



## Value-at-risk for long and short trading positions: Evidence from developed and emerging equity markets<sup>☆</sup>

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### ABSTRACT

The financial crisis of 2007–2009 has questioned the provisions of Basel II agreement on capital adequacy requirements and the appropriateness of VaR measurement. This paper reconsiders the use of Value-at-risk as a measure for potential risk of economic losses in financial markets by estimating VaR for daily stock returns with the application of various parametric univariate models that belong to the class of ARCH models which are based on the skewed Student distribution. We used daily data for three groups of stock market indices, namely Developed, Southeast Asia and Latin America. The data covered the period 1987–2009. We conducted our analysis with the adoption of the methodology suggested by Giot and Laurent (2003). Therefore, we estimated an APARCH model based on the skewed Student distribution to fully take into account the fat left and right tails of the returns distribution. The main finding of our analysis is that the skewed Student APARCH improves considerably the forecasts of one-day-ahead VaR for long and short trading positions. Additionally, we evaluate the performance of each model with the calculation of Kupiec's (1995) Likelihood Ratio test on the empirical failure test. Moreover, for the case of the skewed Student APARCH model we computed the expected shortfall and the average multiple of tail event to risk measure. These two measures helped us to further assess the information we obtained from the estimation of the empirical failure rates.

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### 1. Introduction

During the recent years the importance of effective risk management has become extremely crucial. This was the outcome of several significant factors. First, the enormous growth of trading activity that has been taking place in the stock markets, especially those of the emerging economies which, however, led to an increase in financial uncertainty and increased volatility in the stock returns. Indeed,

during the period 1992–2008 an enormous inflow of portfolio funds to the emerging markets of Central and Eastern Europe, Southeast Asia and Latin America was recorded and this capital inflow was due to the fact that over this period the mature markets have reached their limitations with respect to profit opportunities leading portfolio managers and institutional investors to look for new opportunities in these new markets. Second, the financial disasters that took place in the 1990s led to bankruptcy well-known financial institutions. These events have put great emphasis for the development and adoption of accurate measures of market risk by financial institutions. Financial regulators and supervisory committee of banks have favored quantitative risk techniques which can be used for the evaluation of the potential loss that financial institutions can suffer. Furthermore, given that the nature of these risks changes over time effective risk management measures must be responsive to news such as other forecasts as well as to be easily understood even in complicated cases.

This need was further reinforced by a number of financial crises that took place in the 1980s, 1990s and the 2000s such as the worldwide stock markets collapse in 1987, the Mexican crisis in 1995, the Asian and Russian financial crises in 1997–1998, the Orange County default, the Barings Bank, the dot.com bubble and Long Term Capital Management bankruptcy cases as well as the financial crisis of 2007–2009 which led several banks to bankruptcy worldwide with Lehman Brothers being the most notable case. Such financial

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uncertainty has increased the likelihood of financial institutions to suffer substantial losses as a result of their exposure to unpredictable market changes. These events have made investors to become more cautious in their investment decisions while it has also led for the increased need for a more careful study of price volatility in stock markets. Indeed, recently we observed an intensive research from academics, financial institutions and regulators of the banking and financial sectors to better understand the operation of capital markets and to develop sophisticated models to analyze market risk.

Basle I and II Agreements have been the main vehicle globally for the set up of the regulatory framework on financial markets following the dramatic events in financial markets in the late 1980s and early 1990s. Basel I was introduced in late 1980s and it was based on risk classification of assets with the main purpose of forcing banks to provide sufficient capital adequacy against these assets based on their respective risks. However, it turned out that this attempt to impose capital ratios for banks has adverse effects since Basel I put a low risk weight on loans by banks to other financial institutions. In this framework banks were given an incentive to transfer risky assets off their balance sheets. Regulation arbitrage was further incurred since Basel I made possible for banks to treat assets that were insured as government securities with zero risk a feature that was fully exploited by the banks and led to the huge increase of the market for CDS.

In an attempt to remedy some of the problems created since the implementation of Basel I Agreement, Basel II was introduced in the 1990s and it was put in full implementation in 2007. A central feature of the modified Basel II Accord was to allow banks to develop and use their own internal risk management models conditional upon that these models were tested under extreme circumstances and properly “backtested” and “stress tested”. Value-at-risk has become the standard tool used by financial analysts to measure market risk. VaR is defined as a certain amount lost on a portfolio of financial assets with a given probability over a fixed number of days. The confidence level represents ‘extreme market conditions’ with a probability that is usually taken to be 99% or 95%. This implies that in only 1% (5%) of the cases will lose more than the reported VaR of a specific portfolio. VaR has become a very popular tool among financial analysts which is widely used because of its simplicity. Essentially the VaR provides a single number that represents market risk and therefore it is easily understood.<sup>1</sup>

