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DEVELOPMENT OF A FINANCIAL COMPUTABLE GENERAL EQUILIBRIUM MODEL FOR SOUTH AFRICA

By

BOKANG CONSTANCE VUMBUKANI-LEPOLESA

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SUPERVISOR: PROFESSOR HEINRICH BOHLMANN

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DECLARATION

I, Bokang Vumbukani-Lepolesa, declare that the thesis, which I hereby submit for the degree of Doctor of Philosophy in Economics at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

ETHICS STATEMENT

I have obtained, for the research described in this work, the applicable research ethics approval. I further declare that I have observed the ethical standards required in terms of the University of Pretoria's Code of Ethics for Researchers and the Policy guidelines for responsible research.

Signature 

Student name Bokang Constance Vumbukani-Lepolesa

Month Year October 2024

TABLE OF CONTENTS

THE DATABASE

MODEL SIMULATIONS

SIMULATION RESULTS

CONCLUSIONS & FUTURE RESEARCH

APPENDIX

LIST OF IMAGES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AMELIA-F	A Model of Economic Linkage-Financial
BOTE	Back-of-the-Envelope
CoPS	Centre of Policy Studies
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
GDP	Gross Domestic Product
GNP	Gross National Product
GTAP	Global Trade Analysis Project
IMF	International Monetary Fund
IRR	Internal Rate of Return
MPC	Marginal Propensity to Consume
MSG	Multi-Sectoral Growth
NBFI	Non-Bank Financial Institutions
NRH	Non-Reproducible Housing
PNG	Papua New Guinea
RH	Reproducible Housing
SAM	Social Accounting Matrix
SARB	South African Reserve Bank
SNA	System of National Accounts
Stats SA	Statistics South Africa
SUT	Supply and Use Table
UN	United Nations
UPGEM	University of Pretoria General Equilibrium Model
UPGEM-F	University of Pretoria General Equilibrium Finance Model
USAGE	United States Applied General Equilibrium
USAGEF	USAGE Finance

ABSTRACT

Keywords: *Financial model, UPGEM, Dynamic CGE*

This thesis introduces a financial module into a dynamic computable general equilibrium (CGE) model for South Africa. The new hybrid model, University of Pretoria General Equilibrium Finance Model (UPGEM-F), integrates real and financial aspects of the South African economy. This provides a relatively broader description of the economy-wide effects of the shocks compared to conventional CGE models. The real side of the model is anchored in the theoretical specification of the standard University of Pretoria General Equilibrium Model (UPGEM) that recognises many industries and commodities, alongside other economic actors. The financial side of the model considers the following agents, i) the South African Reserve Bank (SARB), ii) commercial banks, iii) the rest of the world, iv) general government, v) households, vi) industries (excluding housing), vii) non-bank financial institutions, viii) established housing, and ix) new housing developments. Additionally, the model recognises five financial instruments: i) notes and coins, ii) deposits and loans, iii) equity, iv) bonds, and v) gold and special drawing rights. The model uses economic data mainly from Statistics South Africa and the South African Reserve Bank.

Two simulations are run to showcase the application of UPGEM-F. The first simulation assesses the economy-wide impact of a decrease in monetary inflows to South Africa from the rest of the world, following a downgrade to South Africa's credit rating. In this application, the cost of investment increases with the increase in the country's investment risk. This leads to a decrease in investment and a plunge in economic activity and factor incomes. This is consistent with the results of a standard UPGEM model, but UPGEM-F provides nuanced linkages between financial and real sectors of the economy. The second simulation assesses the economy-wide impact of an increase in assets held by the SARB, among other things, through bond purchases. This simulation results in a decrease in the interest rate, which, in turn, stimulates investment and improves aggregate demand. This sparks an increase in employment as well as private and public consumption.

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1 INTRODUCTION

1.1 Background

Computable General Equilibrium (CGE) modelling is snowballing as a field that continues to transform the field of practical policy analysis. However, since the Global Financial Crisis (GFC), CGE modellers have identified the need to improve and expand the financial side of CGE models which have historically mainly concerned itself with the real side of the economy. Despite some efforts, in particular from modellers at the Centre of Policy Studies (CoPS) in Melbourne, financial CGE models remain limited is their use and application around the world. The research in this thesis seeks to implement a financial extension to a standard South African CGE model and illustrate its benefits through relevant policy simulations.

In this chapter, we provide background information on the state of the art in CGE modelling and its significance to South Africa. As background to the current research, an outline of the evolution of CGE modelling is provided to contextualise the emerging developments. Importantly, this chapter deals with these at a high level to give a broad understanding of CGE modelling. Detailed modelling insights and developments that form the base for this research are provided in the next chapters.

The chapter also elucidates the rationale and specific objectives of the current research, including explicit statements on the research contributions. The current study develops a financial CGE model for South Africa based on the existing real dynamic CGE model developed by the University of Pretoria (UPGEM) in collaboration with the CoPS. The financial CGE model presented through this research is anchored in CoPS-style modelling, implemented on GEMPACK solution software, and is a hybrid that synthesises real and financial aspects of the South African economy.

The content of this research is a direct value addition to the body of knowledge on CGE modelling in South Africa as it localises some of the emerging developments within the economy-wide modelling landscape. Specifically, the research presents the first financial CoPS-style dynamic CGE model for South Africa, an area that has not been

explored. Additionally, it offers a combination of real and financial data that can be used for further research in the future. Through simulations, this research provides insights on the application of financial CGE modelling within the context of South Africa that are of great value to policymakers and implementers.

We conclude the chapter with the structure of the thesis. This makes it easy for readers to explore the content of the thesis at an abstract level and navigate the areas of interest with much-needed ease.

1.2 The evolution of computable general equilibrium modelling

Modern-day CGE modelling dates back to 1960, with the first iteration being the Multi-Sector Growth Model of Norway, developed by Johansen (1960). This model built on Leontief's input-output (I-O) tables and modelling framework developed in the 1930s. In their tribute to Johansen, Dixon and Rimmer (2016) assert that following his seminal 1960 publication, there were multiple valuable contributions and enhancements - especially in the 1970s - which led to CGE becoming one of the foremost methodologies on which policy decisions are based.

CGE modelling is described by Dixon, Parmenter, Powell and Wilcoxen (1992) as an integration of a general equilibrium theoretical structure, data about the economy of interest, and solution methods to solve the models numerically. Shoven and Whalley (1992) define CGE modelling as a conversion of the Walrasian general equilibrium structure into realistic models of actual economies by specifying production and demand parameters and incorporating data reflective of real economies. Dixon (2006) refers to CGE modelling as a dominant framework for evidence-based policy decision-making.

CGE models are generally understood as economy-wide models that are fundamental in estimating the effects of change in one aspect of the economy on the rest. These models have evolved over the years and are increasingly becoming an essential base

for a broad spectrum of policy discussions across different regions. Mehanna and Haykal (2016) consider CGE models diverse and capable of capturing the potential long-term economic effects of various reforms. Similarly, Xiao, Niu, Guo and Xu (2015) acknowledge CGE models as theoretically solid and relatively more comprehensive than alternatives that most economists have tried and tested in policy discussions. Dixon and Rimmer (2015) consider CGE models essential in studying the effects of changes in tariffs, taxes, commodity prices, technologies, public expenditures, environmental policies, labour-market conditions, and regulations affecting capital inflows and outflows on macro, industry, regional, occupational and environmental variables. Burfisher (2011) believes that a CGE model systematically describes producer and consumer behaviour considering the interactions among parts of the economy, market conditions and prices at which quantities supplied and demanded are at equilibrium. On the other hand, Dervis, Merlo and Robinson (1982) identify CGE models as "useful to provide a bridge between the theorist, the planner, and the practical policy maker". In other words, they emphasize interaction among economic agents, sub-optimizing autonomous behaviour and market-clearing processes.

As CGE models continue to be paramount in evidence policy development worldwide, the evolution of contributions and enhancements on these models becomes crucial. So far, these enhancements have included improvements on the base databases, algorithm changes as well as the overall diversity in application of the developed CGE models across different countries. Norway and Australia are known for their early and strong adaptation to CGE application for policy development. From the two countries, there are two important projects, namely Johansen's Multi Sectoral Growth (MSG) model and the ORANI and MONASH models developed at CoPS (henceforth, CoPS-style models), which include a number of improvements to Johansen's model and continue to influence CGE applications across the globe. The CoPS-style model is preferred since it encompasses dynamic elements and the flexibility to conduct historical, decomposition, forecasts and policy simulations, where:

- Historical simulations produce up-to-date data and estimate trends in technologies, preferences and other naturally exogenous but unobservable variables;
- Decomposition simulations explain historical episodes and place policy effects in a historical context;
- Forecast simulations provide baselines using extrapolated trends from historical simulations together with specialist forecasts; and
- Policy simulations generate effects of policies as deviations from baselines.

Before MSG and CoPS-style models, there were other enhancements of Johansen's model, examples of which included Shoven and Whalley's (1972) algorithm that allowed empirical analysis of "distortions which, due to their size or multiplicity could only be inadequately dealt with by the techniques of differential calculus". This added value to the mathematical theory of general equilibrium.

1.3 The objective and rationale of the research

This research develops a new CoPS-style CGE model for South Africa to address lack of integration of financial aspects of the economy into conventional real CGE modelling. It aims to close some of the gaps arising from the emerging methodological needs within the CGE modelling landscape. CGE models are generally used for economy-wide policy analysis of economic shocks or policy instruments. Conventional CGE models lack the financial details of the economy; therefore, they omit critical aspects in policy evaluation. On the other hand, financial CGE models provide more nuanced information on the financial aspects, which is of particular interest when dealing with poly-crisis, limited fiscal space and its increasing depth.

South Africa has a rich history of application of CGE modelling across a broad spectrum of economic areas. The existing CGE models for South Africa range from conventional static models that only focus on single short or long-run periods, to dynamic models that consider the adjustments and changes in the real economy over time. As defined by Burfisher (2011), static CGE models are single-period models that generally assume

a fixed supply of factors of production (capital in the short run, or labour in the long run). The static models for South Africa include a variety of applications of the following models:

- ORANI is a multisectoral model of the Australian economy described in detail by Dixon, Parmenter, Sutton, and Vincent (1982).
- The International Food Policy Research Institute's (IFPRI) model described by Lofgren, Harris and Robinson (2002). IFPRI models are institutional models based at the institution IFPRI, coded in General Algebraic Modeling System GAMS.
- PEP 1-1 model developed by Decaluwe et.al (2009)

The application of dynamic CGE models in South Africa is based on the Australian CoPS-style CGE model, which is a dynamic version of ORANI, as well as other models based on enhancements of the IFPRI model. While these models are diverse, they are based on the same core principles of integrated supply and demand. The difference lies in the implementation strategies, assumptions or closure options, and the solution software used. IFPRI and PEP models are coded and run in GAMS whereas CoPS-style models are run in GEMPACK.

This research is focused on CoPS-style modelling; therefore, it does not provide nuances on IFPRI-based models. It instead acknowledges the shortfalls within the , CoPS-style conventional CGE modelling in South Africa and creates a base for improvements. Specifically, it augments the financial module into the traditional CoPS-style CGE modelling framework to eliminate the bias towards the real economy associated with the existing conventional CGE models.

1.4 The contributions of the research

Three significant contributions from this research are summarised below and further elaborated in chapters 2, 3 and 4.

First, this research adds new insights to the existing body of knowledge and literature on CGE modelling. Unlike most local studies that only consider the real economy, this research considers both real and financial aspects of the South African economy. Specifically, it augments the financial module to the existing UP General Equilibrium Model (UPGEM) for South Africa. The existing standard UPGEM for South Africa lacks the financial details of the economy, yet the emerging enhancements in CGE modelling warrant the inclusion of real economy and financial analytics. This research contextualises the latest developments in financial CGE modelling to South Africa.

The second contribution is the financial database. The data on which the new financial CGE model for South Africa is built extends the core database on which standard CoPS-style models such as UPGEM are based. It comprises a mix of financial and real economy data, which is helpful not only for this research but also for future applications and refinements of the model. The database is discussed in Chapter 3.

The third contribution is the application of the new model through simulations. The research demonstrates the application of the financial CGE model through two simulations, critical to the South African economy. The first simulation is a benchmarked one per cent reduction in monetary inflows to South Africa due to a downgrade in the country's sovereign credit ratings. This is with the view that the credit ratings downgrade deters investments and prompts a reduction in monetary inflows. The second simulation is a counteraction to the first simulation through monetary policy. It is a benchmarked one per cent expansion in financial assets owned by the South African Reserve Bank (SARB). The two simulations provide relevant evidence for policymakers as well as future research.

1.5 The structure of the thesis

Following the general background provided in Chapter 1, Chapter 2 solely focuses on the Financial CGE modelling theory. Considerable attention is paid to the CoPS-style of CGE modelling and implementation of the financial extension, specifically, as it relates

to UPGEM, which forms the base for UPGEM-F, the new financial CGE model for South Africa developed in this research. The theory of the finance module is presented as an augmentation to the conventional UPGEM.

Chapter 3 presents the data for the model. These data include macroeconomic data that describe the structure of production and use of goods and services within the South African economy in 2017. The chapter also includes financial data—specifically, assets and liabilities of selected agents in the economy, as well as the financial flows.

Chapter 4 outlines two simulations that show the application of UPGEM-F. The first simulation is centred on the economy-wide impact of South Africa's sovereign credit ratings downgrade. The downgrade is proxied by a reduction in monetary inflows to South Africa. The second simulation focuses on an increase in SARB's financial assets. For each simulation, closure settings are provided to explain the assumed economic environment.

Chapter 5 summarises the policy simulation results. This chapter explains the impact of the shocks on the main macro variables and other key variables of the model in line with the theory. Key results of a standard UPGEM model are used to inform a-priori expectations and further highlight the advantages of UPGEM-F. The back-of-the-envelope (BOTE) model is used to explain, in the simplest way, the intuition behind the changes in the modelled variables.

Chapter 6 presents the conclusions and possible areas for further research. The conclusions reiterate some key results to emphasize their importance, especially within the policy space. The areas for further research include ideals that could not be adequately addressed in this research and new areas that may still be explored to enhance the model and strengthen policy decisions.

2 THE UNDERLYING THEORY

2.1 Introduction

This chapter outlines the underlying theory of financial CGE modelling, explicitly focusing on the newly developed model for South Africa, UPGEM-F. As the name suggests, UPGEM-F is an enhancement of UPGEM. It is rooted in CoPS-style modelling, which has existed and been applied to aid policy decisions across different countries since the 1970s[1]. CoPS-style models' evolution and subsequent enhancements continue to increase optimism about CGE models becoming all-encompassing policy instruments. Emerging models like UPGEM-F are beginning to address gaps, such as the exclusion of the financial economy from conventional CGE models; hence, more credible and inclusive policy insights are feasible from modern CGE modelling in the future.

We have structured the chapter to start with a summarised background and origin of modern CoPS-style modelling to give context. Subsequently, a detailed description of the University of Pretoria General Equilibrium Model is provided as it is the base for UPGEM-F. The chapter concludes with theoretical specifications for UPGEM-F as an augmentation to the conventional UPGEM. This augmentation is further reflected in the BOTE model for UPGEM-F, which is included in the theoretical specifications.

2.1.1 Background

Modern CoPS-style CGE models like UPGEM build on the work pioneered by Johansen (1960), which continues to be widely used for quantitative description of economies. As articulated by Dixon and Rimmer (2010a; and 2016), Johansen augmented the original economy-wide Leontief's input-output system to include behavioural aspects of economic agents. This augmentation displayed the need for outcomes of the

[1] A plethora of research mostly anchored on the work of Centre of Policy Studies (CoPS) at Victoria University

economy to be determined by actions of individual agents, coordinated through price adjustments that equalise demand and supply in product and factor markets. In Dixon and Jorgenson's (2013: page 42) handbook of CGE modelling, Dixon, Koopman and Rimmer (2013) outline Johansen's model as one that was based on the 1950 Norway input-output data and 20 industries producing 22 commodities, with 46 exogenous[2] and 86 endogenous[3] variables linked through a simple linear equation. The specific behavioural aspects from Johansen's model were that industries focus on acquiring inputs at a minimum cost, subject to production constraints and the demand for their products, while households decide on their consumption to maximise utility, subject to budget constraints; and investors allocate capital to industries to maximise their returns.

Expanding on Johansen's model, CoPS-style models continue to evolve to explain historical trends, forecasts, and the effects of policies as deviations from baselines. Dixon et al. (2013) posit that CoPS-style models follow from the work of Johansen (1960) but are specifically anchored on three enhancements, namely, elimination of linearisation errors associated with Johansen's model, the introduction of imperfect substitution between imported and domestic goods (the Armington assumption) as well as the inclusion of margins. Expanding on these anchors, Dixon et al. (2013) indicate that while Johansen's linear model made interpretation simpler, it compromised accuracy in that the effects of the underlying non-linearity could only be approximated and not fully measured. Further, the model did not factor in trade realities in that trade was set to be fixed (exogenous); hence, it compromised the quality and precision of trade-specific models.

[2] The exogenous variables comprised aggregate employment, capital, technical change variables for industries and demand for commodities

[3] The endogenous variables comprised 40 labour input and capital input variables, 44 output and prices and 2 variables for capital and aggregate consumption.

Dixon et al. (2013) define CoPS-style models as systems of equations that link variables for specific periods. In other words, all variables used in a particular CoPS-style model correspond to the same period. Despite this, multiple periods can be linked through a sequence of annual solutions to make CoPS-style models dynamic and forward-looking. Further, like Johansen's model, CoPS-style models are in percentage changes, making their interpretation easy since the results reflect deviations from the base.

Dixon et al. (2013) represent a CoPS-style system of equations by

$$F(X, Y) = 0 \qquad \text{E- 2.1}$$

Where ;

F is a vector of m functions; Y is a vector of m endogenous variables corresponding to the number of equations, and X is a vector of n-m variables determined outside the model (exogenous). Importantly, (X,Y) contains stock variables such as capital, flow variables representing supply and demand, and lagged variables relevant to the period of interest.

An essential aspect of CoPS-style modelling is the decision on closure settings. Closures are generally known within the CGE modelling space as decisions or choices of endogenous and exogenous variables for simulations. These decisions and choices often depend on the assumed economic environment within which the model is run. Closures can vary significantly, depending on the modelling exercise's interests and purpose. They differ across the models and may be adjusted depending on the simulations and the intention.

Among the existing books and scholarly work on CoPS-style CGE modelling, Dixon and Rimmer (2002) provide the most simple and practical guide on closure selection. We use this guide as an anchor for UPGEM-F. Dixon and Rimmer (2002) indicate that for every CoPS-style CGE model, a solution exists that hinges on the input-output data for a specific economy. This being the case, simulations are designed and planned to outline variable deviations from the initial solutions. Specifically, in each simulation

exercise, the focus is on the deviation in endogenous variables from the initial solution due to movements in exogenous variables away from their initial values.

To date, CoPS-style model applications are based on four types of closures or modes of analysis: historical, decomposition, forecast and policy closures. The historical mode of analysis provides estimates of movements in technology and consumer preferences (Dixon & Rimmer, 2000). Further, it generates disaggregated information that may be used either to explain periods in history or to update the input-output data. In the historical closure, all variables for which the past is known are set exogenous. According to Dixon et al. (2013), the historical closure allows for detailed levels of macro variables such as employment, consumption, investment and expenditure to be included as shocks in the model. Dixon and Rimmer (2002) indicate that historical closures distinguish between observable and assignable variables, where observable variables are those of which movements are observed from statistical sources for a specific period, and assignable variables are those of which movements can be assigned values without contradicting anything that may have either been observed about the historical period or assumed about the period of interest.

Decomposition focuses on the role of movement in technology, preferences, and other naturally exogenous variables (as outlined by the historical analysis) in explaining the changes in the growth of naturally endogenous variables. Dixon and Rimmer (2002) define decomposition closure as one where all variables (observable and non-observable) that the model may not explain are set to be exogenous. These include variables such as preferences and tariffs, often naturally exogenous.

The forecast closure uses trends from historical simulations to generate the base for the evolution of the future economy (Dixon et al., 2013). Like the historical closure, the forecast closure exogenizes variables for which data exists; however, the focus is on forecasts, not historical information. In other words, the forecast closure sets all variables for which forecasts are available from expert forecasting groups such as

central banks and the World Bank exogenous. These may include endogenous variables such as volumes, prices and other macro variables.

The fourth closure, the policy closure, quantifies the effects of policy changes and exogenous shocks on the economy. Here, all naturally endogenous and exogenous variables are retained in their form, except the policy variables of interest which must be changed to allow for comparison of the simulated change in policy to the baseline.

All four closures can be used sequentially in the same CGE modelling exercise; however, this is not mandatory. The historical closure can be used as the base, but it is not a prerequisite for policy simulations.

2.2 The model theory

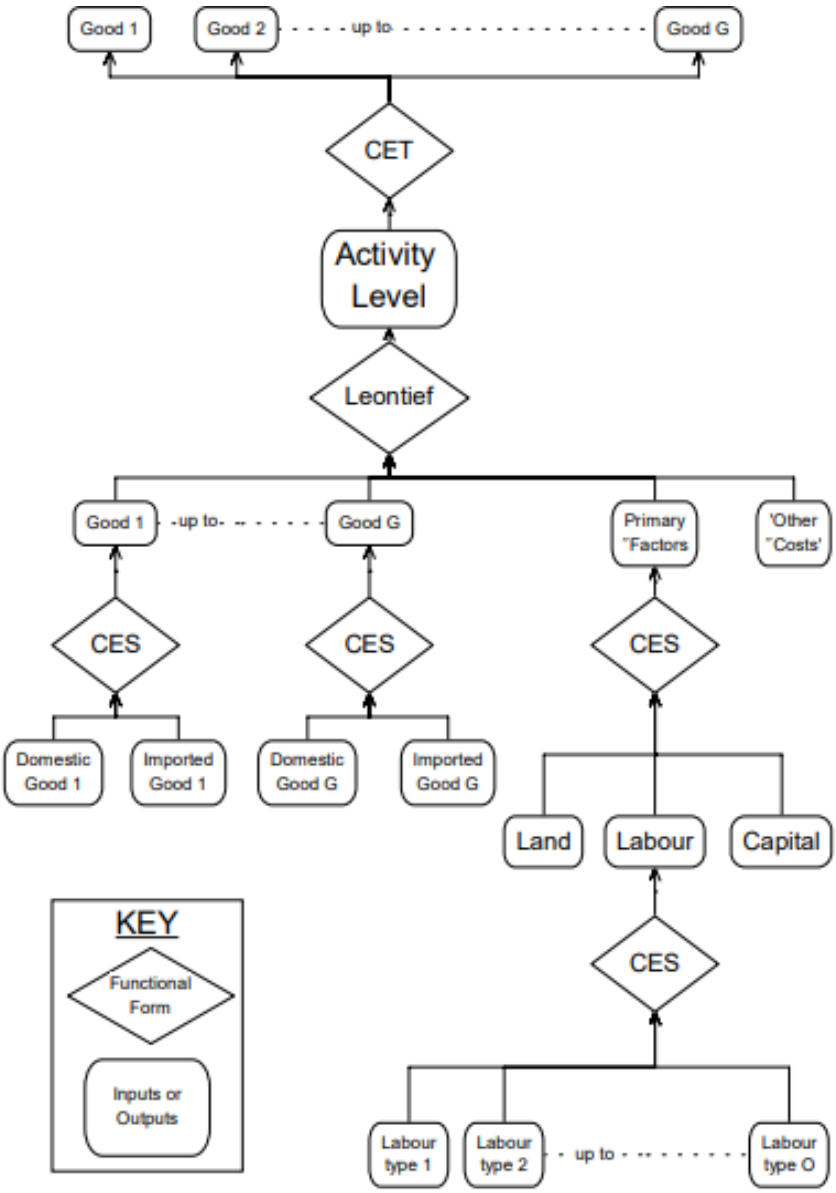
Following the work of Johansen and subsequent ORANI and CoPS-style CGE modelling enhancements, the University of Pretoria, in collaboration with the Centre of Policy Studies (CoPS), developed a "recursive-dynamic computable general equilibrium (CGE) model of the South African economy" (Bohlmann & Breitenbach, 2016), referred to as University of Pretoria General Equilibrium Model (UPGEM). UPGEM is a typical CoPS-style model that is localised to South Africa. In the current context, it is the base for the new financial CoPS-style CGE for South Africa. Despite being dynamic, UPGEM can also be run as a static model focusing on a single period like traditional CGE models. It has a distinct capacity for policy analysis and forecasting, based on standard CoPS-style dynamic CGE modelling as documented in Dixon and Jorgenson (2013: page 1313), where a set of equations is used jointly to describe changes in technology, consumer preferences and other unobservable variables.

As described by Bohlmann et al (2015), UPGEM quantitatively links the South African industry production that depends on labour, capital and technology (neo-classical production) to price-responsive demand. The model endogenously determines prices and quantities in the supply and use matrix to maintain equilibrium in the South African real economy. Like in other CGE models, the core of UPGEM is in the system of

equations that describe the behaviour of agents in the economy. The system specifies equations that explain demand for inputs for production of commodities (intermediate goods), generation of capital (investment), and demand for final goods and services by local households, government, and the rest of the world. Key to these equations and the theoretical specification of UPGEM is the optimisation process, where industries devote efforts to cost minimisation, subject to prices of inputs and constant returns to scale production. Households maximise utility, taking into consideration the need for subsistence income using a Klein Rubin utility function (Klein & Rubin, 1947; Dixon et al., 1982), subject to a budget constraint.

Each industry produces at least one commodity using a combination of intermediate composite goods and services and primary factors in fixed proportions (Leontief function), where primary factors comprise capital, land and different types of labour. The make-up of industry output is determined through constant elasticity of transformation (CET). On the other hand, each composite commodity is a constant elasticity of substitution (CES) function of imports and domestic goods. Quantities of goods and services used within each composite commodity vary across the industries. This is illustrated on the production nest below, as per Horridge (2000).

Image 2-1: Production nest



Source: Horridge 2000

UPGEM uses the supply and use data provided by the national statistics office, Statistics South Africa (Stats SA), to mirror the base year economy prior to shocks being imposed. This paper's version of UPGEM was initially based on Stats SA's 2015 Supply Use Table (SUT) data, updated to 2017, with 53 industries producing 53 commodities and one household sector representative buying commodities for private consumption.

2.2.1 UPGEM imperatives

The following are critical imperatives for the general application of UPGEM:

- The labour market moves towards equilibrium in the long run, owing to adjustments in the real wage rate over time. The model assumes sticky wages in the short run, which tend to be fairly flexible in the medium to long term, allowing unemployment to naturalise (return to its natural rate) in the long run.
- Capital stock values at the end of a year are linked to stock values at the start of the year plus investment net of the depreciation. For each industry, investment is positively linked to the expected rate of return on capital.
- Capital stock is fixed in the short run; therefore, the rate of return on capital adjusts to balance the capital market
- Government debt at the end of the year is linked to the debt at the start of the year and the corresponding interest rate.
- Exports are inversely related to the foreign currency price.
- Government consumption is set to be either exogenous in the baseline or linked to household consumption in policy simulations.

Like other CoPS-style models, UPGEM is built, solved and analysed in TABLO language using GEMPACK software. Specifications of GEMPACK are documented in detail by Horridge et al. (2018), Horridge et al. (1993), and Dixon and Jorgenson (2013: page 1333).

2.2.2 UPGEM application

UPGEM has been widely applied in various areas, including environmental taxes, changes in energy mix, industrial action, tax policy and drought. We provide examples of these applications below to show how useful UPGEM continues to be.

Following the release of the 2013 Carbon Tax Policy Paper in South Africa, which proposed a levy on coal, gas and petroleum fuels, Van Heerden et al. (2016) employed UPGEM to model the possible impacts of the proposed tax. The study showed that while the proposed tax could decrease South Africa's greenhouse gas (GHG) emissions, it would have a negative impact on the country's Gross Domestic Product (GDP).

Bohlmann et al. (2015) used UPGEM to assess the economy-wide impact of the 2014 labour strike in South Africa's platinum industry. Among other interesting findings, the study revealed that while higher nominal wages were expected to drive adverse effects of the strike, the most damage was from the likely reaction from investors in the mining sector. This had a lasting negative impact on the mining sector and the economy of South Africa as a whole.

Bohlmann et al. (2016) conducted an economy-wide evaluation of new power generation in South Africa. The study highlighted the losses within the South African economy for the period leading to the construction of two power stations. Relatedly, Bohlmann et al. (2019) employed UPGEM to estimate the economic effects of changing the electricity generation mix towards less coal. The study discovered that changing the mix was more responsive to export markets. Less global demand for coal would have significant adverse effects on coal-producing provinces.

Additionally, Kilimani et al. (2018) applied the UPGEM theory and data structure to investigate the magnitude of the impact of drought on Uganda's economy to inform the implementation of drought mitigation programmes. The study showed that real GDP, industry output, employment, trade balance and household consumption are negatively affected by drought. Therefore, lack of drought mitigation mechanisms could have a lasting negative impact on the economy.

2.2.3 Building UPGEM-F from UPGEM

Building onto the existing theory of CoPS-style CGE models, details of a CoPS-style financial CGE model for South Africa (UPGEM-F) are presented in this section. UPGEM-F is an extension of the core CoPS-style CGE model for South Africa (UPGEM) outlined in the previous section. It is a hybrid CoPS-style CGE model that integrates real and financial economic aspects - a new development within the CGE modelling environment that has not yet been localised to South Africa.

Hybrid CGE models are increasingly becoming the new norm for CGE modelling. Application of core CGE modelling has historically been solely about simulations of real economies, with no exclusive consideration of the financial aspects of the economy. The emerging trends are bringing simulations of a combination of real and financial economies to the fore; hence this research is in line with the evolving developments. Examples of the emerging applications include the work undertaken by Dixon, Rimmer and Roos (2014) on the assessment of the impact of tighter monetary policy in Papua New Guinea (PNG) - which featured the addition of a set of financial equations to an existing dynamic model for PNG; a mix of USA's General equilibrium model (USAGE) and the financial module which Dixon and Rimmer (2015) named USAGE2F; calibration of a financial general equilibrium model on the Iranian economy (Iman & Narges, 2015); Dixon et al (2020)'s hybrid model of the Global Trade Analysis Project (GTAP) and a financial module; as well as Koike and Segawa (2017)'s regional financial computable general equilibrium (RFCGE) that followed from Lance Taylor's CGE model.

