

A Service of

ZBW

Leibniz-Informationszentrum Wirtschaft Leibniz Information Centre for Economics

Weber, Enzo; Zhang, Yanqun

# Working Paper Common influences, spillover and integration in Chinese stock markets

SFB 649 Discussion Paper, No. 2008-072

**Provided in Cooperation with:** Collaborative Research Center 649: Economic Risk, Humboldt University Berlin

*Suggested Citation:* Weber, Enzo; Zhang, Yanqun (2008) : Common influences, spillover and integration in Chinese stock markets, SFB 649 Discussion Paper, No. 2008-072, Humboldt University of Berlin, Collaborative Research Center 649 - Economic Risk, Berlin

This Version is available at: https://hdl.handle.net/10419/25315

#### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

#### Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



# WWW.ECONSTOR.EU

# SFB 649 Discussion Paper 2008-072

# Common Influences, Spillover and Integration in Chinese Stock Markets

Enzo Weber\* Yanqun Zhang\*\*



\*Freie Universität Berlin and Universität Mannheim, Germany \*\* Chinese Academy of Social Sciences, Beijing, P.R. China

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



# Common Influences, Spillover and Integration in Chinese Stock Markets<sup>1</sup>

### Enzo Weber<sup>2</sup>, Yanqun Zhang<sup>3</sup>

First Version: 9/2008 This Version: 12/2008

#### Abstract

The Chinese stock market features an interesting history of divided market segments: domestic (A), foreigners' (B) and overseas (H). This puts forth questions of market integration as well as cross-divisional information transmission. We address these issues in a structural DCC framework, an econometric technique capable of identifying common factor influences from (bi-directional) spillovers as constituents of contemporaneous correlations. We find initial dominance of transmission from A to B and to a lesser extent from H to B and A to H. However, since the opening of the B-market for Chinese citizens in 2001, common factors have largely replaced direct spillovers.

*Keywords:* China, Stock Market, Integration, Causality, Correlation *JEL classification:* C32, G10

<sup>&</sup>lt;sup>1</sup>This research was supported by the Deutsche Forschungsgemeinschaft through the CRC 649 "Economic Risk". The second author thanks the Chinese Academy of Social Sciences for the finance support through the key research project 2007. We are grateful to Cordelia Thielitz for her comments. Of course, all remaining errors are our own.

<sup>&</sup>lt;sup>2</sup>Freie Universität Berlin and Universität Mannheim, L7, 3-5, D-68131 Mannheim, Germany, enweber@mail.uni-mannheim.de, phone: +49 (0)621 181-1844, fax: +49 (0)621 181-1931

<sup>&</sup>lt;sup>3</sup>Chinese Academy of Social Sciences, Institute of Quantitative & Technical Economics, No.5 Jianguomennei, Beijing 100732, P.R. China, yqzhang@cass.org.cn, phone: +86 (0)10 85195712, fax: +86 (0)10 65126118

# 1 Introduction

In the recent two decades, the rapid development of the Chinese stock market has attracted a large number of domestic and international investors. One of its distinctive features is the market segmentation, since three main types of stocks, namely A, B and H shares, are issued and traded in separate markets.

Both A and B markets are based in Mainland China. Denominated in Chinese currency renminbi (RMB), A shares are traded exclusively by Chinese citizens. B shares, which are denominated in US dollars on the Shanghai Stock Exchange (SHSE) and in HK dollars on the Shenzhen Stock Exchange (SZSE), were by legislation to be traded solely by foreign investors until February 2001. From then onwards, the B markets have been open to Chinese citizens with deposit accounts in foreign currencies. H shares are traded on the Stock Exchange of Hong Kong (SEHK) and denominated in HK dollars.

The segmentation feature of the Chinese stock market has attracted great attention of researchers, concisely reviewed below in section 2.2. Understanding the bilateral relationships between the Chinese segmented stock markets, such as cross-market causalities, spillover effects, etc., is useful for investors' portfolio decisions and for policy makers concerned with developing strategies for the Chinese stock market.

Compared to the rather large A and H markets, which have experienced a consistently fast development, the B market is much smaller sized and less active as an investment avenue. Since 2002, it has almost lost its meaning in raising foreign capital for the domestic industry. This setting triggers the question whether the Chinese Securities Regulatory Commission shall support further independence of the B market or foster a merge into A or H market.<sup>4</sup> For this, investigating the nature and scope of integration sheds light on the issue of informational leadership between the A, B and H markets.

For our empirical analysis, we adopt and modify the structural dynamic conditional correlation (SDCC) framework proposed by Weber (2008b). Daily market index series are deployed for this examination. The sample is divided into two sub-periods, 1997-2001 and 2002-2008. With this structure we can grasp the effects of the new policy, allowing domestic investors to access the B market, which was implemented in February 2001. Results of preliminary tests show that there exists considerable contemporaneous cross-correlation of returns, caused by common factors affecting both markets, or by contemporaneous spillover effects.

<sup>&</sup>lt;sup>4</sup>"Is the mission of the B market over?", http://www.caijing.com.cn/topic/fforum/ (in Chinese)

A broad literature on theoretical and empirical finance concludes that major price adjustment of liquid assets happens at least within one day. This is formalised in the random walk hypothesis, which implies returns uncorrelated with lagged variables. Whether or not this hypothesis is *exactly* fulfilled, in daily data most commonalities in terms of crosscorrelations appear to be contemporaneous. The main contribution of the underlying paper lies in disentangling the sources of these correlations between the different Chinese stock markets, as there are common factors, spillovers in one and such in the other direction. In this, we can fully account for the concepts of informational leadership and market integration, including changes in these measures over time. By doing so, we are reaching beyond relevant existing literature, which investigates interactions and causalities between different markets by means of cross-autocorrelations or Granger causality relying on reduced-form models.

