Preface

Rarely a day goes by when central banks are not saliently featured in the economic news. On one hand, this focus on central banks around the world is due to major events in which they play an influential role. On the other hand, new collaborations between central bank practitioners and academics have been contributing to this significant presence. Monetary economics offers today considerable improvements in the theoretical and empirical frameworks used for monetary policy analysis.

My interest in monetary economics dates back from my graduation at the Hochschule St.Gallen where two dominant works profoundly influenced my way of thinking. Time series econometrics and central bank strategies, both marvelously summed up by the writings of James Hamilton[i] and Alex Cukierman[ii], deeply guided my perspective on monetary economics. Moreover, they illustrate that monetary economics is mainly an empirical science.

Because of constant mutations affecting central banks, the analysis of monetary policy is a challenging issue in today's monetary economics. I focus particularly on the systematic behavior of central banks and on the way to quantify and qualify how central banks actually behave. The aim of this Ph.D. dissertation is at highlighting the strategy of the central bank of Switzerland, the Swiss National Bank. I apply two empirical approaches - estimation of policy rules and identification of monetary policy - enabling to depict how the Swiss National Bank has conducted monetary policy during these last twenty years. In addition, I produce a monthly gross domestic product for these two empirical studies.

When choosing a framework to investigate these issues, one has to take a firm stand. Monetary economics has undergone many changes in the past few decades and is still full of controversy. I purposely use a methodology based on time series econometrics and I am well aware that the presented framework is not the only one to analyze monetary policy in Switzerland.

This thesis is the result of spending five years at the Studienzentrum Gerzensee, Foundation of Swiss National Bank, and at the University of Lausanne. I gratefully acknowledge the support I re-

[i] Hamilton, J. D. (1994). *Time Series Analysis*, Princeton University.

[ii] Cukierman, A. (1992). *Central Bank Strategy, Credibility, and Independence*, MIT.

ceived from these three institutions.

This dissertation would not have been possible without the help and support I received from many sides. First of all, I give special gratitude to my Ph.D. advisor Philippe Bacchetta for guiding me through these five years. I liked very much the mix of substantial freedom and kind assistance, both in good and bad times. Philippe Bacchetta supported my involvement in macroeconomic issues and encouraged me to approach topics that, at the outset, seemed extremely complex. He also gave me a chance to participate in an excellent doctoral program in Gerzensee. These courses provided me with analytical tools for my project and enabled me to sharpen the rather vague ideas I started with in the beginning. My advisor offered me a job as a teaching assistant in Gerzensee and thus gave me the keys to an exciting academic life at the Studienzentrum.

I am grateful to Jean-Pierre Danthine, Harris Dellas, Ilian Mihov, and Michel Peytrignet for their kind and deep commitment within my Ph.D. committee. I appreciated their constructive and pertinent comments. With original propositions, they helped me improve many aspects of my research.

I thank Martin Hess, my co-author in the part concerning the interpolation models, for the ever stimulating atmosphere during the doctoral program and our fruitful collaboration in 'taming' Swiss business cycle indicators.

This dissertation owes an intellectual debt to many people. At various stages, I benefited from the helpful and very encouraging comments from Ramses Abul Naga, Marlene Amstad, Pierre-Alain Bruchez, Christoph Eisenring, Andreas Fischer, Alberto Holly, Jean Imbs, Ladislas Labah, Giovanni Leonardo, Rosario Martinez, Iwan Meier, Markus Meister, Jean-Marc Natal, Klaus Neusser, Jeffrey Nilsen, Bruno Parnisari, Kurt Schmidheiny, Olivier Tinguely, Mark Watson, and Martin Wyss. I thank Central Bankers Courses participants in Gerzensee and seminar participants at the University of Lausanne for enriching many details of my work. I give special gratitude to Walter Wasserfallen who helped me substantially with his accurate focus on empirical studies and who tragically left this world much too early after a long and serious illness.

At this place, I would like to thank all my colleagues working in Gerzensee either for the Foundation or for the SV-Service for their constant logistical support during the writing of my thesis. Finally, I am grateful to all my friends who helped me during this task,

sometimes even without knowing it.

Last but by no means least, I heartily thank my family, Pierre, Mary-Claude, Bastien, Liliane, and Denise for the generous and unconditional encouragement that I have always encountered in my studies from Neuchâtel to St.Gallen and in particular during the achievement of this thesis. They have never doubted over the years my ability to successfully finish this dissertation.

The parts of this thesis are conceived as papers. They can be read independently of each other. I hope that the reader will enjoy reading them.