Other existing research studies include those of Giesecke, Dixon and Rimmer (2017), Nassios et al. (2020) as well as Rasyid et al. (2021). Giesecke et al. (2017) undertook an economy-wide impact assessment of the increased capital adequacy ratio on the Australian economy, which resulted in notably minor changes in the macro variables. Similarly, Rasyid et al. (2021) used the CGE model for Indonesia with the financial module - A Model of Economic Linkage-Financial (AMELIA-F), to assess the impact of strengthened bank capital requirements on the economy of Indonesia. The results

revealed minor negative consequences for the economy. Dixon et al. (2021) augmented a financial module to the Global Trade Analysis Project (GTAP) model to simulate financial decoupling between US and China amidst the tension between the two countries. The results showed that each country would lose the investment from the other but benefit from redirecting financial flows to the domestic economy.

Nassios et al. (2020) applied financial CGE models for the United States (US) and Australia to assess the impact of a 100 basis point rise in bank capital adequacy ratios in the two countries. The macroeconomic results were conflicting – the average cost of capital in the US decreased, thus encouraging more investment whilst that of Australia increased, leading to a decline in real investment. The conflict was primarily caused by the difference in the financial structure of the two economies. The US banks hold relatively more risk-free assets therefore a rise in capital adequacy ratio prompts banks to increase equity finance and reduce their use of deposit and loan finance. Banks increase the rate of return on equity to induce households to redirect their funds from deposits to equity. On the other hand, the Australian banks are more of financial intermediaries therefore an increase in capital adequacy ratio prompts banks to induce more deposits and loans than investment. These types of applications are not only picking up momentum but are also setting the path forward for CGE modelling; hence there is no better time than now to bring the same to the South African context.

In South Africa, this area is still untapped, with the closest related work being that of Makrelov et al. (2018) and Beyers et al. (2020). Makrelov et al. combined CGE and stock and flow models to develop a financial real stock and flow consistent model of the South African economy. On the other hand, Beyers et al. applied a GAMS-based CGE model to conduct comparative analyses of the South African banking sector. These analyses included a risk assessment and estimation of the effect of bank regulation (capital requirement infringement and penalties) on the economy. The results showed that a rise in the default penalty on banks has higher effects on profits and interest rates than the capital requirement infringement penalty.

Beyers, Essel-Mensah and Tsomocos (2024) improved on the work of Beyers et al. (2020), focusing on expansionary monetary policy (during the COVID-19 period) and its effects on the economy. The results show that higher liquidity from expansionary monetary policy leads to an increase in inflation and a marginal increase in GDP, owing to the pandemic. The models used by Beyers et al. (2020) and Beyers et al. (2024) consider banks to be the producers in the economy; consumers to be private sector agents (households/individuals and firms), and markets to comprise deposit, loan and interbank markets. Banks want to maximise their profits, while private sector agents aim to maximise their utility.

These models are intrinsically different from UPGEM-F but they also provide valuable insights into the integration of the financial and real sides of the economy. UPGEM-F is the first of its kind in the country, following from Dixon and Rimmer (2015). It is a local, CoPS-style financial CGE that considers real economic aspects and the financial flows within the South African economy.

The theoretical specifications of financial CGE modelling are centred on the accumulation of financial assets by agents in the economy and decisions on financial asset portfolios in a specific year, taking into consideration the available funds and the expected rates of return. The selection of agents and financial instruments is crucial and may differ across economies, depending on the purpose of the model and the structure of the financial economy of interest. For instance, the PNG financial CGE (Dixon et al., 2014) is based on seven agents; namely, i) households, ii) the rest of the world, iii) government, iv) non-bank financial institutions, v) commercial banks, vi) superannuation funds and vii) industries and eight instruments split between loans, bonds, deposits and business assets. Similarly, the USAGE2F model (Dixon & Rimmer, 2015) is based on eleven agents comprising all agents in the PNG model except Superannuation funds, plus additional four agents (retirement funds, life insurance and two housing agents).

The genesis of UPGEM-F is in the PNG financial CGE model. Its theoretical structure follows that of the PNG model, but the nuanced specifications differ. For example, UPGEM-F identifies nine financial agents, namely i) Commercial Banks (Banks), ii) SARB, iii) the rest of the world (Fgn), iv) Government (Govt), v) Households (Hhlds), vi) Industries (Inds), vii) Non-Bank Financial Institutions (NBFI), viii) Non-Reproducible Housing (NRH) and ix) Reproducible Housing (RH). Like USAGE2F, UPGEM-F includes NRH and RH to distinguish between established housing in built-up suburbs (Non-Reproducible Housing) and new housing developments (Reproducible Housing). The model theory for Non-Reproducible Housing dictates that, given a fixed supply, changes in demand side conditions will be the primary determinant of price changes. On the contrary, for Reproducible Housing, price changes are primarily dictated by the position of its (near) flat supply curve, which in turn depends on the marginal cost of constructing new units.

Each financial agent plays a role in both the asset and liability sides of the financial economy; hence, for ease of differentiation, agents are referred to as either assets or liability agents, depending on which side is being considered at a particular point in time. UPGEM-F adopts the following naming convention for sets of agents and instruments.

Table 2-1: Sets of Financial Agents and Instruments

AA	Asset Agents: a set of asset agents made up of Commercial Banks, the South African Reserve Bank, the rest of the world, Government, Households, Industries, Non-Bank Financial Institutions, Reproducible Housing and Non-Reproducible Housing.
LA	Liability Agents: a set of liability agents made up of Commercial Banks, South African Reserve Bank, the rest of the world, Government, Households, Industries, Non-Bank Financial Institutions, Reproducible Housing and Non-Reproducible Housing.
FI	Financial Instruments: a set of financial instruments made up of Notes & Coins, Deposits & Loans, Bonds, Equity, and Gold & Special Drawing Rights.

UPGEM-F has three major groups of equations. The first group describes the flow of new acquisitions of financial instruments FLOW(s,f,d). The second group describes the power of rates of return RA(s,f,d) and the third describes the portfolios of financial instruments held at the end of the year (A1(s,f,d)).

The following notation is vital.

FLOW(s,f,d) = the flow of new acquisitions of instrument f by asset agent d, issued by liability agent s. From this, total acquisitions become NEWACQ(d), defined as the overall new acquisitions by agent d.

RA(s,f,d) = the power of the rate of return (defined by 1 + interest rate) on financial instrument f, held by asset agent d and issued by liability agent s.

A(s,f,d,) = holding of instrument f by asset agent d, issued by liability agent s.

2.2.3.1 Unpacking the behavioural aspects of financial agents (Optimisation)

UPGEM-F leans heavily on the work developed by Dixon et al. (2014) and Dixon and Rimmer (2015), contextualised to South Africa. The theoretical specification is premised on the assumption that agents are constrained optimisers. At the start of the year, each financial agent decides on a portfolio of assets to hold by the end of the year to maximise returns, based on the stock from the previous year A0(s,f,d), the revaluation factor V(s,f,d), as well as funds available for new acquisitions. To be more precise, asset agents maximise benefits subject to the availability of funds and the expected rates of return across assets, while liability agents minimise financing costs subject to expected rates of return across financial (liability) instruments and available funds.

For a given year t, agent d decides on a portfolio of assets to hold at the end of year t to maximize utility from a return-weighted portfolio of financial instruments, denoted by

$$\mathbf{U_d[RA(s,f,d) * A1(s,f,d)} \quad \textbf{for all s,f]} \qquad \text{E- 2.2}$$

Subject to

$$\text{BA(d)} = \sum_{s,f} A1(s,f,d) \qquad \text{E- 2.3}$$

Where;

- U_d is a utility function with a CES form;
- RA(s,f,d) is 1+ the rate of interest (the power of rate of return) on instrument f held by agent d, issued by liability agent s;
- A1(s,f,d) is the value of end-of-year holding of instrument f by agent d, issued by liability agent s;
- BA(d) represents funds available for agent d to acquire new assets.

The utility function $U_{d,}$ is set in a CES form to avoid unrealistic biasedness towards specific instruments that may seem to be more rewarding compared to others; corner solutions as declared by Dixon et al (2014). With the current structure, RA(s,f,d) can increase without causing unrealistically large reconfigurations of d's asset portfolio. This is corroborated by Giesecke et al (2017), who set the following considerations to avoid biasedness.

1. A rise in the interest on bank loans must not completely disadvantage banks as asset holders. Borrowers must not entirely offset a rise in the cost of borrowing from the bank by shifting to other sources of financial capital. Liability agents must view financial capital raised by loans from banks and that raised from other sources as imperfect substitutes.
2. Household deposits and financial assets such as NBFI equity must be perceived as perfect substitutes. A change in the cost of one must not prompt liability issuers to shift to the other sources of financial capital completely. Commercial banks must view deposit finance and other forms of finance as imperfect substitutes. This will mitigate possible costless switches by banks, between alternative funding sources.
3. There must be a nominal rigidity that prevents monetary shocks from having no impact on the real economy to ensure that changes in monetary policy are not immediately neutralised by costless price adjustment.

As is the case with UPGEM, where capital accumulation at a specific point in time is dependent on the preceding values and new investments, the value of year-end portfolio of financial instruments (A1(s,f,d)) is dependent on the preceding stock of financial instruments (the balance of assets from the previous year) and new acquisitions. This is expressed as follows:

$$A1(s,f,d) = A0(s,f,d) * V(s,f,d) + FLOW(s,f,d) \qquad \text{E- 2.4}$$

Where;

- A0(s,f,d) represents stock of instrument f from the previous year; ie year-start value of financial instrument f, held as an asset by agent d and issued as a liability by agent s;
- V(s,f,d) is the valuation factor or the change in the market value (1+ the rate of appreciation) of instrument f held as an asset by agent d and issued as a liability by agent s;
- and FLOW(s,f,d) defines the flow of instrument f issued as a liability by agent s and held as an asset by agent d.

From equations E-2.2 and E-2.3, Dixon and Rimmer (2015) shape the USAGE2F asset demand equations for agent d as per E-2.5 below, therefore UPGEM-F draws from this.

$$\mathrm{A1(s,f,d)} = \mathrm{BA(d)} * H_{s,f,d}(\mathrm{RA(ss,ff,dd)}) \quad for\ all\ ss\ and\ ff \qquad \text{E- 2.5}$$

Where;

- $H_{s,f,d}$ is a function with positive derivatives with respect to RA(s,f,d) and negative derivatives with respect to all (or at least most) RA(ss,ff,d) where (ss,ff) ≠ (s,f); and
- The sum of $H_{s,f,d}$ over s and f equals one for all d; $\sum_{s,d} H_{s,f,d} = 1$.

From E-2.5, new acquisitions may be linked to available funds and the rate of return as shown by E-2.6.

$$\mathrm{NEWACQ(d)} = N_d(\mathrm{BA(d)}, \mathrm{RA}(s,f,d), for\ all\ s\ and\ f) \qquad \text{E- 2.6}$$

For E-2.6 to be satisfied, funding sources and rates of returns need to be determined for all agents and instruments. Dixon and Rimmer (2015) make this determination

from net acquisitions by individual agents; computed as the differences between new liabilities and assets as per the national financial records. The next sub-section details the sources of funds, liabilities, and assets for each of the agents being considered in this research.

2.2.3.2 Determining sources of funds for financial agents

Agent-specific details are imperative in financial CGE modelling theory; hence, this sub-section outlines sources of funds, liabilities, and assets for each financial agent. This outline is of vital importance to understanding the dynamics of UPGEM-F and the national financial flows that are outlined in the data chapter.

i) Households

Unlike in the real model where households acquire funds through remuneration (wages) and government transfers only, the theory of financial CGE considers that households may further acquire loans from commercial banks and NBFI to add to their financial portfolio. Households may also borrow from the rest of the world; however, this borrowing must be facilitated by commercial banks; hence, it is embedded in loans from commercial banks. In addition, households may also earn property income. However, this is included as part of the macroeconomic output and therefore, not considered an independent source of income by the model.

Loans are the main liabilities for households, the size of which depends on the interest rate and affordability of households. The higher the interest is, the more expensive loans become, and the less enthusiastic households tend to be to borrow. UPGEM-F considers property acquisition (housing equity), an integral part of household wealth accumulation. We focus our attention on housing equity as part of the reason for households to acquire loans. As stated by Grinstein-Weiss et al. (2012), homeownership is not only a common pathway toward building financial stability but is also a buffer during economic downturns.

As outlined in UPGEM, households spend their income primarily on consumption, but within the UPGEM-F context, they also have an obligation to repay loans and pay the

associated interest. The difference between household consumption (including financial obligations) and the available funds or income (savings) makes provision for acquisition of financial instruments. These assets mostly comprise equity, but also include cash and deposits.

ii) Government

The main sources of finance for the government are remittances from abroad and revenue acquired from taxes. Noteworthy is that funds from taxes and remittances are often insufficient to finance government spending; therefore, the government tends to have a persistent budget deficit. According to the National Treasury (2018), the South African government budget deficit constituted 4.3% of the GDP in the financial year 2017/2018. This was about 2 percentage points more than what had been predicted at the start of the year 2017. The persistent deficit often prompts the government to borrow from either the central bank (SARB within the South African context) or domestic and international capital markets to meet its financial obligations. Borrowing from capital markets entails the issuance of bonds, which the government pays back with interest. By and large, these are issued when there is a need for capital injection for large-scale projects that cannot be financed through fiscal allocation.

UPGEM-F considers bonds and loans from SARB, other financial institutions, and the rest of the world as the government's only liabilities. We characterise these under public sector borrowing and link it to the acquisition of liabilities by the government. On the asset side, the government owns financial assets such as deposits in financial institutions and physical assets. In the South African context, government ownership of physical assets includes partial ownership of enterprises such as Eskom, Transnet and other entities. UPGEM-F links asset acquisition by government to public expenditure, implying that government asset acquisition moves with public consumption.

iii) Commercial banks

The source of funds for commercial banks are deposits from other agents as well as loans from SARB and the rest of the world. These are the primary liabilities of

commercial banks. Commercial banks receive deposits from the public, industries, government, and the rest of the world for safekeeping. Through this process, commercial banks pay interest on deposits received but at the same time earn interest from re-investing the same deposits elsewhere. It is important to note that when interest rates increase, there is always a chance that depositors may withdraw their money from commercial banks and invest in financial assets that yield higher returns, thus exposing commercial banks to a risk of reduced liquidity. To mitigate this risk, commercial banks need to pursue new or potential depositors constantly. Of further note is that commercial banks also accept deposits and loans from other banks (interbank and intergroup). In this case, commercial banks become both liability and assets agents. In South Africa, banks also issue bonds on behalf of the government; therefore, in this context, bonds become a liability for banks.

On the other hand, asset acquisition by commercial banks depends on the existing demand for finance by other agents. Commercial banks issue loans to borrowers or liability agents in return for interest and administration fees for the rendered services. As Sinkey (2002) states, commercial banks meet loan demand by purchasing funds in the financial market. As indicated by Battulga, Altangerel and Battur (2021), sometimes loan demand becomes too low, thus prompting banks to lower their credit requirements to encourage loan applications. In other cases, loans are required in foreign currency; hence, commercial banks use foreign currency deposits to meet the demand.

Increases in interest rates paid on loans are often mistakenly assumed to automatically lead to increased earnings by commercial banks. The expectation only holds true for loans offered under variable interest rates. If the initial loans were contracted on fixed interest rates, an increase in interest rates means that the value of loans is lesser; hence, commercial banks are adversely affected. The increased benefit may only be realised in newly issued loans. On the contrary, a decrease in interest rates implies that the value of loans issued under fixed interest rates is higher; hence, the benefit

accrues. Notwithstanding this, newly issued loans don't offer the same benefits as they are issued at relatively lesser interest rates.

Within the context of UPGEM-F, commercial banks may issue loans to all other financial agents except SARB. As part of the assets, commercial banks have an obligation to set aside cash reserves, as per SARB's requirement or threshold. In South Africa, each commercial bank must keep 2.5% of its liabilities as cash reserves, held by SARB (SARB, 2000). Further, commercial banks can have excess reserves at their discretion, over and above the set threshold.

iv) The South African Reserve Bank

Unlike the rest of the financial agents whose participation in the economy is driven by benefits that accrue explicitly to them, SARB's motive is biased towards the benefit of the economy in its entirety. As stated by the South African Reserve Bank Act of 1989, SARB pursues financial stability through monetary policy; therefore, the funding dynamics of SARB need to be understood from this context. South Africa's monetary policy framework has diversely evolved over the years; hence, the following background becomes necessary to unpack.

According to Mohr, Fourie and associates (2008), between 1960 and 1981, a liquid asset-based framework was used to control credit issuance by commercial banks. This framework required commercial banks to hold a share of their liabilities (deposits) in liquid assets which would be adjusted as necessary to acquire financial stability. From 1981 to 1985, the liquid asset-based framework was slowly replaced by the cost-of-cash reserves-based framework, which required commercial banks to hold a portion of their liabilities in cash reserves at SARB. The cash reserves framework was retained for 12 years (1986-1998), but slightly modified to pre-determine monetary growth targets. However, the targets were constantly missed, thus rendering the framework redundant; therefore, a different approach had to be considered. Between 1998 and 1999, the monetary targets were phased out and replaced with a mix of informal inflation targeting of 1% to 5% and daily tenders for SARB funds through repurchase

transactions. In 2000, formal inflation targeting of 3% to 6% came into effect, with the repo rate remaining the main instrument for the monetary policy framework.

This is the rate that SARB uses to regulate the amount of money in circulation within the economy. The higher it is, the more expensive it is for commercial banks to acquire loans from SARB and the more costly borrowing from commercial banks becomes. An increase in the repo rate leads to an increase in market interest rates and a reduction in money circulation and vice versa. The latter usually occurs because industries and households alter their investment and consumption patterns in response to changes in interest. When the repo rate and market interest rates increase, consumer spending and fixed capital formation decrease. This leads to a decrease in economic output and vice versa. Relatedly, when interest rates increase, the local market becomes attractive to the rest of the world, provided inflation is not seen as a deterrent to investment. This causes an appreciation in the exchange rate, leading to cheaper imports and relatively expensive exports. This, in turn, reduces aggregate economic output.

From the above nuances, it suffices to say that SARB accumulates liabilities and acquires assets purely to regulate money supply in the economy. Besides using the repo rate as the main tool and asset for financial stability, SARB participates in the securities market to maintain a balanced financial system in the economy. When there is an abundance of money in circulation, SARB sells bonds to banks and brokers at low prices to drain excess liquidity, which in turn reduces money supply. These are usually bonds for which the government is the custodian. Low prices of bonds are associated with high yield; hence, SARB strategically sets bond prices that influence commercial banks' and brokers' decisions to purchase bonds. Similarly, if the intention is to increase the quantity of money in circulation, SARB buys bonds from the market at high prices to encourage bondholders to sell.

In addition to financial market operations assets, SARB, like other central banks, is the custodian of gold and special drawing rights. These are standing reserves required and

regulated by the International Monetary Fund (IMF) to address international liquidity demand, as indicated by Williamson (2009).

On the liability side, the central bank holds deposits, mainly from commercial banks and the government. In addition to these depositors, there are other agents whose deposits are held by the central bank. These include, within the context of South Africa, the Corporation for Public Deposits and the South African Banknote Company, among others.

v) Non-Bank Financial Institutions

Unlike banks, NBFI do not hold any demand deposits. They mostly rely on banks and private investors (both foreign and local) as their sources of funds. As Dima and Corches (2018) submit, there are multiple types of NBFI operating across a wide spectrum of specialisation, but none of them open current accounts for their clients nor accept current demand deposits like banks. On the liability side, NBFI have an obligation to pay back debt capital and the corresponding interest.

Besides funding from banks and investors, NBFI raise funds through the sale of products and services as well as membership fees and regular contributions where applicable. They offer a range of lending and other financial solutions - examples of which include loans and pension funds. Further, NBFI have deposits in commercial banks and hold fixed-interest securities and shares as part of assets. Importantly, the acquisition of new assets by NBFI depends on the cost of financial capital and the associated risk.

vi) The rest of the world

SARB's quarterly bulletins show that the flow of financial assets and liabilities between South Africa and the rest of the world is explained by the financial account in the balance of payments (BoP). The BoP tracks the interactions between the country of interest and the rest of the world. These interactions include merchandise transactions (exports and imports) - which are recorded in the current account - capital transfers, as well as transactions on financial assets which are tracked through the financial account. The latter features three aspects: direct investment, portfolio investment and

other investment. Transactions under direct investment are mainly about the establishment of new businesses or the acquisition of major shareholding in existing companies by either local investors investing abroad or the rest of the world investing in South Africa. On the other hand, investors in portfolios are primarily interested in the return on investment in bonds and shares that are not included in direct investment. Transactions recorded under other investments include loans, deposits, and all other international transactions that are not included anywhere else.

International transactions are funded through private investments, bonds and loans; therefore, the financial obligations of the rest of the world are equity claims, interests as well as taxes. On the asset side, the rest of the world may hold bonds issued by the government and private sector and further issue loans (through banks) to finance international transactions. Additionally, the rest of the world can also hold deposits in local banks, thus leading to records of foreign-denominated deposits within the local banks. The theory of financial CGE links the acquisition of financial assets by the rest of the world to the need to finance the current account deficit. The purchase of local financial instruments by the rest of the world and the acquisition of foreign instruments by local agents determine the current account deficit.

vii) Industries

Industries' funds depend on equity, loans from banks and the rest of the world as well as returns from their service and product offerings. They also issue bonds to raise funds for bulk projects when necessary. This implies that from the liability side, they have an obligation to pay equity claims, capital, as well as interest on borrowed funds. Industries generally incur financial liabilities to increase investment; hence, UPGEM-F assumes that industry liabilities move with gross fixed capital formation.

In view of assets, industries make deposits in banks from which they earn interest. They own and continuously raise equity and benefit from the value of their physical capital. The theory of financial CGE modelling links the accumulation of financial assets by industry to movements in nominal economic output - a proxy for the value of industry output.

2.2.3.3 Determining the rates of return

Like sources of funds, rates of return are vital in the theory of UPGEM-F. We draw attention to agent-specific rates of return in this sub-section.

As shown by equation E-2.6, rates of return are key in determining new acquisitions. The theory of finance presents multiple ways to calculate rates of return, however UPGEM-F considers the power of the return defined by RA(s,f,d) = 1+the rate (r) as described in equation E-2.3. This is a general, most simple and easy-to-understand calculation, where r is determined either exogenously or endogenously from supply and demand mechanisms, depending on the financial agent and whether the focus is on the liability or asset side. We interpret RA(s,f,d) as the return that asset agent d receives from acquisition of instrument f, issued by liability agent s. Below is an outline of agent-specific rates of return.

i) Households

We assume that the only liability households would issue are mortgages; however, since these are covered under the housing industry, we conclude that households do not issue any liabilities. This being the case, the rate of return on household liabilities [RA(Hhlds,f,d)] is exogenous for all instruments (f) and asset agents (d). However, on the asset side, households may acquire profit from the sale of housing shares or may earn deposit interest from commercial banks; therefore, unlike R(Hhlds,f,d), which is exogenously determined, R(s,f,Hhlds) is dependent on demand and supply of households assets.

ii) Government

Accumulation of government liabilities is directly associated with the need to fund bulk public services, usually done through bond issuance. Therefore, the rate of return on government liabilities R(Govt,f,d) depends on the interest rates often set by the government during issuance of bonds. Further, demand for government bonds also determines the rate of return in that high demand for government bonds leads to a rise in the price of bonds and a fall in the rate of return and vice versa.

iii) Commercial banks

The rate of return on commercial bank liabilities [R(banks,f,d)] is usually measured from the ratio of income to bank liabilities. We let the rate of return on commercial bank liabilities adjust to meet the requirement for acquisition of new liabilities. Acquisition of new liabilities is dependent on the requirement for capital, which, on the other hand, is determined by a variety of factors that include the following:

- the bank capital adequacy ratio, which is usually set by authorities to cover unexpected costs to the banks;
- the number of high-risk assets held by the bank. High-risk assets prompt high capital requirements and vice versa.

As with all other pure financial agents, R(s,f,banks) depends on the demand for finances from other agents in the economy.

iv) The South African Reserve Bank

For SARB, the return on SARB liabilities [R(SARB,f,d)] such as commercial bank deposits and reserves, is determined by the monetary policy. SARB sets the interest rate on lending and borrowing; hence, this may essentially be considered the rate of return on SARB liabilities. On the other hand, R(s,f,SARB) is determined by liability issuers, often based on demand and supply factors. Through the interest rate, SARB directly and indirectly influences the rate at which other agents issue liabilities.

v) Non-Bank Financial Institutions

The rate of return on NBFI liabilities depends on multiple factors, including market forces, regulations, monetary policy and risk appetite. The demand for and supply of funds in the economy and the existing competition influence the rates of return offered on liabilities (R(NBFI,f,d)) and assets (R(s,f,NBFI)) of NBFI.

vi) Rest of the world

The rate of return on foreign liabilities depends on a mix of movements in the exchange rate, economic conditions and the credit risk linked to the issuing country. Changes in the exchange rate may increase or decrease the value of liabilities, depending on the strength of the currency of the country from which the investment comes from. On the

other hand, high-risk liability issuing countries may likely yield high returns as the risk cover remains elevated.

vii) Industries (including RH and NRH)

For industries, the rate of return on liabilities depends on market rates. When market rates increase, the cost of borrowing increases and so does the rate of return on industry liabilities. Apart from market rates, the rate of return on industry liabilities may be determined by the level of creditworthiness. Less credit-worthy industries yield low rates of return on liabilities and vice versa. The incursion of industry liabilities is dependent on gross fixed capital formation and acquisition of financial assets (proxied by industry output)

2.2.3.4 Sourcing the data for UPGEM-F

Since UPGEM-F considers both real and financial sides of the economy, there are two important datasets used. For the real economy, UPGEM_F relies heavily on the supply and use data provided by Stats SA. This is in line with the broad application of the theory of CGE which requires information from the system of national accounts. On the other hand, the financial side of the economy is better depicted by the national financial data; therefore, UPGEM-F is built on the financial records published in SARB's Economic Quarterly Bulletin.

Given the focus on optimisation of financial portfolios, UPGEM-F uses information on assets and liabilities of all financial agents. Decisions on financial portfolios depend on the expected return from the held financial instruments. The value of assets and liabilities is imperative. For a specific year for which UPGEM-F is run, there is a need for information on the value of the financial portfolio at the start of the year, as well as flows and new acquisitions during the course of the year.

Importantly, UPGEM-F requires alignment between the financial and real economy data; hence, the reference period ought to match. We build UPGEM-F from the 2017 data since it is the latest year to which UPGEM is calibrated. The database is fully

outlined in the next chapter. This chapter concludes with critical variables and the equations for the model.

2.2.4 The BOTE model

CGE models are built from an intricate system of equations with multiple datasets and variables with many dimensions. This complexity, inherent in CGE modelling, necessitates development of BOTE models for simplicity and better understanding. These models do not only simplify the complexities surrounding the theoretical structure of CGE models but are also vital for interpretation of variables used in the models and the corresponding results. BOTE models make it easy for non-technical users to comprehend CGE models. Importantly, BOTE models are not the same for all CGE models. They vary depending on the modelled variables and the equations.

In this sub-section, we present the BOTE model for UPGEM-F. The model considers simplified behavioural aspects of agents within the macroeconomic landscape, from the point of view of both real and financial economies. We use 20 equations (E-2.7 – E-2.26) in Table 2-1 to describe key relationships and variables useful for interpretation and understanding of UPGEM-F. These equations are classified into five categories for ease of flow, namely key macro variables, income equations, asset acquisition and incursion of liabilities, rates of return and the interest rate as well as the exchange rate. It is important to note that the BOTE does not represent the modelled variables but rather simplifies the interpretation of the modelled variables.

2.2.4.1 Key macro equations

Equations E-2.7 and E-2.8 show the association between the GDP and other key macro variables. Specifically, equation E-2.7 defines the relationship between GDP and final demand components while E-2.8 relates the GDP to factors of production.

2.2.4.1.1 Expenditure on GDP

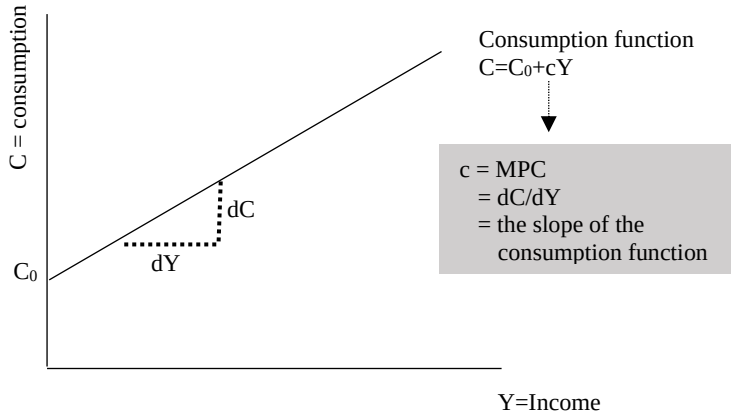
Equation E-2.7 is the identity for expenditure on GDP. It shows the value of final production of goods and services in the economy. It considers household consumption

expenditure (C), investment (I), government expenditure (G) and net exports (X-M). These are defined explicitly as variables under equation E-2.7. Scholarly work such as Landefeld, Seskin and Fraumeni (2008) refers to the GDP expenditure approach as the final demand approach since it considers the final use of goods and services by private and public institutions, investors and the rest of the world. We provide details of each component of expenditure on GDP within the context of the current research below.

i) Households' final consumption expenditure

As part of equation E-2.7, households' final consumption expenditure (C) is defined to be dependent on the total income of households and the proportion of income spent on consumption. The Keynesian consumption function, generally presented in Figure 2-1, where the Marginal Propensity to Consume (MPC) is the slope of the consumption function. Schumpeter (1936) and Mohr et al. (2008) state that an increase in income leads to an increase in consumption. Despite this, the Keynesian theory maintains that the proportion of the increase in income that individuals are likely to spend on consumption as income increases (the Marginal Propensity to Consume (MPC)) slows down as households start saving some of the income (Kimball, 1990; Kuznets, 1955). In other words, as individuals become exposed to more money, their desire to save grows faster than the desire to consume. Any household income not spent on consumption is saved and used for investment. The Keynesian theory postulates that consumption and savings are primarily determined by how much money individuals have at their disposal (Tapsin & Hepsag, 2014).