The outcome of our empirical examination shows that before 2002, a strong contemporaneous spillover from A to B existed, whilst the unconditional correlation of the structural innovations is not significant. This indicates that commonality between the A and B market was primarily based on the informational leading role of the A market. In the second period, the large contemporaneous spillover from A to B is replaced by a considerable fundamental correlation, let alone a relatively small spillover from B to A. Evidently, common factors now dominate the comovement of the A and B market. Combined with the cointegrating relation found in the second period between the A and B market, we conclude that the two markets have increasingly integrated.

For the B-H and A-H pairings, we find similar patterns: The first sub-period is dominated by causal spillovers (from H to B, respectively from A to H), which give way to correlated structural innovations after 2001. However, the interaction between B and H, and even more so between A and H, is far less developed than in the A-B case.

The paper is organized as follows: Section 2 briefly introduces the history of the Chinese stock market and offers a literature review. Section 3 elaborates the methodology of the SDCC model. Empirical results are reported in Section 4. Finally, section 5 summarizes and highlights our findings.

# 2 Background Review

### 2.1 A Brief Introduction to the Chinese Stock Market

Along with the rapid growth of the Chinese economy, also its stock market expanded tremendously during the last two decades. Since the re-opening of the Shanghai Stock Exchange in December 1990 and the additional establishment the Shenzhen Stock Exchange in July 1991, the Chinese stock market has attracted a large number of domestic as well as foreign investors. By the end of 2006, 1434 companies were listed on the Chinese stock exchanges. The market capitalisations of all stocks and of the negotiable stocks were about 43 and 12 percent of the GDP, respectively (China Securities and Futures Statistical Yearbook, 2007).

Despite its rapid development, market segmentation has been a distinctive feature of China's stock market. On the SHSE and SZSE, two types of stocks, A shares and B shares, are traded. Denominated in RMB, A shares are available exclusively to domestic investors. From 1991 onwards, Chinese firms have been allowed to issue B shares to foreign investors. These B shares are denominated in US dollars on the SHSE and in HK dollars on the SZSE. Prior to February 2001, their trading was restricted exclusively to overseas investors, including overseas Chinese residing in Hong Kong, Macao and Taiwan.

In addition to A and B shares, since 1993, the Chinese government has encouraged Mainland Chinese companies to engage in foreign stock trading on the stock exchanges of Hong Kong, London, New York and Singapore. Due to close economic and financial ties between Mainland China and Hong Kong, the SEHK has become the most important place for Chinese firms listing overseas. The shares of Chinese firms listed on the SEHK are known as H shares, its corresponding price index is the Hang Seng China Enterprises Index.

By the end of 2006, there were 1325 Chinese A share and 108 B share firms listed on the SHSE and SZSE. Among them, 86 companies had issued both A shares and B shares. Meanwhile, of 143 H share firms listed on the Hong Kong exchange, 32 have also issued A shares. Under Chinese regulation, A and B shares, or A and H shares, issued by the same company, are legally identical, allowing their holders equal voting and ownership rights. However, for the facts that RMB is non-convertible and the H market being restricted to international investors only, the A, B and H markets are in fact segmented.

Prior to February 2001, the A and B markets were completely divided. The segmentation

was largely the result of two considerations of the Chinese government. Firstly, authorities wanted to attract foreign capital and improve corporate governance by means of permitting international investors into the Chinese stock market. Secondly, the free outflow of capital from China as well as foreign control of domestic firms were intentionally suppressed.

In its early years, the B market expanded rapidly. The number of listed firms increased from only 9 in 1992 to 108 in 1999. International institutional investors showed great interest in the new investment opportunities and dominated the market. In the following years however, the B market fell into continuous stagnation. Since 1999 there have been only a few new listings on the B market.

Compared to the A market, which has experienced consistently fast development, the B market is much smaller in size and less active as an investment avenue. By the end of 2006, the number of B share companies accounts for only 7.6 percent of all listed companies on the SHSE and SZSE. Its market capitalization is only about 1.4 percent of the total and about the same holds true for the turnover in relation to the total market turnover (China Capital Markets Development Report, 2008). In addition, the B share prices were at a great discount relative to A shares.

Adverse effects caused by the lack of transparency and liquidity have hindered the development of the B market. Another contributing factor to its stagnation is the rapid development of the H market. By end of 2006, the market capitalization of H shares had reached about 38 percent of the total of A plus B shares. B and H shares have attracted similar investors groups shifting capital between the two markets. In general, the performance of H shares is better than that of B shares, because only large and viable Chinese firms are permitted listing. In addition, the requirements of corporate governance of these H share firms and shareholder protection for the buyers are more stringent than those for domestically listed companies (Wang and Iorio 2007). Meanwhile, the SEHK presents an efficient and well-regulated trading system. Its importance to international investors has led them to choose trading in China-related stocks in Hong Kong rather than invest in B shares within China (Kim and Shin 2000). As a result, the proportion of institutional investors decreased to 1.2 percent in 2001.

In February 2001, the Chinese Securities Regulatory Commission announced a new policy that allowed Chinese residents with a foreign currency deposit account to trade in B shares. Attracted by the sizeable discount of B share prices relative to A shares, Chinese investors restructured their asset portfolios towards B shortly after the announcement, resulting in a hike of respective B share prices. Consequently, the discount rate was dramatically reduced. Ever since the two markets are aligning.

