



Network for Studies on Pensions, Aging and Retirement

# Application of Machine Learning Techniques for Forecasting Exchange Rate Returns in Emerging Economies

Lilian Shahnazari

MSc 08/2020-005

**NETSPAR ACADEMIC SERIES**

# Application of Machine Learning Techniques for Forecasting Exchange Rate Returns in Emerging Economies

Lilian Shahnazari  
STUDENT NUMBER: 2012594

THESIS SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF SCIENCE IN QUANTITATIVE FINANCE & ACTUARIAL SCIENCE  
SCHOOL OF ECONOMICS & MANAGEMENT  
TILBURG UNIVERSITY

Thesis committee:

Supervisor  
dr. Anne Balter  
Second Reader  
dr. Nikolaus Schweizer

Tilburg University  
School of Economics & Management  
Tilburg, The Netherlands  
August 2020



## **Preface**

First of all, I want to thank Anne Balter for the immense support and valuable expertise during my thesis. Coming from a background not in line with my research she has given me helpful insights from another angle into my process.

I want to furthermore thank Bart Bos and his colleagues from Cardano for providing me with data and offering insights into the latest developments in the field.

And finally, I want to give my special thanks to my partner Tim van Broekhoven who helped me finalize my thesis work and has been an active support throughout the thesis writing.



# Application of Machine Learning Techniques for Forecasting Exchange Rate Returns in Emerging Economies

Lilian Shahnazari

## 1. Introduction

The annual percentage growth of the gross domestic product (GDP) for developing economies have since a few years consistently outperformed those in developed countries (World Economic Situation and Prospects, 2020). In the same report published by the United Nations, developing economies are projected to further increase their growth to 4% in 2020 and 4.3% in 2021 and in comparison the developed markets only by 2.5% and 2.7% respectively. In contrast, the International Monetary Fund released their World Economic Outlook update in June 2020 estimating that the emerging economies will increase its real GDP by 5.9% and advanced economies by 4.8%. In other words, "Today, the issue is not whether to invest in emerging markets – but how much to invest in emerging markets." (Bekaert & Harvey 2017).

Despite the promising growth potential of developing countries, there is also some instability embedded in these foreign investments, for example political, economical and financial ones. Besides, in many developing countries the investments are dominated in the local currency which adds currency risk to the investment portfolio and could potentially deter investors if considered highly volatile of otherwise profitable business opportunities.

In order to eliminate the excess risk of currency fluctuations or even obtaining additional return on investment from the currency volatility, many research papers have attempted to forecast the exchange rate for developing countries. Forecasting models have been developed in various ways, from the use of time series models (for example, Clements & Fry, 2008; Du et al., 2014; Lustig et al., 2011; Nguyen, 2010 etc.) and fundamental analysis models (for example, Byrne et al., 2014; Filippou et al., 2019; Inci & Lu, 2004 etc.). Unfortunately there have been little to no success in past empirical research.

Following the rise in the use of machine learning techniques, some researchers (Baku, 2019; Ponomareva et al., 2019) have examined whether these methods manage to capture perhaps the complex relation between economic fundamentals and the exchange rate fluctuations that has been undetected previously. However, also in these cases, the results were not promising.

As the search for the best forecasting model have been fruitless, this thesis simplifies the search from predicting for the exact exchange rate return to forecasting the movement of the exchange rate return in hopes of better outcomes. Specifically, this paper investigates the relation between the most relevant macroeconomic, financial variables and exchange rate movements in 54 developing countries between January 1996 until March 2015 by applying other machine learning techniques not previously used in this

setting such as Random Forest and Support Vector Machines in combination with the a data manipulation technique used widely for imbalanced datasets. A paper written by Kumar & Thenmozhi (2006), showed that for stock market prediction, the random forest and the support vector machines performed the best out of the most common machine learning techniques. Thus, these are the techniques that will be employed to forecast the exchange rate return movement in our case.

The remainder of the paper has the following structure, in Section 2 the theoretical framework is presented, Section 3 summarises the data used for this paper, Section 4 concerns the methods used, Section 5 displays the results and finally follows by Section 6 and 7 with the discussion and conclusion.

## **2. Theoretical Framework**

### **2.1 Home bias**

When investors are inclined to invest the majority of their portfolio in domestic assets rather than in foreign assets, ignoring the diversification benefits of doing so, they are said to exhibit home bias. It has been empirically shown that investors allocate a large proportion of their wealth to domestic securities and it is suggested that home bias can even hinder financial integration (Molestina Vivar et al., 2020). It is also mentioned in another report that countries with more developed stock markets demonstrate relatively higher home biases (Bakker, 2013).

The main benefit of expanding the portfolio to include enough foreign equities is to lower the amount of systematic risk in a portfolio. By adding these foreign equities, the portfolio is not as severely affected by domestic market changes as it would be with a portfolio only invested in the home country. The phenomenon of home bias is not linked to a particular culture either, it seems to be a wide spread behavior among international agents.

The most common explanation for home bias in the past was due to barriers of trade, such as international taxes and transaction costs. However, recently these barriers to entry have diminished and yet home bias still persists (Babilis & Fitzgerald, 2005; Kho et al., 2009). Besides, funds had higher turnover rates on foreign assets relative to domestic assets, so transaction costs are also not a probable explanation (Bakker, 2013; Babilis & Fitzgerald, 2005).

Given this, another theory have surfaced, the existence of asymmetric information. Barron and Ni in 2008 cite that through a noisy expectation model, when domestic portfolio managers have an information advantage over foreign ones, home bias was shown. Literature review done by Babilis & Fitzgerald in 2005, Bakker in 2013 and Bekaert et al. in 2017 reach the same conclusion. Moreover, another study suggest that foreign portfolio managers mainly invest in stocks of companies that are better known to them regardless of the expected returns being lower than the return on other stocks in the case of Japanese and US stocks (Barron & Ni, 2008; Kho et al., 2009). Kho et al., also found that if investors perceive themselves as knowing more about the operations of the financial markets are more probably of owning foreign stocks. So it could also be irrational behavior at play.

Finally, diversification by investing in international assets comes with a caveat, namely substantial currency risk, which is covered next.