



# Conditional heteroscedasticity with leverage effect in stock returns: Evidence from the Chinese stock market



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## ABSTRACT

In recent years the Chinese stock market has experienced an astonishing growth and unprecedented development, but is also viewed as one of the most volatile markets, which has been called by many observers a “casino”. This study intends to examine the presence of heteroskedasticity and the leverage effect in the Chinese stock markets, and to capture the dynamics of conditional correlation between returns of China's stock markets and those of the U.S. in a bivariate VC-MGARCH framework. The results show that the leverage effect is significant in these markets during the sample period in 2000–2013, and the conditional correlation between mainland China's and the U.S. stock markets is quite low and highly volatile. The Chinese stock markets are found to be highly regimes persistent. These findings have important implication for investors seeking opportunity of portfolio diversification.

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## 1. Introduction

Ever since its inception in the early 1990s, the Chinese stock market has experienced an astonishing growth and unprecedented development, emerged to be the world's second-largest stock market by market capitalization by the end of 2009,<sup>1</sup> thanks to the intensive and extensive reforms in China's securities market in the last decade which have improved substantially the regulatory system and the market-oriented appraisal system for initial public offering (IPO) as well as expanded

capital supply to the market. However, the Chinese stock market is also one of the most volatile markets, which has been called by many observers a “casino”. In the recent years there are several far-reaching events that have reshaped the Chinese stock markets. The most notable events include the “dot-com bubble” in 2000, China's non-tradable shares reform in 2005 and the global financial crisis (GFC) in 2008. The impacts of these events on the daily returns of the Shanghai and Shenzhen markets can be clearly viewed in Fig. 1. It is noted that the “dot-com bubble” has led to much more profound volatility and oscillation in the two Chinese stock markets than in the U.S. markets. With a short-lived bull, the two Chinese stock markets experienced a nearly five-year long bear market until June 2005 when the reform of non-tradable shares was implemented. The non-tradable shares reform has increased the liquidity and brought the markets back to the long-term bull. Since the recent GFC the two Chinese stock markets have shown extreme instability and severe volatility, which has become the major concern to the policy-makers and investors. This has motivated us to examine the persistent variance characteristic of the Chinese stock returns with clustered volatility and the dynamic linkages of the Chinese stock market with that of Hong Kong and the US.

The presence of heteroskedasticity in stock returns affirms that investment decisions in the current period are affected by the unexpected volatility in the previous period. Many existing studies have revealed that the financial time series data exhibit linear dependence in volatility, which indicates the presence of heteroskedasticity, implying the

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<sup>1</sup> There are five different types of equity ownership for the listed companies in the Chinese stock market, including state-owned shares, legal person shares, employee shares, A-shares, and B-shares. The first three types of shares are non-tradable, and only A-shares and B-shares can be traded on the securities market. A-shares are quoted in Renminbi (RMB), and could only be traded by Chinese citizens and late opened up to Qualified Foreign Institutional Investors (QFII) since 2002. The B-shares market was introduced for foreign investors and traded in foreign currency. Since March 2001, Chinese citizens may also trade B-shares with legal foreign currency accounts. According to the report by China Centre for Market Value Management (CCMVM) on 27th January 2010, the value of China's A-share market rose 100.88% year-on-year to 24.27 trillion yuan (\$3.57 trillion) as of the end of 2009, overtaking Japan's \$3.53 trillion, and next to the USA's \$15.08 trillion. Since then, it fell marginally behind Japan in 2010 and 2011, and surpassed Japan again in 2012 with the market value amounting US\$3.7 trillion, according to the World Federation of Exchanges.

