}\ \text{NQC}_t + \hat{\varepsilon}_{1t} \\ \text{NQC}_t &= \underset{(0.037)}{0.328}\ \text{DJIA}_t + \hat{\varepsilon}_{2t} \end{aligned} \tag{11}$$

$$\begin{pmatrix} \log h_{1t}^2 \\ \log h_{2t}^2 \end{pmatrix} = \begin{pmatrix} \underset{(0.028)}{-0.168} \\ \underset{(0.025)}{-0.247} \end{pmatrix} + \begin{pmatrix} \underset{(0.005)}{0.984} & \underset{(0.003)}{-0.008} \\ \underset{(0.006)}{-0.020} & \underset{(0.003)}{0.987} \end{pmatrix} \begin{pmatrix} \log h_{1t-1}^2 \\ \log h_{2t-1}^2 \end{pmatrix} + \begin{pmatrix} \underset{(0.021)}{0.126} & \underset{(0.018)}{0.070} \\ \underset{(0.019)}{0.114} & \underset{(0.021)}{0.176} \end{pmatrix} \begin{pmatrix} |\tilde{\varepsilon}_{1t-1}| \\ |\tilde{\varepsilon}_{2t-1}| \end{pmatrix} + \begin{pmatrix} \underset{(0.010)}{-0.036} & \underset{(0.007)}{-0.030} \\ \underset{(0.010)}{-0.045} & \underset{(0.008)}{-0.039} \end{pmatrix} \begin{pmatrix} \tilde{\varepsilon}_{1t-1} \\ \tilde{\varepsilon}_{2t-1} \end{pmatrix} \tag{12}$$

$$q_t = (1 - \underset{(0.006)}{0.021} - \underset{(0.008)}{0.973}) \cdot \underset{(0.081)}{0.361} + \underset{(0.006)}{0.021} \tilde{\varepsilon}_{1t-1}\tilde{\varepsilon}_{2t-1} + \underset{(0.008)}{0.973} q_{t-1} \tag{13}$$

The unconditional correlation of the structural innovations rises to more than 1/3, compared to less than 1/5 in the SCCC model. This confirms the presumption that a higher degree of coherence in shocks can be found by allowing for time variation, which is picked up by the SDCC specification. While Weber (2008) obtained a relatively high correlation coefficient only after sample shortening, the present approach achieves such a result over the whole sample including the period of economic and financial disturbances. Logically, the SDCC parameters $\hat{\alpha}$ and $\hat{\beta}$ are clearly significant, taking values that are common in the financial volatility literature. Restricting both of them to zero, that is applying the SCCC assumption, is clearly rejected with a decline in log-likelihood of 225.

Figure 1 shows the structural conditional correlation as the off-diagonal element in R_t as well as its reduced-form counterpart, which is calculated from the covariance-matrix (9). That is, the latter mirrors the correlation effects of causal transmission in addition to the fundamental commonalities in the structural innovations.

The most eye-catching drop in correlations appears in the year 2000, where the extreme spike and fall of the Nasdaq Composite index occurred. Thereafter, correlations jump up again coinciding with 9/11 and the US recession. In the years before, further turbulences