Figure 2-1: Keynesian Consumption Function



Household income, private consumption and savings are dependent on the performance of the economy. In a thriving economy, households earn enough money to save while increasing consumption. Batrancea (2021) links deteriorating economic sentiments to declining household consumption.

ii) Investment

Investment is denoted by I in the variable descriptions of equation E-2.7. Investment is a function of the rate of return on capital and the interest rate at which money is borrowed. The literature shows that the interest rate is the cost of investment, therefore from this perspective, it has an inverse relationship with investment (Muhammad, Lakhan, Zafar & Noman, 2013; Osei-Assibey & Baah-Boateng, 2012; Ojo, 2014; Wuhan, Suyuan & Khurshid, 2015). A decrease in the interest rate encourages investment and vice versa. Individuals and businesses borrow to finance investment; therefore, a fall in interest rates reduces the cost of investment, thus leading to an increase in investment.

Relatedly, the level of investment is positively linked to the rate of return on capital. The return on capital indicates the potential for profitability. The higher it is, the more attractive the investment is and vice versa (Arditti, 1967). The return on capital depends on the type and level of investment risk, market interest rates as well as business and economic conditions such as technological advancements and changes in consumer preferences (Petach, 2018; Denison, 1964). High-risk investments often yield high returns to compensate for additional risk incurred by investors. Similarly, high market interest rates are associated with high rates of return on capital. The continuously evolving advancements in technology prompt agility and adaptation to new investments and behavioural changes. Investments that are rigid on old technologies may likely yield negative returns.

iii) Government expenditure

Government expenditure depends on the revenue and the interest rates but most importantly, on the need for services. Gachunga (2019) indicates that public spending is largely driven by the population, tax revenue and inflation. In other words, demand for public services, the overall price level and government income determine

government expenditure. The description of variables in equation E-2.7 shows that public expenditure (G) is dependent on the interest rate and government income. Government income is largely dependent on the performance of the economy. A growing economy is associated with high revenue as businesses and households contribute to the tax pool and are less dependent on government grants and subsidies. Generally, revenue from taxes is not sufficient to finance public expenditure. The government heavily relies on borrowed funds (Mohr et al., 2008). The government usually borrows through issuance of bonds. These are paid back with interest, which varies according to the size and the market dynamics. Government bonds are considered less risky than other types of bonds because of the low risk of default associated with the government.

iv) Net exports

As shown by equation E-2.7, net exports (X-M) are a critical component of the GDP, usually computed as a residual after the determination of the rest of the variables in the E-2.7. A positive value of net exports (trade surplus) adds to the economy, implying that the economy is exporting relatively more than it is importing and is, therefore, receiving more income from foreign markets than it is spending abroad. A negative value (trade deficit) subtracts from the GDP, implying that the economy is paying relatively more than it receives from the foreign markets. Export and import volumes are dependent on prices. Prices determine the cost and market competitiveness of exports and imports and therefore influence volumes of exports and imports in various ways. Exports and imports in turn, affect the economic growth. Excess exports over imports lead to a trade surplus and the reverse leads to a trade deficit. Cetintas and Barisik (2009) show that the dependencies between GDP and exports and imports vary across countries; however, there is a general bidirectional causality between imports and GDP growth. These scholars argue that import of inputs and technologies required for a faster growth of the countries plays an important role in economic growth. Likewise, an increase in production stimulates an increase in income, which in turn leads to an increase in imports.

2.2.4.1.2 The general production function

Equation E-2.8 displays a relationship between GDP and factors of production, taking into consideration the need for technology in production processes. From the economic theory, E-2.8 is the general production function that describes how GDP can be increased through increased inputs of capital and labour, as well as improved productivity in the economy. Efficiency in the economy is attained when there is more production from using fewer resources such as technology. This is confirmed by Goshal and Goswami (2017), who argue that a firm is technically efficient if it produces the maximum output from the minimum quantity of factors of production such as labour, capital, and technology.

2.2.4.2 Income equations

The second category displays income equations, taking into consideration key deductions such as Tax. Income is generally computed as the difference between income and expenses; hence we use the same logic to deduce income for both households and government in the BOTE.

Equation E-2.9 relates the household income to the value of national output after payment of taxes and liabilities. The value of real GDP is expressed in terms of the average price level of GDP (PY) and CPI; ie GDP*PY/CPI. PY does not include import prices but includes prices of good produced locally for export. On the other hand, the CPI does not include export prices but includes prices of imported goods. From this, PY/CPI is considered a function of terms of trade (TofT), thus the value of real GDP is expressed as GDP*f(TofT). Positive economic growth increases the ability of companies and industries to absorb the unemployed hence incomes of households increase as a result thereof. Besides the increase in employment, a growing economy creates further opportunities for households to generate income from other economic activities. Within the current context where households can own housing equity and let their property for rental, and thus earn rental income. In this research, this source of income is not explicitly singled out in the simulations since it is automatically included in the

GDP. It is instead integrated into the interpretation of the results and further used to illuminate the connection between the housing industry and households.

Equation E-2.10 defines net government income as the difference between total revenue and the cost of borrowing. The government receives revenue from taxes and duties imposed on individuals, businesses, and goods and services. This is often the largest portion of the government income. The organisation for Economic Corporation and Development (OECD, 2019) shows that on average, 60% of the revenues raised by governments across OECD countries comes from taxes. Tax revenue is positively linked to GDP in that in a growing economy where most people are employed, and industries are thriving, tax revenue is higher. Besides tax, the government receives non-tax revenue, which includes proceeds from government-owned assets such as land, buildings, and natural resources among others, as well as fees and charges for fines and government services. This research recognises borrowing as another stream of government funding, which includes both foreign and domestic borrowing, often in the form of bonds. Borrowed funds are usually repaid with interest. This is assumed to be included in the cost of borrowing in equation E-2.10.

2.2.4.3 Equations for acquisition of assets and incursion of liabilities

The third category of equations describes the acquisition of assets and the incursion of liabilities. As shown by equation E-2.11, the value of financial instruments acquired at the end of the year depends on the rate of return and the budget available to purchase new financial instruments. Investors prefer to maximise the return from their portfolio; hence, they choose investments that are associated with high returns and are within acceptable risk levels and the available budget.

Equation E-2.12 indicates that the incursion of liabilities by households is a function of investment in housing. UPGEM-F assumes that households take up liabilities mainly to buy equity in real estate. Household liabilities include equity issued to the rest of the world and loans acquired from banks and NBFI. In terms of assets, households own housing equity, equity in NBFI, cash and deposits in banks. Equity in NBFI is mostly

pension contributions. The accumulation of household assets depends on savings. This is shown by equation E-2.13.

Equation E-2.14 shows that the government's net acquisition of financial instruments is positively linked to government deficit. Government expenditure often exceeds total revenue due to the magnitude of projects the government finances as part of public services; hence, the government is forced to borrow from other agents through bonds or other debt instruments and mechanisms. As indicated by equation E-2.15, government purchases of assets depend largely on the available budget.

Equation E-2.16 relates the net acquisition of financial instruments by industries to investment. Investment by industries determines their net acquisitions. UPGME-F assumes that new acquisitions for industries are positively aligned to the value of their activity, estimated from the GDP. This is described by equation E-2.17. Any increase in the financial assets of industries points to a likely increase in production. The more financially healthy industries become, the more the economy grows. This is supported by Ewetan and Ike (2014), whose assessment of the linkage between industrialisation and the development of the financial sector identified a positive relationship between the industrial output and the disbursement of funds by banks to companies operating in the private sector.

Equation E-2.18 presents the net acquisitions by the rest of the world as a function of the current account deficit. Acquisitions of local assets by the rest of the world are done in foreign currency; therefore, increases in acquisitions reduce the current account deficit. On the other hand, the purchase of foreign assets by domestic agents leads to a decrease in foreign currency within the local economy. This affects the current account balance negatively. Relatively high volumes of imports (outflows) compared to exports (inflows) widen the country's current account deficit. It is important to note that this largely depends on the movements in the exchange rate. An increase in the exchange rate leads to an increase in the outflow of capital as it becomes relatively cheaper to buy foreign assets and vice versa. Equation E-2.19 shows that net acquisitions are zero

for all pure financial agents, namely commercial banks, NBFI, and SARB. This implies that liabilities and assets of all pure financial agents must always be equal.

2.2.4.4 Rates of return and interest rate equations

The fourth and last category of equations describes the relationships and dependencies between the interest rate and other variables. These dependencies are described from two perspectives: firstly, from the definition of interest rate as a cost of borrowing and secondly, from the definition of interest rate as a return on investment in interest-bearing assets.

From the viewpoint of interest as the cost of borrowing, equation E-2.20 shows that interest rate is a function of money supply. In other words, the interest rate is influenced by changes in money supply. When SARB participates in market operations and buys bonds as part of regulating monetary policy, money supply increases. This prompts banks to drop interest rates to attract borrowing. A drop in the interest rates means that the cost of borrowing is relatively less; hence, individuals and businesses take up more credit. The converse is also true. A decrease in money supply implies that there is less money available in the economy, therefore borrowers compete for scarce funds, thus stimulating an increase in interest rates. An increase in interest rates discourages borrowing and leads to a reduction in demand for credit. Conversely, from the point of view of the interest rate as a return on investment, an increase in the interest rate encourages investment in high-yield assets and vice versa. This is explained by the description of I in equation E-2.7 as narrated earlier.

Equations E-2.21 to E-2.25 outline the agent-specific returns and interest rate dependencies. While government borrowing is included in equation E-2.10 at an abstract level, it is imperative to show how it associates with interest rate and changes thereof. Therefore, equation E-2.21 explicitly defines government borrowing as a function of government expenditure, government income and interest rate. The government primarily borrows money to finance public debt and mega public goods and services. Depending on the revenue generated, the need for provision of public

goods and services, the existing debt and the interest rate, government borrowing may increase or decrease. Changes in the interest rate influence government decisions to borrow. An increase in the interest rate makes it costly for the government to service debt; hence, it discourages borrowing. Similarly, a decrease in interest rates lowers the cost of financing public debt and various public goods.

Relatedly, equation E-2.22 expresses the return on government liabilities as a function of the price of bonds and the interest rate. This is primarily because the government issues bonds as liabilities; hence the return on liabilities is the bond yield. The price of bonds is inversely related to the interest rate. When the market interest rates rise, existing bondholders can sell their bonds only at lower prices, as the existing coupons are lower than the market interest rates. The inverse also holds true. A decrease in the market interest rate increases the value of the existing coupons; hence investors can sell at relatively higher prices than the original bond purchase price.

Equation E-2.23 expresses the return on industry liabilities as a function of expected return on investment and the interest rate. Industries generally incur liabilities for investment purposes; hence the value of industry liabilities and the associated return depend on the expected return on investment as well as the interest rate. Highly profitable investments are associated with high returns as industries are likely to invest significantly in these and vice versa. On the other hand, an increase in the interest rates leads to an increase in the cost of borrowing for investment purposes and vice versa. It is important to note that for the BOTE, we include the real estate industry (housing) in E-2.23 (as part of the general liability issuing industry) to avoid a repeat of the same nuances.

Equation E-2.24 shows that the return associated with domestic agents buying instruments issued by the rest of the world is influenced by foreign interest rates and the exchange rate. The acquisition of foreign financial instruments depends on the willingness of domestic agents to purchase instruments issued by the rest of the world. Depending on how enticing the foreign interest rates are compared to domestic

interest rates, agents may choose to buy more or less foreign-issued instruments. UPGEM-F sets the foreign interest rates exogenous. Besides the interest rates, the exchange rate also impacts the rate of return on foreign instruments. Changes in the value of the currency of the country where the liabilities are relative to that of the country in which the liabilities are held (the exchange rate) affect the rates of return. When the currency of the liability issuing country appreciates, the return to the liability holding country decreases and vice versa.

Equation E-2.25 relates the returns on liabilities for commercial banks, SARB and NBFI to the interest rate. Depending on the rates of return issued by these agents, asset agents decide on the value of instruments to acquire. The rates of return are endogenously determined through the zero-profit concept, which requires a perfect match between liabilities and assets. In other words, commercial banks, SARB and NBFI make profits only if they can issue more liabilities and earn equivalent assets in return. Issuing more liabilities implies that attractive interest rates must be offered.

2.2.4.5 The exchange rate

The exchange rate (phi) is a function of the foreign currency and the domestic currency as indicated by equation E-2.26. An increase in phi indicates an appreciation of the domestic currency. In other words, less local currency is required to purchase one value of the foreign currency. The reverse is also true. A decrease in phi implies a depreciation of the domestic currency as more local currency is required to purchase one value of the foreign currency. An appreciation of the domestic currency leads to a decrease in demand for local exports.

Phi is usually used as a numeraire against which all prices are benchmarked. Under this condition, the change in demand for local exports depends on the domestic price of exports and export demand elasticity. In the long run, the exchange rate is a relative function of the CPI.

Table 2-2: UPGEM-F BOTE

Macro equations

GDP	$= C + I + G + X - M$	E- 2.7
Where		
C	$= APC * HINC$	
I	$= f(RoR, i)$	
G	$= f(i, GINC)$	
X	$= f(PX, F\_X)$	
M	$= f(TofT, TWS)$	
GDP	$= A * f(K, D)$	E- 2.8

Income equations

HINC	$= \mathbf{GDP} * \mathbf{f(TofT)} * (\mathbf{1} - \mathbf{TQ}) - (\mathbf{BTRW.D}) * \mathbf{TL} - (\mathbf{NFLH} * \mathbf{R})$	E- 2.9
GINC	$= \mathbf{GDP} * \mathbf{f(TofT)} * \mathbf{TQ} + (\mathbf{BTRW.D}) * \mathbf{TL} - (\mathbf{NFLG} * \mathbf{R})$	E- 2.10

Equations for acquisition of assets and accumulation of liabilities

A1(s, f, d)	$= \mathbf{f}(\mathbf{R}(\mathbf{s}, \mathbf{f}, \mathbf{d}), \mathbf{BA}(\mathbf{d}))$	E- 2.11
A_T_1(Hhlds, f, d)	$= \mathbf{f}(\mathbf{INV\_HOUS})$	E- 2.12
A_T_1(s, f, Hhlds)	$= \mathbf{f}(\mathbf{SAV})$	E- 2.13
NETACQ(Govt)	$= \mathbf{f}\ (\mathbf{GOV\_DEF})$	E- 2.14
A_T_1(s, f, Govt)	$= \mathbf{f}\ (\mathbf{BA}(\mathbf{GOV}))$	E- 2.15
NETACQ(Ind)	$= \mathbf{f}(\mathbf{INV\_IND})$	E- 2.16
A_T_1(s, f, Ind)	$= \mathbf{f}(\mathbf{GDP})$	E- 2.17
NETACQ(Fgn)	$= \mathbf{f}\ (\mathbf{CAD})$	E- 2.18
NETACQ(d)	$= \mathbf{0}\ \forall\ \mathbf{d} \in \{\boldsymbol{Banks}, \boldsymbol{SARB}, \boldsymbol{NBFI}\}$	E- 2.19

Interest rate and Rate of return equations

i	$= \mathbf{f}\ (\mathbf{M2})$	E- 2.20
G_B	$= \mathbf{f}\ (\mathbf{G}, \mathbf{GINC}, \mathbf{i})$	E- 2.21
R(Govt, f, d)	$= \mathbf{f}(\mathbf{P}(\mathbf{B}), \mathbf{i})$	E- 2.22
R(Ind, f, d)	$= \mathbf{f}(\mathbf{E\_ROI}, \mathbf{i})$	E- 2.23
R(Fgn, f, d)	$= \mathbf{f}(\mathbf{phi}, \mathbf{fgn\_}\ \mathbf{i})$	E- 2.24
R(s, f, d)$\forall$ s $\in \{Banks, SARB, NBFI\}$	$= f(i)$	E- 2.25

The exchange rate equation

phi	$= \$\mathbf{Fgn/ZA}$	E- 2.26

Table 2-3: Description of Variables in UPGEM-F BOTE

A	Primary factor augmenting technical change
APC	Average propensity to consume
A(s,f,d)	The value of financial instrument f held by agent d, issued by liability agent s
A_T_1	Year-end portfolio
BA(d)	Funds available for agent d to acquire new assets
BTRW	Before-tax real wage
C	Real private household expenditure
CAD	Current Account Deficit
D, L	Labour demand, Labour supply
E_ROI	Expected Return on Investment
Fgn	Rest of the world
Fgn_i	Foreign interest rate
F_X	Export demand shift variable
G	Real government expenditure
G_B	Government borrowing
GDP	Real gross domestic product
GINC, HINC	Real government income, Real household income
GOV-DEF	Government deficit
i	Interest rate
I	Real investment expenditure
Ind	Industries
INV-HOUS	Housing investment
INV-IND	Industry investment excluding housing
K	Capital stock
M	Import volumes
M2	Money supply
NETACQ(d)	Net acquisitions by agent d
NFLG	Real net foreign liabilities of government
NFLH	Real net foreign liabilities of households
P(B)	Bond Price
PX, PM	Foreign-currency export price, Foreign-currency import price
Phi	Exchange rate
R	Interest rate on net foreign liabilities
RoR	Rate of return on capital
R(s,f,d)	Rate of return on instrument f, held by d, issued by liability agent s
SAV	Savings
TL, TQ	Labour tax rate, Production tax rate
TofT	Terms of trade
TWS	Cost-neutral import/domestic preference twist
X	Export volumes

2.3 Summary

This chapter provided the theoretical foundation of UPGEM-F. It summarised the history of CoPS-style CGE modelling and its context to South Africa. This included highlights of UPGEM and its application. UPGEM-F was introduced as the first CoPS-style financial CGE model for South Africa, built from UPGEM.

Nuances of the financial module additions to UPGEM were outlined. These included specifications of financial agents and instruments and the behavioural aspects of agents. UPGEM-F is rooted in the work of Dixon et al. (2014), based on nine agents and five financial instruments. The theoretical specifications dictate that each agent decides on the financial portfolio to hold for a specific period, depending on the value of the previous portfolio and new acquisitions. New acquisitions and flows mostly depend on the available budget and the returns. Asset agents maximise benefits subject to the availability of funds and the expected rates of returns, while liability agents minimise financing costs subject to budget and the expected rates of returns.

The chapter also provided a list of equations that simplify the theory of UPGEM-F and the interpretation of its application. These equations included macroeconomic equations that link various variables in the economy; income equations; equations for acquisition of financial instruments and those explaining the rates of return.

3 THE DATABASE

3.1 Introduction

In this chapter, we describe the datasets for UPGEM-F. By virtue of being a CGE model, UPGEM-F considers the structure of the South African economy as well as the interdependencies among its agents. From this backdrop, the SUT and the Social Accounting Matrix (SAM) become an inevitable base for UPGEM-F; hence we consider these the core databases of the model.

SUT provide fundamental inputs for social accounting matrices, input-output data, and the overall CGE modelling. These tables provide detailed information on the supply and use of domestically produced and imported products and services. As Kavese and Phiri (2020) indicate, SUT do not only show how goods and services originate from local industries and imports but also how these are allocated to intermediate inputs and final demand (both domestic and foreign). The same is implied by Rodrigues et al. (2019), who show that SUT describe the quantities of products consumed by industries in a use table, and those of goods and services produced by industries in the supply table. These tables are often acquired from the statistics offices of countries, as dictated by the United Nations' (UN) System of National Accounts (SNA) 2008.

Relatedly, a SAM is an array of transactions made within an economy, usually used as the core base for CGE modelling. Hayden and Round (1982) and Pal and Bandarlage (2017) refer to a SAM as a data or accounting system for an economy, which represents each macroeconomic account by a column of payments and a row of receipts. This is corroborated by Pyatt and Round (1985) as well as Reinert and Roland-Holst (1997), who indicate that a SAM captures transfers and transactions between the agents in an economy. Similarly, Karimsakov and Kadak (2017) define a SAM as a square matrix, columns and rows of which capture the expenditure and receipt accounts of economic actors respectively. Whilst there is a plethora of definitions of a SAM in the literature, a common feature that stands out is that it is a comprehensive economy-wide dataset that explains how an economy typically operates and links to the rest of the world through trade flows. Debowicz (2016) emphasizes the importance of SAMs in determining the effects of counterfactuals on the economy in terms of indicators such

as production, sector contribution to value added and international trade. SAMs are developed and calibrated from the SUT or Input-Output tables (I-O).

UPGEM-F does not use I-O; however, it is worth underscoring its importance and relevance to CGE modelling. I-O tables have extensively been used by CGE modellers to explain the distribution of goods and services for both intermediate and final consumption purposes. Research continues to show that I-O data is important in explaining the structure of the economies and the associated value chains. For example, Anghelache and Anghelach (2017) consider I-O data fundamental in explaining existing flows and interdependencies between industries in the national economy in which economic activity is taking place. Echoing the same sentiments, Hongsakhone, Islam, and Ichihashi (2021) assert that I-O information is crucial in quantitative analytics of interdependencies between production sectors of the economy. This is further affirmed by Erkok (2021) who defines I-O data as a matrix that does not only provide a systematic composition of economic activities within an economy but that further reveals inter-sectoral flows and dependencies.

Since UPGEM-F is a hybrid of UPGEM and the financial aspects of the economy of South Africa, we anchor its base on that of UPGEM but consider the updated economic data to remain as close as possible to the reality of the South African economy. The real economy base data is structured from the 2017 SAM for South Africa as well as the 2015 SUT. The year 2017 is selected as the base year because it is not too far from the base year for the benchmark and rebasing of national accounts for South Africa (2015).

On the other hand, the data from the South African Reserve Bank is used for the financial aspects of the South African economy. Unlike the real economy which concerns production and flow of goods and services, the financial side of the economy considers the flow of financial instruments in an economy. These instruments may vary, depending on the model and the interests. UPGEM-F specifically considers cash (notes and coins), equity (shares), debt (bonds and loans) as well as gold and special drawing rights. Key to these instruments are present and expected future values, upon

which decisions on the quantities held (stocks) are based. As implied by Leyshon and Thrift (2007), the financial aspects of the economy are rooted in the mobilization of investment capital from sources such as banks, government-assisted financing, industrial development bonds, venture capital firms and other various sources. For consistency with the real economy dataset, the financial flows for the year 2017 are considered.

3.2 The base data

This section outlines the base data for UPGEM-F as per the structure of CoPS-style models outlined by Dixon et al. (2013). These data form the foundation on which the initial solution for UPGEM-F is built. The data is often split into three matrices, namely the absorption matrix, joint production and import duty matrices. In this research, the import duty matrix is not presented independently, but rather included in taxes. Table 3-1 contextualises the absorption and joint production matrices to South Africa using 2017 aggregate figures.

3.2.1 Absorption matrix

The absorption matrix summarises the basic flows of commodities across different users, margin commodities, and taxes on commodities.

3.2.1.1 Basic flows

The basic flows – denoted by BAS, are shown on the first row of the absorption matrix, typically comprising C x S rows; where C denotes the number of commodities and S, the number of sources or origins of commodities. UPGEM-F considers 53 commodities and 2 origins of commodities (domestic and imported); therefore, the basic flows matrix has 106 (53 x 2) rows. Each component of the basic flows matrix represents the value of a specific commodity of either domestic or imported, used by a specific user.

Users of commodities are uniquely identified by numbers and the corresponding dimensions in the column headings. Specifically, producers and investors both have I

columns and are identified by numbers 1 and 2 respectively; where I is the number of industries, usually aligned to commodities. For the current context, 53 industries are being considered, therefore I=53=C. Besides 53 producers and investors, UPGEM-F considers a single representative of households (identified by the number 3), foreign users of local commodities (purchasers of exports) (identified by 4), government (identified by 5) and inventory (identified by 6). These are shown in Table 3-1.

Table 3-1: Absorption and Joint Production Matrices[1] (Rm[2])

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Household	Export	Government	Inventories
	Size	I	I	1	1	1	1
Basic Flows	C×S	V1BAS 4,552,728	V2BAS 810,983	V3BAS 2,304,803	V4BAS 1,255,379	V5BAS 967,898	V6BAS -3013
Margins	C×S×M	V1MAR 387,423	V2MAR 62,240	V3MAR 243,119	V4MAR 123,367	V5MAR 0	n/a 0
Indirect Taxes	C×S	V1TAX 258,495	V2TAX 0	V3TAX 208,618	V4TAX 0	V5TAX 0	n/a 0
Basic Flows+ Margins + Taxes=PUR values	C	V1PUR 5,198,646	V2PUR 873,223	V3PUR 2,756,540	V4PUR 1,378,746	V5PUR 967,898	V6BAS -3013
Labour costs	O	V1LAB 2,294,554					
Capital Rentals	1	V1CAP 1,750,307					
Land rentals	1	V1LND 74,963					
Production Taxes	1	V1PTX 67,347					

Number of commodities	C = 53
Number of industries	I = 53
Number of occupation types	O = 10
Number of household types	H = 1
Source (domestic, imported)	S = 2
Number of commodities used as margins	M = 2

	Joint Production Matrix
Size	I
C	MAKE MATRIX 9,385,815

[1] These values are based on the 2017 update of the Stats SA's SUT and not the rebased aggregate GDP figures

[2] Rand Million

Basic flows are valued at basic prices. These prices exclude sales taxes and margins that facilitate the flow of commodities. The first component of the basic flow matrix, V1BAS, represents the value of commodities used as inputs in production by industries. As depicted by Table 3-1, for the base year under consideration (2017), the South African economy recorded a total flow of R4,552,728m worth of production input commodities from both domestic and foreign origins. This was the value of local and imported inputs used by South African industries for production (intermediate consumption) in 2017.

The second component of the basic flows matrix (V2BAS) contains the total value of commodities originating from local and international economies, used to generate capital across all industries (capital formation). From Table 3-1, South Africa's capital formation inputs reached R810,983m in 2017, 48% of which were construction inputs, 20% other metal equipment and 15% transport equipment.

The third (V3BAS) and fourth (V4BAS) components of the basic flow matrix reflect the aggregate values of household consumption and export commodities respectively. In 2017, South African households consumed R2,304,803m worth of commodities. Real estate and food were the most consumed commodities, contributing 14% and 13% to the total household consumption respectively. In the same period, R1,255,379m worth of commodities were exported. Metal ore and other metal equipment had the largest share of the value of exports, 25% and 16% respectively. The fifth (V5BAS) and sixth (V6BAS) components of the basic flows matrix represent the flow of commodities to government and changes in inventory respectively. The South African government consumed R967,898m worth of government services in 2017. There was also a drawdown of R3,013 in inventories in the same period.

3.2.1.2 Margin commodities

The second row of the absorption matrix contains the value of margin commodities that are used within an economy to facilitate the basic flows. These are structured as sub-matrices denoted by MAR, comprising C x S x M rows and columns that correspond to the dimensions of users; where C and S are as defined in the basic flow matrices and M is the number of margin commodities. Dixon et al. (2013) identify typical margins as

domestic wholesale and retail trade, road, air, rail and water transport as well as natural gas. UPGEM-F considers 2 aggregate margin commodities namely, trade and transport; therefore, the margin commodity matrix has 212 rows (53 x 2 x 2).

South Africa incurred a total cost of R387,423m on margins that facilitated movement of domestic and imported goods and services required for industry production (V1MAR) in 2017. Chemicals took up 14% share of the total cost of margins for intermediate consumption, followed by other metal equipment at 9% and refined petroleum, iron and steel, wood and paper at 8% each. On the other hand, it cost the country R62,240m to facilitate capital formation (V2MAR) across the different industries, 43% of which was for transport equipment and 39% for other metal equipment. A further R243,119m was incurred to facilitate movement of goods and services to households (V3MAR). Food took up 29% of the cost of margins for household consumption, beverages and tobacco contributed 14% and refined petroleum products contributed 12%. Export margins (V4MAR) were worth R123,367m. These were dominated by other metal equipment (24%), transport equipment (15%), iron and steel (15%) as well as chemicals (12%).

3.2.1.3 Taxes

The third row of the absorption matrix contains a matrix of net taxes associated with the flow of commodities from different sources to users, denoted by TAX. Each cell of the TAX matrix contains net taxes, computed as the difference between tax collections and subsidy payments (taxes less subsidies). Net taxes are associated with input commodities for production, capital formation, exports, and commodities consumed by households and the government.

South Africa's net taxes amounted to R467,113m in 2017. Of this, R258,495m was associated with intermediate commodities (V1TAX) while R208,618m was associated with household consumption (V3TAX). Refined petroleum products and transport equipment were the largest contributors (8% each) to net taxes associated with intermediate consumption. Beverages and tobacco made the largest contribution (27%) to net taxes associated with household consumption.

Taxes associated with imports amounted to R112,905m, 24% of the overall net taxes. These taxes may be presented separately in the import duty matrix, otherwise referred to as the TARRIF matrix. This is a matrix of dimension C×1, which presents the tariff revenue by imported commodities. We do not exclusively present the import duty matrix as part of Table 3-1 but consider import tax estimates in the data.

3.2.1.4 Purchase values

The fourth row of the absorption matrix provides the value of commodities and services at purchase values (PUR). For each agent in the economy, the purchase value defines the cost of commodities at purchase prices, computed as follows:

$$\text{PUR} = \text{BASIC FLOWS} + \text{MARGINS} + \text{TAXES} \qquad \text{E- 3.1}$$

In the PUR matrix, the total intermediate use of commodities and services at purchasers' prices is denoted by V1PUR. Final demand is denoted by V2PUR, V3PUR, V4PUR, V5PUR and V6PUR for investors, households, exports, government and change in inventories respectively. The sum of final demand components (V2PUR, V3PUR, V4PUR, V5PUR and V6PUR) minus imports can be referred to as expenditure of GDP.

From Table 3-1, the purchase value of intermediate inputs (V1PUR) was R5,198,646m in 2017. Inputs for capital formation (V2PUR) were worth R873,223m at purchase value in the same period. Households consumed R2,756,540m worth of commodities at purchase value (V3PUR). The purchase value of exports (V4PUR) was R1,378,746m while that of government goods and services was (V5PUR) R967,898m. There is no consideration for taxes on change in inventories, therefore the purchase value of change in inventories (V6PUR) is the same as the drawdown in inventories (V6BAS) R3,013m.

