ANALYSIS OF MONETARY POLICY RULES FOR SOUTH AFRICA

by

NDAHIRIWE KASAI

A Thesis

Submitted in fulfilment of the requirements for the Degree

PhD Economics

in the

FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

at the

UNIVERSITY OF PRETORIA

2011
© Copyright by

Ndahiriwe Kasai

2011
ANALYSIS OF MONETARY POLICY RULES FOR SOUTH AFRICA

Presented by

Ndahiriwe Kasai, Licence, M.com.

Major Advisor

Dr. Ruthira Naraidoo

Associate Advisor

Prof. Rangan Gupta

University of Pretoria

2011
Declaration

“I declare that the Thesis, which I hereby submit for the degree PhD Economics at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at another university.”
DEDICATION

This thesis is dedicated to

my beloved wife, Niyonsaba Cécile,

my daughter Teta Kasai and

my sons Caleb Kasai and Béni Kasai.
ACKNOWLEDGMENTS

It is with praise and highest honour that I thank God whose amazing grace made this thesis possible.

My deep and sincere gratitude are expressed to my supervisor, Dr Ruthira Naraidoo, who kept telling me that there is always room for improvement. Up-to-date econometric techniques he introduced to me provided a solid foundation for the present thesis. His ideals and concepts will have a remarkable influence on my teaching and research career.

I am grateful to my co-supervisor, Prof Rangan Gupta, for his inspirational way of doing research and for having gone through this work. I am also still indebted to his important guidance at Masters Level which became the cornerstone of my abilities in the field of research.

I owe my most sincere gratitude to Prof Balinda Rwigamba and his wife Marie Louise Nyirashyirambere, whose faith in my abilities, encouragement and continuous support enabled me to stand firm during the completion of the thesis. Their affection to my family when I was abroad has provided a good peace of mind.

I owe my sincere gratitude to my mother in law, Sarah Nyirarwandiko, for her unfailing love and availability for my children. Similarly, my deep gratitude goes to my parents Dismas Rukamata Mpfizi and Béatrice Nyirakaratwa who did everything they could to
satisfy my unlimited needs since my first cry. They perfectly accomplished their responsibility as parents. They are wonderful.

I am also grateful to all my Professors and colleagues for providing a warm working environment. Special thanks go to Dr Josine Uwilingiye, who was like a sister to me. I wish her all the best for her new career.

I also express my gratitude to the Rwandan government, whose financial support enabled me to achieve my aspirations for a doctoral degree. My most sincere gratitude is particularly expressed to the Rwandan High Commission based in Pretoria for having perfectly accomplished its responsibility during my stay in South Africa. I always felt at home.

Finally, I would like to offer my regards and blessings to all my entire family and friends for their contribution in making my dreams come true. To my wife Cécile Niyonsaba, when I was abroad for studies you performed quit well, more than I could imagine! Children are well raised, your family in law is proud of you, the house I never left is nice and you kept your very demanding lectureship. There is no single word to express my love and satisfaction. You are perfect!
FINANCIAL ASSISTANCE

“Study loan provided by the Rwandan Ministry of Education in respect of the costs of this study is hereby acknowledged. Opinions or conclusions that have been expressed in this study are those of the writer and must not be seen to represent the views, opinions or conclusions of the Republic of Rwanda.”
ABSTRACT

Besides the introduction and conclusion, this thesis is comprised of six independent chapters. In this thesis we provide an in-sample and out-of-sample assessment of how the South African Reserve Bank (SARB) sets its policy rate, post 2000 inflation targeting regime, in the context of both linear and nonlinear Taylor-type rule models of monetary policy.

Chapter 2 provides the theoretical foundations and the case study discussion. The literature has shown that the Taylor (1993) rule has gone through many modifications since the last decade of the 20th century. The modifications of the Taylor rule include interest rate smoothing, backward and forward looking versions, and nonlinear approximations. Furthermore, there has been increasing debate on whether central banks should respond to asset prices and financial variables. Despite some disagreements, economists seem to agree on the role of the financial market in determining inflation and economic performance. As far as South Africa is concerned, a stable financial system is one of the mandates of the central bank.

Chapter 3 discusses the research methods used in the thesis. First, the chapter provides an overview on the Hodrick-Prescott Filter used to detrend some series. Second, more
focus is oriented on a class of estimators, used in this thesis, called Generalized Method of Moments (GMM) estimators. GMM is important in that it can be applied to several estimation contexts besides the linear model. In fact, GMM can provide a simple alternative to other estimators, especially when it is difficult to write down the maximum likelihood estimator.

