Chapter 9

A Mixture Price Trend Model for Long-Term Risk Management

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ABSTRACT

In financial forecasting, a long-standing challenging issue is to develop an appropriate model for forecasting long-term risk management of enterprises. In this chapter, using financial markets as an example, we introduce a mixture price trend model for long-term forecasts of financial asset prices with a view to applying it for long-term financial risk management. The key idea of the mixture price trend model is to provide a general and flexible way to incorporate various price trend behaviors and to extract information from price trends for long-term forecasting. Indeed, the mixture price trend model can incorporate model uncertainty in the price trend model, which is a key element for risk management and is overlooked in some of the current literatures. The mixture price trend model also allows the incorporation of users’ subjective views on long-term price trends. An efficient estimation method is introduced. Statistical analysis of the proposed model based on real data will be conducted to illustrate the performance of the model.

INTRODUCTION

Forecasting price dynamics of financial assets has long been a central issue in business and economic forecasting, in particular, financial forecasting. The forecasts of future movements of asset prices provide an important piece of information for financial risk management. These forecasts have been used by central bankers, investment firms, risk managers and individual traders to aid their financing and investment decisions and their risk management practice. In business, economic and financial forecasting, a long-standing challenging issue is to develop an appropriate model which is able to generate accurate and reliable long-term forecasts with a view to applying it to long-term risk management of enterprises.
A Mixture Price Trend Model for Long-Term Risk Management

Risk Management has attracted serious attention among regulators, academia, market practitioners and even retail investors due to the increasingly complex and unexpected business environment. This is also one of the main areas, where business, economic and financial forecasts may find many important and interesting applications. The current global financial crisis starting from sub-prime mortgages in the United States may be attributed to doubtful practices and incorrect assessments of risk. Some big names in banking, finance, insurance industries and corporations, like GM, AIG and Lehman Brothers, collapsed because of incorrect assessment and inappropriate management of their exposures to risk. This raises concerns of regulators, academia and market practitioners to the current practice of risk assessment and management.

Value at Risk (VaR) emerged as a popular and important tool for risk management. Its use in finance industries was popularized by the Risk Metric Group of J.P.Morgan, which is now an independent risk consulting company. Nowadays, VaR has been a benchmark for risk assessment and management. Technically speaking, VaR is defined as the percentile of a Profit/Loss distribution of a trading position at a certain probability level in a fixed time horizon. It estimates the maximum amount of loss one is prepared to incur at a certain probability level in a fixed time horizon. For example, if the 95% daily VaR of a trading position is one millions US dollars, this means that one is prepared to incur the amount of loss of one millions or more with (a small) probability 5% in a day. In practice, the probability level is set to be either 95% or 99% and the fixed time horizon is often set to be one day or seven days. For example, in calculating daily VaR, J.P. Morgan uses 95% while Bankers Trust uses 99%. However, VaR as a popular risk measure is flawed as pointed out in Artzner et al. (1999), where an axiomatic, or a theoretical, approach to risk measures and the notion of coherent risk measures were proposed. Artzner et al. (1999) introduced a set of four intuitive properties that a theoretically consistent risk measure should satisfy. One of these four properties is the sub-additive property, which states that the allocating assets over two risky positions should reduce risk. The sub-additive property has its origin in the diversification effect, which is consistent with the old saying “Don’t put all your eggs in a basket” and formulated mathematically in the mean-variance portfolio selection model of Markowitz (1952). Artzner et al. (1999) pointed out that VaR is not, in general, sub-additive. This means that if VaR is used as a measure of risk, allocating assets over two risky positions will increase risk, and, this is not consistent with the diversification effect.

Artzner et al. (1999), Boyle et al. (2002), and others, proposed the use of the Expected Shortfall (ES) as an alternative for financial risk management. ES is defined as the average loss of a trading position when the loss exceeds a certain level, which is usually set to be the VaR at a certain probability level. It gives us the information about how much loss of a trading position one may incur if the loss of the trading position exceeds the VaR level. Under certain conditions, ES is a coherent risk measure, (see, for example, Boyle et al. (2002) for further discussion).

Besides selecting appropriate risk measures for risk assessment and management, an important issue is to incorporate model uncertainty. Indeed, incorporating model uncertainty is important for any modeling exercises. The importance of incorporating model uncertainty has been highlighted in the consultative document of the amendment of Basel II 2009. For an introduction to financial risk management, interested readers may refer to Alexander (2001, 2005), Dowd (2005), McNeil et al. (2005), Dowd and Blake (2006), and others.

In this chapter, using financial markets as an example, we introduce a mixture price trend model for long-term forecasts of financial asset prices with a view to apply it for long-term financial risk management. The key idea of the mixture price trend model is to provide a general and flexible way to incorporate various price trend behaviors and to extract information from price trends for