3.2.1.5 Factors of production

The fourth, fifth and sixth rows of the absorption matrix outline the cost to industries, associated with the primary factors of production (labour, capital and land). This cost comprises compensation of labour (V1LAB), rental values of fixed capital (V1CAP) and

land (V1LND). V1CAP and V1LND describe the cost allocated to industries for the use of capital and land respectively.

As shown by Table 3-1, the South African industries paid R2,294,554m as compensation for employees across 10 occupation categories in 2017. Skilled occupations had the largest share of wages (53%), while semi-skilled and low-skilled occupations took up 34% and 5% of the wages respectively. Unspecified occupations contributed 8% to wages. This points to the imbalance of the South African labour.

The rental values of fixed capital and land were R1,750,307m and R74,963m respectively. The rental value of land was allocated from that of fixed capital (a portion of capital) to accommodate agriculture and mining industries, whose activities require land.

3.2.1.6 Production taxes

The final row of the absorption matrix contains net production taxes. These are computed as the difference between taxes that producers pay as part of production costs and subsidies that producers receive as part of production. These include taxes and subsidies on business operations, ownership or use of land or buildings, as well as taxes related to employee compensation.

A total of R67,347m net production taxes were recorded for South Africa in 2017. More than 50% of these were linked to real estate activities and trade.

3.2.2 Joint production matrix

The joint production matrix, popularly known as the MAKE matrix in CoPS-style CGE models, presents the commodity outputs by industries; hence it is a C × I matrix. Each entry of the matrix represents the value of output of a specific commodity c, from a specific industry i. Importantly, MAKE matrices can either be diagonal or non-diagonal, where a diagonal matrix presents a situation where each industry produces only one

commodity, and a non-diagonal one implies that industries produce more than one commodity.

Within the current context, the MAKE matrix is non-diagonal and has dimension 53 × 53. Some commodities are produced by multiple industries; for instance, rental equipment and machinery is produced across various industries. The total value of the basic flows produced in South Africa in 2017 or the MAKE matrix was R9,385,815m, 13% of which was from the general government.

3.2.3 Key variables in the economy

We use the data from the matrices to compute values for key economic variables. Specific attention is drawn to the final demand for goods and services, GDP at both supply and demand sides, intermediate consumption, and net exports.

i) ***Final demand for goods and services***

The value of the final demand for goods and services in South Africa in 2017 was R5,973,394m. The final destination of goods and services differs across the agents in the economy, depending on the intended use. The use varies from investment, consumption and exports to inventories. We compute final demand as the sum of investment (V2PUR; R873,223m), household consumption (V3PUR; R2,756,540m), exports (V4PUR; R1,378,746m), government consumption (V5PUR; R967,898m) and the drawdown in inventories (V6PUR; R3,013m). It must be noted that the drawdown is negative; hence, it is subtracted from the sum of other final destinations for goods and services.

ii) Gross Domestic Product

We compute the GDP from the demand side as the difference between final demand for goods and services and imports. This is identified by the below equation.

$$\text{GDP EXPENDITURE} = \text{V2PUR} + \text{V3PUR} + \text{V4PUR} + \text{V5PUR} + \text{V6BAS} - \text{V0IMP} \qquad \text{E- 3.2}$$

Given the final demand of R5,973,394m and imports valued at R1,344,945m, the GDP from the demand side was R4,628,449m in 2017.

From the supply side, the GDP is computed as the sum of incomes from factors of production and taxes (R4,558,571m). Specifically, this is the sum of capital rentals (V1CAP), land rentals (V1LND), income from labour (V1LAB), net production taxes (V1PTX), and indirect taxes (TAX) as shown by equation E-3.3.

$$\text{GDP INCOME} = \text{V1LAB} + \text{V1CAP} + \text{V1LND} + \text{V1PTX} + \text{TAX} \qquad \text{E- 3.3}$$

iii) Intermediate consumption

The total value of intermediate consumption (V1PUR) in the economy of South Africa in 2017 was R5,198,646m. It must be noted that this is measured at purchaser's prices.

iv) Net exports

The value of South Africa's exports in 2017 was R1,378,746m while that of imports was R1,344,945m. These figures resulted in a trade surplus of R33,801m.

3.3 Financial data

Following the core database descriptions in the previous section, we now provide a description of the supplementary financial database that is being used to create UPGEM-F. Importantly, as is the case with the real economy data in the core database, the base year data for the financial database is for 2017. This harmonises the two data sets to allow a complete reflection of the nominal and real side of the South African economy in the 2017 base year.

In the context of the financial database, we focus on assets and liabilities and the associated flows between nine different agents across five different instruments. As noted in the previous chapter, the agents considered in this research are Commercial Banks (Banks), SARB, the Rest of the World (Fgn), Government (Govt), Households (Hhlds), Industries (Inds), Non-Bank Financial Institutions (NBFI), Reproducible Housing (RH) and Non-Reproducible Housing (NRH). Flows for each agent are measured as the difference between start-of-year and end-of-year stocks across all financial instruments. As previously outlined in Table 2-1, these instruments include

notes and coins, equity, deposits and loans, bonds, as well as gold and special drawing rights.

We present the main structure of the financial database in UPGEM-F through Table 3-2. The financial database is a three-dimensional matrix, consisting of nine asset agents, nine liability agents, and five financial instruments (9x9x5). Since only two dimensions can be shown at a time, Table 3-2 represents flows between the nine asset and liability agents for every financial instrument. The rows represent liabilities, whilst the columns present assets. Importantly, the entries of the matrix are denominated in millions of Rands (Rm).

Table 3-2: Flow of funds matrix structure

		Flow of funds								
		1	2	3	4	5	6	7	8	9
		Banks	CB	Foreigners	Govt	Households	Industries	NBFI	NRH	RH
1	Banks	1. Notes & Coins 2. Deposits & Loans 3. Bonds 4. Equity 5. Gold — The sum of the differences in the start and year end stocks								
2	CB									
3	Foreigners									
4	Govt									
5	Households									
6	Industries									
7	NBFI									
8	NRH									
9	RH									
		Each cell represents the sum of the differences between year-start and year-end stocks of financial instruments.								

Each cell of the flow of funds matrix presents the sum of differences between the stocks of financial instruments at the start and end of the reference period (2017), for a specific agent.

We provide explicit descriptions of each of the financial instruments below and further outline the breakdown of liabilities and assets for each agent, at the start and end of 2017 – as per the June 2019 Quarterly Bulletin of SARB (South African Reserve Bank, 2019). The nuances of liabilities and assets allow easy computation of the ultimate flow of funds matrix used for simulations.

3.3.1 Notes and coins

Notes and coins define cash in circulation, which is generally considered a liability of SARB. All other agents are eligible asset holders of notes and coins, as most transactions are made in currency. SARB acquires notes and coins liability directly from banks and government or indirectly from households, the non-financial sector and the rest of the world. Allocation of notes and coins between asset agents largely depends on counterparty source data; hence due to limitations associated with the latter, SARB derives estimates where direct inputs are not provided. Further details on the allocation are provided below.

3.3.1.1 Direct inputs on the holding of notes and coins

SARB receives data on holding of notes and coins directly from the financial sector and government. For the financial sector, Deposit-taking corporations (Banks) provide direct inputs which SARB centralises on a digital platform[3].

Besides Banks, holding of notes and coins by the rest of the financial sector is considered insignificant. On the other hand, other direct inputs are sourced from government sub-sectors, specifically Central and Provincial Government, Local government and Public non-financial corporations sector.

3.3.1.2 Indirect inputs on the holding of notes and coins

There is no direct data on the holding of cash from the rest of the world, households, or the non-financial sector. SARB derives estimates as follows:

- For the rest of the world, Common Monetary Authority compensation payments data are used for quarterly estimations.

[3]https://www.resbank.co.za/en/home/what-we-do/statistics/releases/banking-sector-information/banks-ba900-economic-returns

- a residual approach is used for households, where 70% of the remaining value post allocation to the rest of the world is allocated to households.
- SARB uses a residual approach to allocate 30% of the remaining value to the private non-financial corporations sector.

Table 3-3 outlines the allocation of notes and coins received by the SARB at the start and end of 2017, as stated by the South African Reserve Bank (2019). Since SARB is the only liability agent for notes and coins, the rest of the agents have no notes and coins liabilities. Importantly, we split the balance from allocation to banks between households (70%) and NFBI (30%) as per SARB's approach.

Table 3-3: Notes and coins in 2017

Notes & Coins (Rm)	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	
					Year-start					***Total***
1 Banks	-	-	-	-	-	-	-	-	-	-
2 SARB	41,605	-	-	-	75,312	-	32,277	-	-	**149,194**
3 Fgn	-	-	-	-	-	-	-	-	-	-
4. Govt	-	-	-	-	-	-	-	-	-	-
5 Hhlds	-	-	-	-	-	-	-	-	-	-
6 Inds	-	-	-	-	-	-	-	-	-	-
7 NBFI	-	-	-	-	-	-	-	-	-	-
8 NRH	-	-	-	-	-	-	-	-	-	-
9 RH	-	-	-	-	-	-	-	-	-	-
Total	***41,605***	***-***	***-***	***-***	***75,312***	***-***	***32,277***	***-***	***-***	***149,194***

					Year-end					***Total***
1 Banks	-	-	-	-	-	-	-	-	-	-
2 SARB	41,763	-	-	-	80,114	-	34,335			**156,212**
3 Fgn	-	-	-	-	-	-	-	-	-	-
4. Govt	-	-	-	-	-	-	-	-	-	-
5 Hhlds	-	-	-	-	-	-	-	-	-	-
6 Inds	-	-	-	-	-	-	-	-	-	-
7 NBFI	-	-	-	-	-	-	-	-	-	-
8 NRH	-	-	-	-	-	-	-	-	-	-
9 RH	-	-	-	-	-	-	-	-	-	-
Total	***41,763***	***-***	***-***	***-***	***80,114***	***-***	***34,335***	***-***	***-***	***156,212***

Data Source: South African Reserve Bank (2019)

Page S-2 of South African Reserve Bank (2019) shows that SARB's liability in the form of notes and coins was worth R149,194m at the beginning of 2017. This was about 21% of SARB's total liabilities. As the year progressed, SARB incurred an additional liability of R7,018m worth of notes and coins, which led to a cumulative liability of R156,212m worth of notes and coins at the end of the year.

In view of allocation, page S-8 of South African Reserve Bank (2019) indicates that Banks owned R41,605m worth of notes and coins at the start of 2017, which was approximately 28% of the overall notes and coins liability incurred by SARB. These increased by R158m, reaching R41,763m by the end of 2017 – a percentage point reduction in the share to 27%. We follow SARB's 70:30 allocation of the balance to households and NBFI, and this leads to households realising an increase of R4,802m in the value of assets held in cash by SARB in 2017, from R75,312m at the beginning of the year to R80,114m at the end of the year. This was more than double the increase in the value of cash owned by NBFI from R32,277m at the start of 2017 to R34,335m at the end of the period.

3.3.2 Deposits and loans

Deposits and loans are different instruments; however, within the context of UPGEM-F, they are classified as one instrument since they are both associated with exclusive transactions with financial institutions. Importantly, this classification does not imply that the two are the same; the distinction in the meaning and terms associated with each are still maintained.

Loans broadly define funds borrowed from financial institutions (Banks and NBFI), often payable within an agreed period. Any of the financial institutions may be loan issuers if they can lend funds to other agents, either on a temporary or long-term basis, at a pre-determined fee (interest). Households and businesses are principal borrowers of money hence primary recipients of loans; however, they are not sole recipients of loans. Other agents within the financial economy may also be recipients or liability agents of loans depending on their needs. For instance, the government can take up

loans to finance some of the public projects while at the same time issuing bonds to finance other projects.

Deposits have multiple definitions; however, from a financial point of view, they are funds transferred to financial institutions by other agents for safekeeping. Importantly, deposits attract interest that varies according to the type of deposit (fixed or demand). Fixed deposits earn pre-determined interest for a specific period, while demand deposits earn interest related to the market.

Table 3-4 presents stocks of deposits and loans in the South African economy at the start and end of 2017.

Table 3-4: Deposits and loans in 2017

Deposits & Loans (Rm)	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	
	Year-start									***Total***
1 Banks	118,984	57,104	354,702	321,942	989,250	1,753,461	149,385	-	-	***3,744,828***
2 SARB	97,515	-	10,276	183,988	-	-	11,427	-	-	***303,206***
3 Fgn	430,694	61	-	29,954	-	60,069	-	-	-	***520,778***
4. Govt	1,029	104	182,509	-	-	-	-	-	-	***183,642***
5 Hhlds	107,927	-	-	-	-	-	21,557	-	-	***129,484***
6 Inds	1,850,051	-	150,660	-	-	-	-	-	-	***2,000,711***
7 NBFI	-	3,054	-	-	-	404,092	-	-	-	***407,146***
8 NRH	706,124	-	-	-	-	-	-	-	-	***706,124***
9 RH	577,737	-	-	-	-	-	-	-	-	***577,737***
Total	***3,890,061***	***60,323***	***698,147***	***535,884***	***989,250***	***2,217,622***	***182,369***	-	-	***8,573,656***

Deposits & Loans (Rm)	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	
	Year-end									***Total***
1 Banks	96,159	60,504	443,584	313,348	1,088,355	1,748,748	158,028	-	-	***3,908,726***
2 SARB	103,042	-	9,217	180,519	-	-	11,192	-	-	***303,970***
3 Fgn	403,005	59	-	28,588	-	98,469	-	-	-	***530,121***
4. Govt	751	68	202,840	-	-	-	-	-	-	***203,659***
5 Hhlds	112,239	-	-	-	-	-	22,313	-	-	***134,552***
6 Inds	1,938,428	-	237,372	-	-	-	-	-	-	***2,175,800***
7 NBFI	-	5,333	-	-	-	441,845	-	-	-	***447,178***
8 NRH	736,710	-	-	-	-	-	-	-	-	***736,710***
9 RH	602,762	-	-	-	-	-	-	-	-	***602,762***
Total	***3,993,096***	***65,964***	***893,013***	***522,455***	***1,088,355***	***2,289,062***	***181,422***	***-***	***-***	***9,033,367***

Data Source: South African Reserve Bank (2019)

3.3.2.1 SARB: deposits and loans

Liabilities

At the start of 2017, SARB had R303,206[4]m liabilities in the form of deposits and loans combined, which increased by 0.3% to R303,970m at the end of 2017. Of these liabilities, loans took up R14m and remained constant for the rest of the year, comprising mainly foreign loans acquired by the government from the rest of the world, for which SARB assumed liability.

[4] This takes into consideration the information on pages S-2 and S-8 of South African Reserve Bank (2019)

Nearly 61% of the total deposits and loans at the start of the year (R183,988m) were government deposits, 40% (R113,796m) of which were foreign currency denominated and 24% (R70,192m) were Rand-denominated. Additionally, about 32% of the total deposits (R97,515m) were from banks and mutual banks, of which R90,892m were required reserves, R379m were excess reserves, and R6,244m were other commercial bank deposits. The balance of the deposits was split between other domestic (R11,427m) and foreign (R10,276m) agents; where other domestic agents include the Corporation for Public Deposits, SA Banknote Company and SARB retirement fund among others, which we classify under NBFI.

At the end of 2017, government deposits decreased to R180,519m, retaining the largest share (59%) of SARB's deposits and loan liabilities despite the decrease. Of these, R110,751m were foreign currency denominated and R69,768m were Rand-denominated. Foreign deposits and deposits from NBFI decreased to R9,217m and R11,192m respectively, while commercial bank deposits increased by R5,527m to R103,042m. The latter included required reserves (R98,032m), excess reserves (R239m), other balances not including deposits denominated in foreign currencies (R2,410m) and other commercial deposits worth R2,361m.

Assets

SARB issued R60,322m worth of loans at the beginning of 2017, which increased by R5,642m to reach R65,964m at the end of the year. Loans issued to commercial banks amounted to R57,104m at the beginning of 2017. These increased to R60,504m at the end of the year. These included the liquidity that SARB, through cash reserves that commercial banks use on an overnight basis to clear their end-of-day positions. SARB's assets include advances to the government, valued at R104m at the start of 2017 and R68m at the end of the year. The balance of the assets included debtors, forward exchange contract assets and other accounts, which we classify under loans to NBFI. At the start of 2017, SARB loans to NBFI amounted to R3,054m, which increased to R5,333m at the end of the year. These included loans to Corporation for Public Deposits

and other SARB subsidiaries. SARB also issued long-term loans[5] to the rest of the world, which amounted to R61m at the beginning of 2017 and R59m at the end of the year.

3.3.2.2 Commercial Banks: deposits and loans

Liabilities

Commercial banks had deposits and loan liabilities of R3,744,828m at the start of 2017, which increased to R3,908,726m at the end of the year. When the year started, government deposits were worth R321,942m – composed of R151,935m, R48,547m and R121,460m deposits from the national government, local government and public enterprises respectively, as indicated on page S-10 of South African Reserve Bank (2019). At the end of the year, the overall deposits by the government to commercial banks decreased to R313,348m, primarily due to a decrease in national government deposits to R141,122m. Conversely, local government deposits and those from public enterprises increased to R49,349m and R122,877m respectively.

Apart from the government, other sources of deposits included the following:

NBFI:

The value of deposits for NBFI was R149,385m at the beginning of the reference year; comprising R137,013m deposits from insurers and pension funds and R12,372m from other monetary institutions as shown on page S-10 of South African Reserve Bank (2019). At the end of the reference year, the value of deposits by NBFI decreased to R158,028m – comprising R147,917m deposits from insurers and pension funds and R10,111m from other monetary institutions.

[5] Page S-93 of South African Reserve Bank (2019)

Interbank and intragroup:

The deposits and loans from banks to other commercial banks were valued at R118,984m and R96,159m at the beginning and end of the reference year respectively.

Industries:

Deposits from industries were worth R1,753,461m at the beginning of the reference period and R1,748,748m at the end of the year.

Households:

Households' deposits amounted to R989,250m and R1,088,355m at the start and end of the reference year respectively.

Rest of the world:

The value of deposits from the rest of the world was R354,702m at the start of the reference year before increasing to R443,584m at the end of the year.

Assets

The commercial banks issued R3,890,061m worth of loans at the beginning of 2017, which increased to R3,993,096 at the end of the year. These included loans granted under resale agreements, advances, overdrafts, mortgages, and other loans to domestic agents and the rest of the world.

Commercial bank loans to households and industries amounted to R107,927m and R1,850,051m respectively, at the start of 2017. These increased to R112,239m and R1,938,428m at the end of the year. Mortgage advances were valued at R1,283,861m at the start of 2017 and R1,339,472m at the end of the year. We allocate these liabilities to the housing industry (RH and NRH assuming a ratio of 45:55).

3.3.2.3 Government: deposits and loans

Liabilities

At the start of the reference year, the government had a total of R183,642m in liabilities in the form of loans from SARB, commercial banks, and the rest of the world. These increased to R203,659m at the end of the year, due to an increase of R20,331m in

government borrowing from the rest of the world. In the same period, the government decreased borrowing from commercial banks and SARB by R278m and R36m respectively.

Assets

Government assets in deposits amounted to R535,884m at the start of the reference year before decreasing by R13,429m to R522,455m at the end of the year. Government deposits in commercial banks decreased by R8,594m, contributing 64% to the overall decrease in government deposits. Government deposits with SARB and the rest of the world decreased by R3,469m and R1,366m, respectively, contributing 26% and 10%.

3.3.2.4 Households: deposits and loans

Liabilities

Households' loans stood at R129,484m at the beginning of 2017. Of these, 83% were issued by commercial banks while 17% were provided by NBFI. At the end of the year, household loans increased by R5,068m to R134,552m. About 85% of the increase was due to commercial bank loans.

Assets

Households' assets in deposits were only in commercial banks. These increased by 10% from R989,250m at the start of 2017, reaching R1,088,355m at the end of 2017.

3.3.2.5 Industries: deposits and loans

Liabilities

Industries acquired R175,089m (8,8%) worth of new loans, from R2,000,711m at the beginning of 2017 to R2,175,800m at the end of the year. Commercial bank loans increased by 5% from R1,850,051m to R1,938,428m at the end of the year. Loans from the rest of the world increased by 58%, from R150,660m to R237,372m at the end of the year.

Assets

Industries' deposits with commercial banks and the rest of the world increased by R33,687m, from R1,813,530m at the start of the year to R1,847,217m at the end of the

year. Industries increased funds to NBFI by 9% from R404,092m at the beginning of the reference year to R441,845m at the end of the year.

3.3.2.6 Housing industry: deposits and loans

Liabilities

The housing industry acquired mortgage loans from commercial banks, valued at R1,283,861m at the start of 2017. These increased to R1,339,472m at the end of the year. We split the mortgage liability 55:45 between NRH and RH, leading to year-start and year-end liabilities worth R706,124m and R577,737m for NRH and R736,710m and R602,762m respectively, for RH.

Assets

The only assets for NRH and RH are residential buildings and not financial assets.

3.3.2.7 NBFI: deposits and loans

Liabilities

NBFI loan liabilities increased by R40,032m in 2017. Funding liabilities acquired from industries increased by R37,753m from R404,092m at the start of the year to R441,845m at the end of the year. SARB loans increased by R2,279m from R3,054m to R5,333m at the end of the year.

Assets

At the end of 2017, NBFI had R23,260m less deposit and loan assets than at the start of the year. Deposits with commercial banks decreased by R1,468m from R149,385m at the beginning of the year, reaching R158,028m at the end of the year. Deposits with the SARB decreased by R235m from R11,427m to R11,192m at the end of the year. NBFI loans to households decreased by R21,557m in the same period.

3.3.2.8 Rest of the world: deposits and loans

Liabilities

The rest of the world acquired R9,343m more liabilities in the form of deposits from government and industries and loans from SARB and commercial banks. This was primarily due to an increase of R38,400m in industry deposits, from R60,069m at the

beginning of the year to R98,469m at the end. Government deposits decreased by R1,366m to R28,588m at the end of the year. The rest of the world acquired fewer loans from SARB (-R2m) and commercial banks (-R27,689m).

Assets

Page S-92 of South African Reserve Bank (2019) indicates that part of foreign liabilities to South Africa included deposits to monetary authorities valued at R10,276m and R9,217m at the start and end of 2017 respectively. We classify these under deposits to SARB. Additionally, R182,509m worth of loans were issued to the government by the rest of the world at the start of the reference year. These increased by R20,331m to R202,840m at the end of the year. Deposits with commercial banks increased by R88,882m from R354,702m at the start of the year to R443,584m at the end of the year. Other assets included loans issued to industries, valued at R150,660m and R237,372m at the start and end of 2017 respectively.

3.3.3 Bonds

In finance, a bond is generally considered a form of security that allows an issuer an opportunity to borrow fixed income from investors/bondholders. Bonds are usually issued by the government and companies that need to finance big projects, such as infrastructure development.

Table 3-5 presents the bond trade in South Africa during the year 2017.

Table 3-5: Bond trade in 2017

Bonds (Rm)	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	
					Year-start					***Total***
1 Banks	4,040	-	19,284	-	-	36,602	296,146	-	-	**356,072**
2 SARB	101	-	-	-	-	-	100	-	-	**201**
3 Fgn	27,478	547,269	-	491	-	-	237,459	-	-	**812,697**
4. Govt	295,954	7,766	832,535	-	-	-	1,327,824	-	-	**2,464,079**
5 Hhlds	-	-	-	-	-	-	-	-	-	**-**
6 Inds	334,773	-	-	-	-	-	765,187	-	-	**1,099,960**
7 NBFI	-	-	396,595	-	-	-	-	-	-	**396,595**
8 NRH	-	-	-	-	-	-	-	-	-	**-**
9 RH	-	-	-	-	-	-	-	-	-	**-**
Total	***662,346***	***555,035***	***1,248,414***	***491***	***-***	***36,602***	***2,626,716***	***-***	***-***	***5,129,604***
					Year-end					***Total***
1 Banks	21,175	-	19,997	-	-	39,425	277,844	-	-	**358,441**
2 SARB	101	-	-	-	-	-	100	-	-	**201**
3 Fgn	32,171	525,930	-	73	-	-	268,045	-	-	**826,219**
4. Govt	311,179	7,976	981,353	-	-	-	1,434,998	-	-	**2,735,506**
5 Hhlds	-	-	-	-	-	-	-	-	-	**-**
6 Inds	437,007	-	-	-	-	-	826,948	-	-	**1,263,955**
7 NBFI	-	-	373,234	-	-	-	-	-	-	**373,234**
8 NRH	-	-	-	-	-	-	-	-	-	**-**
9 RH	-	-	-	-	-	-	-	-	-	**-**
Total	***801,633***	***533,906***	***1,374,584***	***73***	***-***	***39,425***	***2,807,935***	***-***	***-***	***5,557,556***

Data Source: South African Reserve Bank (2019)

3.3.3.1 SARB: securities

Liabilities

Within the context of SARB, bonds/securities are issued to the market to drain excess liquidity and not necessarily to influence the bond yield. Participants in SARB securities are banks and brokers. In 2017, SARB issued securities valued at R201m at the beginning of the year and no additional securities during the year to control the money supply in the economy. Banks and brokers are the players in the SARB security market; hence, we split these securities as assets for commercial banks and NBFI 50:50.

Assets

On the asset side, SARB held R21,129m fewer bonds at the end than at the start of the year. This was partly due to a decrease of R21,339m in foreign bonds between the start and end of the year (from R547,269m to R525,930m). These were primarily non-gold foreign assets, which we classify as foreign exchange reserves held in foreign bonds. SARB also held R7,766m worth of investment in government securities as part of debt securities at the beginning of 2017, which increased to R7,976m at the end of the year.

3.3.3.2 Commercial banks: securities

Liabilities

Most commercial banks in South Africa sell government bonds; hence, we consider debt securities issued by banks part of these bonds. At the start of 2017, banks issued debt securities worth R356,072m, which increased by R2,369m to R358,441m at the end of the year. Most of these were held by NBFI and industries; commercial banks and the rest of the world held the lowest percentage combined, 6% and 11%, at the start and end of the year, respectively.

Assets

Commercial banks held R662,346m worth of bonds at the beginning of 2017, which increased to R801,633m at the end of the year. Industry bonds held in commercial banks increased by R102,234m from R334,773m to R437,007m at the end of the year. Government bonds increased by R15,225m from R295,954m to R334,773m; foreign bonds increased by R4,693m from R27,478m to R32,171m; inter-bank securities surged from R4,040m to R21,175m while SARB bonds remained unchanged at R101m.

3.3.3.3 NBFI: securities

Liabilities

NBFI issued fixed-interest securities worth R396,595m at the start of 2017. These decreased by R23,361m to R373,234m at the end of 2017. We classify these as bonds held by the rest of the world.

Assets

At the beginning of 2017, NBFI held R2,626,716m worth of bonds. Just over half of these were government bonds; 29% were issued by industries; 11% were issued by banks; 9% were issued by the rest of the world, and a very small fraction was issued by SARB. At the end of 2017, NBFI acquired an additional R181,219m worth of bond assets.

3.3.3.4 Industries: securities

Liabilities

At the beginning of 2017, industries issued R1,099,960m worth of bonds. Of these, R334,773m were held by commercial banks and R765,187m by NBFI. At the end of the year, industries issued R163,995m additional bonds, which led to a total of R1,263,955m worth of bond liabilities for industries at the end of the year.

Assets

On the asset side, industries held R36,602m worth of bonds at the start of 2017, which increased by R2,823m to R39,425m at the end of the year. These were solely bonds issued by commercial banks.

3.3.3.5 Rest of the world: securities

Liabilities

At the start of 2017, foreign bond liabilities amounted to R812,697m. Of these, 67% were held in SARB, 29% in NBFI, 3% in commercial banks, and about 0.1% in government. At the end of the year, the rest of the world acquired R13,522m new bond liabilities, leading to a total of R826,219m.

Assets

The rest of the world held R 1,248,414m worth of bonds at the start of the year, which increased to R1,374,584 m at the end of the year. These mainly comprised bonds issued by the government, valued at R832,535m and R981,353m at the start and end of the reference period respectively. NBFI bonds held by the rest of the world were valued at R396,595m at the beginning and R373,234m at the end of the year. Bonds issued by commercial banks increased by R713m from R19,284m to R19,997m.

3.3.4 Equity

Equity is usually defined by the value of assets that have liabilities linked to them. Table 3-6 presents equity for financial agents considered in this research, for the year 2017.

Table 3-6: Equity in 2017

Equity (Rm)	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	
					Year-start					*Total*
1 Banks	-	-	506,588	-	-	262,926	-	-	-	***769,514***
2 SARB	-	-	-	-	-	-	228,250	-	-	***228,250***
3 Fgn	109,812	-	-	6,023	-	1,273,722	2,972,019	-	-	***4,361,576***
4. Govt	-	-	13,045	-	-	-	-	-	-	***13,045***
5 Hhlds	-	-	299,093	-	-	-	-	-	-	***299,093***
6 Inds	158,056	6,292	897,280	-	-	-	2,556,067	-	-	***3,617,695***
7 NBFI	-	-	1,794,560	-	5,683,489	315,908	-	-	-	***7,793,957***
8 NRH	-	-	-	-	699,676	-	-	-	-	***699,676***
9 RH	-	-	-	-	572,463	-	-	-	-	***572,463***
Total	***267,868***	***6,292***	***3,510,566***	***6,023***	***6,955,628***	***1,852,556***	***5,756,336***	***-***	***-***	***18,355,269***

					Year-end					*Total*
1 Banks	-	-	463,025	-	-	432,395	-	-	-	***895,420***
2 SARB	-	-	-	-	-	-	200,321	-	-	***200,321***
3 Fgn	133,121	-	-	4,416	-	1,601,820	3,737,581	-	-	***5,476,938***
4. Govt	-	-	7,364	-	-	-	-	-	-	***7,364***
5 Hhlds	-	-	380,760	-	-	-	-	-	-	***380,760***
6 Inds	170,162	6,011	1,142,279	-	-	-	2,443,158	-	-	***3,761,610***
7 NBFI	-	-	2,284,558	-	5,978,372	321,409	-	-	-	***8,584,339***
8 NRH	-	-	-	-	743,340	-	-	-	-	***743,340***
9 RH	-	-	-	-	608,188	-	-	-	-	***608,188***
Total	***303,283***	***6,011***	***4,277,986***	***4,416***	***7,329,900***	***2,355,624***	***6,381,060***	***-***	***-***	***20,658,280***

Data Source: South African Reserve Bank (2019)

3.3.4.1 SARB: equity

Liabilities

SARB's equity liabilities decreased by R27,929m from R228,250m at the beginning of 2017 to R200,321m at the end of the year. These were assets owned by NBFI, which included SARB's shareholders' wealth, amounts due to SARB group companies and SARB Debentures, among other things.