Before the B market was opened to Chinese citizens, the investors' structure in the A and B markets was different. While investors in the A market were mostly individuals with limited trading experience and resources for obtaining and analysing market information, those in the B market were dominated by international institutions capable of processing information and rapidly executing transactions accordingly (Kim and Shin 2000). After the opening of the B market to domestic traders, its mix of market players adopted to the pattern of the A market. As of 2006, about 83 percent of investors in this market were individuals from Mainland China. The proportion of foreign institutional investors in the total has declined to about 1.1 percent. But because the RMB is still not fully convertible, Chinese investors cannot trade foreign currencies freely and the two markets therefore remain partially segmented.

### 2.2 Literature Review

The unique segmentation of Chinese stock markets has attracted great attention of researchers. Much empirical work concentrates on analysing the segmentation and linkages between Chinese stock markets, as well as integration of Chinese with international stock markets (Wang and Iorio, 2007; Girardin and Liu, 2007). Meanwhile, some studies investigate issues concerning discounts of B shares relative to A shares based on asset pricing models. Chan et al. (2008) and Chakravarty et al. (1998) show that information asymmetry explains a significant portion of the cross-sectional variation of the B share discounts. Ma (1996) finds evidence that the price differences between A shares and B shares are correlated with investors attitudes toward risk and correlation between B shares and foreign shares.

In addition, a large number of researchers focus on exploring causality issues or leadlag relations, as well as information transmission between the segmented Chinese stock markets.

Taking cross-autocorrelations as measures of the adjustment speed of stock prices to a common factor, several studies explore lead-lag relations among different markets (Chui and Kwok 1998; Kim and Shin 2000; Chan et al. 2007; Qiao et al. 2007). Various Granger-causality-type tests are conducted to examine the causalities between different markets (Kim and Shin 2000; Qiao et al. 2008). VAR and VECM models are applied

to investigate lead-lag relations, long-run cointegration relationships among the different markets indices and short-run adjustment speed (Qiao et al. 2007; Chiang et al. 2008). Some studies apply GARCH models to analyse volatility spillover effects between the A, B and H markets (Qiao 2007).

While some studies focus on the aggregated market price indices, others apply data of firms dual-listed on the A and B, or A and H markets (Chan et al. 2007; Qiao 2007). Most deploy data of daily (Chui and Kwok 1998; Kim and Shin 2000; Qiao et al. 2008) or weekly returns (Chiang et al. 2008; Qiao et al. 2007). Some authors (Chan et al. 2007) apply high frequency intra-day transaction data to circumvent the simultaneity problem. To characterize the impact of China's policy change on February 19, 2001, allowing domestic investors to trade B shares, commonly data samples are split into two sets.

The results of the empirical studies concerning the lead-lag relations and the information transmission between Chinese segmented stock markets appear to be inconclusive.

Chan et al. (2007) use high frequency intra-day transaction data of firms dual-listed on the different markets and find that, before February 2001, the A market led the B market in price discovery. After February 2001, there exists a causality from the B to the A market. For both sub-periods, the A market dominates the price discovery process. Based on a fractionally integrated VECM and GARCH models, estimated with weekly data of the stock prices from 1995 to 2005, Qiao et al. (2007) find evidence that A, B and Hong Kong stock markets are fractionally cointegrated. The A market is most influential in terms of both mean and volatility spillover effects. There are bi-directional volatility spillovers between the B market and the Hong Kong market, and unidirectional spillover from the A market to the Hong Kong market. The exploration of the causalities between A, B and H shares by Kim and Shin (2000) is conducted by measuring cross autocorrelations and applying Granger causality tests. They find B shares in tendency to lead H shares from 1996 onwards. Although A shares tend to lead B shares before 1996, such relations have either disappeared or been reversed since 1996. Chui and Kwok (1998) examine cross-autocorrelations between price changes in A and B shares using daily returns from 1993 to 1996, and find that the information flow runs from B to A shares.

### 3 Methodology

To begin with, let us establish the key features of the SDCC model introduced by Weber (2008b). As has been discussed in the Introduction, this model serves to identify bi-

directional spillovers and correlated innovations as sources of overall return correlation. We approximate the data generating process of the n stock indices in the vector  $y_t$  by the structural-form vector error correction model (SVECM) with lag length p

$$A\Delta y_t = \alpha \beta' y_{t-1} + \mu_1 + \mu_2 d_t + \sum_{j=1}^p B_j \Delta y_{t-j} + \varepsilon_t .$$

$$\tag{1}$$

A and  $B_j$ , j = 1, ..., n are  $n \times n$  coefficient matrices, where the main diagonal elements in A are normalised to unity.  $\mu_1$  and  $\mu_2$  are *n*-dimensional parameter vectors,  $d_t$  denotes dayof-the-week dummies and  $\varepsilon_t$  is a vector of heteroscedastic innovations with unrestricted covariance matrix.  $\beta$  spans the space of the *r* cointegrating vectors, and  $\alpha$  contains the corresponding adjustment coefficients. In case no cointegration exists between the I(1) stock indices,  $\alpha\beta'$  has rank r = 0, leaving a simple SVAR in first differences or returns.

As a matter of fact, (1) represents a fully simultaneous system that fails identification by conventional methods. Therefore, in a first step we estimate the reduced-form VECM

$$\Delta y_t = \alpha^r \beta' y_{t-1} + \mu_1^r + \mu_2^r d_t + \sum_{j=1}^p B_j^r \Delta y_{t-j} + u_t .$$
<sup>(2)</sup>

All new coefficients are obtained by premultiplying  $A^{-1}$  in (1), therefore being marked by the superscript r for "reduced" as in  $\alpha^r = A^{-1}\alpha$ . Accordingly, the new residuals are given by  $u_t = A^{-1}\varepsilon_t$ .

