



# Macro fundamentals as a source of stock market volatility in China: A GARCH-MIDAS approach<sup>☆</sup>

Eric Girardin<sup>a</sup>, Roselyne Joyeux<sup>b,\*</sup>

<sup>a</sup> Aix-Marseille University, Aix-Marseille School of Economics, CNRS, EHESS, France

<sup>b</sup> Macquarie University, Sydney, Australia

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## ABSTRACT

In order to shed new light on the influence of volume and economic fundamentals on the long-run volatility of the Chinese stock market we follow the methodology introduced by Engle et al. (2009) and Engle and Rangel (2008) to account for the effects of macro fundamentals, and augment it with speculative factors. We show that the Chinese A-share market presented speculative characteristics before WTO entry in late 2001. However, after that date macroeconomic fundamentals and their volatility played an increasing role in the A-share market, especially CPI inflation, at the expense of speculative factors, proxied by volume. The B-share market has shown speculative characteristics since it was opened to domestic investors in 2001. However the disconnect of long-run stock market volatility from real economic activity in China is particularly noteworthy.

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## 1. Introduction

In a country where financial development is still ongoing we should not expect the stock market to behave in line with the theory of efficient markets. The Chinese stock market is usually considered to be no exception to this rule. Given the limited alternative investment opportunities, initially a reduced float, still binding short-sale constraints, and an overwhelming domination of individual over institutional investors, its behavior in the 1990s has generally been portrayed as highly speculative (Mei et al. 2009), at least in its main segment, being thus at times comparable to a casino (Girardin and Liu, 2003). However, the reforms introduced in the new millennium both in the stock market and in the economy, linked in part to WTO entry, may have strengthened the role of macroeconomic fundamentals in driving stock market volatility at the expense of speculative factors. This paper provides tests of such a maintained hypothesis, not only using a modified Mixed Data Sampling (MIDAS) methodology (Ghysels et al. (2005)) in which stock market volatility is modeled as a combination of macroeconomic effects and time series dynamics, but also augmenting such a model with trading volume in order to account for the role of speculative factors.

Over the twenty years of existence of the stock market in modern China, the economy has posted impressive average rates of real growth, but with sharp contrasts between some episodes of growth slowdown, as in the late nineties, and periods of accelerated growth as in the mid-2000s. Similarly, the inflation pattern has been all but uniform, starting from a highly inflationary period in the mid-nineties, through a deflationary one in the late nineties, and a revival of inflation a decade later. However, the boom and bust periods of the Chinese stock market are generally not considered to match the movements of growth or inflation (de Bondt et al., 2010).

The Chinese stock market is divided between two segments, among which the largest one, the A-market, denominated in Chinese Renminbi, was initially reserved to (mostly uninformed individual) domestic investors, while the B-market, denominated in foreign currency, was initially restricted to foreign investors. Existing work on China's stock market provides us with evidence in support of the speculative character of the A-share market (Mei et al., 2009). The high turnover on that market is a manifestation of this feature. Earlier evidence indeed showed that the mixture-of-distribution hypothesis, which explains conditional volatility by volume, fits well the Chinese market (Su and Fleisher, 1999).

However, a number of deep reforms, implemented in the last decade, may have lessened the speculative character of the market, leaving an increasing role for macroeconomic fundamentals. First, an expanding number of listed firms in China are increasingly representative of an economy where non-state-owned firms' output now accounts for three quarters of industrial activity. Even state-owned firms which benefited from an early listing have been seriously restructured with sharp lay-offs. They have

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\* Corresponding author at: Department of Economics, Faculty of Business and Economics, Macquarie University, Sydney, 2109, Australia, Tel.: +61 6298508487; fax: +61 298506069.

E-mail addresses: [eric.girardin@univ-amu.fr](mailto:eric.girardin@univ-amu.fr) (E. Girardin), [roselyne.joyeux@mq.edu.au](mailto:roselyne.joyeux@mq.edu.au) (R. Joyeux).

refocused on market behavior at the expense of their role as providers of the social safety net. The entry into the World Trade Organization (WTO) in December 2001 has symbolized this shift in the Chinese economy. Second, the sharp hiatus between the float and the capitalization in the stock market – due to the privileged control by various government entities of a very sizeable proportion of shares, thus never traded – was promptly all but eliminated after the split-share reform initiated in May 2005 and completed in late 2006 (Beltratti et al., 2009). Third, the door of the A-share market for large foreign institutional investors (the so-called Qualified Foreign Institutional Investors' scheme, QFII) left ajar from 2003 onwards, and similarly for domestic investors to invest abroad (the so-called Qualified Domestic Institutional Investors' scheme, QDII) from 2004 onwards, was gradually opened with the qualification of an increasing number of them (amounting to a total quota of respectively \$21 and 74 billion).

All these deep changes imply that the behavior of the Chinese stock market may have become closer to that of its peers in other large countries. Within this perspective de Bondt et al. (2010) consider the influence of fundamentals in the Chinese case, using Shiller's (1981) 'excess volatility' perspective, as a reflection of the earnings potential of firms. They find evidence of stable relationships, though with episodes of sharp misalignments. However, such work does not tell us whether the volatility of the Chinese stock market is linked to the behavior of macroeconomic variables and their volatilities. As stressed by Schwert (1989), if macroeconomic data "provide information about the volatility of either future expected cash flows or future discount rates, they can help explain why stock return volatility changes over time" (Schwert, 1989, p. 1116). A GARCH approach is used by Wang (2010) to show that the volatility of inflation but not of output causes stock market volatility in China. A line of research, inspired by Schwert, considers macro-variables as potential determinants of long-run stock market volatility. It focuses almost exclusively on the U.S. market and has been applied to China only insofar as the latter country has been included in large panels where its specificity is all but lost (Diebold and Yilmaz, 2010, Engle and Rangel, 2008).