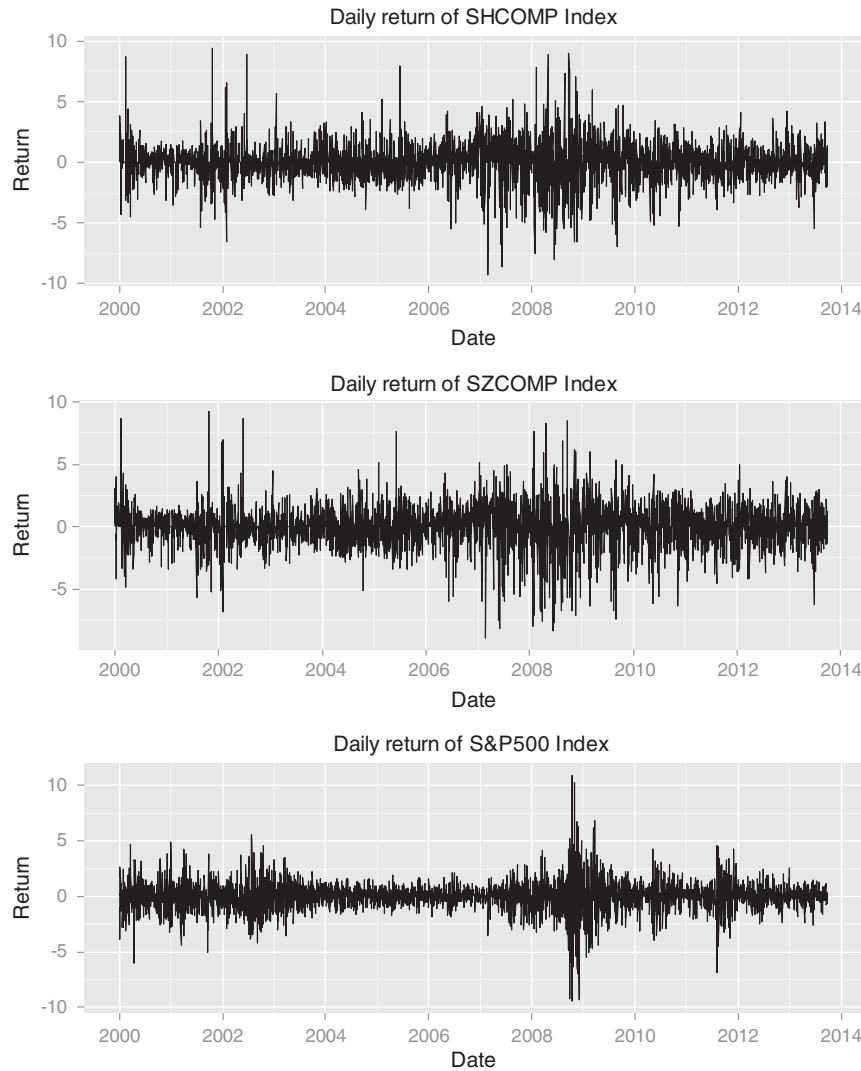


Fig. 1. Daily returns of Shanghai, Shenzhen and S & P 500.

existence of volatility clustering, in the developed countries. There have been a few studies on modeling and forecasting stock market volatility in China. Xu (1999) studies the volatility for daily spot returns of Shanghai composite stock index in 1992–1995, and found that the generalized autoregressive conditional heteroscedasticity (GARCH) model is superior to that of either EGARCH or GJR–GARCH models, indicating that there is almost no so-called leverage effect in the Shanghai stock market since volatility is mainly caused by the changes in governmental policy. Lee et al. (2001) examine the time-series features of stock returns and volatility in four of China's stock exchanges and found strong evidence of time-varying volatility, indicating volatility is highly persistent and predictable. Copeland and Zhang (2003) also find no evidence of leverage effect in mainland China's stock markets when they adopt the EGARCH model to capture the volatility during the period in 1994–2001. Based on the four-variable asymmetric GARCH fitted in the BEKK structure developed by Engle and Kroner (1995), Li (2007) concludes that no direct linkage exists between mainland China's stock markets and the U.S. market, thereby furnishing portfolio investors with diversification benefits. More recently, Johansson and Ljungwall (2009) use MGARCH model to explore the spillover effects and linkages among the three stock markets in the Greater China region. They find no indications of long-run relationships among the three markets in Mainland China, Hong Kong and Taiwan, but there exist short-run spillover effects in both returns and volatility in the region. Lin et al. (2009) employ the dynamic conditional correlation (DCC) model to study the

correlation between the Chinese and world stock markets, and find no evidence of an increasing trend of correlation from 1993 to 2006. Moon and Yu (2010) use GARCH(1,1)-M models to examine the short-run spillover effects of daily stock returns and volatilities between the Standard & Poor's (S&P) 500 stock index in the U.S. and the Shanghai Stock Exchange index in China, and find evidence of a symmetric and asymmetric volatility spillover effect from the U.S. to China, but symmetric volatility spillover effect from China to the U.S. in the period of 2005–2007.

In this paper, we intend to examine the presence of heteroskedasticity and the leverage effect in the Chinese stock market, and to capture the dynamics of conditional correlation between returns of China's stock markets and those of the U.S. in a bivariate time-varying correlation multivariate GARCH (VC-MGARCH) framework with daily stock return data ranging from January 3, 2000 to September 30, 2013. In particular, we employ an array of MGARCH models to study the leverage effects and weekday effects in these markets, and employ the time-varying-parameter models with Markov-switching heteroskedasticity and Engle's (2002) dynamic conditional correlation (DCC) model to explore the regime persistence and the spillover effects between the Chinese and U.S. markets. To the best of our knowledge, this is the first study that estimates both the dynamic conditional correlation and the leverage effects in the Chinese stock market in a unified framework with the most updated data set. This study implies three major contributions. First, this study is among the first few to examine comprehensively the leverage

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