Sentana and Fiorentini (2001) note that latent-factor-type models like (1) become uniquely identifiable in presence of time-varying second moments. Elaborating our model into this direction, denote the conditional variances of the elements in  $\varepsilon_t$  by

$$\operatorname{Var}(\varepsilon_{jt}|I_{t-1}) = h_{jt}^2 \qquad j = 1, \dots, n , \qquad (3)$$

where  $I_{t-1}$  stands for the whole set of available information at time t-1. The standardised white noise residuals are obtained as

$$\tilde{\varepsilon}_{jt} = \varepsilon_{jt}/h_{jt} \qquad j = 1, \dots, n .$$
 (4)

The volatility dynamics are modelled by a set of univariate GARCH(1,1) processes. We will show in the empirical part that this adequately picks up the data properties in the Chinese stock markets. For j = 1, ..., n we write

$$h_{jt}^2 = (1 - g_j - d_j)c_j + g_j h_{jt-1}^2 + d_j \varepsilon_{jt-1}^2 , \qquad (5)$$

where  $c_j$  denotes the unconditional variance and  $g_j$  and  $d_j$  are GARCH and ARCH coefficients. The single variances are stacked into the vector  $H_t = \begin{pmatrix} h_{1t}^2 & \dots & h_{nt}^2 \end{pmatrix}'$ .

While the fundamental factors in classical structural dynamic systems are uncorrelated, Weber (2008a) allows for common driving forces of the variables by identifying and estimating a constant conditional correlation (CCC) specification for the structural disturbances. Weber (2008b) extends this concept by introducing structural dynamic conditional correlation (SDCC), which represents a clearly more flexible set-up. For the conditional correlation matrix  $R_t$ , define

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

Therein,  $Q_t$  follows the process

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

which corresponds to a GARCH(1,1) with parameters  $\alpha$  and  $\beta$ .  $\overline{Q}$  denotes the unconditional covariance matrix of the standardised residuals  $\tilde{\varepsilon}_t$ .

With  $R_t$  at hand, the conditional covariance-matrix  $\Omega_t$  of the structural disturbances  $\varepsilon_t$  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 GARCH-variances,  $\Omega_t$  is assured to be positive definite. This property carries over to the conditional covariancematrix of the reduced-form residuals  $u_t = A^{-1} \varepsilon_t$ 

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

due to its quadratic form.

Weber (2008b) discusses identifiability of his SDCC model. In essence, he shows that a simultaneous system like (1) complemented by the structural second-moment processes contains less parameters than a fully general multivariate GARCH model in conventional reduced form. In addition, a sufficient condition is given by linear independence of the conditional variances.

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

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

where the vector  $\theta$  stacks all free parameters from  $A, \alpha, \beta, \overline{Q}, c_j, g_j, d_j, j = 1, ..., n$ . The estimation proceeds by maximising (10), simultaneously determining the coefficients governing the variances, correlations and spillovers. As assuming conditional normality is often problematic for financial markets data, we rely on Quasi-Maximum-Likelihood (QML, see Bollerslev and Wooldridge 1992). Numerical likelihood optimisation is performed using the BHHH algorithm (Berndt et al. 1974).

To facilitate practical estimation, we follow a three-step procedure: First, we estimate reduced-form VAR / VEC models as in (2). Then, the obtained residuals  $\hat{u}_t$  are plugged into (10) in order to maximise the "concentrated" likelihood of the SDCC model. At last, with values of the spillover coefficients from A determined in the second step, the mean equations can be re-estimated, now in structural form.

### 4 Empirical Results

### 4.1 Data

We employ daily close data of the A and B indices from the Shanghai Stock Exchange (Shenzhen as robustness check) as well as the Hang-Seng China Enterprises Index from the SEHK ("H index"). Weekends and holidays are not contained in the sample. Figure 1 shows the log index development and the returns from 1/2/1992, the day the Shanghai A market started, until 5/30/2008.

In 2001, the B index made an enormous jump when the corresponding market was opened to Chinese citizens. Thereafter, A and B market seem to move closely together, partly in contrast to the preceding period. Throughout, idiosyncratic developments are most significant in the H index. The first years until 1996 seem to have constituted a difficult starting period for all markets. Concerning the returns, sizeable outliers and volatility characterised the A segment, while the B market appears rather inactive by that time. Indeed, trade volumes and turnover rates increased considerably in 1996 (e.g. Kim and Shin 2000). Since compared to previous studies, our sample has significantly lengthened, we cut the first years and begin in 1/3/1997.

Before we begin with the multivariate analysis, let us shortly establish the integration properties of the data. The ADF tests in Table 1 show that all indices (with constant and linear trend) are non-stationary, whereas the returns (with constant) are I(0).





Series	A index	B index	H index	A return	B return	H return	
ADF statistic	-1.20	-1.52	-2.17	-54.88	-48.57	-47.11	
Table 1: ADF tests							

The contemporaneous cross-correlations of the returns can be found in Table 2. The A-B correlation is highest, followed by B-H. Additionally, the sample is split after 2001, when the repercussions of the B market opening from February seem to have faded out. The correlations with the A returns are clearly higher in the second sub-sample, possibly a first sign of rising market integration. However, determining the structural sources for this phenomenon is one of the tasks for the following analysis.

### 4.2 Reduced-form Specifications

In the first step, we specify bivariate reduced-form VAR / VEC models as in (2) for the A-B, A-H and B-H indices in both periods, 1997-2001 (I) and 2002-2008 (II). We choose the lag length based on usual information criteria and check for no residual autocorrelation by

	A-B	A-H	B-H
1997-2008	0.60	0.20	0.27
1997-2001	0.48	0.14	0.29
2002-2008	0.75	0.30	0.24

 Table 2: Return correlations

means of LM tests. Table 3 displays the choices for p as well as LM p-values for different orders. These tests show that the relatively small but significant serial correlations from the raw return series are conveniently picked up by the model dynamics.

