Chapter 1

Introduction

The financial world has changed dramatically in recent years. Governments in many countries have put a lot of effort into developing effective financial systems, but have not always been able to control these systems. Something happened recently in Asia that has had a profound effect on people's lives. What happened is known as the 'Asian economic meltdown'. As a result, the value of the Indonesian rupiah relative to the US dollar dropped by more than 75%. The Thai baht and the Malaysian ringgit also suffered: each lost about one-third of its value. And South Korea had similar problems.

Nobody really understands what happened. Some, including Malaysia prime minister Dr Mahathir Mohammed, blamed American market speculators such as George Soros. Others found more complex reasons, such as the structural problems in both the real and the financial sectors, the failure to rectify them in time, the failure to improve the exchange system, the lack of necessary financial infrastructure, and the lack of business sector's skill in financial management under the free and open market system.

The currency crisis on the East Asia region began with the bursting of the economic bubble in Thailand and spread to other countries in the region. The Mexican peso crisis in 1995 and 1996, and the appreciation of the US dollar, further weakened Thailand's export competitiveness, as its currency, the Thai baht, had been effectively fixed to the US dollar. Thailand is bubble economy finally burst in 1997, the Thai baht currency coming under harsh attack several times, the strongest in May. This forced the bank of Thailand to spend a large amount of international reserves in an attempt to defend the Thai baht, but to no avail. On 2nd July 1997, the authorities changed the exchange rate regime from a basket system to a managed float. This resulted in a rapid depreciation of the Thai baht value. The Thai baht depreciated by about 15 percent in the first week alone. The Indonesian rupiah, the Malaysian ringgit, and the Philippine peso also depreciated gradually during that period.

Whatever the causes, these currency movements have had profound effects on peoples' lives. For some, it is no longer possible to finance their children's education, More seriously, others have lost their jobs and incomes, and many have been reduced to poverty.

This phenomenon has not only affected developing countries. It has spread to Russia, Japan, and Latin American.

Another phenomenon has been occurring in academic circles in the world. Universities in the developed countries have been changing their fields of study. Rather than the training grounds for elite scientists and professionals of 30 years ago, modern universities in the developed world have turned their attentions to studying business and finance, and in providing education in these areas for students from the developing world. In contrast, universities in developing countries are still focusing on more traditional fields, such as chemistry and physics, mathematics and engineering, and few have developed programs in economics, business and finance.

In view of this, there is some pressure on universities in the developing world to invest in their own programs in business and finance. Such a strategy would achieve two objectives.

(a) Funds for graduate education could be spend internally, rather than abroad.

(b) It would provide a better basis for controlling their financial processes, rather than being at the whim of overseas institutions.

The financial problem could be protected or solved if we could understand the process of financial variables such as currency exchange rates. This study aims to find an appropriate model for describing what happens in currency exchange systems, particularly the volatility of time series fluctuations.

Objectives and rationale

The problem considered in this thesis is to select a statistical model that accounts for the time series variation in currency exchange rates. The currencies chosen are the Japanese yen, the British pound sterling, and the German deutsche

mark, and the US dollar is taken as the basis for measuring these exchange rates. These are the leading currencies in the world, so any serious study of world financial movements should include them.

Until about 20 years ago the most powerful countries in the world attempted to control their currency exchange rates in various ways, with limited success. But with the introduction of the European Monetary System (EMS) in 1979, market forces have largely determined these fluctuations. The period chosen extends from January 1986 to April 1994. This period is selected because it begins after the introduction of the EMS, and also includes the greatest shock to financial markets that has occurred in recent years, apart from the Asian meltdown itself, namely, the crash of Monday 19 October 1987. On this day the New York Stock Exchange Standard & Poor 100 Index plummeted from 274.13 to 216.31, a loss of nearly 25%. The Nikkei index in Tokyo and the FTSE1000 index in London also plunged substantially on the same day. The period of our study also ends well before the Asian meltdown occurred.

Modelling financial time series is important because it enables predictions of future economic variables, based on information contained in the past history of these variables. Exchange rates have been selected for our study because they are the most tangible indicators of a country's economic health, and they affect almost everybody.

The following specific objectives are addressed.

1. To describe the variation in currency exchange rate of the Japanese yen, the British pound sterling, and the German deutsche mark, with respect to the US dollar.

2. To develop a statistical method based on an appropriate statistical model for stochastic volatility.

The results obtained could be used to develop a methodology for modelling exchange rates that can be applied to other currencies, including the Thai baht, the Indonesian rupiah, the Malaysian ringgit and Philippine peso.

Literature review

Financial time series, particularly stock price indexes and currency exchange rates determined by market forces, tend to behave unpredictably. This random behaviour has been long recognised by economists. Baumol (1965, page 39) referred to 'the random-walk hypothesis', and described it as follows:
'The model which provides the "best" description of the time-path of the price of any particular stock predicts that in any future period that price will be equal to the price of that same security in the immediately preceding period plus some number randomly chosen.'

Such observations led statisticians to develop models for stock prices using standard methods for analysing random processes (see, for example, Granger and Morgenstern, 1963).

However, it has become recognised that the standard approaches used by statisticians to analyse time series do not work very well for financial data. This is because the basic statistical assumption of *variance homogeneity*, that is, that the variability or *volatility* of the series does not change with time, does not hold (see, for example, Pagan & Schwert, 1990).

Given that financial time series have changing volatilities, it would be expected (given the random or unpredictable nature of the process) that this volatility would itself behave like a random process. For if things were otherwise, it would be possible to predict the volatility, and thus use the resulting information for forecasting. A time series in which the volatility changes randomly with time is said to have *stochastic volatility.*

There is a vast and rapidly growing literature related to stochastic volatility models. As Shephard (1996) pointed out in a recent review of the subject, this activity is driven largely by two factors:

(a) the need to develop better theoretical models in finance;

(b) the need to develop better statistical models for time series.

Relevant literature on stochastic volatility up to 1985 is summarised in the book by Taylor (1986), and Shephard (1996) cites over 100 relevant papers published during the following decade.

There has also been an explosion of interest in quantitative methods in finance among universities and institutions including banks and insurance companies. Conferences attract large numbers of attendees. For example, a four-day convention, run in December 1998 by the University of Technology in Sydney, attracted over 500 attendees, each paying $350 to hear 73 papers by speakers from Australian, Japanese, European and American universities and financial institutions (UTS, 1998).