We apply the Mixed Data Sampling (MIDAS) methodology to explain the Chinese A and B-share markets' long-run volatility estimated from daily squared returns using monthly data on macroeconomic variables and also account for trading volume as a proxy for speculative activity. We show that the Chinese A-share market presented speculative characteristics before WTO entry in late 2001. We also find that, subsequently, macroeconomic fundamentals and their volatilities played an increasing role, especially for CPI inflation, while the influence of volume on the A-share index vanished. The B-share market, however, started showing speculative characteristics only after its opening to domestic investors in 2001.

The empirical analyses of the effect of macroeconomic variables on long-run stock market volatility, as well as existing evidence on the speculative character of the Chinese stock market will be presented in section two. The Mixed Data Sampling methodology as well as the data used in the present paper will be introduced in section three. Section four will discuss the results of the application of the MIDAS framework to the A and B share markets over the last decade and a half, and provide interpretations. Section five will offer some conclusions.

## 2. Fundamentals, speculation and the stock market

### 2.1. Macro fundamentals and the stock market

Many researchers have studied movements in aggregate stock market volatility. Schwert (1989) reviews the numerous attempts in the seventies and eighties to relate stock market volatility to expected stock returns. Among those the 'excess volatility' hypothesis of Shiller (1981), in which the level of stock market volatility appears far too high relative to the ex post variability of dividends, occupies a prominent place. Nevertheless, Schwert rightly stresses that the literature on "excess volatility" has not addressed the question of why stock return

volatility is higher at some times than at others. Accordingly, Schwert proposes to relate stock market volatility to the time-varying volatility of a variety of macroeconomic variables, including inflation, money growth, industrial production growth, and other measures of economic activity.

Engle and Rangel (2008) propose to model stock market volatility as a combination of macroeconomic effects and time-series dynamics. High-frequency return volatility is specified as the product of a slow-moving component, represented by an exponential spline, and a GARCH process. This slow-moving component, proxying low-frequency volatility, is estimated for 50 countries with daily data. The annual low-frequency time-series volatility is then modeled as a function of macroeconomic and financial variables in a balanced panel. The low-frequency component of volatility is a positive function of the volatility of output growth, while inflation and short-term interest rates are more volatile. In addition, low-frequency volatility is larger when output growth is low and inflation is high. Volatility is higher both for emerging markets (including China) and for large economies. Along different lines, Diebold and Yilmaz (2010) examine for forty countries the links between asset return volatility and the volatility of its underlying macroeconomic determinants. They find a positive relationship between stock return and GDP (or consumption) growth volatilities.

Engle et al. (2009) examine the relation between stock market volatility and macroeconomic variables with a component model that distinguishes short run from secular movements. They call this new model the GARCH-MIDAS model. The GARCH-MIDAS component model uses a mean-reverting unit daily GARCH process, similar to Engle and Rangel (2008), and a MIDAS polynomial applied to monthly, quarterly, or biannual macroeconomic or financial variables, proposed by Ghysels et al. (2006). Engle et al. (2009) apply this new method to the study of long U.S. series of aggregate stock market volatility, starting in the late 19th century, as in Schwert (1989). The long-term component of return volatility is driven by inflation and industrial production growth.

The use of a fundamentals-based approach to model stock return volatility should leave room for the alternative/complementary view in which trading activity is a major driver of volatility. This is a new application of the GARCH-MIDAS approach which only focused on fundamentals in previous applications. Such an inquiry can draw from the comparison made by Zhang (2010) between the approach based on fundamental variables, in the spirit of the present-value model used by Shiller (1981), and the theories which link return volatilities to trading volume. In the U.S. case, he conjectures that increased realized stock return volatilities have something to do with factors which increased trading volume, such as institutional trading, derivative trading, and information-induced trading. The results, for the U.S. market, show that both fundamentals and trading volume explain the upward trend in average volatilities up to 2000. However, trading volume loses its explanatory power for the period from 2001 to 2006, while the explanatory power of the fundamental variables remains strong.

### 2.2. Speculative behavior and Chinese stock market

#### 2.2.1. Speculative character of the Chinese stock market

Speculation is a major candidate to explain the breakdown of the link between stock prices and fundamentals. Scheinkman and Xiong (2003) and Hong et al. (2006) show that, in the presence of both heterogeneous beliefs and short sale constraints, investors may be induced to overpay for a stock if they expect to sell it to another investor who will be willing to pay even more in the future. Accordingly, asset prices may contain a sizeable speculative component, which manifests itself by large trading volume and high return volatility. In the models of Baker and Stein (2004) and Hong et al. (2006), volume is taken as a proxy for irrational traders and speculative activity.

China's stock markets, with a dominance of inexperienced individual investors (who were initially new to stock trading), binding short-sales constraints, a small asset float (before the split-share reform of 2005–2006 which all but suppressed the difference between

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