Series pair	A-B		A-H		B-H	
Period	Ι	II	Ι	II	Ι	II
Lag length $p$	4	6	2	4	3	4
LM(1) p-value	0.64	0.41	0.55	0.07	0.31	0.22
LM(2) p-value	0.80	0.14	0.37	0.18	0.31	0.13
LM(5) p-value	0.80	0.05	0.03	0.62	0.19	0.23
LM(10) p-value	0.85	0.29	0.22	0.49	0.06	0.39
Trace p-value	0.20	0.09	0.41	0.75	0.80	0.49

Table 3: Reduced-form specifications

Additionally, p-values for Johansen Trace tests with the null hypothesis of no cointegration (r = 0) can be taken from the last row of Table 3. Evidence for common trends does not emerge but at most in the second sub-sample between the A and B markets. In this case, we find furthermore that the hypothesis of equal weights in the long-run equilibrium,  $\beta = (1, -1)'$ , cannot be rejected by a likelihood ratio test with a p-value of 0.57. Consequently, the two Shanghai-based markets tend parallel in the long run since the B segment has been opened for Chinese citizens, whereas the Hong Kong market has an idiosyncratic development. Statistically, we proceed with a VECM for the second A-B period and with VARs in first differences in all other cases.

### 4.3 Spillovers, Fundamental Correlation and Structural Change

Now, in the second step, the residuals  $\hat{u}_t$  obtained from the reduced-form models serve as input variables for estimating the SDCC model. The goal is to split up the important contemporaneous correlations (see Table 2) into their three constituents common influences, spillovers in one and spillovers in the other direction. We account for a possible break after 2001 by including shift dummies for the unconditional correlation parameter  $\bar{q}$  (the off-diagonal element in  $\bar{Q}$ ) and the spillover coefficients  $a_{12}$  and  $a_{21}$  (the off-diagonal elements in A). Particularly, the shift parameters indicate the change in these measures from the first to the second period. To enhance efficiency, the GARCH and DCC parameterisation, in which breaks are neither supposed nor of special interest, is held constant throughout the sample.

After the values for the spillover coefficients as entries in the A-matrix in (1) have been determined, this system is re-estimated to arrive at a full structural dynamic model in the last step. In both the SDCC and SVAR / SVECM estimation, parameters that failed to reach significance at the 10% level have been sequentially eliminated. The following results for the different models were obtained (deterministics and residuals not displayed):

#### <u>A-B 1997-2001</u>

$$\Delta A_{t} = \underbrace{0.121}_{(0.035)} \Delta B_{t} - \underbrace{0.033}_{(0.015)} \Delta B_{t-1} + \underbrace{0.068}_{(0.026)} \Delta A_{t-4}$$
  
$$\Delta B_{t} = \underbrace{0.582}_{(0.107)} \Delta A_{t} - \underbrace{0.095}_{(0.047)} \Delta A_{t-1} + \underbrace{0.155}_{(0.028)} \Delta B_{t-1} - \underbrace{0.043}_{(0.025)} \Delta B_{t-2} + \underbrace{0.073}_{(0.025)} \Delta B_{t-3} \quad (11)$$

The interaction between the A and B markets in first period is dominated by a strong contemporaneous spillover from A to B, while the one in the reverse direction is much smaller. Lagged effects are rather weak. The unconditional structural correlation  $\bar{q}$  is not significantly different from zero. This is, the commonalities between citizens' and foreigners' markets were mainly based on the informational leading role of the A market. In contrast, advantages of large foreign investors in information processing and financial management seemed to have played but a subordinate role.

#### A-B 2002-2008

In contrast, in the second period the large contemporaneous spillover has completely disappeared. Logically, the considerable return correlation now relies on significant common influences as shown by  $\bar{q} = 0.747$ . Evidently, the B-market liberalisation led to strong integration of the A and B segments in the sense that new information hits both markets simultaneously and has not to be transmitted through observed movements in the A index. Interestingly, the instantaneous spillover from B to A, though relatively small, has not significantly changed; since foreigners are still restricted to the B market, its limited signalling function continues. In case equilibrium deviations appear, it is the B market which slowly closes the gap over time through its adjustment to the cointegrating relation.<sup>5</sup> Consequently, in a sense related to Hasbrouck (1995), discovery of the single efficient price of the two markets takes place in the A segment.

#### <u>B-H 1997-2001</u>

$$\Delta B_{t} = \underbrace{0.246\Delta H_{t} - 0.061\Delta H_{t-3} + 0.111\Delta B_{t-1} - 0.054\Delta B_{t-2} + 0.058\Delta B_{t-3}}_{(0.024)} \Delta H_{t} = \underbrace{0.064\Delta B_{t-2} + 0.170\Delta H_{t-1} - 0.062\Delta H_{t-2}}_{(0.028)} H_{t-2}$$
(13)

Bearing in mind the correlation results from Table 2, it is not surprising that the mutual influences between the B and H indices are relatively weak. Between 1997 and 2001, the contemporaneous H return exerts the main impact on the B market.  $\bar{q}$  is not significantly different from zero, so that the limited commonalities are due to the signalling function of the SEHK. Obviously, Hong Kong was more important as an overseas outlet than the B segment, which had initially been supposed to take this role.

#### <u>B-H 2002-2008</u>

$$\Delta B_{t} = \underbrace{0.046\Delta H_{t-1} + 0.084\Delta H_{t-3} + 0.056\Delta H_{t-4} + 0.094\Delta B_{t-1}}_{(0.025)} \Delta H_{t} = \underbrace{0.090\Delta H_{t-1} - 0.052\Delta H_{t-2}}_{(0.024)} (14)$$

In the second period, the contemporaneous influence on the B returns has vanished. Several lagged effects are left, however. The fundamental correlation now amounts to  $\bar{q} = 0.264$ . Even if this link stays rather weak, as in the A-B case we find again that transmission to the B segment has been replaced by common influences. The above explanation for this phenomenon is likely to carry over to the B-H relations: As early as well informed domestic investors have been allowed to participate in the B segment, the reason for its (limited) informational orientation towards Hong Kong has vanished.