Chapter 4 is aimed to provide the source of data, to show the transformation made to some of them and to explore the data for preliminary results. The Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), GLS transformed Dickey-Fuller (DFGLS) and Kwiatkowski, et. al. (KPSS) tests suggest that all the series follow a stationary process. The chapter also reveals that the financial conditions index measured as an equal weight average of its components yields a smallest AIC than other alternative suggested herein. Furthermore, the chapter shows that the models that consider coincident business cycle indicator, rather than industrial production, perform better in terms of goodness of fit.

Given the controversial debate on whether central banks should target asset prices for economic stability, chapter 5 investigates whether the SARB pays close attention to asset and financial markets in their policy decisions. The main findings are that the SARB policy-makers pay close attention to the financial conditions index when setting interest rate. In the same chapter, it is also found that nonlinear Taylor rule improves its performance with the advent of the financial crisis, providing the best description of in-sample SARB interest rate setting behaviour. The 2007-2009 financial crisis witnesses an overall increased reaction to inflation and financial conditions. In addition, the financial
crisis saw a shift from output stabilisation to inflation targeting and a shift, from a symmetric policy response to financial conditions, to a more asymmetric response depending on the state of the economy. Although one could have expected that the SARB’s response of monetary policy to output during the crisis to increase, the response has dropped significantly. These results show the concern over the high level of inflation observed during the second semester of 2008.

In chapter 6, we test the concept of Opportunistic Approach to monetary policy. The findings support the two features of the opportunistic approach. First, we find that the models that include an intermediate target that reflects the recent history of inflation rather than a simple inflation target improve the fit of the models. Second, the data supports the view that the South African Reserve Bank (SARB) behaves with some degree of non-responsiveness when inflation is within the zone of discretion but react aggressively otherwise. Recursive estimates from the preferred model reveal that overall there has been a subdued reaction to inflation, output and financial conditions amidst the increased economic uncertainty of the 2007-2009 financial crisis.

Chapter 7 compares forecast performance of linear and nonlinear monetary policy rules estimated in the two previous chapters but rewritten in their backward looking versions. Recursive forecasts values are computed for 1- to 12-step ahead for the out-of-sample period 2006:01 to 2010:12. For the nonlinear models we use bootstrap method for multi-step ahead forecasts as opposed to point forecasts approach used for linear models. The aim is to evaluate the performance of three competing models in an out-
of-sample forecasting exercise. Overall ranking reveals the superiority of the nonlinear model that distinguishes between downward and upward movements in the business cycles in closely matching the historical record. As such, forecasting performance tests reveal that the SARB pays particular attention to business cycles movements when setting its policy rate.
# TABLE OF CONTENTS

DEDICATION.................................................................................................................. i  
FINANCIAL ASSISTANCE.............................................................................................. iv  
ABSTRACT ...................................................................................................................... v  
TABLE OF CONTENTS ................................................................................................. ix  
LIST OF TABLES ......................................................................................................... xiii  
LIST OF FIGURES ....................................................................................................... xiv  
LIST OF ACRONYMS .................................................................................................. xv  

Chap. 1: Introduction ................................................................................................... 1  
1.1. Introduction ........................................................................................................... 1  
1.2. Problem statement ............................................................................................... 2  
1.3. Aim and research objectives ............................................................................... 7  
1.4. Importance of the research ................................................................................ 8  
1.4.1. Personal learning experience ....................................................................... 8  
1.4.2. Conceptual interest ....................................................................................... 8  
1.4.3. Specific context of South Africa ................................................................... 8  
1.5. Methodology ....................................................................................................... 9  
1.5.1. Type of research ........................................................................................... 9  
1.5.2. Research methods and techniques ............................................................... 10  

ix
1.5.3. Data collection ........................................................................................................... 12
1.6. Scope of study .................................................................................................................. 12
1.7. Limitations of study ....................................................................................................... 13
1.8. Structure of the thesis .................................................................................................. 14

Chap. 2: Theoretical foundations and case study discussion ........................ 17
2.1. Theoretical foundations: Monetary policy and rules ................................................. 17
  2.1.1. The original Taylor rule ......................................................................................... 21
  2.1.2. Modified versions of the Taylor rule ................................................................. 22
2.2. The South African monetary policy: contextual overview......................................... 30
  2.2.1. Background ......................................................................................................... 31
  2.2.2. Mandate ............................................................................................................... 31
  2.2.3. Functions .............................................................................................................. 32
  2.2.4. Monetary policy framework ................................................................................. 33
2.3. Conclusion .................................................................................................................. 34