Assets

SARB had R6,292m worth of equity in Industries at the beginning of 2017, which decreased by R281m to R6,011m at the end of 2017.

3.3.4.2 Commercial banks: equity

Liabilities

At the start of the year, commercial banks' equity liabilities amounted to R769,514m. Two-thirds of these were foreign equity owned by the rest of the world, the value of which was R506,588m. The balance was industry-owned equity, which was valued at R262,926m at the start of the reference year. At the end of the year, commercial banks' equity liabilities increased by R125,906m, reaching a year-end value of R895,420m. About 52% of this was foreign-owned equity, and 48% owned by industries.

Assets

Commercial banks had R267,868m worth of equity assets at the start of 2017. These comprised industry shares worth R158,056m and foreign equity valued at R109,812m. At the end of the year, commercial banks accumulated more industry equity (R12,106m) and foreign equity (R23,309m), leading to total equity assets of R303,283m.

3.3.4.3 Government: equity

Liabilities

The government issued equity liabilities worth R13,045m to the rest of the world at the beginning of 2017. These decreased by R5,681m to R7,364m at the end of the year.

Assets

The government had equity liabilities worth R6,023m issued by the rest of the world at the beginning of 2017. These decreased by R1,607m to R4,416m at the end of the year.

3.3.4.4 Households: equity

Liabilities

At the beginning of 2017, households' equity liabilities were valued at R299,093m. These decreased by R1,607m to R4,416m at the end of the year.

Assets

Household equity assets amounted to R6,955,628m at the beginning of the reference year. These comprised equity held in NBFI via pension contributions, valued at R5,683,489m and housing equity valued at R1,272,139m. The latter is the difference between the value of assets and mortgage loans. At the end of the year, household equity assets increased to R7,329,900m. Pension contributions increased by R294,883m to R5,978,372m, while the housing equity increased by R79,389m, reaching R1,351,528m at the end of the year.

3.3.4.5 Industries: equity

Liabilities

Industries had equity liabilities of R 3,617,695m at the start of the reference year. These comprised equity owned by commercial banks (R158,056m), SARB (R6,292m), the rest of the world (R897,280m) and NBFI (R2,556,067m). At the end of the year, industries' equity liabilities increased to R3,761,610m. This was a net effect of increases in equity owned by banks (R12,106m), the rest of the world (R244,999m) and decreases in equity owned by SARB (-R281m) and NBFI (-R112,909m).

Assets

Industry equity assets amounted to R1,852,556m at the beginning of 2017 and R2,355,624m at the end of the year. More than 65% of these were equity assets in the rest of the world. The balance of the assets was in NBFI and the commercial banks.

3.3.4.6 Housing industry: equity

Assuming the 55:45 split between NRH and RH, the value of equity liability for the two agents in the housing industry stood at R699,676m and R572,463m, respectively, at the beginning of the year and R743,340m and R608,188m at the end of the year.

3.3.4.7 NBFI: equity

Liabilities

NBFI had equity liabilities of R7,793,957m at the beginning of 2017, which increased to R8,584,339m at the end of the year. About 73% of NBFI's equity liabilities at the start of the year belonged to households. We link these to pension contributions, worth R5,683,489m. Besides households, NBFI had equity liabilities from the rest of the world (R1,794,560m), which comprised 23% of the total equity liabilities at the start of the year, and industry equity, which comprised 4%. At the end of the year, NBFI's equity liabilities increased to R8,584,339m, with household equity amounting to R5,978,372m, contributing 70% to total NBFI equity liabilities; foreign equity valued at R2,284,558m, contributing 27% and industry equity valued at R321,409m, contributing 3%.

Assets

NBFI had equity assets worth R5,756,336m at the beginning of the reference year. Approximately 52% of these assets were issued by the rest of the world, 44% by industries and 4% by SARB. At the end of the year, NBFI's equity assets increased by R624,724m to R6,381,060m, dominated by foreign equity (59%), followed by industry equity (38%) and SARB (3%).

3.3.4.8 Rest of the world: equity

Liabilities

The rest of the world acquired R1,115,362m worth of new equity liabilities in 2017; from R4,361,576m at the beginning of the year to R5,476,938m. Equity owned by NBFI increased by R765,562m from R2,972,019m to R3,737,581m; industry-owned equity increased by R328,098m from R1,273,722m to R1,601,820m while government-owned equity decreased by R1,607m from R6,023m to R4,416m.

Assets

The value of equity assets for the rest of the world increased by R767,420m in 2017; from R3,510,566m at the start of the year to R4,277,986m at the end of the year. This was a net effect of increases and decreases in equity assets accumulated from different agents. The most significant increase was in NBFI equity (R489,998m), from R1,794,560m at the start of the year to R2,284,558m at the end of the year. Additional increases were in equity issued by industries (R244,999m) and households (R81,667m). Fewer equity assets were held in government (R5,681m) and commercial banks (R43,563m).

3.3.5 Gold & special drawing rights

Table 3-7 presents the holding of gold as an asset and liability in 2017.

International Monetary Fund (IMF) member countries are mandated to hold reserves of gold that may be exchanged for currency when necessary. At the beginning of 2017, SARB had gold worth R100,555m, which decreased by R1,708m to R98,847m at the end of 2017. This was a liability for the rest of the world.

On the other hand, SARB held gold as a liability worth R41,354m at the start of 2017, which increased by R2,670m, reaching R44,024m at the end of the year. This was gold owned by banks and the rest of the world. At the start of the year, commercial banks owned R8,534m worth of gold, which increased to R12,701m at the end of the year. The rest of the world owned R32,820m worth of gold at the beginning of 2017, which decreased to R31,323m at the end of the year.

Table 3-7: Gold & special rights in 2017

Gold & Special rights (Rm)	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	
	Year-start									***Total***
1 Banks	-	-	-	-	-	-	-	-	-	-
2 SARB	8,534	-	32,820	-	-	-	-	-	-	***41,354***
3 Fgn	-	100,555	-	-	-	-	-	-	-	***100,555***
4. Govt	-	-	-	-	-	-	-	-	-	-
5 Hhlds	-	-	-	-	-	-	-	-	-	-
6 Inds	-	-	-	-	-	-	-	-	-	-
7 NBFI	-	-	-	-	-	-	-	-	-	-
8 NRH	-	-	-	-	-	-	-	-	-	-
9 RH	-	-	-	-	-	-	-	-	-	-
Total	***8,534***	***100,555***	***32,820***	***-***	***-***	***-***	***-***	***-***	***-***	***141,909***
	Year-end									***Total***
1 Banks	-	-	-	-	-	-	-	-	-	-
2 SARB	12,701	-	31,323	-	-	-	-	-	-	***44,024***
3 Fgn	-	98,847	-	-	-	-	-	-	-	***98,847***
4. Govt	-	-	-	-	-	-	-	-	-	-
5 Hhlds	-	-	-	-	-	-	-	-	-	-
6 Inds	-	-	-	-	-	-	-	-	-	-
7 NBFI	-	-	-	-	-	-	-	-	-	-
8 NRH	-	-	-	-	-	-	-	-	-	-
9 RH	-	-	-	-	-	-	-	-	-	-
Total	***12,701***	***98,847***	***31,323***	***-***	***-***	***-***	***-***	***-***	***-***	***142,871***

Data Source: South African Reserve Bank (2019)

3.3.6 Assets and liability flows in 2017

In this section, the focus is on the flows of financial instruments in 2017. These are computed from year-start and year-end figures; therefore, we first present arrays of aggregated liabilities and assets in Tables 3-8 and 3-9 for the start and end of 2017 respectively. Each cell aggregates all five financial instruments considered in this research.

Table 3-8: Total assets and liabilities at the beginning of 2017(Rm)

	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH
					Year-start				
1 Banks	123,024	57,104	880,574	321,942	989,250	2,052,989	445,531	0	0
2 SARB	147755	0	43,096	183,988	75,312	0	272,054	0	0
3 Fgn	567,984	647,885	0	36,468	0	1,333,791	3,209,478	0	0
4. Govt	296,983	7,870	1,028,089	0	0	0	1,327,824	0	0
5 Hhlds	107,927	0	299,093	0	0	0	21,557	0	0
6 Inds	2,342,880	6,292	1,047,940	0	0	0	3,321,254	0	0
7 NBFI	0	3,054	2,191,155	0	5,683,489	720,000	0	0	0
8 NRH	706,124	0	0	0	699,676	0	0	0	0
9 RH	577,737	0	0	0	572,463	0	0	0	0
Total A	**4,870,414**	**722,205**	**5,489,947**	**542,398**	**8,020,190**	**4,106,780**	**8,597,698**	0	0
Total L	**4,870,414**	**722,205**	**5,795,606**	**2,660,766**	**428,577**	**6,718,366**	**8,597,698**	**1,405,800**	**1,150,200**

Data Source: South African Reserve Bank (2019)

Table 3-9: Total assets and liabilities at the end of 2017(Rm)

	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH
					Year-end				
1 Banks	117,334	60,504	926,606	313,348	1,088,355	2,220,568	425,761	0	0
2 SARB	157,607	0	40,540	180,519	80,114	0	245,948	0	0
3 Fgn	568,297	624,836	0	33,077	0	1,700,289	4,005,626	0	0
4. Govt	311,930	8,044	1,191,557	0	0	0	1,434,998	0	0
5 Hhlds	112,239	0	380,760	0	0	0	22,313	0	0
6 Inds	2,545,597	6,011	1,379,651	0	0	0	3,270,106	0	0
7 NBFI	0	5,333	2,657,792	0	5,978,372	763,254	0	0	0
8 NRH	736,710	0	0	0	743,340	0	0	0	0
9 RH	602,762	0	0	0	608,188	0	0	0	0
Total A	**5,152,476**	**704,728**	**6,576,906**	**526,944**	**8,498,369**	**4,684,111**	**9,404,752**	**0**	**0**
Total L	**5,152,476**	**704,728**	**6,932,125**	**2,946,529**	**515,312**	**7,201,365**	**9,404,751**	**1,480,050**	**1,210,950**

Data Source: South African Reserve Bank (2019)

Banks had R4,870,414m worth of liabilities and assets in 2017 at the start of the year. These increased by R282,062m to R5,152,476m at the end of the year. Industry-issued liabilities constituted 42% and 43% of commercial bank liabilities at the start and end of the year respectively. Households' deposits and foreign-issued liabilities made the second and third most significant contributions (20% and 18% respectively) to commercial bank liabilities. The rest of the liability agents collectively contributed less than 20%. On the other hand, nearly 50% of commercial banks' assets were held in industries, dominated mainly by loans. About 26% of the assets were in the housing industry (mortgages).

SARB had R722,205m worth of liabilities and assets at the start of 2017, which decreased to R704,728m at the end of the year. NBFI-issued liabilities took up more than 30% of SARB's liabilities in 2017. Of these, more than 80% was equity. The liabilities issued by the government and commercial banks made up 25% and 20% of SARB's liabilities, respectively. These were mainly deposits. Notes and coins contributed 21% to the total liabilities of SARB. Half of the cash liabilities belonged to households. On the assets side, 90% of SARB assets were held in the rest of the world, with a notable portion being in bonds. Other assets included loans and advances to commercial banks, small investments in industries, government bonds and gold.

At the beginning of 2017, the rest of the world had R5,795,606m liabilities and R5,489,947.4m assets, which increased to R6,932,125m and R6,576,905m respectively at the end of the year. Over 50% of the liabilities of the rest of the world were issued by NBFI, of which more than 90% was equity. Equity liabilities comprised more than 75% of the liabilities of the rest of the world during the year 2017. Bonds made up just over 10%, while deposits and loans remained below 10% at the start and the end of 2017. About 40% of the assets of the rest of the world were in NBFI. These were mainly equity. Other significant assets were equity in industries and commercial banks, government bonds and deposits and loans to banks and SARB.

The government's liabilities stood at R2,660,766m at the start of 2017 before increasing to R2,946,529m at the end of the year. Bonds contributed significantly (93%) to government liabilities. NBFI held more than 50% of government bonds throughout 2017; R1,327,824m at the start and R1,434,998m at the end of the year. On the other hand, the government had R542,398m worth of assets at the start of 2017; 59% and 34% were deposits with commercial banks SARB respectively, and the balance was foreign assets. These increased to R526,944m at the end of the year, still dominated by deposits with commercial banks.

Households had R428,577m worth of liabilities at the start of 2017, which increased to R515,311m at the end of the year. These were mainly loans from commercial banks and NBFI, as well as equity owned by the rest of the world. Households' assets amounted to R8,020,189.8m and R8,498,370m at the start and end of 2017 respectively. These mainly comprised non-bank equity (70%), which included pension contributions, among other things. Other assets were housing equity, deposits in commercial banks and cash.

The liabilities of industries amounted to R6,718,366m and R7,201,365m at the beginning and end of the reference year respectively. More than half of these were equity liabilities, owned mainly by NBFI; a third were loans, and the balance was bonds. Industries' assets increased from R4,106,780m at the beginning of the year to R4,684,111.2m at the end of the year. These mainly comprised deposits with commercial banks, equity in NBFI and the rest of the world, and funding for NBFI.

NBFI had R8,597,697.48m worth of liabilities and assets at the start of 2017, which increased to R9,404,750.9m at the end of the year. More than 90% of the liabilities at the start of the reference period (R7,793,957m) were equity liabilities. These increased to R8,584,339m at the end of the period, dominated by household equity. Over 70% of the assets were held in the rest of the world and industries. These were primarily equity assets. Besides equity, NBFI held government bonds worth (R1,327,824m at the

start of the year and R1,434,998m at the end of the year) and issued loans to households.

The housing industry only had liabilities. These amounted to R1,405,800m for NRH and R1,150,200m for RH at the beginning of the year; and R1,480,050m for NRH and R1,210,950m for RH at the end of the year.

3.3.6.1 Flows

Table 3-10 presents the assets and liabilities flows during 2017. We interpret these flows in line with the BOTE model described in section 2.2.4.

Table 3-10: Assets and liabilities Flows in 2017(Rm)

	1 Banks	2 SARB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH
					Year-end				
1 Banks	-5,690	3,400	46,032	-8,594	99,105	167,579	-19,770	0	0
2 SARB	9,852	0	-2,556	-3,469	4,802	0	-26,106	0	0
3 Fgn	313	-23,049	0	-3,391	0	366,498	796,148	0	0
4. Govt	14,947	174	163,468	0	0	0	107,174	0	0
5 Hhlds	4,312	0	81,667	0	0	0	756	0	0
6 Inds	202,717	-281	331,711	0	0	0	-51,148	0	0
7 NBFI	0	2,279	466,637	0	294,883	43,254	0	0	0
8 NRH	30,586	0	0	0	43,664	0	0	0	0
9 RH	25,025	0	0	0	35,725	0	0	0	0
Change in assets	**282,062**	**-17,477**	**1,086,959**	**-15,454**	**478,179**	**577,331**	**807,053**	**0**	**0**
Change in liabilities	**282,062**	**-17,477**	**1,136,519**	**285,763**	**86,735**	**482,999**	**807,053**	**74,250**	**60,750**

Data Source: South African Reserve Bank (2019)

From the BOTE equation E-2.19 [*NETACQ(d)=0 ∀d ϵ {Banks, SARB, NBFI}*], the difference between changes in liabilities and assets of all financial institutions is zero. This is evident in changes in liabilities and assets of commercial banks, SARB and NBFI in Table 3-10. Commercial banks increased liabilities and assets by R282,062m in 2017, implying zero net acquisitions (change in liabilities minus change in assets). Similarly, SARB had zero acquisitions due to decreases in both assets and liabilities of R17,477m, while NBFI increased the liabilities and assets by R807,053m leading to null net acquisitions.

The difference between the liabilities incurred by the rest of the world (R1,086,958m) and the assets acquired by the rest of the world (R1,136,519m) in 2017 was a current account surplus of R49,561m for South Africa. This is based on equation E-2.18 [NETACQ(Fgn)=f(CAD)] of the BOTE. On the other hand, in line with equation E-2.14 [NETACQ(Govt)=f(GOV_DEF)], the gap between liability incursion by the government (R285,763m) and asset acquisition (-R15,454m) resulted in a government deficit of R301,217m. Households acquired more assets and therefore made savings of R391,446m. Based on equation E-2.16 [NETACQ(Ind)=f(INV_IND)], the difference between liability incursion by industries (R577,331m) and asset acquisition (R482,999m) led to R94,332m worth of investment funds for industries. Liability incursion by NRH (R74,250m) is linked to an increase in equity while that of RH (R60,750m) is linked to investment in housing.

3.4 Summary

This chapter presented core databases for UPGEM-F. These included the main economic and financial data sets for South Africa and the flows in 2017.

From the real side of the economy, the base data was presented in two matrices; the absorption matrix and the joint production matrix. The absorption matrix presented the basic flows of commodities across different users, margin commodities and taxes. The joint production matrix presented the commodity outputs by industries. The tariff revenue was embedded in the taxes and not independently presented in the import duty matrix.

From the financial side of the economy, stocks of financial instruments and flows during 2017 were presented. These included the assets and liabilities of nine agents considered in the model, defined for each of the five instruments.

Integrating the financial data into the base CGE model data provided a holistic view and understanding of South Africa's economy and facilitated the foundation for future

financial CGE modelling. The unique database provided by this research forms a good base for monetary policy analytics going forward.

4 MODEL SIMULATIONS

4.1 Introduction

This chapter details the design of the simulations used in the application of UPGEM-F. It outlines the choice of model closures and the explicit shocks considered in this research. As indicated in section 2.1.1, there are four types of closures usually considered in CGE modelling; namely, historical, decomposition, forecast and policy closures. While all four closures are linked and may sometimes be applied sequentially, it is not mandatory to have all closures in one application. In other words, historical and decomposition closures are not prerequisites to forecast and policy closures.

UPGEM-F is a dynamic model; therefore, we use the baseline forecast closure as a precursor for policy simulation. We outline in much detail, the baseline forecast closure as the foundation for simulation of the following specific policy shocks:

1. A downgrade in South Africa's credit rating and
2. An expansion in SARB's assets

Each policy simulation has unique closure settings that create a suitable environment for the specific shock to be imposed. Details of these settings are provided to explain the economic environment that is assumed for each simulation. The results of the simulations are discussed in the next chapter.

4.2 Specifying the baseline forecast closure for UPGEM-F

Like other dynamic CGE models, UPGEM-F links a series of short-run year-on-year closures to create a dynamic closure that provides foresight on the set scenarios. Importantly, since UPGEM-F is a financial CGE model, we augment the conventional CGE closure with the financial module to retain the hybrid nature of the model.

The assumed state (endogeneity/exogeneity) of key variables is detailed below for the baseline closure settings to be understood. We refer to the BOTE in section 2.2.3 to explain the linkages between some of the variables. For simplicity, we split the variables for the core model from those in the financial module.

4.2.1 Variables for the core model

i) Technological change

Technological change variables are naturally not determined endogenously from movements in other variables in the model; therefore, we retain the exogenous nature of most of them in the baseline forecast closure. As shown by equation E-2.8, GDP=A*f(K,D), technology facilitates production, and as such, is an important factor for GDP.

We allow the overall primary factor, technological change, to be endogenously determined and impose a fixed growth on GDP. This allows for changes in GDP to be linked to technology that enhances the productivity of all primary factors.

ii) Capital

We exogenously derive capital stock from the base year and allow the model to endogenously determine movements in the rate of return on capital, which in turn influence new investments. The investment/capital ratio is endogenized to allow investments to be driven by the rates of return. The importance of rates of return in investment decisions is emphasized by equation E-2.23 [*R(Ind,f,d)=f(E_ROI,i)],* which links rates of return to the cost of investment (interest rate). At the start of each year, the balance of capital from the previous year is used as the base on which new investments are augmented during the year, depending on the rate of return. Collectively, capital inventory from the previous year and new investments constitutes capital formation for the year.

iii) Employment and real wages

The model assumes that wages are sticky in the short run but flexible in the medium to long run to allow employment to adjust to the base. In the forecast closure, we impose a percentage growth rate in total employment and allow real wages to adjust labour market imbalances. As Dixon and Rimmer (2002) indicate, adjustments in the wage rate eliminate employment effects over time; hence in line with this, in the forecast

closure, we allow the model to endogenously determine real wages and fix total employment.

iv) Consumption

As Dixon and Rimmer (2002) indicate, private and public consumption is linked to Gross National Product (GNP[1]); hence, changes may be imposed on the average propensity to consume (APC) to influence the ratio of consumption to GNP. This relationship is confirmed by C=APC*HINC in equation E-2.7, which shows the dependency of households' final consumption expenditure on the total income of households and the proportion of income spent on consumption.

In our simulations, we exogenously determine the ratio of consumption to GDP and let the model endogenously determine GNP. Importantly, we do not impose any values on the government expenditure but rather let it follow household consumption. This is because goods and services provided by the government are mostly consumed by households. In other words, the supply of public goods and services is driven by household demand.

v) Taxes

We set the tax rate on labour income and all other tax shift variables exogenous as they are not determined by the model.

vi) Import prices

South Africa does not influence global prices hence we set the shifters for foreign currency price of imports exogenous, thus treating import prices exogenous.

vii) Exchange rate

[1] Includes GDP and production by citizens from elsewhere worldwide

We use the exchange rate as the numeraire and therefore, set it as exogenous. It is considered a benchmark against which prices are measured. As per Giesecke et al (2017), a percentage increase in phi leads to an equivalent decrease in local prices without any effect on real variables. Equation E-2.26, phi=$Fgn/ZA, confirms the inverse relationship between the exchange rate and local prices.

viii) Population, households and land

The population size, number of households and industry land use are fixed in the simulations. We keep the population size at its baseline and use it to determine government expenditure on social security. Further, we assume one household representative, critical in computation of demand for commodities.

4.2.2 Variables in the financial module

i) Rates of return on financial assets

The rate of return on financial instruments ROIA(*,f,*) is endogenously derived in the model, but from the asset holder point of view, the rate of return is exogenously determined. As shown by equation E-2.11, A(s,f,d) = f(R(s,f,d), BA(d)), agents make decisions on investment in financial assets based on the expected rates of return; hence, we assume that the base power of rate of interest is pre-determined. While this applies to all financial agents, it ought to be emphasized that SARB's interest is not in maximising returns but rather in maintaining a balance in the monetary policy. This implies that the rates of return paid to and by SARB are monetary policy variables.

ii) Year-start financial assets

The value of financial assets at the start of each period accrues from year-end assets in the preceding period; therefore, in the baseline forecast, we set year-start assets as exogenous.

iii) Year-end financial assets

We allow the model to endogenously determine the acquisition of financial assets during the year, implying that the year-end asset holding is determined by the optimization process.

iv) New acquisitions

We endogenously determine the incursion of liabilities and the acquisition of new assets. To achieve this, we exogenize the available budget for asset acquisition by other agents except the rest of the world, which is highly dependent on the exchange rate. In fixing the budget, we allow the value of the aggregate portfolio and changes thereof to be determined by changes in new acquisitions and the value of year-start portfolio. Importantly, for SARB, the aggregate portfolio, or the budget available for the purchase of financial assets is a policy instrument; therefore, it is naturally exogenous.

Net acquisitions are computed from the links between new acquisitions by non-pure financial agents and real economy indicators as explained through the agent-specific mechanisms below.

- **Linking net acquisitions by the rest of the world to the current account deficit**

Net asset acquisitions for the rest of the world (Fgn) are derived from the current account deficit (CAD) as per equation E-4.1. CAD increases with an increase in net foreign liabilities (more foreign ownership of domestic assets relative to domestic ownership of foreign assets).

$$d\_new\_netacq("Fgn") = d\_CAD + d\_f\_new\_netacq("Fgn") \quad \text{E- 4.1}$$

Where;

- d_CAD = change in current account deficit
- d_f_new_netacq("Fgn") = the shifter for net asset acquisitions for the rest of the world. It remains zero to activate the mechanism between CAD and new net acquisitions, unless a non-zero is imposed for a specific policy closure.

- **Linking government net acquisitions to public sector debt**

Government net asset acquisition is derived from the public sector deficit/savings and a shifter for new acquisitions by government as indicated by E-4.2. The government often acquires a deficit due to the constant need for borrowing to finance bulk public projects. The revenue that government generates is not sufficient to finance projects.

$$d\_new\_netacq("Govt") = d\_gov\_sav + d\_f\_new\_netacq("Govt") \quad \text{E- 4.2}$$

Where;

- d_gov_sav = change on government deficit/saving
- d_f_new_netacq("Govt") = the shifter for net acquisitions for government

- **Linking household net acquisition to savings**

Households' net asset acquisition is linked to savings. Households can only acquire new financial assets if they consume relatively less than their disposable income. In other words, net acquisitions are entirely dependent on household savings as per E-4.3.

$$d\_new\_netacq("\text{Hhlds}") = .01 * HOUS\_SAV * housav + d\_f\_new\_netacq("Hhlds") \quad \text{E- 4.3}$$

Where;

- HOUS_SAV = the coefficient for household saving
- housav = Household savings
- d_f_new_netacq("Hhlds") = the shifter for household net acquisitions

- **Linking net asset acquisition by industries to investment**

New asset acquisition by the industry is linked to industry investment as shown by equation E-4.4. This includes new investments and inventory but excludes public investment as it is included under government, and housing since it is considered an independent industry in this research.

$$d\_new\_netacq("Inds") = .01 * V2IND * w2\_ind + d\_f\_new\_netacq("Inds") \quad \text{E- 4.4}$$

Where;

- V2IND = the coefficient for investment (excluding real estate)
- w2_ind = value of investment excluding government investment and real estate
- d_f_new_netacq("Inds") = the shifter for industry net acquisitions

- **Linking net asset acquisition by the reproducible housing industry to investment**

As is the case with other industries, net asset acquisition by the reproducible housing industry is linked to real estate investment as shown by equation E-4.5.

d_new_netacq("RH")= .01*V2TOT($RealEstate$)*w2tot("$RealEstate$") + $d\_f\_new\_netacq$("RH") E- 4.5

Where;

- V2TOT = the coefficient for investment in real estate
- w2tot(RealEstate) = value of investment in real estate
- d_f_new_netacq("RH") = the shifter for reproducible housing industry net acquisitions

- **Determining net asset acquisition by commercial banks, SARB, NBFI and NRH**

For pure financial agents, namely, SARB, commercial banks and NBFI, assets and liabilities are equal; therefore, net acquisition is null. For NRH, there are no new acquisitions of assets since there is no room for expansion of property hence net acquisition is defined by a shift variable.

4.2.3 Exogenous variables for automatic and forecast closures

Table 4-1 presents lists of exogenous variables for the automatic and forecast closures. The automatic closure classifies variables that are not directly described by an equation in the model as exogenous. Several swaps are made between the closures to lay the foundation for forecasting. For example, real wages and capital stock are assumed to be sticky; hence, they are swapped with employment and rates of return respectively.

Table 4-1: Exogenous variables for the automatic and forecast closures

Automatic closure	Forecast closure
• Employment (empl_jobs) • Technological change variables • Average propensity to consume (APC) • Year-end asset accumulation (a_t_1) • Year-start assets accumulation (a_t) • Exchange rate (phi) • Import price shifter (f_pf0cif) • Power of rate of return on asset holding (roipowa) • Population (pop) • Households (q) • Land (lnd) • Taxes (tax_l_r)	• Real wage for consumers (real_wage_c) • A shifter for capital stock for production (d_f_cap_t(i)) • Household consumption • A shift variable for assets held at the end of the year (f_a_t_1) • A shift variable for assets held at the start of the year (d_f_a_t) • Budget available for asset accumulation (big_bud) • Imports • A shifter for capital growth/ rate of return (d_f_eeqror_j) • A shifter for accumulation of new liabilities (d_shiftl4) • Net asset acquisition (d_f_new_netacq) • Expected real rate of return for all industries excluding government (INDLG) • Nominal rate of interest on public sector debt (d_int_psd)

4.2.4 Macro forecasts (shocks to macro variables)

Dixon and Rimmer (2002) advocate the use of existing macro forecasts from modelers. We consider a mix of official statistics and forecasts for the South African economy. Importantly, these are specifically for the reference period considered by this research (2017) and the outer years for which the data was available.

Table 4-2: Macro forecasts 2018 - 2027

	2017	*2018-2022*	*2023-2024*	*2025-2027*
GDP	1.2%	0.5%	1.0%	2.4%
CPI	5.3%	2.8%	6.3%	5.5%
Real wage	4.4%	6.0%	9.4%	7.6%
Aggregate Employment	2.1%	-1.2%	0.6%	0.8%

Source: Statistics South Africa; Quantec

- **Population**: An annual population growth rate of 1% is assumed. Stats SA's 2022 mid-year population estimates show that the South African population expanded from R56m in 2016 to R56,8m in 2017. The same population growth rate is retained for outer years beyond 2017 as per the mid-year population projections of 2022. These estimates are critical in many aspects of government expenditure, particularly social security.

- **Real GDP:** According to Stats SA, the expenditure on GDP for South Africa expanded from R4.4tn in 2016 to R4.5tn in 2017. Based on this, real GDP is estimated to grow by 1.2%. Further, as indicated on Table 4-2, between 2018 and 2022, South Africa recorded a slowdown in annual average GDP growth rate (0.49%), weighed down by the economic contraction in 2020. Between 2023 and 2024, economists expect that the country's growth rate will pick up steam to an average annual growth rate of 1%, which will improve further to 2.4% between 2025 and 2027 (Quantec, 2022).

- **The Consumer Price Index (CPI)**: At 5.3% in 2017, South Africa's CPI in 2017 (5.3%) edged relatively lower than the 6.3% in previous year. This eased further to an annual average of 8.25% between 2018 and 2022. It is expected that CPI in South Africa will rise to 6.3% on average between 2023 and 2024 before easing to 5.5% between 2025 and 2027.

- **Aggregate employment:** Stats SA' s labour market dynamics of 2017 show that South Africa's aggregate employment expanded to 16.1m in 2017, up from 15.7m in 2016 (2.1% growth). Between 2018 and 2022, aggregate employment growth decelerated to -1.2%. Gradual recovery in employment is expected, at the rate of 0.6% in the period (2023 – 2024) and 0.8% from 2025 to 2017.