#### <u>A-H 1997-2001</u>

$$\Delta A_t = -\underbrace{0.050}_{(0.028)} \Delta A_{t-2}$$
  
$$\Delta H_t = \underbrace{0.208\Delta A_t}_{(0.051)} \Delta A_t + \underbrace{0.158\Delta H_{t-1}}_{(0.027)} \tag{15}$$

 $<sup>{}^{5}</sup>$ The A market shows positive adjustment to such deviations, thereby nominally widening the gap. However, the value of 0.004 is economically small and does not impair system stability in presence of the much larger right-directed B market reaction.

Between the A and H markets, we find a moderate contemporaneous spillover from A to H in the first period. The fundamental correlation of the innovations is statistically zero. Literally speaking, information advantages in the domestic market seem to have outweighed the international rank of the SEHK.

#### A-H 2002-2008

$$\Delta A_{t} = \underbrace{0.075\Delta H_{t-1} + \underbrace{0.054\Delta H_{t-3} + \underbrace{0.054\Delta H_{t-4}}_{(0.021)}}_{(0.021)} \Delta H_{t} = \underbrace{0.090\Delta H_{t-1} - \underbrace{0.048\Delta H_{t-2}}_{(0.024)}$$
(16)

The second period features a fundamental correlation of  $\bar{q} = 0.261$ , whereas the contemporaneous spillover has disappeared. However, non-trivial lagged transmission from H to A can be established. All in all, the interactions between the major Chinese market and the Hong Kong based index are clearly least developed.

### 4.4 Conditional Variances and Correlations

The foregoing section has shown contemporaneous and dynamic interactions among the different markets as well as fundamental correlations of the structural shocks. We have not addressed yet the conditional variances and correlations, which are now at the centre of interest.

First, Table 4 summarises the estimates for the GARCH processes (5). The results are typical for financial data: All ARCH parameters are significant, lending credibility to our identification procedure, and the sum of ARCH and GARCH coefficients reveals considerable persistence. The fact that this measure is especially high for the H-market probably explains the indeterminacy of its unconditional volatility level c, which stands in contrast to the A and B results.<sup>6</sup>

	A - B	A - H	В-Н
Constant $c$	$\begin{array}{ccc} 2.832 & 5.720 \\ \scriptscriptstyle (0.882) & (1.318) \end{array}$	$\begin{array}{ccc} 2.879 & 10.53 \\ \scriptscriptstyle (0.676) & (11.99) \end{array}$	$\begin{array}{cccc} 5.874 & 11.19 \\ \scriptstyle (1.142) & (17.68) \end{array}$
ARCH $d$	$\substack{0.103 \\ (0.042)} \ \substack{0.174 \\ (0.027)}$	$\substack{0.106\\(0.051)}, \substack{0.099\\(0.026)}$	$\substack{0.182\\(0.032)} \begin{array}{c} 0.095\\(0.024)\end{array}$
GARCH $g$	$\begin{array}{ccc} 0.875 & 0.774 \\ \scriptscriptstyle (0.058) & \scriptstyle (0.031) \end{array}$	$\substack{0.864\\(0.082)}, \substack{0.897\\(0.026)}$	$\begin{array}{ccc} 0.758 & 0.901 \\ \scriptscriptstyle (0.040) & \scriptstyle (0.023) \end{array}$

 Table 4: GARCH parameter estimates

<sup>&</sup>lt;sup>6</sup>Besides, exactly the same can be observed in standard reduced-form univariate GARCH.

Figure 2 shows the conditional variances of the three structural innovations.<sup>7</sup> All series share pronounced increases in 2007 and 2008, which have been preceded by a relatively calm period in the years before. The repercussions of the Asian financial crisis can be observed in the H-market, and to a lesser extent in the A and B segments. Somewhat differently, the 2001 economic and financial downturn left its mark particularly in the volatilities of the two mainland indices.



Figure 2: Structural conditional variances

It remains to demonstrate the merits of allowing for *dynamic* fundamental correlations. In Table 5, one can find the estimates for the DCC parameters from (7). For A-B and B-H, the coefficients are highly significant, implying time-varying structural correlations. In contrast, for A-H, past shocks did not significantly influence the conditional correlation, so that  $\alpha$  and  $\beta$  were restricted to zero. In this case, including the structural break was obviously sufficient for modelling the change of correlation through time. The first row of zeros restates the lack of common influences on the structural innovations in the 1997-2001 period. For assessing this outcome, recall that here we are dealing with *fundamental* correlations of structural shocks; as the SVARs / SVECMs in the previous section have shown, causal contemporaneous spillovers additionally contribute a lot to the overall return correlation, especially in the first period.

The structural conditional correlations resulting from the processes addressed in Table 5 are displayed in Figure 3. Most importantly, all correlations rise over time, naturally including the distinct shift after 2001. Furthermore, for A-B and B-H the ups and downs characterising time-varying correlations become apparent. Weber (2008b) has argued that neglecting such variability is prone to understate the contribution of common influences to comovement of time series, lending undue weight to spillovers. Concretely, our SDCC specification plays an important role in identifying the deepening of Chinese stock market

<sup>&</sup>lt;sup>7</sup>In the three bivariate models, naturally each variance has been estimated twice. Since the visual impression is virtually identical, we opted arbitrarily for displaying the variances from the A-B model and the H variance from the A-H model.