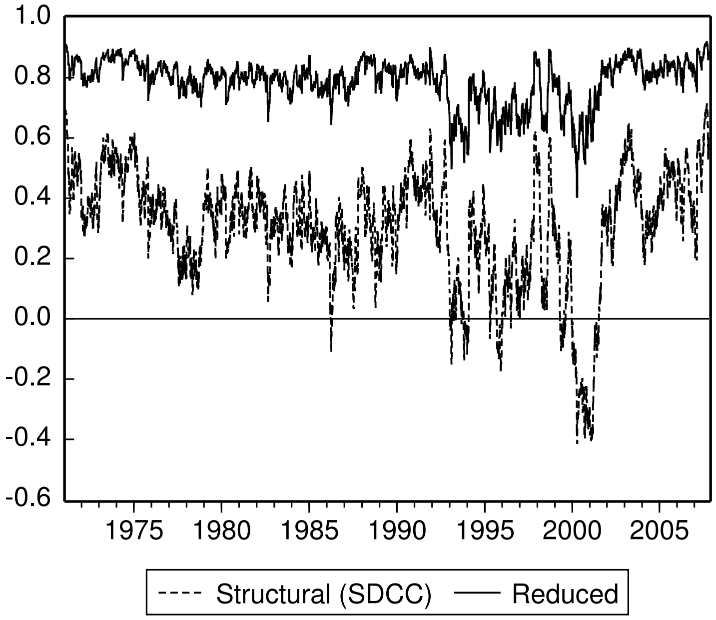

Figure 1: Conditional correlations

took place from the end of 1992 onwards, comprising numerous financial crises like those in Mexico, South-East Asia, Russia and Brazil. A similar pattern has as well been found by Engle (2002) in his reduced-form DCC approach within a shorter sample.

Concerning the direct spillovers, both coefficients in A are highly significant. Since the Dow effect is only marginally higher, the moderate dominance of the Dow found before hardly carries over to the SDCC model. Nevertheless, the causality-in-variance effects from (12) still reveal higher cross-segment influences of the Dow Jones as compared to the Nasdaq Composite. This transmission can be interpreted as a proxy for information flows between markets (Ross 1989). The negative parameters of the signed shocks represent the well-known asymmetric volatility effects. The negative off-diagonal coefficients in the autoregressive matrix indicate a certain dampening influence, which is however economically small. Being smaller than one, both eigenvalues of this matrix meet the stability criterion, even though the usual substantial persistence in variance can be found.

Finally, the model is subjected to several specification tests: As in Weber (2008), the autocorrelations of the squared standardised disturbances $\tilde{\varepsilon}_{jt}^2$ do not exceed the approximate 95% confidence bands, except for the Nasdaq first-order autocorrelation, which does however not reach significance at the 1% level. Furthermore, the autocorrelations of the cross product $\varepsilon_{1t}\varepsilon_{2t}$, standardised by the conditional covariance, are insignificant by the same criterion; again, this shows the benefit of *dynamic* correlations compared to the

SCCC model of Weber (2008), which could not absorb the whole time variation in the structural covariance. Even though the standardised residuals have excess kurtosis (4.1 and 1.6), allowing for heavy tails as in the Student-t-distribution does not relevantly alter the outcome of the maximum likelihood procedure.

4 Concluding Summary

Weber (2008) proposed the structural constant conditional correlation (SCCC) model, which complements non-restricted simultaneous effects between several variables by interaction in their fundamental innovations. That is, an observed correlation can be traced back to the sources direct causality and common shocks. This paper improved on the SCCC model by allowing for *dynamic* conditional correlations in the structural shocks (SDCC).

The methodological enhancement has the effect that even the *time variation* in correlations between financial variables can potentially be explained by unobserved third-party influences in addition to the direct mutual spillovers. In a system of Dow Jones and Nasdaq Composite returns, Weber (2008) found a 20% correlation of the fundamental structural shocks. This relatively low value increased to 36% when the new SDCC model was applied. The reason turned out to be the extremely volatile period in the second half of the 1990s, which could be picked up well by the dynamic specification for the conditional correlations.

In future research, the econometric progress of the SDCC model might be exploited for finding economic interpretations of structural systems, which have hitherto been treated in reduced form. By the same token, existing identification schemes could be checked for their consistence with empirical data.

References

[1] Berndt, E., B. Hall, R. Hall, J. Hausman (1974): Estimation and Inference in Nonlinear Structural Models. Annals of Social Measurement, 3, 653-665.

[2] Bollerslev, T., J.M. Wooldridge (1992): Quasi-Maximum Likelihood Estimation and Inference in Dynamic Models with Time Varying Covariances. Econometric Reviews, 11, 143-172.

[3] Engle, R.F. (2002): Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. Journal of Business & Economic Statistics, 20, 339-50.

[4] Nelson, D.B. (1991): Conditional Heteroskedasticity in Asset Returns: A New Approach. Econometrica, 59, 347-370.

[5] Rigobon, R. (2002): The Curse of Non-Investment Grade Countries. Journal of Development Economics, 69, 423-449.

[6] Rigobon, R. (2003): Identification through heteroscedasticity. Review of Economics and Statistics, 85, 777-792.