- **Terms of trade:** – Terms of trade increased by 4.5% in 2017, potentially leading to an increase in the current account deficit as exports reduce due to the rise in the price and imports increase due to the decrease in the price. Between 2018 and 2021, South Africa saw an average annual expansion of 4% in terms of trade, weighed down by a contraction in terms of trade in 2018.

- **Real wages:** Real wages increased by 4.4% in 2017 before spiking to 6%, 9.4% and 7% in 2018-2021, 2022-2024 and 2025-2027 respectively.

- **Households**: As is the case with the application of UPGEM in Bohlmann (2015), there is only one representative household in the model.

4.3 The policy closure

We impose changes on the forecast closure to prepare for the policy shock and endogenize naturally endogenous macro variables. Dixon and Rimmer (2002) consider this useful in that it allows macro variables to be affected by policy shocks being considered, thus making it easy for the impact to be measured. We provide further details for each macro variable below:

- *GDP*: We endogenize production via its linkages to the functions of factors of production.
- *Consumption*: As per Dixon and Rimmer's (2002) approach, consumption is endogenized through the link between GNP and the change in real public and private consumption. We endogenize consumption and exogenize average propensity to consume

- *Rates of return and investment*: We retain the endogeneity of rates of return, investment/capital ratio as in the forecast closure,
- *Technology* is exogenous hence it remains unchanged from the forecast simulation/base run
- Similarly, *real wages* remain fixed.
- *Employment* is endogenously explained by CPI-deflated pre-tax wages
- *CPI* is fixed but the exchange rate (phi) is endogenous
- The balance of trade is endogenous
- The exchange rate is endogenous to allow the foreign budget available for asset acquisition to be exogenously determined.
- The foreign budget available for asset acquisition is endogenous to allow it to be determined by changes in the average rate of return in the rest of the world.
- The real rate of interest on business borrowing is endogenous.

4.3.1 Policy shocks

We consider the following shocks to simulate the application of UPGEM-F.

4.3.1.1 1% reduction in monetary inflows to South Africa

We shock the model with a one percent reduction in monetary inflows to South Africa. As is the case with other financial agents, the rest of the world (Fgn) devotes budget for acquisition of financial assets. The base data shows that of the five financial instruments being considered by this research, the rest of the world mainly participates in loans, bonds and equity markets. This being the case, the assumed reduction in monetary inflows talks to a reduction in the foreign budget devoted to acquisition of bonds and equity as well as issuance of loans to local agents.

The shock is a once-off permanent reduction in monetary inflows. This shock assumes a downgrade in South Africa's sovereign credit rating, which significantly deters foreign investment in South Africa, thus leading to a reduction in monetary inflows. A downgrade in the credit ratings implies that the risk of payment defaults is high. This prompts caution in investors, and investment withdrawals in some cases. This is

supported by Mokoaleli-Mokoteli (2019), who argues that credit rating downgrades may lead to disinvestment from the economy, leading to deterioration in macroeconomic indicators. Almeida, Cunha, Ferreira and Restrepo (2017) also indicate that credit rating downgrades can trigger bond covenant violations, increases in bond coupons or loan interest rates, and forced bond repurchases.

In 2015, South Africa had a series of downgrades that exposed the country to a greater risk to private sector investment. Mugobo and Mutize (2016) show that South Africa's sovereign credit ratings were downgraded three times in a single year in 2015. By the end of 2015, both Standard and Poor (S&P) and Fitch rated South Africa BBB-[2] with a negative outlook. This led to a deterioration in the country's external debt to GDP ratio, a significant decrease in business confidence and investment, which subsequently led to poor economic performance. According to Mokoaleli-Mokoteli (2019), in emerging and transitional economies like South Africa, the market reacts significantly negatively to credit rating downgrades.

4.3.1.2 1% expansion of SARB assets

In pursuit of its mandate to maintain financial stability in the country, SARB may choose to buy securities or bonds, issue loans and advances to commercial banks, or to participate in repurchase agreements and special drawing rights when necessary. We simulate a permanent one percent increase in SARB's financial assets to stimulate the economic activity following a reduction in monetary inflows discussed in section 4.3.1.1.

In terms of the mechanics of the model, the simulation directly affects budget allocations for loans, bond purchases as well as gold. The assumed causal effect of the increase in SARB assets is outlined under a-priori expectations in the results chapter

[2] One notch above the non-investment grade

below; however, it suffices to say that the increase stimulates more money circulation, which, if not controlled, can lead to inflationary pressure in the economy.

4.4 Summary

This chapter presented the design of model simulations, the results of which are presented in the next chapter. Closure settings were presented, and two policy shocks outlined. Four closures were defined in section 2.1.1 however not all of them were used in this research. It is not compulsory to apply all existing closures in a single CGE modelling exercise, hence only relevant closures were considered.

A downgrade in South Africa's sovereign credit ratings was presented as the first shock. It was assumed that the downgrade would be best proxied by a reduction in monetary inflows to South Africa. Therefore, the simulation was structured as a reduction in monetary inflows and not the explicit credit ratings downgrade. The second shock was an increase in SARB assets. This was considered a counteraction to the first shock, through monetary policy.

The closure settings were specified for the simulations. The baseline forecast closure was presented as a precursor for the policy simulation. The financial and non-financial variables were described according to their assumed state (endogeneity or exogeneity). These portrayed the assumed environment for the simulations. Forecasts were provided for some of the macroeconomic variables. These show the assumed future trajectory for the economy.

5 SIMULATION RESULTS

5.1 Introduction

This chapter presents the results of the policy simulations. These simulations are run under the macroeconomic conditions and assumptions described in section 4.2. Importantly, as also indicated in the previous chapters, these simulation results portray the deviation from the unperturbed business-as-usual baseline forecast caused by the policy shocks. For ease of navigation of the content and comprehension of results, we initiate the discussions with a-priori expectations for each simulation. These allow easy comparison and interrogation between what could have intuitively been expected and the actual results from the modelling simulations.

5.2 A-priori expectations

5.2.1 Simulation 1: Credit ratings downgrade

As outlined in the previous chapter, in the first simulation, we impose a reduction in foreign monetary inflows due to an assumed downgrade in South Africa's sovereign credit rating. This effectively implies that South Africa's risk of default on debt payments is increased. This is equivalent to an increase in the country's investment risk profile. This being the case, we base our a-priori expectations on the macro results of an equivalent standard UPGEM model in which an increase in investment risk, specifically, a 1% increase in the required rate of return, is simulated. The simulation is run over a five-year period from 2017 to align to UPGEM-F. Table 5-1 presents the key results from the simulation. We refer to the same results later in the chapter, to illuminate the value of UPGEM-F.

Table 5-1: % deviations in key macro variables of the UPGEM standard model

	t+1	t+2	t+3	t+4
Investment	-4.70	-5.05	-5.26	-5.36
Real GDP	-0.50	-0.71	-0.90	-1.08
Employment	-0.53	-0.63	-0.70	-0.76
Private Consumption	-0.87	-0.89	-0.90	-0.93
Public Consumption	-0.87	-0.89	-0.90	-0.93

A 1% increase in the required rate of return has a permanent damage on investment and real GDP. Theoretically, an increase in required rate of return implies an increase in the cost of capital. The required rate of return often increases to compensate the increased investment risk (Gardner, McGowan & Moeller, 2010) which in a way discourages investment. From Table 5-1, investment decreases and worsens in each of the four years post the shock. This leads to consistent annual decreases in GDP throughout the years being considered. Major reductions are in the construction industry because of its linkages to investment. Annual decreases in GDP lead to reductions in employment and consumption. Similar macro results are expected from the credit ratings downgrade simulation as it is a risk to investment. Additionally, the financial module may trigger the following a-priori expectations:

- An increase in interest rates on borrowing as lenders become cautious about the likelihood of the country not being able to meet its financial obligations. With the expected increase in the interest rates, the price of bonds is expected to decrease given the inverse relationship between the two, as explained in section 2.2.3.4 of the BOTE model.
- A spike in market bond yields as a result of a decrease in the price of bonds.
- Withdrawals of investments or disinvestments as investment becomes less enticing (riskier). This could include investment in financial shares.
- Weakening of the exchange rate due to investment outflows. As shown by equation E-2.26 of the BOTE, the exchange rate is the ratio of the foreign currency to the domestic currency. A reduction in monetary inflows from the rest of the world will lead to a reduction in the exchange rate.
- Reduced spending by industries as borrowing becomes more costly.
- Weak overall economic performance due to reduced investments and spending.

In simulating the economic effects of a downgrade in South Africa's credit rating, we impose an explicit shock on the monetary flows into South Africa, from the rest of the world. This is with the view that a downgrade in creditworthiness deters investment from the rest of the world, relative to an unperturbed business-as-usual scenario, hence foreign monetary or investment inflows fall.

5.2.2 Simulation 2: Expansion of SARB assets

In the second simulation, an expansion of SARB assets is considered to counter the effects of the credit ratings downgrade discussed in section 5.2.1. The simulation specifically assumes a one percent (1%) increase in the budget available for asset accumulation by SARB. We assume that the increase in the budget is directed to domestic assets. SARB's primary responsibility is to regulate and maintain financial stability in the country through monetary policy. In the pursuit of this goal, SARB buys and sells various financial assets, including both foreign and domestic government bonds. We note from the database that foreign assets comprised over 88% of SARB's total assets in 2017. Of these, 10% was gold and 90% other assets which included foreign currency reserves, foreign government bonds and special drawing rights. On the other hand, SARB's domestic assets were predominantly liquidity provided to banks in the form of loans. Advances and investments in instruments such as government bonds made up about 11% of domestic assets in the reference period.

An expansion in SARB assets intuitively implies that banks may likely want to reduce lending rates, thus making it easy for other agents to acquire credit. This in turn stimulates borrowing and increases consumption and ultimately GDP. From this simulation, we are anticipating the following:

- A reduction in interest rates as more money circulates. When more money becomes available for borrowing, lenders may want to lower interest rates to make borrowing more attractive. As indicated by equation E-2.20, i=f(M2), the interest rate is a function of money supply. Participation of SARB in market operations through the purchase of bonds as part of monetary policy prompts an increase in money supply and subsequently, a decrease in the interest rates, and vice versa.
- An increase in industry production as money becomes easily accessible.
- An increase in consumption, which may likely lead to higher inflation in the short run. An increase in money supply pushes household income higher. This increases household consumption, as confirmed by equation E-2.7 (C=APC*HINC).

- An increase in household savings, following an increase in household income. The APC increases at a decreasing pace when household income increases, thus implying that the propensity to save increase.
- A rise in household investment as savings increase. From the BOTE, equation E2.18 [A_T_1(s,f,Hhlds)=f(SAV)] shows that households accumulate financial assets when they have savings.
- Increased aggregate demand, owing to increased industry production and household consumption. The increased aggregate demand stimulates the need for more workers in the short run.

5.3 Simulation 1: The impact of South Africa's sovereign credit ratings downgrade

This section discusses the impact of a downgrade in South Africa's sovereign credit ratings. The downgrade is represented by a benchmark 1% decrease in monetary flows from the rest of the world into South Africa. This is based on the view that a downgrade in the credit ratings discourages investment into the country, leading to a decrease in capital inflows. As discussed in Chapter 4, evidence from recent credit ratings downgrades in South Africa supports this sequence of events.

We start the discussion with the first-round effects of decreased monetary flows into South Africa and conclude with the second-round effects. In the context of this paper, the first-round effects are explained by the change in the GDP and the associated variables as per the BOTE model. Examples of the variables for the first-round effects include investment, household consumption, government consumption, exports, imports, employment and capital rental. The second-round effects explain the extended impact of the shock on variables that do not directly affect the GDP as per the BOTE model. The variables linked to the second-round effects are prices and acquisitions of financial instruments. The distinction between first and second round effects eases the flow of discussions and differentiates between the direct and indirect impact of the shock.

5.3.1 First-round effects of a decrease in monetary inflows to South Africa

As highlighted in section 5.2.1, a downgrade in the credit rating of South Africa implies a decrease in its creditworthiness and monetary inflows from the rest of the world. This immediately and directly affects the interest rate, investment, as well as the broader economic performance. The flow of first-round effects is shown below.

Image 5-1: The flow of first-round effects

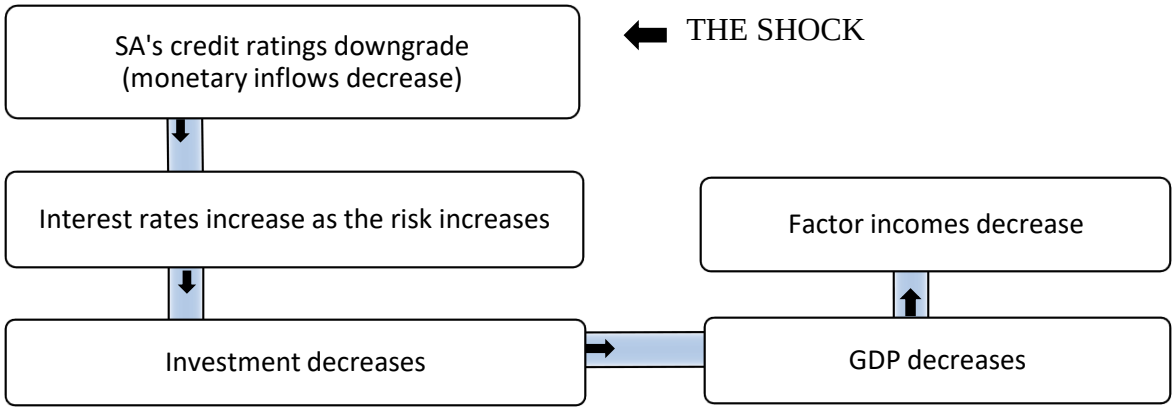


Table 5-2 provides a summary of the changes in macro variables following a downgrade in South Africa's sovereign credit ratings, proxied by a reduction in monetary inflows.

Table 5-2: % or Rm deviations in macro variables

	t+1	t+2	t+3	t+4
Investment	-0.58	0.17	0.37	0.41
Household consumption	-0.40	-0.16	-0.10	-0.09
Exports	-0.38	-0.38	-0.34	-0.29
Imports	-0.38	0.00	0.10	0.12
Government consumption	-0.40	-0.16	-0.10	-0.09
Real GDP	-0.43	-0.20	-0.13	-0.10
Employment	-0.79	-0.33	-0.22	-0.18
Average capital rental	-1.84	-1.00	-0.88	-0.95
Average land rental	-1.67	-1.29	-1.23	-1.25
Real Interest rate change	0.02	-0.01	0.00	0.00
Consumer Price Index	-1.24	-0.87	-0.84	-0.91
Household saving (Rm)	-943.77	3,980.90	9,941.80	18,983.60
Current account deficit (Rm)	1,408.20	4,510.80	6,545.30	7,364.30
Government saving (Rm)	-15,853.20	-15,889.10	-22,057.20	-33,001.30

From Table 5-2, it is evident that the interest rate increases with a decrease in monetary inflows. A decrease in the creditworthiness of a country is viewed as an increase in the risk, which investors want to be compensated for, often through high interest rates. From the results, this is visible from an increase in the real interest rate by 0.02 percentage point following a decrease in monetary inflows by a benchmark 1%.

A reduction in financial inflows leads to a decrease in money supply and an increase in interest rates. In the context of sovereign credit ratings, a downgrade leads to an increase in the risk of default; therefore, interest rates rise to counter the increased risk. This is consistent with Almeida, Cunha, Ferreira and Restrepo (2017), who indicate that a sovereign ratings downgrade leads to a rise in the cost of borrowing, thus propelling firms to reduce reliance on credit markets. Montes and Maia (2023) indicate that an economy that is in a sovereign risk deterioration period does not only encounter difficulties obtaining international funding but also faces higher costs to finance itself domestically.

Conversely, as stated by Doojav (2008), large capital inflows into an economy finance a higher economic growth, thus leading to among other things, a reduction in the

domestic interest rate. As noted in section 2.2.4.4, interest rates reduce with an increase in money supply and vice versa. Financial inflows increase money supply and therefore contribute to a reduction in the cost of borrowing. Beyond the period of the shock, the interest rate decreases and normalises to zero as the economy moves to the base.

5.3.1.1 Investment slumps with credit ratings downgrade

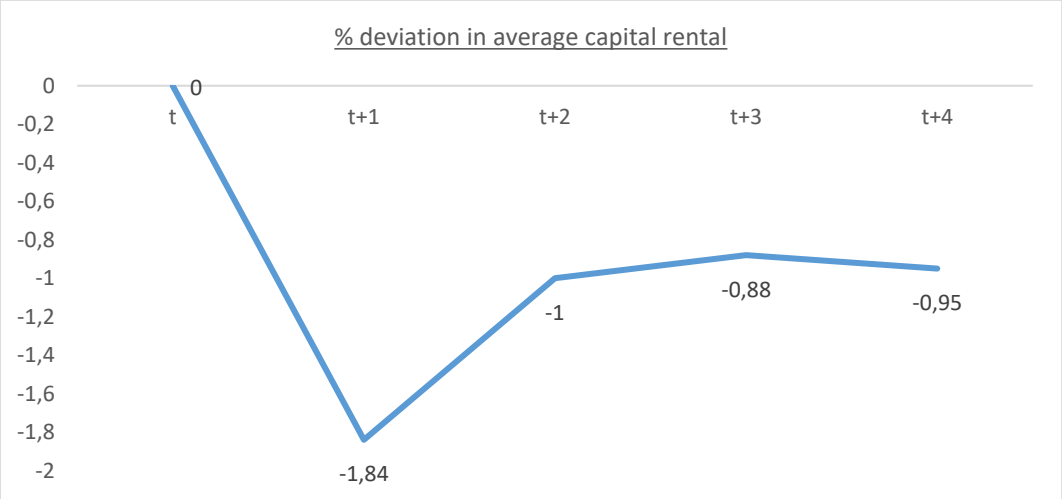
As shown by Table 5-2, a reduction in monetary flows into South Africa from the rest of the world adversely affects investment. A decrease of 1% in South Africa's monetary inflows reduces investment by 0.58%. In theory, this implies that capital reduces with decreased monetary inflows. Equation E-2.16, A_T_1(IND,f,d)=f(INV_IND), links the acquisition of industry liabilities to investment. Industries acquire liabilities to invest; therefore, if acquisition of liabilities is restricted, investment also becomes constrained. It becomes difficult for businesses to acquire funds for investment when funds from abroad are limited, and interest rates are high. As shown by equation E-2.7, I=f(RoR,i), investment depends on the interest rate; the higher it is, the more costly investment is, and the more unfavourable borrowing conditions are. The converse is true. An increase in monetary flows expands the pool of funds that can be accessed for investment purposes.

Investors become more cautious and risk-averse when monetary inflows reduce, particularly because of a downgrade in the credit rating. The investment level decreases as some investments are either withdrawn or delayed. This is echoed by Almeida et al. (2017), who state that firms reduce investment as sovereign credit ratings downgrade. The cost of capital increases with a downgrade in credit ratings as discussed in section 5.2.1, and the uncertainty about the returns and the performance of the economy escalates. These deter new investments.

The simulation results show that compared to other components of expenditure on GDP, investment is the most negatively affected (Table 5-2). This is because, compared to other components of expenditure on GDP, investment largely depends on the

interest rate. The results also show a decrease in the average capital rental (Figure 5-1) by 1.84%. This is consistent with the decrease in investment as it signifies less use of capital. Beyond the period of the shock, the use of capital increases slightly but remains significantly low. This implies that the shock has lasting effects on the use of capital.

Figure 5-1: Deviation in average capital rental (%)



5.3.1.2 A fall in investment prompts a contraction in GDP

The BOTE equation E-2.7 ($GDP = C + I + G + X - M$) shows that the GDP is influenced by investment, household and government consumption and net foreign trade. The net foreign trade is the residual that keeps the GDP identity balanced.; with imports mainly being driven by the exchange rate while exports depend on the consumer price index. From the simulation results, investment is the main driver of the contraction in GDP. This is because the simulated shock (monetary inflows) has a relatively more direct impact on investment than other components of expenditure on GDP therefore it has the most influence on the movement of GDP.

As shown by Table 5-2, GDP falls by 0.43% following a decrease of 0.58% in investment. In the long run, the GDP growth improves slightly, reaching -0.1% in time t+4. The economic output decreases across all industries, as shown in Figure 5-2. However,

industries that bear the most brunt of the shock include radio and TV, rubber, electrical machinery, insurance services, textile and footwear, glass, other financial services, plastic, transport equipment and construction. These industries, except transport equipment and construction, are consumption and trade-related; therefore, they are likely to be affected by shocks in the short run. Transport equipment and Construction are closely linked to investment; hence, it is unsurprising that they are among the biggest losers. On the other hand, real estate, other manufacturing, petrol refinery, coal and water industries are relatively the least affected. This could likely be because it is not practical to change decisions on these abruptly as they often involve extensive activities and projects.

In the long run (t+4), output increases in capital-intensive industries like construction (Figure 5-3). The discrepancy between Figures 5-2 and 5-3 may be attributed to short-run supply elasticities. As highlighted in section 2.2.1, capital stock is fixed in the short term, hence movements are restricted in capital-intensive industries. Over time, the performance of these industries changes in line with movements in capital stock.

Figure 5-2: Deviation in the output of industries at period t+1 (%)

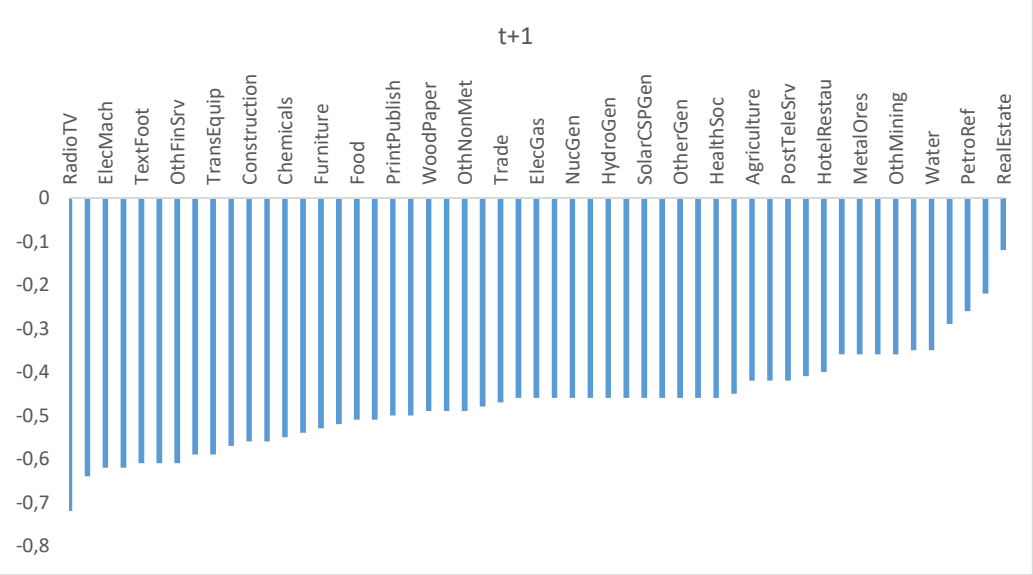
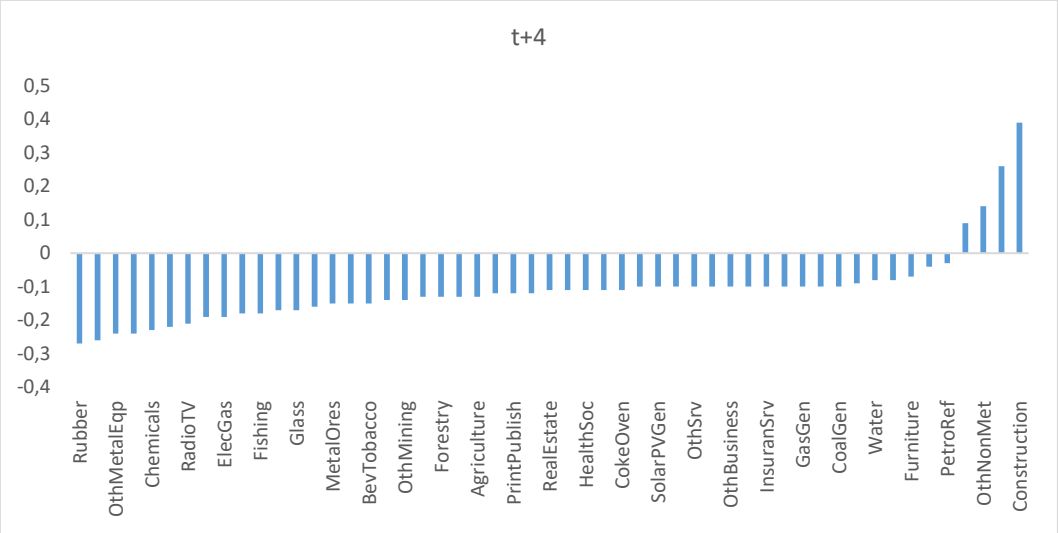


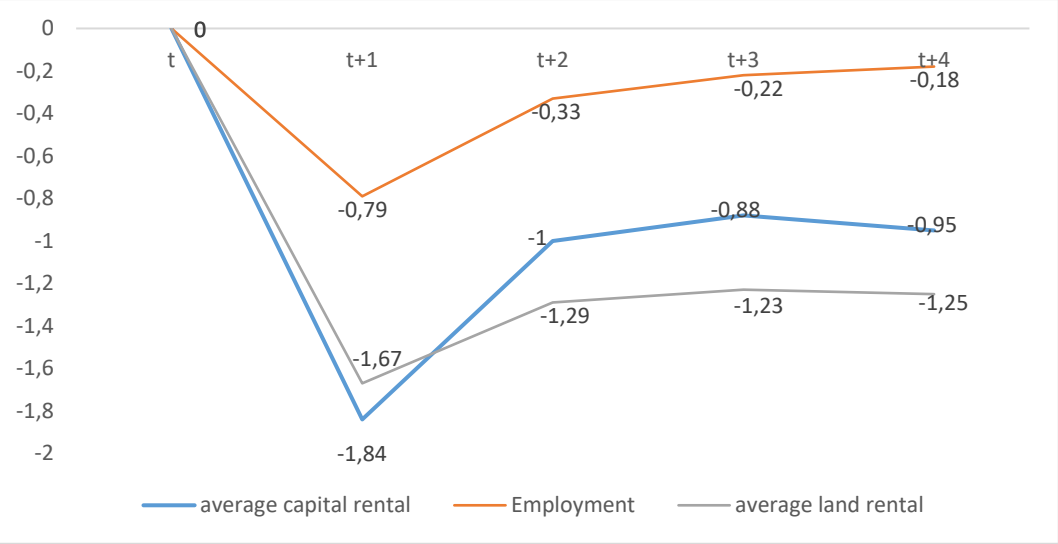
Figure 5-3: Deviation in the industry output at period t+4 (%)



Other results show that consistent with the decrease in aggregate demand, factor incomes decrease as employment and the use of capital and land decrease. Less aggregate demand prompts less use of factors of production, as shown in Figure 5-4. Both capital and land rentals reduce by more than 1.5% while employment declines by 0.79%. This research assumes sticky wages in the short run; therefore, movements in the labour market, including those in the cost of labour, are determined by changes in employment.

Employment decreases (increases) with a reduction (increase) in business activity, as shown by Mitchell and Muysken (2006). Low investment and muted economic activity lead to layoffs and reduced employment opportunities as businesses try to manage costs. The reduction in investment discussed in 5.2.1 implies that, among other things, business expansions are halted or cancelled; therefore, plans for new jobs are also cancelled.

Figure 5-4: Deviation in average factor rentals and employment (%)



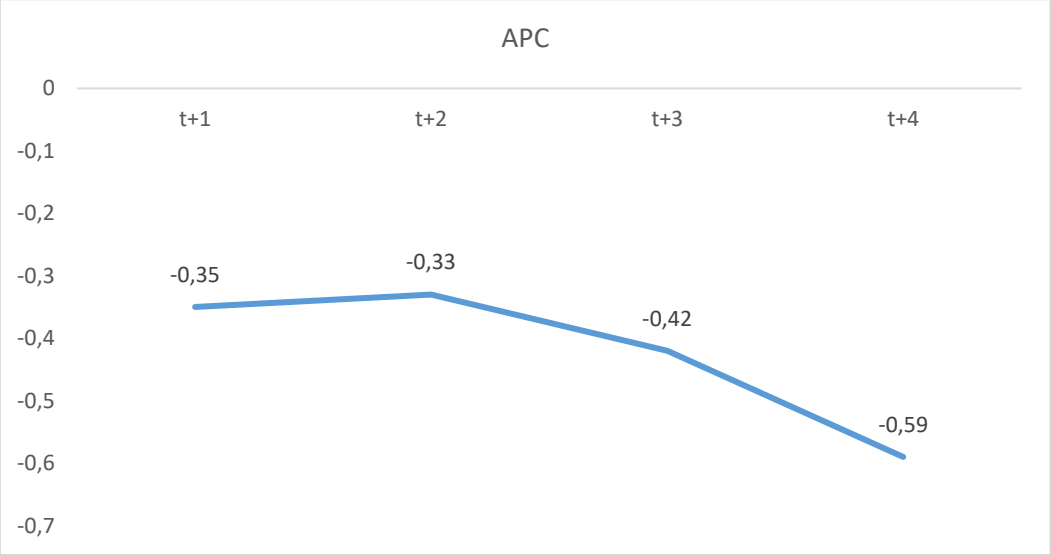
5.3.1.3 Households cut back on spending as the economy contracts.

Household consumption reduces by 0.4% as the economy contracts by 0.43% (Table 5-2). Household consumption is dependent on economic conditions as discussed in section 2.2. As shown by equation E-2.9 $[\text{HINC} = \text{GDP} * \text{f(TofT)} * (1 - \text{TQ}) - (\text{BTRW.D}) * \text{TL} - (\text{NFLH} * \text{R})]$, household disposable income is defined as earnings after deduction of taxes and foreign liabilities to households. Household income and the propensity to consume determine household consumption as indicated by equation E-2.7 $[\text{C} = \text{APC} * \text{HINC}]$. An increase (decrease) in either household income or the average propensity to consume leads to an increase (decrease) in household consumption.