Gerzensee, February 2000 Nicolas Alexis CUCHE

Contents

Notation

Matrix Algebra

A $[m \times n]$ matrix $\mathbf{A}$ is an array of numbers ordered into m rows and n columns. Single column or row vectors are described by $\mathbf{a}$ or $\mathbf{a}'$. A single element is represented by a. For time series econometrics, this convention implies the following interpretation: a single observation of a time series 'x' is represented by a $[1 \times 1]$ scalar x; all the observations of this same series are vertically stacked in a $[sample \times 1]$ vector $\mathbf{x}$; finally, all the observations of j series 'x' are represented by a $[sample \times j]$ matrix $\mathbf{X}$. $\mathbf{I}_n$ represents a $[n \times n]$ identity matrix and $\mathbf{i}_n$ a $[n \times 1]$ vector of 1.

Operators and Signs

χ^2_n	Chi-square distribution with n degrees of freedom
R^2	Coefficient of determination
$Cov[x, y]$	Covariance between random variables x and y
E	Expectation operator
Δ	First difference operator
iid	Independent and identically distributed
I(n)	Integrated of order n
IS	IS curve representing goods market equilibrium
$\mathcal{L}$	Lagrangean
LM	LM curve representing money market equilibrium
$M0$	Monetary base
$M1$	Money stock $M1$
$M3$	Money stock $M3$
$N(\mu, \sigma^2)$	Normal distribution with mean μ and variance σ^2
plim	Probability convergence
$V[x]$	Variance of random variable x

Variables and Data

Part II Variables

s	Exchange rate gap $q - q^*$
π	Inflation rate
Ω	Information set
i	Interest rate
x	Output gap $y - y^*$
w	Policy instrument
p	Price level
q	Real exchange rate
r	Real interest rate
y	Real output
u	Residual of IS equation
v	Residual of market equation
e	Residual of Phillips curve equation
$\hat{\cdot}$	Superscript for fitted value
$\tilde{\cdot}$	Superscript for long-term value
$\cdot^*$	Superscript for target value

Part II Data

cr	Call rate
$M0$	Growth rate of real monetary base
$M1$	Growth rate of real money stock $M1$
$giro$	Growth rate of real sight deposits
π	Inflation rate
x_e	Output gap used for experimental estimation
x_1	Output gap calculated with trend 1
x_2	Output gap calculated with trend 2
x_3	Output gap calculated with trend 3
x_4	Output gap calculated with trend 4
x_5	Output gap calculated with trend 5
s^{dm}	Real Deutschmark gap
s^{us}	Real US$ gap
s^{all}	Trade-weighted real exchange rate gap

Part III Variables

ε^x	Exchange rate shock
ε^s	Monetary shock
ε^d	Money demand shock
k	Number of lags in first SVAR(k)
m	Number of nonpolicy variables
n	Number of policy variables
$\mathbf{u}^{\underline{z}}$	Vector of extracted nonorthogonal policy residuals
$\mathbf{r}^{\overline{z}}$	Vector of nonorthogonal nonpolicy residuals
$\mathbf{r}^{\underline{z}}$	Vector of nonorthogonal policy residuals
$\mathbf{z}$	Vector of nonpolicy and policy variables
$\overline{\mathbf{z}}$	Vector of nonpolicy variables
$\underline{\mathbf{z}}$	Vector of policy variables
$\boldsymbol{\varepsilon}$	Vector of structural shocks

Part III Data

$\underline{z}^{cr}$	Call rate
$\overline{z}^{com}$	Commodity price index
$\overline{z}^{pl}$	Consumer price index
$\overline{z}^{fcr}$	Foreign call rate (Germany)
$\overline{z}^{gdp}$	Gross domestic product
$\underline{z}^{mon}$	Monetary aggregate ($\underline{z}^{mon_0}$ $M0$, $\underline{z}^{mon_1}$ $M1$)
$\underline{z}^{exr}$	Real exchange rate (Deutschmark)
$\overline{z}^{rs}$	Value of retail sales

Part IV Variables

p	Cointegrating series
y	Monthly GDP
x	Monthly related series
T	Number of months
l	Number of related series
y^+	Quarterly GDP
x^+	Quarterly related series
$\boldsymbol{\xi}$	State vector with three monthly GDP values
y^s	Stationarized monthly GDP
$\cdot_{GLS}$	Subscript for Chow and Lin variables
x^*	Sum of three subsequent monthly related series
$\hat{\cdot}$	Superscript for fitted value
$\mathbf{v}$	Vector of observation equation residuals
$\mathbf{u}$	Vector of state equation residuals

Part IV Data

x^{comip}	Composite index of industrial productions
x^X	Exports volume
x^M	Imports volume
x^{brdip}	Industrial production in Germany
x^{ukip}	Industrial production in UK
x^{nl}	Non-utilized construction loans
gdp	Quarterly GDP
x^{rs}	Value of retail sales