During the last decade several approaches in estimating the profit and losses distribution of portfolio returns have been developed, and a substantial literature of empirical applications have emerged which provided an overall support for the use of VaR as the appropriate measure of market risk. A number of these models have focused on the computation of the VaR on the left tail of the distribution which corresponds to the negative returns. This implies that it is assumed that portfolio managers or traders have long trading positions, which means that they bought an asset at a given price and they are concerned with the case that the price of this asset falls resulting in losses. More recent approaches dealt with modeling VaR for portfolios that includes both long and short positions. Therefore, they considered the modeling and calculation of VaR for portfolio managers who have taken either a long position (bought an asset) or a short position (sold an asset). As it is well known, in the former case the risk of a loss occurs when the price of the traded asset falls, while in the later case the trader will incur a loss when the asset price increases.<sup>2</sup> Hence, in the first case we model the left tail of the distribution of returns and in the second case we model the right tail of the distribution.

Furthermore, given the stylized fact that the distribution of asset returns is non-symmetric, Giot and Laurent (2003) using daily data for FTSE100, NASDAQ and NIKKEI225 have shown that models which

rely on a symmetric density distribution for the error term underperform with respect to skewed density models when the left and right tails of the distribution of returns must be modeled. Therefore, in such a case the VaR for portfolio managers or traders who hold both long and short positions cannot be accurately modeled by the application of the standard normal and Student distributions. Giot and Laurent (2003) also showed that similar problems arise when we try to model the distribution with the asymmetric GARCH models which assume that an asymmetry exists between the conditional variance and the lagged squared error term, (see also El Babsiri & Zakoian, 2001). So and Yu (2006), Tang and Shieh (2006), McMillan and Speight (2007) and McMillan and Kambouroudis (2009) provided recent evidence on the performance of alternative VaR models for a large number of stock as well as exchange rate markets. They confirmed prior evidence that models which take into consideration the asymmetric effects and long memory features of the data perform better than the specifications which model the conditional variance errors to be normally distributed.

The financial crisis of 2007–2009 has raised questions regarding the usefulness of the regulatory framework underlined by the Basel I and II agreements and it also questioned the appropriateness of the VaR as the measure to capture extreme cases like the ones the banking sector and global financial markets experienced over this turbulent period (see for example, Brunnermeier, 2009; De Grauwe (2009) and Welfens (2009)). De Grauwe (2009) argued that the Basel approach to stabilize the banking system has an implicit assumption that financial markets are efficient. Market efficiency implies that returns are normally distributed. However, it has by now documented in the finance literature that asset returns are not normally distributed but they have distributions with fat tails. Therefore, De Grauwe (2009) argued that the Basel Accords have failed to provide stability in the banking sector since the risks linked with universal banks are tails risks associated with bubbles and crises. Fat tails are linked to the occurrence of bubbles and crises and this implies that models based on normally distributed errors substantially underestimate the probability of large shocks.

Furthermore, the extent and severity of the recent financial crisis have revealed in a most dramatic way the weaknesses of the national and supranational regulatory bodies since they failed to diagnose correctly and managed with the appropriate tools this specific crisis of systemic nature that has caused enormous problems in the international banking system. This failure became more important given that such credit and financial crisis erupted at a time when the international banking and financial banking system was in its peak, given the favorable international economic environment, the introduction of new financial instruments and strong profitability. A major explanation for this failure of the regulatory bodies lies on the assumption that these regulatory bodies erroneously identified the concept of systemic risk and of financial stability with that of robustness and stability of each individual financial institution. However, the recent financial crisis has proved wrong the use of this micro-prudential framework which was fully encoded in Basel II (see for example Greek Economic Review, 2010).

Given this failure of Basel II, Caruana (2010), Yellen (2009) and IMF (2009) argued that this micro-prudential framework is not enough by itself to ensure international financial stability and that the regulatory bodies should develop in addition a macro-prudential approach which would eventually lead to the sustainability and operation of the international banking system independently of the failure of individual banking and financial institutions. The development of this macro-prudential approach is the main task of the regulatory bodies which is expected to be formalized in Basel III. This approach is expected to focus on two directions. First, it will lead to the creation of new supranational regulatory bodies and committees which will have as a major task the coordination of the national regulatory committees and the harmonization of the rules and acts of the national regulatory bodies (see de Larosiere Group, 2009; Turner, 2009; BIS, 2010; Goodhart, 2010). The second direction of this approach focuses on the development of new

<sup>1</sup> See also Bank for International Settlements (1988, 1999a,b,c, 2001).

<sup>2</sup> Bodie et al. (2009) provide a comprehensive analysis of trading strategies.

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