The decrease in GDP sparks low confidence and uncertainty about economic and financial prospects. This influences households to become cautious about spending. From the results, the contraction in the economy by 0.43% leads to a reduction in employment by 0.79% (Table 5-2). As fewer people become employed, household income reduces, thus prompting a decrease in expenditure on goods and services. Additionally, increases in interest rates restrict borrowing; hence, it becomes difficult for households to acquire credit. With less financial security, households are left with no option but to cut spending. The propensity to consume reduces as the economy contracts. This is confirmed by the decline in average propensity to consume by 0.35%,

shown in Figure 5-5. The decline in the average propensity to consume worsens significantly beyond of the shock onwards. This implies that the impact of the economic contraction has devastating effects on households.

Figure 5-5: Deviation in the average propensity to consume (%)

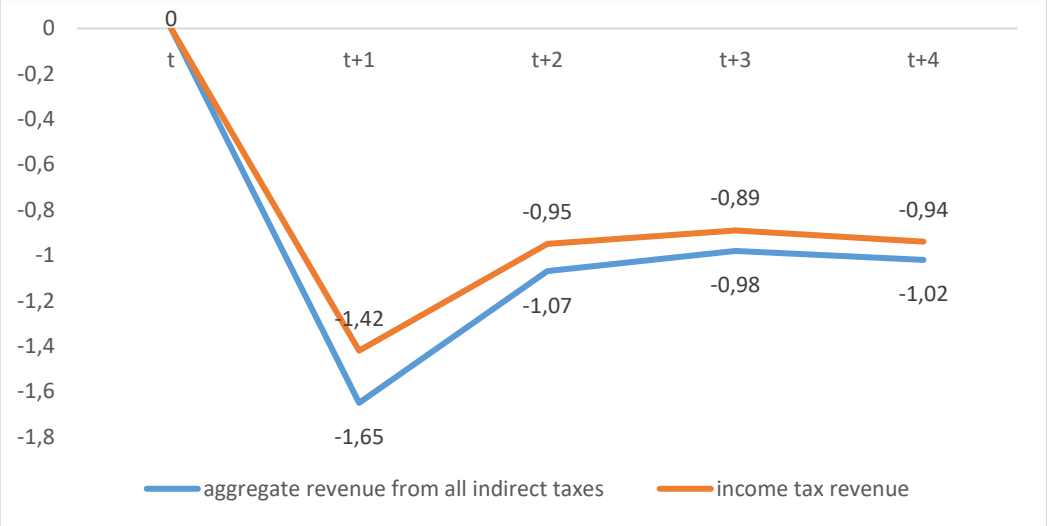


5.3.1.4 Government expenditure reduces with a decline in household consumption

In the closure settings, we let government expenditure follow household consumption. This is because households are the primary consumers of public goods and services. Table 5-2 shows that government expenditure reduces by 0.4%. This is consistent with the decline in household consumption. When the buying capacity of households decreases, the government is forced to reduce the provision of public goods and services.

On the other hand, the government relies on tax revenue and international funds; therefore, a decrease in monetary inflows implies that the government is constrained from receiving funds from abroad. Additionally, revenue from taxes reduces as employment reduces. This leads to a reduction in overall production and spending. Figure 5-6 confirms the decline in tax revenue due to the shock and the slow recovery in the medium to long term. This compounds the spending constraints by the government.

Figure 5-6: Deviation in tax revenue (%)



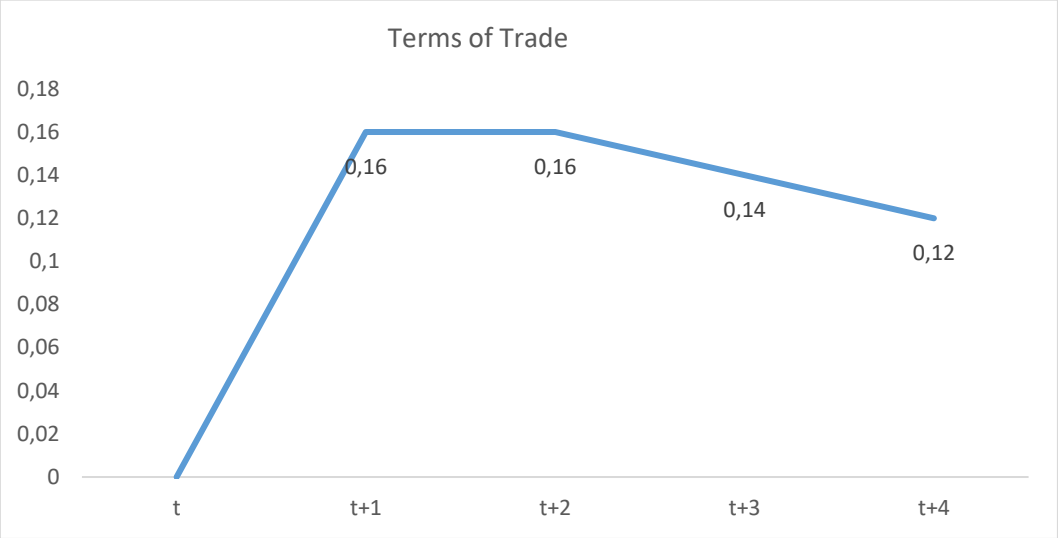
5.3.1.5 International trade declines but has a muted effect on the GDP

As indicated by the BOTE equation E-2.7, international trade is a critical part of the GDP, usually used to balance the GDP identity. Depending on the prices as shown by [X = f(PX, F_X)] and [M = f(TofT, TWS)], exports and imports can change, thus contributing to the expenditure on GDP. Exports are positively related to GDP while imports are inversely related to the GDP. A decrease in exports impacts the economy negatively while a decrease in imports adds to the expenditure on GDP. The results of the simulation show that exports and imports decrease by the same margin (0.38%) (Table 5-2). The exchange rate increased by 1.3, thus increasing the cost of imports. On the other hand, exports decrease with a decrease in CPI, pointing to a lagged export demand to decreased inflation.

The import equation in E-2.7 shows that the volume of imports is dependent on the terms of trade. Janus, Riera-Crichton and Tarufelli (2022) define terms of trade as the price ratio of exports to imports. Improvements in the terms of trade imply that the economy needs less exports to pay for imports. Conversely, a deterioration in the terms of trade implies that more exports are needed to pay for imports. From the simulation results, import prices decline relatively more than export prices. This leads to an increase in the terms of trade, as indicated by Figure 5-7, implying that more imports can be purchased by the same amount of exports. This augurs well for the economy and

if sustained, there could be a trade surplus. However, overtime, the terms of trade decrease constantly as the economy moves back to the base.

Figure 5-7: Deviation in terms of trade (%)



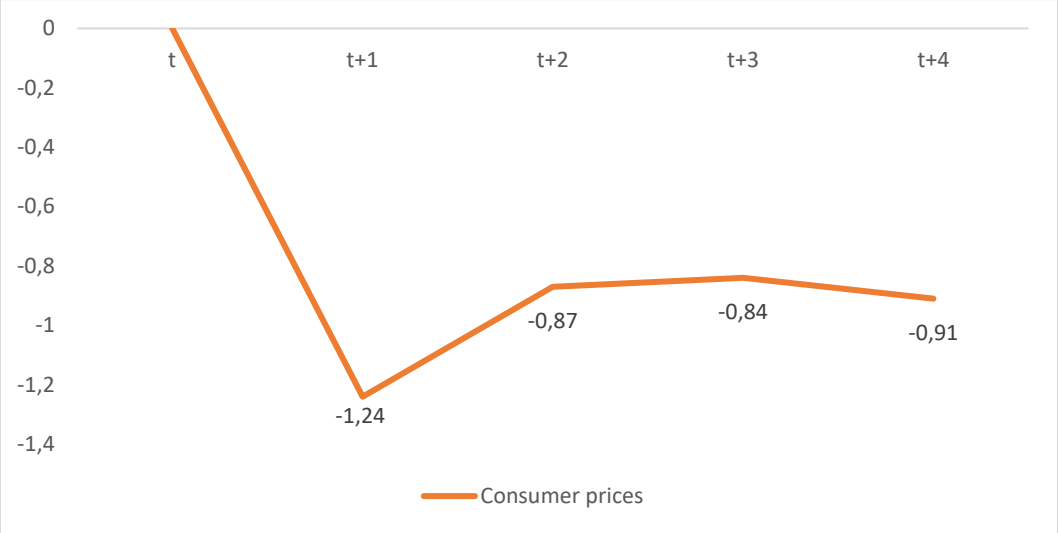
5.3.2 Second round effects of reduced monetary inflows

This section outlines a chain reaction of economic occurrences (second-round effects) triggered by first-round effects of reduced monetary inflows. We specifically consider changes in consumer prices, acquisition of financial instruments and financial flows.

5.3.2.1 Consumer prices reduce as aggregate demand decreases

Following a decrease in aggregate demand, consumer prices reduce by 1.24% as indicated by Figure 5-8. This is relatively more than the decrease of 0.43% in expenditure on GDP, which indicates that prices are highly responsive to changes in demand. A reduction in aggregate demand for goods and services implies that consumers are spending relatively less; therefore, as a counter-response, industries reduce prices to encourage spending.

Figure 5-8: Consumer prices (% deviation from the baseline)

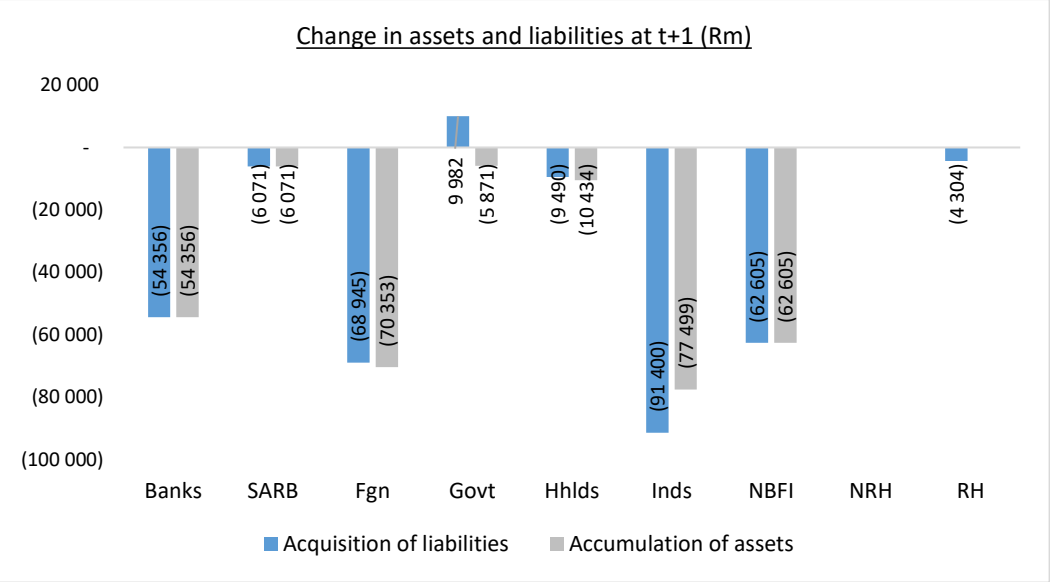


5.3.2.2 Agents acquire fewer financial instruments as monetary inflows decrease

A reduction in monetary inflows leads to decreases in both accumulation of assets and acquisition of liabilities (Figure 5-9). All agents accumulate relatively fewer assets as monetary inflows decrease. This is largely due to weak economic conditions and bleak prospects for economic growth and returns, which make it difficult for agents to set aside funds for investment amidst high interest rates. Equation E-2.11 $[A(s,f,d) = f\big(R(s,f,d), BA(d)\big)]$ shows that acquisition of financial instruments depends on the available funds and the returns; therefore, constrained access to funds restricts acquisitions.

Agents issue fewer liabilities as the borrowing capacity becomes limited from both the supply and demand sides. From the supply side, reduced monetary inflows imply less credit capacity and resources available. Where capacity exists, lenders become cautious about extending credit amidst constraint economic conditions. On the demand side, a decrease in monetary inflows increases the risk of borrowers not meeting repayment obligations.

Figure 5-9: Change in assets and liabilities



The largest relative decreases in asset accumulation and acquisition of liabilities are in industries. This explains the high knock-on effects of the shock investment discussed in section 5.3.1.1. Changes in the acquisition of liabilities by industries impact investment directly, as shown by equation E-2.16 [$A\_T\_1(Ind, f, d) = f(INV\_IND)$]. A reduction in liabilities leads to a decrease in investment and vice versa. This is because industries issue liabilities primarily to finance investment. From the simulation results, the 1% decrease in monetary inflows leads to industries acquiring R91.4bn fewer liabilities. On the other hand, given the constrained monetary inflows, industries produce relatively less output. As indicated by equation E-2.17 [$A\_T\_1(s, f, Ind) = f(GDP)$], asset accumulation by industries is directly linked to the country's economic output. A decrease in industries' assets is associated with a reduction in production capacity and the overall economic output, and vice versa. The simulation results show a reduction of R77.5bn in industry assets following the decrease in monetary inflows.

Commercial banks and NBFI reduce their acquisition of liabilities and accumulation of assets by R54.4bn and R62.6bn respectively, as monetary inflows decrease by 1%. These financial institutions largely depend on the financial health of other agents. A reduction in monetary inflows limits the ability of borrowers to service existing loans and acquire new ones. This implies that demand for financial products and services

decreases with a decrease in monetary inflows; therefore, financial institutions accumulate fewer assets.

Households accumulate R10.4bn fewer assets and acquire R9.4bn less liabilities. As seen in section 5.3.1.3, household consumption declines, suggesting that there is little to no room for savings. Equation E-2.18 [A_T_1(s, f, Hhlds) = f(SAV)] shows that households acquire assets only when savings exist. This being the case, the constrained savings that result from reduced monetary inflows lead to a reduction in assets accumulated by households. Likewise, as indicated by equation E-2.12 [A_T_1(Hhlds, f, d) = f(INV_HOUS)], acquisition of liabilities by households is linked to investment in real estate; hence, a reduction in monetary inflows and the subsequent reduction in the value of real estate assets discourages households from acquiring liabilities to invest in housing equity.

Contrary to the rest of the agents, the government acquires more liabilities amidst reduced monetary inflows. This is because the provision of government services needs to continue despite unfavourable economic conditions. With restricted funds from the rest of the world, the government makes alternative plans to borrow to avoid disruptions in the delivery of public services.

5.3.2.3 Limited acquisitions prompt a reduction in financial flows

The constrained accumulation of assets and acquisition of liabilities lead to an overall reduction in flows. We provide nuances on how the shock affects each financial instrument below.

5.3.2.3.1 Deposits and loans decrease as borrowing conditions tighten

As indicated by Table 5-3, the reduction in monetary inflows leads to a decrease of R39bn in deposits made with commercial banks. This is consistent with the contraction in the economy and investment. This is in line with Dipasha (2016), who identified a positive association between economic growth and various aspects of the financial economy such as usage of banking services like deposits.

The decrease in deposits cuts across all agents. Industries account for 72% of the decrease, the rest of the world and the government contribute 12% and 9% respectively, while inter and intra-banking contribute 3%, the same contribution from NBFI. Households and SARB constitute 1% of the decrease.

Tight borrowing conditions lead to a R44,3bn reduction in commercial bank loans (Table 5-3), which increases to R47,8bn in time t+4 (section 8.4 Appendix). Of the total reduced loans, 63% are loans to industries, 11% are for RH, 9% for the rest of the world, 7% for NRH% and 5% for households. Households reduce loans from the banks and NBFI by R2,1bn and R319m respectively. Industries cut loans from the banks and rest of the world by R21,9bn and R3,3bn respectively. NBFI reduce loans from industries by R8,698bn, and we associate this with a reduction in household demand for loans. SARB loans to commercial banks decline by R515m while commercial bank deposits to SARB decrease by R1,1bn. The government acquires R3m worth of loans from commercial banks and reduces the loan liabilities to the rest of the world by R39m. The government borrows unceasingly despite the dire economic conditions to address the continuous need for public goods and services.

Table 5-3: Flows in deposits and loans (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	Total
Banks	-989	-515	-4,668	-3,523	-312	-28,362	-1,054	0	0	***-39,423***
SARB	-1,067	0	-93	-1985	0	0	-86	0	0	***-3,230***
Fgn	-4,174	-1	0	-314	0	-1,532	0	0	0	***-6,021***
Govt	3	0	-39	0	0	0	0	0	0	***-36***
Hhlds	-2,143	0	0	0	0	0	-319	0	0	***-2,462***
Inds	-27,913	0	-3,279	0	0	0	0	0	0	***-31,192***
NBFI	0	-59	0	0	0	-8,698	0	0	0	***-8,756***
NRH	-3,058	0	0	0	0	0	0	0	0	***-3,058***
RH	-4,923	0	0	0	0	0	0	0	0	***-4,923***
Total	***-44,265***	***-574***	***-8,078***	***-5,822***	***-312***	***-38,592***	***-1,459***	***0***	***0***	***-99,103***

5.3.2.3.2 Notes and coins decrease as interest rates increase

Table 5-4 shows a reduction of R854m cash in circulation. Commercial banks, households and NBFI hold fewer notes and coins as interest rates increase. The opportunity cost of holding money increases with an increase in the interest rate; therefore, agents optimise and carry less cash. In the long run (time t+4), banks and NBFI continue carrying less cash while households increase their cash-holding following a slight improvement in the economic conditions as shown in Table 5-2.

Table 5-4: Flows in notes and coins (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	Total
Banks	0	0	0	0	0	0	0	0	0	***0***
SARB	-433	0	0	0	-158	0	-264	0	0	***-854***
Fgn	0	0	0	0	0	0	0	0	0	***0***
Govt	0	0	0	0	0	0	0	0	0	***0***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	0	0	0	0	0	0	0	0	0	***0***
NBFI	0	0	0	0	0	0	0	0	0	***0***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***-433***	***0***	***0***	***0***	***-158***	***0***	***-264***	***0***	***0***	***-854***

5.3.2.3.3 Households make non-housing equity withdrawals to increase housing equity

Table 5-5 shows that equity declines across all agents except the housing industry. Overall, equity assets and liabilities decline by R165,8bn. The decline in liabilities is mainly driven by equity issued to the rest of the world (R55bn), NBFI (R49bn) and industries (R44,9bn). Equity assets decrease primarily due to declines in equity owned by NBFI and the rest of the world, each with -R57bn difference from the base year.

Households withdraw equity from NBFI to reduce equity liabilities owned by the rest of the world and increase housing equity. Household-owned equity held in NRH increases relatively more than that held in RH, suggesting that households pay more towards property to mitigate elevated interest rates.

We attribute the cross-cutting decline in equity to weak economic conditions. The contraction in GDP and unemployment discussed in section 5.3.1.2 prompts equity withdrawals.

Table 5-5: Equity flows (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	Total
Banks	0	0	-4,872	0	0	-7013	0	0	0	***-11,885***
SARB	0	0	0	0	0	0	-1,539	0	0	***-1,539***
Fgn	-1,379	0	0	-49	0	-24928	-28,718	0	0	***-55,073***
Govt	0	0	-1	0	0	0	0	0	0	***-1***
Hhlds	0	0	-7,028	0	0	0	0	0	0	***-7,028***
Inds	-2,450	-73	-15,780	0	0	0	-26,636	0	0	***-44,939***
NBFI	0	0	-29,122	0	-13,642	-6,327	0	0	0	***-49,091***
NRH	0	0	0	0	3058	0	0	0	0	***3,058***
RH	0	0	0	0	620	0	0	0	0	***620***
Total	***-3,829***	***-73***	***-56,803***	***-49***	***-9,964***	***-38,268***	***-56,893***	***0***	***0***	***-165,879***

5.3.2.3.4 Bond issuance decreases across the board

As shown by Table 5-6, all bond-issuing agents, except the government, decrease the issuance of bonds. The government increases debt securities held by banks, SARB and NBFI by R1,1bn, R34m, and R9bn respectively; and decreases foreign bonds R189m. This confirms the government's continuous need for funding for bulk service delivery despite the unfavourable economic conditions.

Table 5-6: Bond flows (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	Total
Banks	-218	0	-210	0	0	-639	-1,980	0	0	***-3,047***
SARB	-1	0	0	0	0	0	-1	0	0	***-2***
Fgn	-333	-4,594	0	-1	0	0	-2,060	0	0	***-6,987***
Govt	1,147	34	-189	0	0	0	9,028	0	0	***10,019***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	-6,293	0	0	0	0	0	-8,976	0	0	***-15,269***
NBFI	0	0	-4,758	0	0	0	0	0	0	***-4,758***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***-5,698***	***-4,560***	***-5,157***	***-1***	***0***	***-639***	***-3,989***	***0***	***0***	***-20,044***

5.3.3 The impact of a downgrade in South Africa's credit rating in summary

A decrease in South Africa's creditworthiness and the subsequent reduction in monetary inflows prompt an increase in the interest rate. The credit ratings downgrade increases the risk of default and discourages investment. In response, SARB increases the interest rate to attract investment eroded by the increased uncertainty and risks associated with the credit ratings downgrade. The increased interest rate increases the cost of investment and further discourages investment. This leads to a decrease in the GDP, which prompts decreases in private and public consumption and international trade.

The constrained credit makes it difficult for agents to acquire liabilities. For industries, the reduced liabilities restrict investments. Low investment levels impose further difficulties on business expansions and employment of new staff and/or retention of the existing staff. This triggers layoffs and reduces the aggregate employment level. The industry output decreases across the board. In the short run, the biggest losers are radio and TV, electrical machinery, textile and footwear, other financial services, transport equipment and construction. Contrarily, real estate is the least affected. In the long run, capital-intensive industries such as construction and cement are the biggest winners. We attribute this to the macro assumption of fixed capital in the short-run.

It is worth noting that the macro results are consistent with those of a standard UPGEM model; however, UPGEM-F provides a nuanced understanding of the financing mechanism. For instance, the theory of UPGEM-F shows that industries acquire funding for investment purposes. This funding occurs through equity and borrowing, therefore, movements in the required rate of return and interest rates influence investment decisions. Increases in either of the two increase the cost of investment funding. This increases the liabilities of industries; therefore industries react to this by cutting down on investments, thus adversely affecting the overall GDP. These details are not obvious from a standard UPGEM model but are explicit from UPGEM-F.

5.4 Simulation 2: The impact of expansion of SARB assets

In this section, the impact of an expansion of SARB assets by a benchmark 1% is discussed. The discussion commences with a look at the first-round effects to show the immediate impacts of the shock. Subsequently, the second-round effects of the shock are discussed to show the indirect and lagged effects of the shock in the economy.

5.4.1 First-round effects of expansion of SARB assets

As indicated in section 5.2.2, an increase in SARB assets includes expanding not just monetary policy securities (government bonds) but also bank refinancing and SARB-owned foreign assets. In other words, it directly increases liquidity in the economy, resulting in more money being injected into the economy (equivalent to quantitative easing policies used elsewhere in the world).

We summarise the first-round effects of this increase in liquidity in the schematic below and provide details of the impacts on each variable in the respective sections to follow. In the current context, first-round effects refer to the immediate impact of the shock on investment and GDP via the channels illustrated in the BOTE model as per Image 5-2. At first, the increase in liquidity prompts a fall in the interest rate. This leads to an increase in investment, which in turn, stimulates an increase in the GDP from both the income and expenditure sides. An increase in the GDP leads to increases in private and public consumption as well as international trade, with labour and capital increasing accordingly.

Image 5-2: BOTE channels

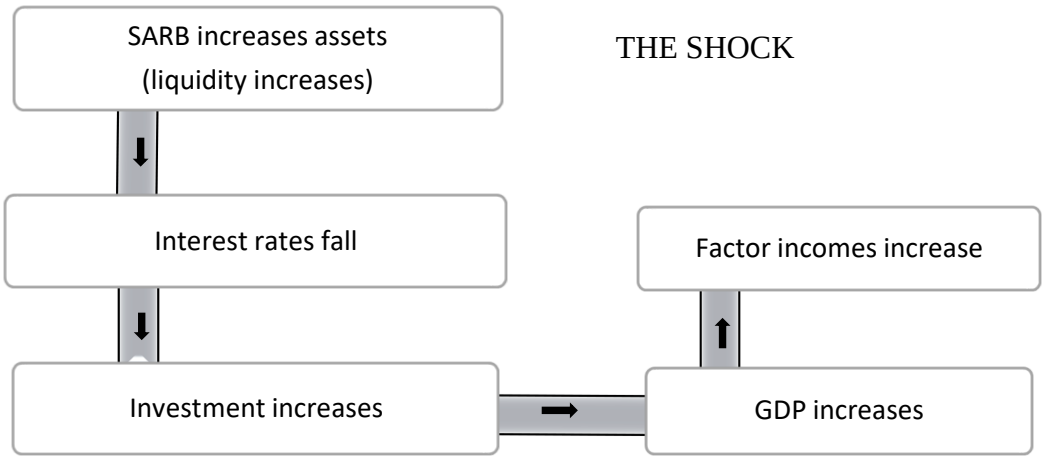


Table 5-7 outlines the macro results of an increase in SARB assets (an increase in liquidity). These are the core results on which the simulation's first and second-round effects are based.

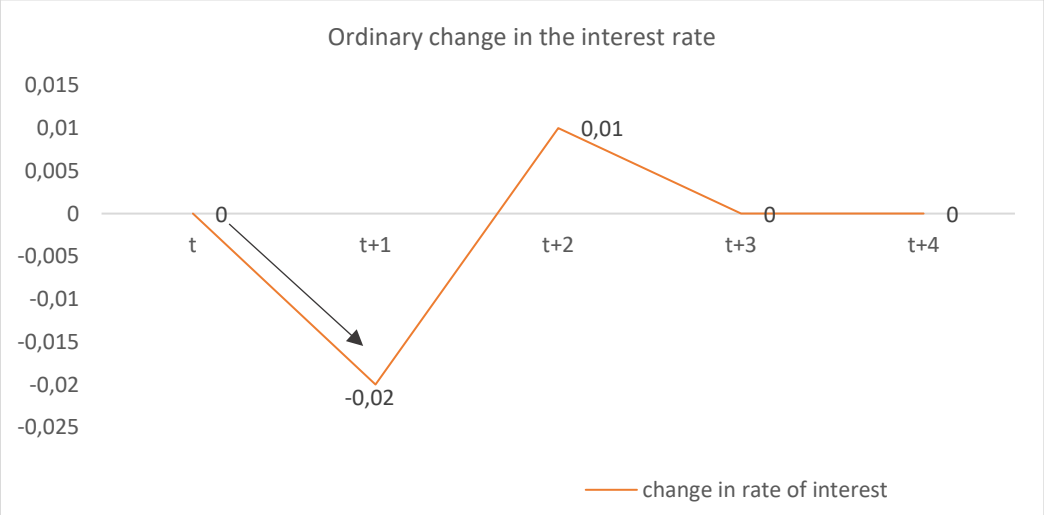
Table 5-7: % or Rm deviations in macro variables

	t+1	t+2	t+3	t+4
Investment	1.20	0.29	0.09	0.11
Household consumption	0.46	0.11	0.01	0.00
Exports	0.11	0.07	0.04	0.00
Imports	0.64	0.14	0.02	0.03
Government consumption	0.46	0.11	0.01	0.00
Real GDP	0.45	0.12	0.03	0.01
Employment	0.83	0.14	-0.04	-0.07
Average capital rental	1.99	0.54	0.16	0.12
Average land rental	1.46	0.64	0.37	0.26
Real Interest rate	-0.02	0.01	0.00	0.00
Consumer Price Index	1.27	0.51	0.29	0.25
Household saving (Rm)	1,380	-3,631	-8,027	-13,588
Current account deficit (Rm)	8,031	1,960	649	1,352
Government saving (Rm)	16,512	11,134	12,414	17,465

5.4.1.1 The interest rate falls as liquidity increases

Cornell (1983) defines the liquidity effect as a short-run phenomenon which shows that, as the supply of money increases, interest rates fall to create an offsetting increase in demand for money. The increase in liquidity in the economy instantly affects the interest rate as it plays a critical role in transmitting changes to the money supply. The results show that an increase in SARB assets by 1% leads to a decrease of 0.02 percentage points in the real interest rate (Figure 5-10). This corroborates equation E-2.20 [i= f (M2)], which states that the interest rate is a function of money supply. An increase in money supply prompts a decrease in the interest rate (cost of borrowing), thus making it easier for individuals and businesses to access credit. When liquidity increases in the economy, banks decrease interest rates to attract borrowing to soak up the additional liquidity. Cornell (1983) and Hamilton (1997) confirm that monetary expansion leads to lower interest rates through the liquidity effect. The converse is, of course, also true.

Figure 5-10: Ordinary change in the real interest rate (% points)

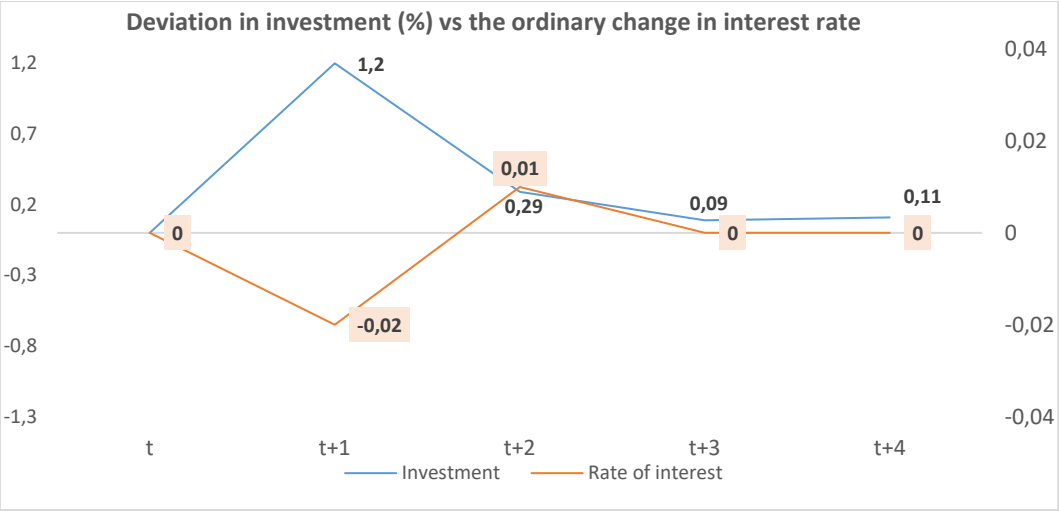


Beyond the period of the shock, the economy adjusts to the new base and the interest rate increases, as depicted by Figure 5-10. This increase in the interest rate in outer periods is prompted by changes in other economic variables, examples of which include prices.