[7] Ross, S.A. (1989): Information and volatility: the no-arbitrage martingale approach to timing and resolution irrelevancy. Journal of Finance, 44, 1-17.

[8] Sentana, E., G. Fiorentini (2001): Identification, estimation and testing of conditionally heteroskedastic factor models. Journal of Econometrics, 102, 143–164.

[9] Weber, E. (2007): Volatility and Causality in Asia Pacific Financial Markets. CRC 649 Discussion Paper 2007-004, Humboldt-Universität zu Berlin.

[10] Weber, E. (2008): Structural Constant Conditional Correlation. CRC 649 Discussion Paper 2008-015, Humboldt-Universität zu Berlin.

SFB 649 Discussion Paper Series 2008

For a complete list of Discussion Papers published by the SFB 649, please visit http://sfb649.wiwi.hu-berlin.de.

001 "Testing Monotonicity of Pricing Kernels" by Yuri Golubev, Wolfgang Härdle and Roman Timonfeev, January 2008.
002 "Adaptive pointwise estimation in time-inhomogeneous time-series models" by Pavel Cizek, Wolfgang Härdle and Vladimir Spokoiny, January 2008.
003 "The Bayesian Additive Classification Tree Applied to Credit Risk Modelling" by Junni L. Zhang and Wolfgang Härdle, January 2008.
004 "Independent Component Analysis Via Copula Techniques" by Ray-Bing Chen, Meihui Guo, Wolfgang Härdle and Shih-Feng Huang, January 2008.
005 "The Default Risk of Firms Examined with Smooth Support Vector Machines" by Wolfgang Härdle, Yuh-Jye Lee, Dorothea Schäfer and Yi-Ren Yeh, January 2008.
006 "Value-at-Risk and Expected Shortfall when there is long range dependence" by Wolfgang Härdle and Julius Mungo, Januray 2008.
007 "A Consistent Nonparametric Test for Causality in Quantile" by Kiho Jeong and Wolfgang Härdle, January 2008.
008 "Do Legal Standards Affect Ethical Concerns of Consumers?" by Dirk Engelmann and Dorothea Kübler, January 2008.
009 "Recursive Portfolio Selection with Decision Trees" by Anton Andriyashin, Wolfgang Härdle and Roman Timofeev, January 2008.
010 "Do Public Banks have a Competitive Advantage?" by Astrid Matthey, January 2008.
011 "Don't aim too high: the potential costs of high aspirations" by Astrid Matthey and Nadja Dwenger, January 2008.
012 "Visualizing exploratory factor analysis models" by Sigbert Klinke and Cornelia Wagner, January 2008.
013 "House Prices and Replacement Cost: A Micro-Level Analysis" by Rainer Schulz and Axel Werwatz, January 2008.
014 "Support Vector Regression Based GARCH Model with Application to Forecasting Volatility of Financial Returns" by Shiyi Chen, Kiho Jeong and Wolfgang Härdle, January 2008.
015 "Structural Constant Conditional Correlation" by Enzo Weber, January 2008.
016 "Estimating Investment Equations in Imperfect Capital Markets" by Silke Hüttel, Oliver Mußhoff, Martin Odening and Nataliya Zinych, January 2008.
017 "Adaptive Forecasting of the EURIBOR Swap Term Structure" by Oliver Blaskowitz and Helmut Herwatz, January 2008.
018 "Solving, Estimating and Selecting Nonlinear Dynamic Models without the Curse of Dimensionality" by Viktor Winschel and Markus Krätzig, February 2008.
019 "The Accuracy of Long-term Real Estate Valuations" by Rainer Schulz, Markus Staiber, Martin Wersing and Axel Werwatz, February 2008.
020 "The Impact of International Outsourcing on Labour Market Dynamics in Germany" by Ronald Bachmann and Sebastian Braun, February 2008.
021 "Preferences for Collective versus Individualised Wage Setting" by Tito Boeri and Michael C. Burda, February 2008.

SFB 649, Spandauer Straße 1, D-10178 Berlin
http://sfb649.wiwi.hu-berlin.de

This research was supported by the Deutsche Forschungsgemeinschaft through the SFB 649 "Economic Risk".

