Chapter 2
An Application of Genetic Programming to Forecasting Foreign Exchange Rates

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ABSTRACT

There is a great need for accurate predictions of foreign exchange rates. Many industries participate in foreign exchange scenarios with little idea where the exchange rate is moving, and what the optimum decision to make at any given time is. Although current economic models do exist for this purpose, improvements could be made in both their flexibility and adaptability. This provides much room for models that do not suffer from such constraints. This chapter proposes the use of a genetic program (GP) to predict future foreign exchange rates. The GP is an extension of the DyFor GP tailored for forecasting in dynamic environments. The GP is tested on the Australian / US (AUD/USD) exchange rate and compared against a basic economic model. The results show that the system has potential in forecasting long term values, and may do so better than established models. Further improvements are also suggested.

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INTRODUCTION

There is a great need in many industries for accurate future foreign exchange rate prediction. The uses of such a system are varied, from assisting international corporations dealing with international contracts to assisting currency speculators in determining the most profitable trading decisions. The process of predicting future foreign exchange rates is known as forward rate prediction. Forward rate prediction is an interesting problem that has seen research in many disciplines, including economics, mathematics and computer science (Álvarez-Díaz & Álvarez, 2005; Brabazon & O’Neill, 2004; Neely & Weller, 2003).

There are a number of economic models used to forecast forward rates, the majority of which do not adequately model the nonlinear nature of the market, and more importantly, do not dynamically adapt to changing market conditions. This has led to a large number of studies completed to determine the aptitude of computing based heuristic models, such as neural networks (NNs) and evolutionary algorithms (EAs), among others (Andreou, Georgopoulos, & Likothanasssis, 2002; Jan & Dirk, 1999).

The purpose of this chapter is to further explore the potential of genetic programming (GP), a subclass of EAs, at providing a more robust and adaptive alternative for predicting forward rates.

EAs are based on natural processes such as continuous evolution of a population using the Darwinian principle of survival of the fittest and genetic operators such as recombination (crossover) and mutation. EAs are adept solvers for a wide spectrum of problems, and are capable of overcoming problems such as escaping from local optima, searching through large and complex search spaces and adapting quickly to changing environmental conditions (Koza, 1993). GP is a sub-field of EAs that represents individuals as program trees. It is most adequate in environments where the space of potential solutions is a program or function (Koza, 1993). This makes GP a good candidate for creating a robust forward rate prediction system.

In this chapter a system that uses GP for predicting forward rates is proposed and an implementation is developed and analysed. The goals of the chapter are:

- To assess the feasibility of defeating the Unbiased Interest rate Parity (UIP) by utilising limited information.
- To examine the effects of additional operators added to the system.
- To record the knowledge of the market derived by the GP system for use in other systems.

This chapter is organised in the following manner: The background section provides a brief overview of the fields of foreign exchange markets and forward rates and an introduction to EAs and GP. Next, we review some related work to both fields, followed by a detailed explanation of the objectives of the chapter. This is followed by a detailed description of the model used in this chapter and the methodology taken. The results section details the findings of the model along with its limitations. The chapter then concludes with a number of possible extensions as well as future work foreseen for this model is detailed.

BACKGROUND

This section serves as a basic introduction to forward rates and EAs, as an understanding of these is necessary for the reading of this chapter.

A forward rate is a part of a financial tool used to lower the risk associated with foreign exchange transactions. It is used in a forward contract between two parties in which they specify a date at which to exchange a specified amount of one currency into another using a specified rate, regardless of the actual exchange rate at that time. The rate that they agree to exchange at is the forward rate.