Chap. 3: Research methodology .......................................................... 35
3.1. Introduction .................................................................................................................. 35
3.2. The Hodrick-Prescott Filter ..................................................................................... 36
3.3. Generalized Method of Moments (GMM) ................................................................. 37
  3.3.1. GMM and the traditional Method of Moments (MOM) ...................................... 38
  3.3.2. Testing the validity of a GMM in Eviews ............................................................ 40
  3.3.4. Application of GMM on the Taylor monetary policy rule .................................. 42
3.4. Conclusion .................................................................................................................. 44

Chap. 4: Data analysis and preliminary results ........................................ 45
4.1. Introduction ...................................................................................................................... 45
4.2. Data source and analysis ............................................................................................... 45
  4.2.1. Data transformation .............................................................................................. 47
  4.2.2. Time series plot and descriptive statistics .......................................................... 55
  4.2.3. Unit root test .......................................................................................................... 58
4.3. Preliminary results ......................................................................................................... 61
4.4. Conclusion ...................................................................................................................... 65

Chap. 5: Financial assets, linear and nonlinear policy rules: an in-sample assessment of the reaction function of the South African Reserve Bank ......................................................................................................................... 67
5.1. Introduction ..................................................................................................................... 67
5.2. Linear and nonlinear Taylor rule models ................................................................... 71
5.3. In-sample analysis ......................................................................................................... 75
  5.3.1 Empirical results for the first window of estimation ......................................... 76
  5.3.2 Parameter evolution with recursive expanding windows of estimation ....... 79
  5.3.3. Parameter evolution with fixed-length rolling windows of estimation .......... 86
5.4. Conclusions .................................................................................................................... 92

Chap. 6: The opportunistic approach to monetary policy and financial market conditions ................................................................................................................................. 94
6.1. Introduction ..................................................................................................................... 94
6.2. Model specification ....................................................................................................... 99
6.3. Empirical results .......................................................................................................... 106
  6.3.1. Tests and parameter estimates ........................................................................... 106
6.3.2. Recursive estimates ....................................................................................................... 112
6.3.3. Rolling estimates ........................................................................................................... 114
6.4. Conclusion ...................................................................................................................... 118

Chap. 7: Evaluating the forecasting performance of monetary policy rules in South Africa ....................................................................................................................... 120

7.1. Introduction .................................................................................................................... 120
7.2. Alternative models ......................................................................................................... 122
7.3. Forecasting methodology ............................................................................................ 125
7.4. In-sample evaluation .................................................................................................... 131
7.5. Out-of-sample evaluation ............................................................................................ 134
7.6. Conclusion .................................................................................................................... 142

Chap. 8: Conclusions and implications ................................................................................. 143

8.1. Introduction .................................................................................................................... 143
8.2. Findings ........................................................................................................................ 145
8.2.1. Findings on the first three objectives (chapter 5) .................................................... 145
8.2.2. Findings on opportunistic approach (chapter 6) ..................................................... 146
8.2.3. Findings on forecast evaluation (chapter 7) ............................................................ 148
8.3. Policy implications ....................................................................................................... 148

References .......................................................................................................................... 150
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>List of monthly raw data and source</td>
<td>46</td>
</tr>
<tr>
<td>2</td>
<td>Descriptive statistics of the main variables</td>
<td>58</td>
</tr>
<tr>
<td>3</td>
<td>Unit root test</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>GMM estimates of a non extended linear Taylor rule (2000-2010)</td>
<td>62</td>
</tr>
<tr>
<td>5</td>
<td>GMM estimates of the linear forward-looking Taylor rule extended with FCI</td>
<td>64</td>
</tr>
<tr>
<td>6</td>
<td>Model estimates, 2000:M01 - 2005:M12</td>
<td>78</td>
</tr>
<tr>
<td>8</td>
<td>In-sample estimates for the backward looking versions of Models 1&amp;2</td>
<td>132</td>
</tr>
<tr>
<td>9</td>
<td>Backward looking version of the Opportunistic Approach Model 3</td>
<td>133</td>
</tr>
<tr>
<td>10</td>
<td>Mean squared prediction error rank (recursive estimates)</td>
<td>136</td>
</tr>
<tr>
<td>11</td>
<td>Median squared prediction error rank (recursive estimates)</td>
<td>136</td>
</tr>
<tr>
<td>12</td>
<td>Forecast Accuracy Evaluation ((DM - t))</td>
<td>139</td>
</tr>
<tr>
<td>13</td>
<td>Forecast Accuracy Evaluation ((ENC - t))</td>
<td>140</td>
</tr>
<tr>
<td>14</td>
<td>Forecast Accuracy Evaluation ((CW - t))</td>
<td>141</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1: Interest rate and inflation ................................................................. 55