	A - B	A - H	В-Н
Constant $\overline{q}$ (I)	0 (-)	0 (-)	0 (-)
Constant $\overline{q}$ (II)	$\underset{(0.039)}{0.747}$	$\underset{(0.025)}{0.261}$	$\underset{(0.054)}{0.264}$
ARCH $\alpha$	$\underset{(0.025)}{0.087}$	0 (-)	$\underset{(0.006)}{0.018}$
GARCH $\beta$	$\underset{(0.053)}{0.837}$	0 (-)	$\underset{(0.012)}{0.965}$

Table 5: DCC parameter estimates

integration.



Figure 3: Structural conditional correlations

Finally, the models for the second moments are subjected to several specification tests: The vast majority of autocorrelations of the squared standardised disturbances  $\tilde{\varepsilon}_{jt}^2$  and the cross products  $\varepsilon_{1t}\varepsilon_{2t}$ , standardised by the conditional covariances, do not exceed the approximate 95% confidence bands. Exceptions were the first order in the A-B model and the first and third orders of the H innovations. However, even those do not reach significance at the 1% level. The analysis was repeated using the reduced-form residuals  $u_t$ instead of  $\varepsilon_t$ . The constancy (apart from the break) of the conditional correlation in the A-H H case was additionally checked by the procedure proposed in Engle and Sheppard (2001): In short, the cross products of the multivariately standardised (structural) residuals are tested to not follow an autoregression. Since the null is not rejected regardless of the AR order of the auxiliary model, our specification is confirmed.

### 4.5 Common Factors

Until here, we have learned about fundamental correlations and spillovers between the Chinese stock segments. An interesting question left to ask is what observable economic factors might explain our measurements. At the daily frequency, we have picked the Hang-Seng (Hong Kong), Straits Times (Singapore), Nikkei (Japan) and Dow Jones (USA) indices as well as the crude oil price (WTI Cushing) and the Chinese one-week interbank rate.<sup>8</sup>

The crucial point is how significance of these variables for our findings of structural correlations and spillovers should be assessed. In order to integrate this additional analysis into the existing model framework, we opted for including the factors as exogenous variables in our structural equation systems. In case for example fundamental correlations conditional on the factors are significantly lower than in the baseline scenario, we can think of the market correlation being explained by common factor dependence. In detail, we first estimate the reduced form (2) including the additional regressors and then re-examine the SDCC with the new residuals.

Unsurprisingly, the Hang Seng return exerts by far the largest influence in the VARs / VECMs, which is however much smaller for A and B than for the H market. In all cases, the effect rises considerably in the second sub-period, what might indicate deepening stock market integration. Furthermore, the H market reacts to Straits Times returns, even if to a much lesser extent. The interest rate and oil price coefficients are estimated mostly negative, but none of them reaches statistical significance; the latter applies as well to the Dow Jones returns. Even though world market (respectively, US market) integration of Chinese stock exchanges is known to be limited, one should bear in mind that US and Chinese trading hours do not overlap, so that US innovations can hardly be expected to reveal the same immediate effect originating for example from the Hang Seng.

Concerning the structural parameters, relevant changes occur only in the A-H and B-H cases, but not in the A-B model. Obviously, the Hang Seng influence on the H market represents the only important factor. In the first sub-period, the instantaneous spillover effect from H to B falls from 0.246 to 0.180, and their fundamental correlation  $\bar{q} = 0.264$  in the second sample half is reduced to 0.199. A-H is similar: In the first sub-period, the transmission to the H segment is lessened from 0.208 to 0.149, while the second sub-period structural correlation falls from 0.261 to 0.206. Whereas on the one hand, these impacts are not negligible, they are quite limited in size compared to the overall measures of market interaction obtained from the SDCC approach. Similar results of low explaining power of observables in equity models have been obtained for example by King et al. (1994). Evidently, once again this underlines the econometric merits of the current identification procedure for determining sources of stock market comovement in absence

<sup>&</sup>lt;sup>8</sup>Dow Jones and oil price have been lagged by one day due to the time shift. Observations on days not present in the Chinese stock series were deleted. Furthermore, missing values (compared to the Chinese stock series) were filled up by the preceding number.

of comprehensive sets of observable explaining variables.

### 4.6 Robustness Checks

We have subjected our estimations to a battery of robustness checks. Since we encountered no decisive deviations, we just list the most important issues:

- The SHSE has been picked as the largest Chinese stock exchange. However, using the leading indices of the not much smaller SZSE leaves the results unchanged.
- The choice of the lag length p did not prove crucial. This is not surprising, since we are mainly dealing with contemporaneous effects.
- It was not exactly clear at which date the structural break due to the B market opening should be set. While our date, the beginning of 2002, was chosen to take the evident market reactions into account, splitting the sample in February 2001 right after the liberalisation occurred leads to no qualitatively different conclusions.
- In section 4.5, lags of the common factors could have been included. Doing so just wastes degrees of freedom for insignificant coefficients, except for few lagged Hang Seng returns.
- Apart from the most recent period, during our sample the Chinese exchange rate was almost fixed. Thus, we were able to replicate the results when all series were converted into a common currency.

# 5 Concluding Summary

In this paper, we have identified sources of contemporaneous correlation of stock markets, which can originate in both common influences hitting the markets and spillover effects between them. This way, we have empirically analysed integration and informational transmission between the Chinese segmented stock markets. The sample is divided into two sub-periods, before and after 2002, in order to characterize the impact of the B market opening to Chinese citizens. Methodologically, we adopted the new SDCC framework of Weber (2008b).

The outcome of our empirical examination shows that in general the integration of the A, B and H markets has significantly deepened in the second period. The A and B markets are more closely integrated compared to A and H or B and H. Before 2002, the main

contribution to the contemporaneous return correlations stemmed from causal spillovers. In contrast, since 2002 common factors dominate the correlation of the markets.

