Pacific-Basin Finance Journal 39 (2016) 70–83

Contents lists available at ScienceDirect

Pacific-Basin Finance Journal

journal homepage: www.elsevier.com/locate/pacfin

Chinese stock market volatility and the role of U.S. economic variables

Jian Chen [a], Fuwei Jiang [b,*], Hongyi Li [c], Weidong Xu [d,*]

[a] Department of Finance, School of Economics, Xiamen University, Xiamen, China
[b] School of Finance, Central University of Finance and Economics, Beijing, China
[c] Department of Decision Sciences and Managerial Economics, Chinese University of Hong Kong, Hong Kong, China
[d] School of Management, Zhejiang University, Hangzhou, China

ARTICLE INFO

Article history:
Received 7 February 2015
Received in revised form 17 September 2015
Accepted 26 May 2016
Available online 28 May 2016

JEL classification:
C22
C53
G11
G12
G17

Keywords:
Volatility forecasting
U.S. economic variables
Out-of-sample forecasting
Combination forecast
Chinese stock market

ABSTRACT

This paper investigates the effects of U.S. economic variables on the time variation of Chinese stock market volatility. We find that U.S. economic variables such as the dividend price ratio, dividend yield and industrial production strongly forecast the future monthly volatilities of the Chinese stock market. The predictability is statistically and economically significant and can be further improved when combining the information in all U.S. economic variables together. Forecast encompassing tests and regression tests show that the forecasting power of U.S. economic variables is incremental when comparing with the Chinese domestic economic variables. Our findings are robust for the out-of-sample analysis and a number of Chinese industry portfolios volatilities.

1. Introduction

Volatility forecasting is crucial to many fundamental issues in finance, including risk management, asset pricing, and asset allocation. A large body of literature documents positive evidence on stock market volatility predictability by applying different econometric models to different predictors (e.g., see Engle et al., 2013 and the references therein). In particular, Christiansen et al. (2012), Paye (2012), Corradi et al. (2013), and Engle et al. (2013) provide strong evidences that economic variables can forecast the future movements of U.S. stock market volatility. However, out of the U.S. market, little research analyzes the predictive power of economic variables. This paper adds to the international volatility predictability literature by exploring whether U.S. economic variables are useful in predicting the time variation of Chinese stock market volatility. China is of growing importance in terms of international trade, GDP, and stock market size. It has the second largest stock market in the world, valued at four trillion dollars (with the Shanghai and Shenzhen exchanges combined), and has more than two thousand public firms listed. Thus, understanding whether the Chinese stock market volatility is predictable is of great importance.

* Corresponding authors.
E-mail addresses: jchenl@xmu.edu.cn (J. Chen), jfuwei@gmail.com (F. Jiang), hongyi@baf.msmail.cuhk.edu.hk (H. Li), weidxu@zju.edu.cn (W. Xu).

http://dx.doi.org/10.1016/j.pacfin.2016.05.013
0927-538X/

Over the last two decades, China has been increasingly integrated to the global economy, particularly after China's admission into the WTO in the end of 2001 (Glick and Hutchison, 2013). U.S., the largest economy in the world, is China's largest trade partner. Harvey (1991) and Bekaert and Harvey (1995) show that U.S. economic conditions are highly correlated with world economic conditions. Since stock market volatility is strongly influenced by foreign factors when the stock markets are integrated (Bekaert and Harvey, 1997), U.S. economic variables therefore may have great predictive power for the Chinese stock market volatility. Rapach et al. (2013), Jordan et al. (2014), and, particularly, Goh et al. (2013) find that U.S. economic variables have significant forecasting power for Chinese stock market returns. Complementing these existing studies, we examine whether U.S. economic variables contain forecasting information for the Chinese stock market *volatility*. We also explore whether U.S. economic variables contain additional forecasting information beyond that embedded in the Chinese domestic predictors.