Figure 2: Output measures .......................................................................... 56

Figure 3: Financial conditions index .............................................................. 57

Figure 4: Recursive coefficients for the linear model .................................... 81

Figure 5: Implied inflation target for the linear recursive model .................. 82

Figure 6: Recursive coefficients for the nonlinear model ............................... 84

Figure 7: Implied inflation target for the nonlinear model ............................. 85

Figure 8: AIC for linear and nonlinear recursive models ............................... 86

Figure 9: Rolling coefficients for the linear model ........................................ 87

Figure 10: Implied inflation target for the linear rolling model..................... 88

Figure 11: Rolling coefficients for the nonlinear model .................................. 89

Figure 12: Implied inflation target for the nonlinear rolling model ............... 90

Figure 13: AIC for linear and nonlinear rolling models ................................. 91

Figure 14: Transition function and inflation .................................................. 111

Figure 15: Recursive estimates for the OAD model ....................................... 113

Figure 16: AIC for recursive Models 1, 2 and 3 ............................................ 114

Figure 17: Rolling estimates for the OAD model .......................................... 116

Figure 18: AIC for rolling Models 1, 2 and 3 ............................................... 117
**LIST OF ACRONYMS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIC</td>
<td>Akaike information criterion.</td>
</tr>
<tr>
<td>AR</td>
<td>Autoregressive.</td>
</tr>
<tr>
<td>CPI</td>
<td>Consumer price index.</td>
</tr>
<tr>
<td>CS</td>
<td>Credit spread.</td>
</tr>
<tr>
<td>CW-t</td>
<td>Clark and West Test.</td>
</tr>
<tr>
<td>DFGLS</td>
<td>Dickey-Fuller Test with Generalized least squares (GLS) Detrending</td>
</tr>
<tr>
<td>DM-t</td>
<td>Diebold and Mariano Test.</td>
</tr>
<tr>
<td>ECB</td>
<td>European central bank.</td>
</tr>
<tr>
<td>EHS</td>
<td>Eichenbaum, Hansen and Singleton.</td>
</tr>
<tr>
<td>ENC-t</td>
<td>Encompassing Test.</td>
</tr>
<tr>
<td>ERSA</td>
<td>Economic Research Southern Africa</td>
</tr>
<tr>
<td>F</td>
<td>Future interest spread.</td>
</tr>
<tr>
<td>FCI</td>
<td>Financial conditions index.</td>
</tr>
<tr>
<td>FCI(_{\text{EW}})</td>
<td>Financial conditions index measured as an equal weight average of its components.</td>
</tr>
<tr>
<td>FCI(_{\text{Kal}})</td>
<td>Financial conditions index for which the Kalman Filter algorithm is used to determine the time varying weights of its components.</td>
</tr>
<tr>
<td>FCI(_{\text{OLS}})</td>
<td>Financial conditions index for which the OLS estimation of the output gap is used to determine the weights of its components.</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product.</td>
</tr>
</tbody>
</table>
GMM : Generalised method of moments.
HP : Hodrick-Prescott.
KPSS : Kwiatkowski, Phillips, Schmidt, and Shin Test.
LSTAR : Logistic Smooth Transition Autoregression.
MedSPE : Median squared prediction error.
MOM : Method of moments.
MPC : Monetary policy committee.
MSC : Moment selection criteria.
MSPE : Mean squared prediction error.
OAD : Opportunistic approach to disinflation.
OAMP : Opportunistic approach to monetary policy.
OLS : Ordinary least squares
PC : Phillips curve
PP : Phillips-Perron
REER : Real effective exchange rate.
RH : Real house price.
RS : Real stock price.
S.E : Standard error.
SA : South Africa.
SARB : South African reserve bank.
SIC : Schwarz information criterion
STAR : Smooth Transition Autoregression
UK : United Kingdom.

2SLS : Two-stage least squares.