022 "Lumpy Labor Adjustment as a Propagation Mechanism of Business Cycles" by Fang Yao, February 2008.
023 "Family Management, Family Ownership and Downsizing: Evidence from S&P 500 Firms" by Jörn Hendrich Block, February 2008.
024 "Skill Specific Unemployment with Imperfect Substitution of Skills" by Runli Xie, March 2008.
025 "Price Adjustment to News with Uncertain Precision" by Nikolaus Hautsch, Dieter Hess and Christoph Müller, March 2008.
026 "Information and Beliefs in a Repeated Normal-form Game" by Dietmar Fehr, Dorothea Kübler and David Danz, March 2008.
027 "The Stochastic Fluctuation of the Quantile Regression Curve" by Wolfgang Härdle and Song Song, March 2008.
028 "Are stewardship and valuation usefulness compatible or alternative objectives of financial accounting?" by Joachim Gassen, March 2008.
029 "Genetic Codes of Mergers, Post Merger Technology Evolution and Why Mergers Fail" by Alexander Cuntz, April 2008.
030 "Using R, LaTeX and Wiki for an Arabic e-learning platform" by Taleb Ahmad, Wolfgang Härdle, Sigbert Klinke and Shafeeqah Al Awadhi, April 2008.
031 "Beyond the business cycle – factors driving aggregate mortality rates" by Katja Hanewald, April 2008.
032 "Against All Odds? National Sentiment and Wagering on European Football" by Sebastian Braun and Michael Kvasnicka, April 2008.
033 "Are CEOs in Family Firms Paid Like Bureaucrats? Evidence from Bayesian and Frequentist Analyses" by Jörn Hendrich Block, April 2008.
034 "JBendge: An Object-Oriented System for Solving, Estimating and Selecting Nonlinear Dynamic Models" by Viktor Winschel and Markus Krätzig, April 2008.
035 "Stock Picking via Nonsymmetrically Pruned Binary Decision Trees" by Anton Andriyashin, May 2008.
036 "Expected Inflation, Expected Stock Returns, and Money Illusion: What can we learn from Survey Expectations?" by Maik Schmeling and Andreas Schrimpf, May 2008.
037 "The Impact of Individual Investment Behavior for Retirement Welfare: Evidence from the United States and Germany" by Thomas Post, Helmut Gründl, Joan T. Schmit and Anja Zimmer, May 2008.
038 "Dynamic Semiparametric Factor Models in Risk Neutral Density Estimation" by Enzo Giacomini, Wolfgang Härdle and Volker Krätschmer, May 2008.
039 "Can Education Save Europe From High Unemployment?" by Nicole Walter and Runli Xie, June 2008.
040 "Solow Residuals without Capital Stocks" by Michael C. Burda and Battista Severgnini, August 2008.
041 "Unionization, Stochastic Dominance, and Compression of the Wage Distribution: Evidence from Germany" by Michael C. Burda, Bernd Fitzenberger, Alexander Lembcke and Thorsten Vogel, March 2008
042 "Gruppenvergleiche bei hypothetischen Konstrukten – Die Prüfung der Übereinstimmung von Messmodellen mit der Strukturgleichungs-methodik" by Dirk Temme and Lutz Hildebrandt, June 2008.
043 "Modeling Dependencies in Finance using Copulae" by Wolfgang Härdle, Ostap Okhrin and Yarema Okhrin, June 2008.
044 "Numerics of Implied Binomial Trees" by Wolfgang Härdle and Alena Mysickova, June 2008.

SFB 649, Spandauer Straße 1, D-10178 Berlin
http://sfb649.wiwi.hu-berlin.de

This research was supported by the Deutsche Forschungsgemeinschaft through the SFB 649 "Economic Risk".