Concerning the interactions between the A and B markets, the spillover effects from A to B prior to 2002 indicate that commonality between A and B was primarily based on the leading role of A in terms of informational advantages. Since the B market was opened to Chinese citizens, common influences have become the main source of the rising correlation.

Compared to this process of integration, the H market is still more or less segmented even after 2002. In the first period, transmission runs from A to H and from H to B, whereas common influences are insignificant. These spillovers are replaced by fundamental correlations of the innovations in the second period, which are however limited in size. When exogenous factors are included as additional regressors in the system, we mainly find that Hang Seng and Straits Times returns affect H returns, especially after 2002. Obviously, the H market is to some extent linked to other important Asian stock markets, where the SEHK naturally proves most influential.

In a structural VECM, cointegration between the indices of the two markets A and B occurs since 2002. While the price of the A market is nearly weakly exogenous, the B price adjusts with respect to cointegration deviations; in the long run, the A market determines the common stochastic trend. In the sense of Hasbrouck (1995), this finding leads to the interpretation that the discovery of the efficient price takes place in the A market. This is likely to provide the prerequisite for a potential merge of the B into the A market, a strategy further supported by the evidence that both markets are moving towards close integration in both long and short run since 2002. The H market remains separate from the markets A and B for the time being.

# References

- 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] Chakravarty, S., A. Sarkar, L. Wu (1998): Information Asymmetry, Market Segmentation and the Pricing Of Cross-Listed Shares: Theory and Evidence from Chinese A and B Shares. Journal of International Financial Markets, Institutions and Money, 8, 325"C355.
- [4] Chan, K., A. Menkveld, Z. Yang (2007): The Informativeness of Domestic and Foreign Investors' Stock Trades: Evidence from the Perfectly Segmented Chinese Market. Journal of Financial Markets, 10, 391-415.
- [5] Chan, K., A. Menkveld, Z. Yang (2008): Information Asymmetry and Asset Prices: Evidence from the China Foreign Share Discount. Journal of Finance, 1, 159-196.
- [6] Chiang, T., E. Nelling, L. Tan (2008): The Speed of Adjustment to Information: Evidence from the Chinese Stock Market. International Review of Economics & Finance, 17, 216-229.
- [7] China Securities and Futures Statistical Yearbook, 1999-2007. Also available from www.csrc.gov.cn.
- [8] China Securities Regulatory Commission (2008): China Capital Markets Development Report. China Finance Press House.
- [9] Chui, A., C. Kwok (1998): Cross-autocorrelation Between A Shares and B Shares in the Chinese Stock Market. Journal of Financial Research, 3, 333-353.
- [10] Engle, R.F., K. Sheppard (2001): Theoretical and empirical properties of dynamic conditional correlation multivariate GARCH. NBER Working Paper 8554.
- [11] 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.
- [12] Introduction of Chinese Securities and Futures Markets (in Chinese). Available from www.csrc.gov.cn.
- [13] Girardin, E., Z. Liu (2007): The Financial Integration of China: New Evidence on Temporally Aggregated Data for the A-Share Market. China Economic Review, 18, 354-371.
- [14] Hasbrouck, J. (1995): One Security, Many Markets: Determining the Contributions to Price Discovery. Journal of Finance, 50, 1175-1199.

- [15] Kim, Y., J. Shin (2000): Interactions among China-Related Stocks. Asia-Pacific Financial Markets, 7, 97-115.
- [16] King, M., E. Sentana, S. Wadhwani (1994): Volatitliy and Links between National Stock Markets. Econometrica, 62, 901-933.
- [17] Ma, X. (1996): Capital Controls, Market Segmentation and Stock Prices: Evidence from the Chinese Stock Market. Pacific-Basin Finance Journal, 4, 219-239.
- [18] Qiao, Z., T. Chiang, W. Wong (2007): Long-Run Equilibrium, Short-Term Adjustment, and Spillover Effects Across Chinese Segmented Stock Markets and the Hong Kong Stock Market. Journal of International Financial Markets, Institutions & Money. Forthcoming.
- [19] Qiao, Z., Y. Li, W. Wong (2008): Policy Change and Lead-Lag Relations Among China's Segmented Stock Markets. Journal of Multinational Financial Management, 18, 276-289.
- [20] Rigobon, R. (2002): The Curse of Non-Investment Grade Countries. Journal of Development Economics, 69, 423-449.
- [21] Rigobon, R. (2003): Identification Through Heteroscedasticity. Review of Economics and Statistics, 85, 777-792.
- [22] Sentana, E., G. Fiorentini (2001): Identification, Estimation and Testing of Conditionally Heteroskedastic Factor Models. Journal of Econometrics, 102, 143-164.
- [23] Wang, Y., A. Iorio (2007): Are the China-Related Stock Markets Segmented with Both World and Regional Stock Markets? Journal of International Financial Markets, Institutions & Money, 17, 277-290.
- [24] Weber, E. (2007): Volatility and Causality in Asia Pacific Financial Markets. CRC 649 Discussion Paper 2007-004, Humboldt-Universität zu Berlin.
- [25] Weber, E. (2008a): Structural Constant Conditional Correlation. CRC 649 Discussion Paper 2008-015, Humboldt-Universität zu Berlin.
- [26] Weber, E. (2008b): Structural Dynamic Conditional Correlation. CRC 649 Discussion Paper 2008-069, 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



- 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 Strukturgleichungsmethodik" 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



- 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



- 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.
- 072 "Common Inuences, Spillover and Integration in Chinese Stock Markets" by Enzo Weber and Yanqun Zhang, December 2008.
- 073 "Testing directional forecast value in the presence of serial correlation" by Oliver Blaskowitz and Helmut Herwartz, December 2008.

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