In our empirical analysis, we use 17 U.S. economic variables, including the book-to-market ratio (BM), treasury bill rate (TBL), long-term yield (LTY), net equity expansion (NTIS), inflation (INFL), long-term return (LTR), dividend-price ratio (DP), dividend yield (DY), earnings-price ratio (EP), dividend-payout ratio (DE), term spread (TMS), default yield spread (DFY), default return spread (DFR), commercial paper-to-treasury spread (CP), industrial production growth (IP), volatility of industrial production growth (IPVOL), and volatility of producer's price index (PPIVOL) as volatility predictors. We measure the stock market volatility as the logarithm of monthly realized volatility, which is calculated as the square root of sum squared daily returns on the aggregate Chinese stock market. In addition, while Ferson and Harvey (1999) and Ferson and Korajczyk (1995) have studied the predictability of industry portfolios returns, little research investigates the forecasting power of economic variables for the industry volatilities, which become more and more important with the increasing popularity of industry exchange-traded funds (ETFs). In this paper, we provide empirical evidence on industry portfolios volatilities forecasting beyond the market volatility forecasting. Our sample spans from January 1997 through December 2012.[1]

We regress the log realized volatility of Chinese stock market on the lagged U.S. economic variables, with controls of lagged Chinese and U.S. volatilities, since Chinese stock market volatility is fairly persistent and is negatively associated with U.S. stock market volatility (Chow and Lawler, 2003). Thus, we test whether incorporating U.S. economic variables can improve the Chinese stock market volatility forecasting compared with the benchmark autoregressive (AR) model. Our in-sample results show that five U.S. economic variables (NTIS, LTR, DP, DY, and IP) significantly forecast the Chinese stock market volatility during the full-sample period from January 1997 to December 2012, while five variables (NTIS, LTR, DP, TMS, and CP) strongly forecast the Chinese volatility during the sub-sample period from January 2002 to December 2012. The predictive regression models based on U.S. economic variables generate economically large and statistically significant ΔR^2 statistics, the increase in R^2 relative to that of the benchmark model, up to 2.18% (6.65%) during the full-sample (sub-sample) period. We next combine the forecasting information in U.S. economic variables together using the partial least square (PLS) method, following Kelly and Pruitt (2013, 2015) and Huang et al. (2015). Our results show that the combined factor strongly predicts the future Chinese stock market volatility during the full- and sub-sample periods. The predictive power is statistically and economically significant with ΔR^2 statistic of 2.17% (5.05%) for the full-sample (sub-sample), larger than most individual economic variables.

We also run the predictive regressions after controlling for Chinese domestic predictors, to test the incremental forecasting information contained in U.S. economic variables. We find that the U.S. economic variable's predictive power is still strong and significant. Moreover, we carry out the forecast encompassing test of Harvey et al. (1998) and the results show that none of Chinese domestic economic variables encompass the U.S. economic variables, and neither do the combined Chinese factors. It indicates that the U.S. economic variables indeed contain useful information for the predictability of Chinese stock market volatility beyond that embedded in Chinese domestic predictors.

To address concerns relating to the potential fragility of in-sample results, we study the out-of-sample performance of the U.S. economic variables.[2] This analysis is based on Campbell and Thompson (2008)'s out-of-sample R^2_{OS} statistics relative to the benchmark forecast. In our study, we consider three benchmark models: the historical average model, AR model incorporating lagged Chinese and U.S. market volatilities, and Chinese economic variable augmented AR model. The out-of-sample forecasts of Chinese stock market volatility are generated recursively only using data available through the period of forecast formation, *t*. We then calculate the R^2_{OS} statistics following Campbell and Thompson (2008).

Our results show that six U.S. economic variables (BM, NTIS, DP, DY, IP, and PPIVOL) generate positive and significant R^2_{OS} statistics in comparison with the historical average forecast, ranging from 0.16% to 16.28%. Comparing with the benchmark forecasts of AR model and Chinese variable augmented AR model, U.S. economic variables like DP, DY, and IP delivery positive R^2_{OS} statistics which are statistically significant and economically sizable. It indicates that these volatility forecasts based on U.S. economic variables produce substantially smaller mean squared forecasting errors (MSFE) than those generated by the benchmark models. This finding suggests that incorporating the U.S. economic variables helps to improve the out-of-sample forecast of Chinese stock market volatility, which is consistent with our in-sample results.

We also use the mean, median, trimmed mean methods, as well as the PLS method to generate out-of-sample combination forecasts, following Rapach et al. (2010), to incorporate information in all U.S. economic variables together. Forecasts based on these four combining methods generate positive out-of-sample R^2_{OS} statistics for all three benchmark models, ranging from 0.67% to 15.36%. Most of the R^2_{OS} statistics are statistically significant and economically large. In particular, the R^2_{OS} statistics of

[1] Our sample period for industry volatility spans from January 2002 to December 2012 due to the data availability.

[2] Welch and Goyal (2008) show that a large number of economic variables with in-sample significance generate poor out-of-sample performance. See Lettau and Ludvigson (2009) for a literature review on in-sample versus out-of-sample asset return predictability.