045 "Measuring and Modeling Risk Using High-Frequency Data" by Wolfgang Härdle, Nikolaus Hautsch and Uta Pigorsch, June 2008.
046 "Links between sustainability-related innovation and sustainability management" by Marcus Wagner, June 2008.
047 "Modelling High-Frequency Volatility and Liquidity Using Multiplicative Error Models" by Nikolaus Hautsch and Vahidin Jeleskovic, July 2008.
048 "Macro Wine in Financial Skins: The Oil-FX Interdependence" by Enzo Weber, July 2008.
049 "Simultaneous Stochastic Volatility Transmission Across American Equity Markets" by Enzo Weber, July 2008.
050 "A semiparametric factor model for electricity forward curve dynamics" by Szymon Borak and Rafał Weron, July 2008.
051 "Recurrent Support Vector Regreson for a Nonlinear ARMA Model with Applications to Forecasting Financial Returns" by Shiyi Chen, Kiho Jeong and Wolfgang K. Härdle, July 2008.
052 "Bayesian Demographic Modeling and Forecasting: An Application to U.S. Mortality" by Wolfgang Reichmuth and Samad Sarferaz, July 2008.
053 "Yield Curve Factors, Term Structure Volatility, and Bond Risk Premia" by Nikolaus Hautsch and Yangguoyi Ou, July 2008.
054 "The Natural Rate Hypothesis and Real Determinacy" by Alexander Meyer-Gohde, July 2008.
055 "Technology sourcing by large incumbents through acquisition of small firms" by Marcus Wagner, July 2008.
056 "Lumpy Labor Adjustment as a Propagation Mechanism of Business Cycle" by Fang Yao, August 2008.
057 "Measuring changes in preferences and perception due to the entry of a new brand with choice data" by Lutz Hildebrandt and Lea Kalweit, August 2008.
058 "Statistics E-learning Platforms: Evaluation Case Studies" by Taleb Ahmad and Wolfgang Härdle, August 2008.
059 "The Influence of the Business Cycle on Mortality" by Wolfgang H. Reichmuth and Samad Sarferaz, September 2008.
060 "Matching Theory and Data: Bayesian Vector Autoregression and Dynamic Stochastic General Equilibrium Models" by Alexander Kriwoluzky, September 2008.
061 "Eine Analyse der Dimensionen des Fortune-Reputationsindex" by Lutz Hildebrandt, Henning Kreis and Joachim Schwalbach, September 2008.
062 "Nonlinear Modeling of Target Leverage with Latent Determinant Variables – New Evidence on the Trade-off Theory" by Ralf Sabiwalsky, September 2008.
063 "Discrete-Time Stochastic Volatility Models and MCMC-Based Statistical Inference" by Nikolaus Hautsch and Yangguoyi Ou, September 2008.
064 "A note on the model selection risk for ANOVA based adaptive forecasting of the EURIBOR swap term structure" by Oliver Blaskowitz and Helmut Herwartz, October 2008.
065 "When, How Fast and by How Much do Trade Costs change in the EURO Area?" by Helmut Herwartz and Henning Weber, October 2008.
066 "The U.S. Business Cycle, 1867-1995: Dynamic Factor Analysis vs. Reconstructed National Accounts" by Albrecht Ritschl, Samad Sarferaz and Martin Uebele, November 2008.
067 "Testing Multiplicative Error Models Using Conditional Moment Tests" by Nikolaus Hautsch, November 2008.
068 "Understanding West German Economic Growth in the 1950s" by Barry Eichengreen and Albrecht Ritschl, December 2008.

SFB 649, Spandauer Straße 1, D-10178 Berlin
http://sfb649.wiwi.hu-berlin.de

This research was supported by the Deutsche Forschungsgemeinschaft through the SFB 649 "Economic Risk".

069 "Structural Dynamic Conditional Correlation" by Enzo Weber, December 2008.

070 "A Brand Specific Investigation of International Cost Shock Threats on Price and Margin with a Manufacturer-Wholesaler-Retailer Model" by Till Dannewald and Lutz Hildebrandt, December 2008.

071 "Winners and Losers of Early Elections: On the Welfare Implications of Political Blockades and Early Elections" by Felix Bierbrauer and Lydia Mechtenberg, December 2008.

SFB 649, Spandauer Straße 1, D-10178 Berlin
http://sfb649.wiwi.hu-berlin.de

This research was supported by the Deutsche Forschungsgemeinschaft through the SFB 649 "Economic Risk".