5.4.1.2 The fall in interest rates stimulates investment

The fall in interest rates and the subsequent increase in borrowing encourage investment. This is evidenced by an increase of 1.2% in investment in year t+1, as shown by Figure 5-11. The surge in investment, or gross fixed capital formation, amidst low interest rates does not mean that investors are attracted to low interest rates per se; instead, it indicates that low interest rates attract borrowing for such investment purposes. This conforms to the theory that there exists a general inverse relationship between the interest rate and investment (Hall et al., 1977), which is expressed and interpreted in this research, through equation E-2.7 of the BOTE model.

Figure 5-11: % deviation in investment and the ordinary change in the interest rate



In equation E-2.7, the variable description [I = f(RoR, i)] indicates that the level of investment depends on the interest rate and the rate of return on investment. In principle, this implies that the interest rate is the major determinant of investment since it also influences the rate of return on investment. A decrease in interest rates reduces the cost of investment, which results in high returns on investment and vice versa. Low investment costs encourage investment in high-yield investments, thus potentially increasing returns.

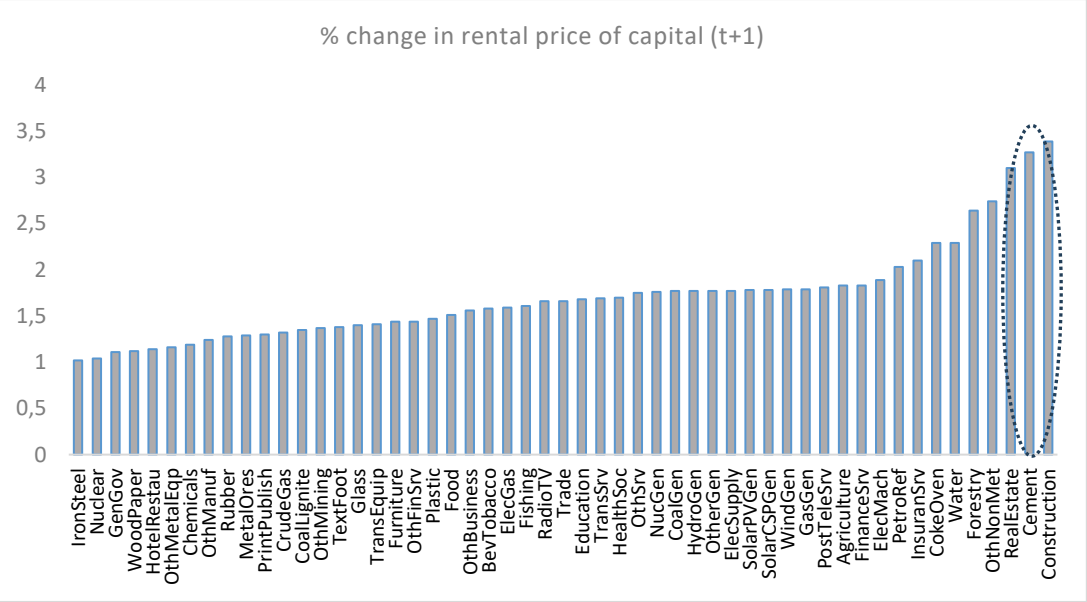
In the context of this research, a reduction in the cost of investment largely benefits industries more than other agents in the economy. Equation E-2.23 of the BOTE expresses the acquisition of liabilities by industries as a function of expected return on

investment and interest rate [R(Ind, f, d) = f(E_ROI, i)]. Industries acquire liabilities primarily for investment purposes, hence changes in interest rate affect investment decisions made by industries directly. When the interest rate reduces, it becomes cheaper for industries to acquire liabilities (the cost of capital reduces); hence, investment increases, and vice versa. From the simulation results, this is evidenced by an increase of 0.42% in liabilities acquired by industries.

For the housing industry in particular (RH), a decrease in the interest rate allows households to acquire mortgages at a low cost, thus leading to an increase in demand for housing and, subsequently, an increase in investment in reproducible housing. This is corroborated by an increase of 0.39% in liabilities acquired by RH.

A closer look at the industry-specific details reveals that the construction, cement and real estate industries have the most increase in the rental price of capital (Figure 5-12). This indicates that investment in these industries increases relatively more than other industries, despite the increase in the rental price of capital cutting across all industries. The construction industry is directly linked to investment; hence, an increase in investment prompts an increase in construction activities and vice versa. This is largely supported by scholarly work on developmental policies such as that of Dervis et al. (1982), who attribute construction activities to between a third and half of total investment.

Figure 5-12: % change in rental price of capital (t+1)



Overall, the increase in SARB assets has short-run effects on both the interest rate and investment. As shown by Figure 5-11, the impact of the shock is short-lived. Beyond the period of the shock, the interest rate moves towards the base and investment plunges. It remains on a downward trend, likely influenced by the long-term interest rates and the performance of the economy.

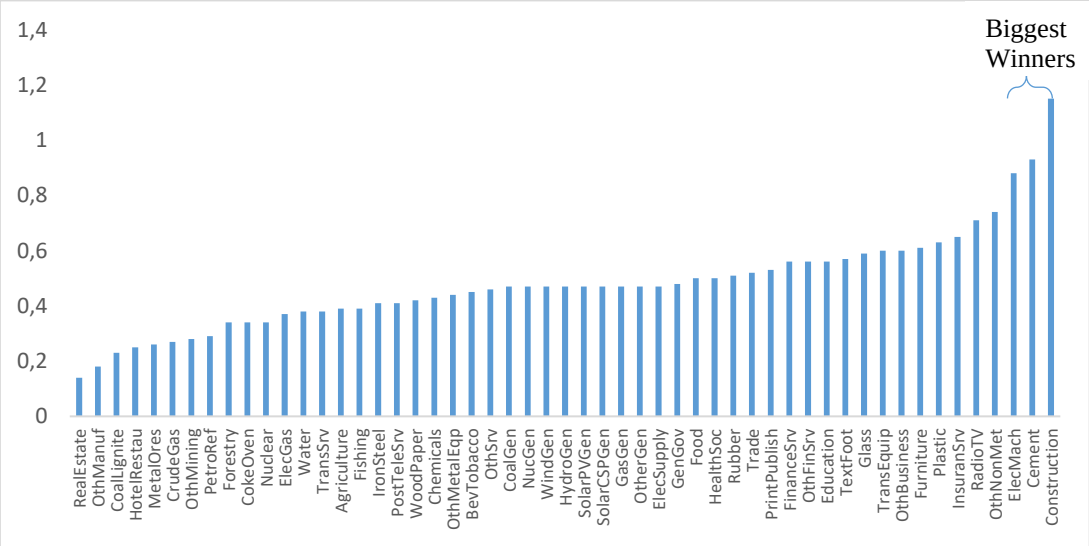
5.4.1.3 GDP increases with an increase in investment

As confirmed by equation E-2.7 ($GDP = C + I + G + X - M$), investment is one of the key drivers of GDP. Table 5-7 shows that the increase in SARB assets affects investment relatively more than the rest of the components of expenditure on GDP. All components of GDP increase; however, investment increases relatively more than the rest of the components; almost twice the change in imports, ten times the change in exports and three times the change in private and public consumption. This is primarily due to high responsiveness and dependency of investment on changes in the interest rate and monetary policy.

As shown on Table 5-7, following a fall in the interest rate and a surge in investment by 1.2%, the GDP increases by 0.45%. In view of industries, Figure 5-13 indicates that the

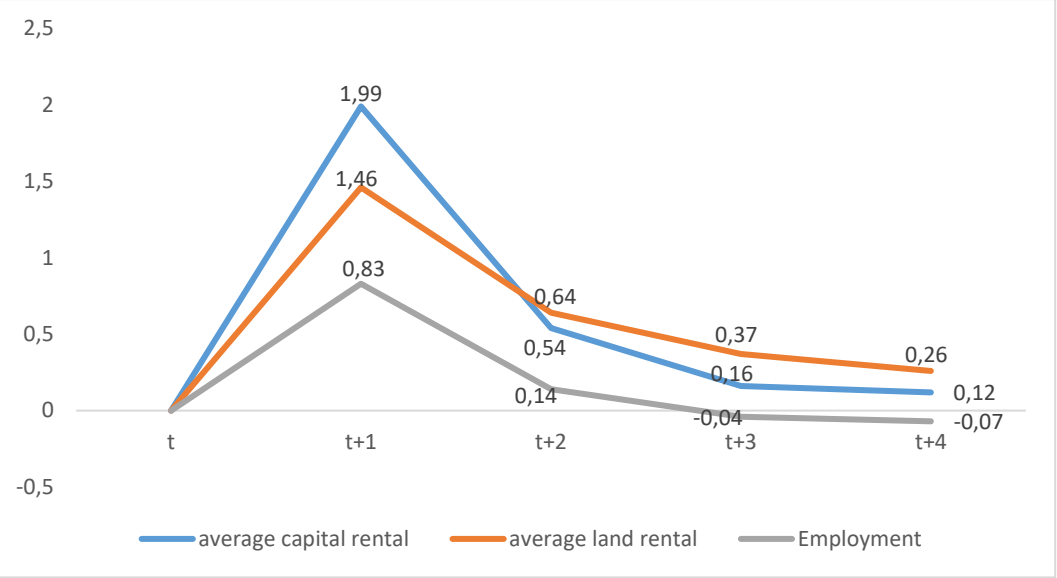
largest increases in output are in construction (1.15%), cement (0.98%) and electrical machinery (0.88%). Real estate output expands by the least percentage (0.14%) compared to the rest of the industries, despite the significant increase in the rental price of capital. We attribute this to the intrinsic link between the construction and real estate industries, which is such that the real estate activities follow construction. In other words, construction lays the base for real estate; therefore, there is a lagged effect of the shock on the real estate industry.

Figure 5-13: % deviation in industry output (t+1)



On the GDP income side, Figure 5-14 shows that the average capital rental increases by 1.99% while the average land rental increases by 1.46%. We exclude wages as these are fixed in the short run. Instead, we gauge movements in the labour market through changes in employment. Consistent with capital and land, employment increases by 0.83%. An increase in aggregate demand stimulates more use of capital, land and labour.

Figure 5-14: % deviation in employment and capital and land rentals



Money supply influences employment through the responses of businesses and consumers to the changes in the flow of money. When liquidity in the economy increases, investment surges as the cost of capital reduces and businesses expand their operations. This leads to an increase in employment; more so as aggregate demand increases and businesses implement counter measures to balance the increased demand. These measures include the following:

- increasing prices where a time lag exists between increased demand the response by businesses and
- increasing production and supply of good and services to balance the increased demand.

The latter prompts businesses to hire more employees to cater for the need for increased production. In the short run, this is often on a temporary basis, depending on future expectations.

5.4.1.4 The increase in GDP leads to a rise in household consumption

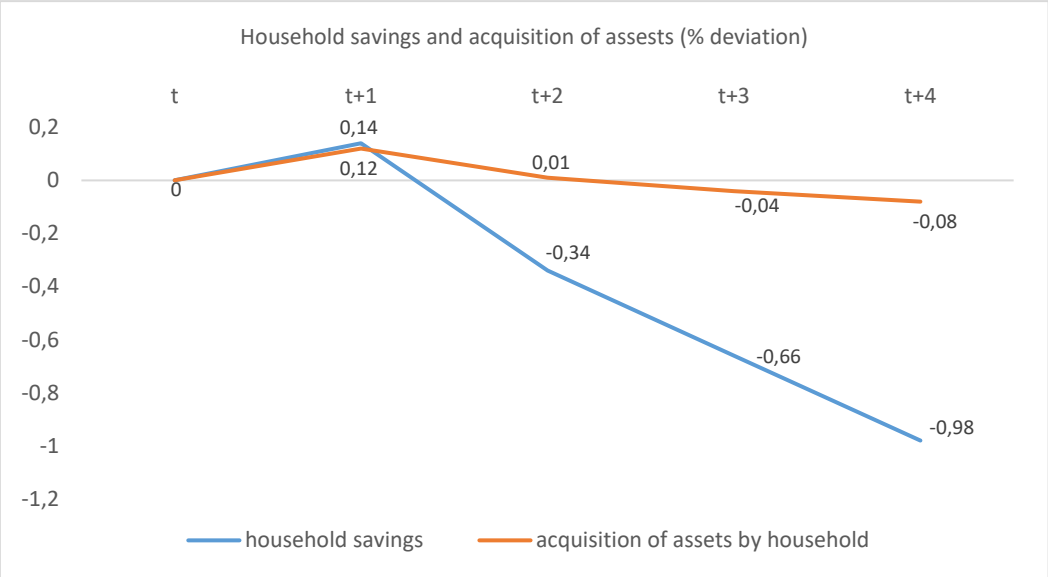
Equation E-2.9 $[\text{HINC} = \text{GDP} * \text{f(TofT)} * (1 - \text{TQ}) - (\text{BTRW.D}) * \text{TL} - (\text{NFLH} * \text{R})]$ shows that household income is dependent on GDP. An increase in GDP impacts household income positively. From the results, this is confirmed by an increase of 0.46% in household consumption following an increase in GDP (Table 5-7). As indicated by Figus

et al (2017), an expansion in the economy leads to an increase in labour income and income from capital services, hence household income increases as a result thereof. An increase in household income leads to an increase in household consumption. This is confirmed by $[C = APC * HINC]$ in equation E-2.7, which shows that household consumption depends on household income level and the proportion of income set aside for consumption (average propensity to consume).

The increase in household consumption is relatively less than that of the rest of the components of expenditure on GDP, except for exports. The soft impact of the shock on household consumption is due to a relatively muted increase in the APC (0.36%) compared to household disposable income (1.37%).

An increase in both APC and disposable income leads to an increase in household consumption and vice versa. Importantly, the magnitude of change in consumption largely depends on the APC. When more money becomes available, households increase their consumption. However, the proportion of additional income spent on consumption decreases as individuals become keen to save for investment. From the results, this is corroborated not just by the subdued increase in the APC but also by a slight increase in household savings, as depicted by Figure 5-15.

Figure 5-15: % deviation in household savings and acquisition of assets



As shown by equations E-2.18 [A_T_1(s, f, Hhlds) = f(SAV)] and E-4.3 [d_new_netacq("Hhlds") = .01 ∗ $HOUS\_SAV$ ∗ $housav$ + $d\_f\_new\_netacq$("$Hhlds$")], households accumulate assets only if they acquire savings. From the simulation results, and as depicted on Figure 5-14, this is confirmed by an increase of 0.12% in assets accumulated by households as savings increase by 0.14%. Beyond the period of the shock, households' asset acquisition falls as savings decrease with an increase in the interest rate.

5.4.1.5 Government consumption increases with an increase in household consumption

Table 5-7 shows that government consumption increases by 0.46% as GDP expands by 0.45% following the money supply shock. Like private consumption, government consumption depends on the GDP. Government consumption primarily depends on government income, as indicated by [G = f(i, GINC)]] in equation E-2.7. On the other hand, the government income is highly influenced by the GDP as shown by equation E-2.10 [GINC = GDP ∗ f(TofT) ∗ TQ + (BTRW. D) ∗ TL − (NFLG ∗ R)]. In a growing economy, government revenue tends to be high (attributable to tax revenue), as individuals and businesses thrive and make significant contributions to the pool of funds for

government. Tosun and Abizadeh (2005) associate high taxes with economic growth and development. The authors indicate that high levels of development and industrialisation lead to high tax revenue, which supports public expenditure and the provision of vital public services.

Despite the increases in GDP and government consumption, government revenue is never enough to finance public services; hence, the government always needs funding. Solikin and Nizar (2023) indicate that government borrowing is unavoidable because the budget is always in deficit. In the context of this research, the government acquires financial instruments to fund the government deficit as indicated by equation E-2.14 [A_T_1(Govt, f, d) = f (GOV_DEF)]. As the interest rate falls, the government acquires liabilities to reduce debt. This is supported by an increase of 1.91% in government liabilities and a simultaneous decrease in government deficit, shown in Table 5-8.

Table 5-8: Ordinary change in public sector deficit vs % change in government liabilities

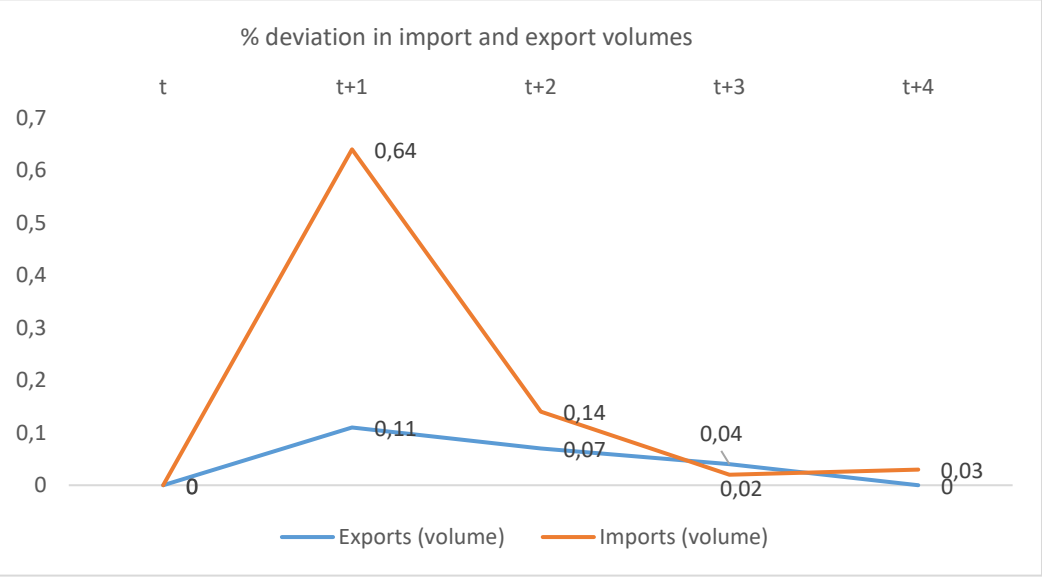
	t	t+1	t+2	t+3	t+4
Ordinary change in public sector deficit (Rm)	0	-13,217	-9,757	-11,567	-16,672
% deviation in government liabilities	0.00	1.91	0.99	0.62	0.45

Importantly, as indicated in section 2.2.1, UPGEM assumes that Government consumption follows household consumption. This is primarily because the public goods and services that are provided by the government, which include infrastructure, education, and healthcare among others, are mostly consumed by households. From the results, both public and private consumption increase by the same margin, thus confirming the interplay between public and private consumption.

5.4.1.6 International trade expands as GDP increases

Table 5-7 and Figure 5-16 show that exports increase by 0.11% while imports increase by 0.64%, contributing to the 0.45% increase in GDP. Exports increase relatively slower than the rest of the components of expenditure on GDP while imports increase relatively faster than all components except investment. We attribute an increase in imports to a decrease in the exchange rate. The cost of imports becomes cheaper with a decrease in the exchange rate. An increase in imports could potentially drag the economy down since imports deduct from the expenditure on GDP; however, the combined increase in the rest of the components of GDP offset the increase in imports and therefore augurs well for the economy. The muted export increase is a bit of a surprise, given that export commodity prices and the consumer prices increased and the exchange rate decreased, all of which would have typically led to a reduction in export volumes. The results show that the demand for exports increases, though by a small margin, despite the increases in prices.

Figure 5-16: % deviation in import and export volumes



Terms of trade are an important aspect of international trade and the economy. According to the export and import price index manual of the International Labour Office et al. (2009), terms of trade directly impact real income. An improvement in the terms of trade, signified by a relatively faster rise in the price of exports relative to

imports, leads to an increase in the real income of a country. The converse is also true. The simulation results show a relatively faster increase in the import price index than the export price index. This leads to a decline in the terms of trade, implying that more exports are needed to pay for a given volume of imports. This is a trading loss for the country.

The changes in imports and exports are important for the country's current account. When imports increase relatively faster than exports, the trade deficit widens, leading to an increase in the current account deficit. From the theory of financial GCE, the current account deficit influences the foreign investment portfolio. As shown by equation E-2.23 [A_T_1(s, f, Fgn) = f (CAD)], issuance of foreign liabilities and acquisition of foreign assets depends on the current account deficit. The current account deficit widens with a relatively higher increase in imports than exports and vice versa.

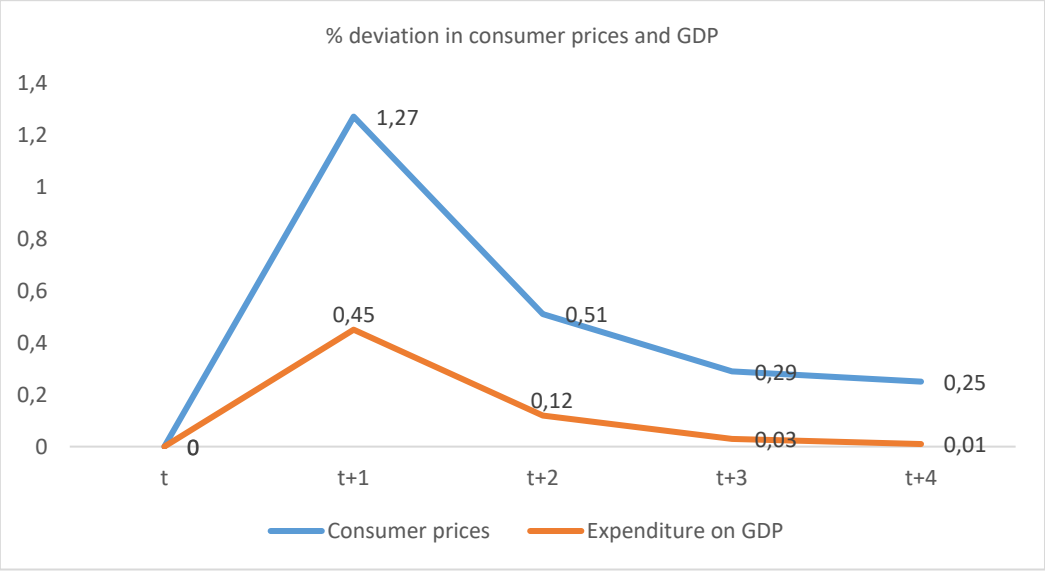
5.4.2 Second round effects of expansion of SARB assets

The second-round effects of expansion of SARB assets are discussed in this subsection. The discussion focuses on the extended impact of the shock on variables that do not directly affect the GDP as per the BOTE model. These include prices, employment, wages, the exchange rate, and assets and liabilities of the agents in the economy.

5.4.2.1 Consumer prices increase following an increase in aggregate demand

Figure 5-17 shows that consumer prices increase by 1.27% as aggregate demand increases by 0.45%. In economic theory, this is referred to as demand-pull inflation, a case where prices increase because consumers compete for limited quantities of goods and services. The increase in demand for goods and services prompts price increases when quantities supplied remain unchanged or do not increase quickly enough to meet the emerging demand. Barth and Bennett (1975) explain it as "too much money chasing too few goods".

Figure 5-17: % deviation in consumer prices



Beyond the period of the shock, consumer prices remain elevated above the baseline, likely influenced by increasing costs to businesses as the economic conditions normalise.

5.4.2.2 Assets and liabilities increase across the board

Table 5-9 presents the changes in assets and liabilities of agents for periods t+1 and t+4, following an increase in SARB assets. This allows a comparison of the immediate and long-term effects of the shock. As seen in section 5.4.1, a 1% increase in SARB assets translates to a decrease of 0.02 in the interest rate and, subsequently, an increase in liquidity. This creates an opportunity for agents to expand their portfolios. As shown by equation E-2.11 $[A(s,f,d) = f(R(s,f,d), BA(d))]$, money influences the acquisition of financial instruments.

Table 5-9: Change in total assets and liabilities of financial agents (Rm)

t+1	Assets (A)	Liabilities (L)	A-L	
1 Banks	42,159	42,159	0	
2 SARB	7,047	7,047	0	
3 Fgn	69,527	61,496	8,031	Change in CAD
4 Govt	80,735	64,223	16,512	Government saving
5 Hhlds	12,071	10,691	1,380	Household saving
6 Inds	27,953	49,006	-21,053	An increase in industry investment
7 NBFI	47,495	47,495	0	
8 NRH	0	0	0	
9 RH	0	4,870	-4,870	An increase in housing investment

t+4	Assets (A)	Liabilities (L)	A-L	
1 Banks	25,688	25,688	0	
2 SARB	0	0	0	
3 Fgn	-746	-2,098	1,352	Change in CAD
4 Govt	32,948	15,483	17,465	Government saving
5 Hhlds	-11,436	2,152	-13,588	Household dissaving
6 Inds	7,363	12,824	-5,461	An increase in industry investment
7 NBFI	2,762	2,762	0	
8 NRH	0	0	0	
9 RH	0	-232	232	Decrease in housing investment

Table 5-9 shows that as SARB increases assets by 1%, commercial banks increase their total assets and liabilities by R42bn in period t+1 and R25,7bn in t+4, to service the increased demand for financial instruments. The increase in commercial bank assets is driven by loans to local agents while liabilities increase primarily because of a rise in

deposits. We attribute the difference in the results of the two periods to the interest rate, which is relatively higher in time t+4, thus not as attractive as that of t+1.

NBFI increase liabilities and assets by R47bn in time t+1 and R2,7bn in t+4. The increase in assets in t+1 is due to increases in government bonds, deposits to commercial banks, foreign equity and household loans. Over time, these assets decrease, primarily due to decreases in industry-issued bonds and NBFI-owned equity held in industries and the rest of the world. On the other hand, the increase in liabilities in t+1 is primarily due to increases in equity owned by the rest of the world and households, as well as commercial bank loans. In t+4, household-owned equity held in NBFI decreases significantly, while that owned by the rest of the world increases. Further, commercial bank loans increase significantly.

In the short run (t+1), the current account deficit increases by R8bn due to increases in both assets and liabilities of the rest of the world. Capital outflows increase relatively more than capital inflows; hence, the country's current account deficit widens. As indicated by equation E-4.1 [$d\_new\_netacq("Fgn") = d\_CAD + d\_f\_new\_netacq("Fgn")$], net acquisitions by the rest of the world determine the country's current account deficit. An increase in the country's liabilities to the rest of the world widens the deficit and vice versa. Foreign-owned equity in industries decreases; however, that in NBFI and commercial banks increases relatively higher. This results in a positive net effect on equity owned by the rest of the world.

Relatedly, foreign equity owned by the government increases, but that owned by NBFI reduces by a relatively large amount, resulting in a reduction in the total foreign equity owned by local agents. SARB, commercial banks, and NBFI hold fewer foreign bonds and more local bonds. As interest rates decrease locally, bonds become more enticing as bond prices increase. This is evidence of an inverse relationship between interest rates and the price of bonds, partially explained by equation E-2.22 [R(Govt, f, d) = f(P(B), i)]. In the long run (t+4), both capital inflows and outflows decrease. Their net effect prompts the widening of the current account deficit since inflows decrease

relatively more than outflows. Inflows decrease mainly due to decreases in bonds held by domestic agents, commercial bank foreign deposits and loan assets, NBFI-owned equity held by the rest of the world and gold.

For government, the assets and liabilities increase by R80bn and R64bn respectively, in time t+1, leading to an overall increase of R16,5bn in government savings. Relatedly, as indicated in Table 5-8, the public sector deficit decreases by R13,2bn. In time t+4, government assets increase by R32,9bn while liabilities increase by R15bn, leading to R17bn worth of government savings. The increase in assets in both periods is mainly influenced by increases in deposits in commercial banks and equity. Industries and the rest of the world combined account for about 95% of the rise in government-owned equity in time t+1. In contrast, in time t+4, 98% of the rise in government-owned equity is associated with increased equity held in industries. On the other hand, an increase in government liabilities in time t+4 is mainly due to bonds issued to foreign and domestic agents.

Households increase their liabilities and assets by R10,7bn and R12bn respectively in time t+1, leading to a R1,3bn change in household savings. This translates to an increase of 0.14% in households' savings from the base, as discussed in section 5.4.1.2. The increase in household liabilities is solely driven by increased loans from banks and NBFI. On the other hand, the increase in assets is driven by an increase in cash (notes and coins). In time t+4, liabilities increase by R2bn while assets decrease by R11bn. This leads to a dissaving of R13,6bn. We attribute this to the increased interest rate beyond the period of the shock. Equity drives the decrease in households' assets, constituting 96% of the total assets. Significant decreases are in equity held in NBFI and housing, with the latter also becoming visible in the reduced investment in the RH industry.

Industries increase assets by R27bn and liabilities by R49bn in time t+1, leading to an increase of R21bn funds available for investment. Equation E-2.16 [NETACQ(Ind)=f(INV_IND)] implies that industries' net acquisitions are a function of

investment in all industries except housing. The increase in assets is due to increased deposits with commercial banks. Liabilities increase due to the need for investment funding, which is evident in increases in loans issued to industries by commercial banks and NBFI and bonds and equity issued by industries. In time t+4, the assets and liabilities of industries increase by R7bn and R12,8bn respectively, resulting in net acquisitions of R5,5bn for investment. Notable is the decrease in equity and bonds issued by industries. We link this to the relatively higher interest rate in time t+4 than t+1.

5.4.2.3 Flows in financial instruments

Nuances on the changes in the financial instruments are provided below to further contextualise the simulation results.

5.4.2.3.1 Deposits and loans

As indicated by Table 5-10, all agents except households and the housing industry increase deposits with commercial banks when liquidity increases. Households' deposits with commercial banks decrease because household consumption rises. Households increase loans from commercial banks and NBFI by R2,7bn and R8bn respectively, as interest rates fall. Industries and the government increase deposits with commercial banks relatively more than the rest of the agents: R27,5bn and R4,7bn respectively. Interestingly, despite low domestic interest rates, the government takes up more foreign loans (R4,6bn) than those issued by local agents. Commercial banks issue significant loans to all agents except the government.

Table 5-10: Flows in deposits and loans (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	*Total*
Banks	829	665	1,277	4,702	-353	27,544	1,580	0	0	***36,243***
SARB	996	0	11	2183	0	0	0	0	0	***3,189***
Fgn	2,730	0	0	0	0	0	0	0	0	***2,730***
Govt	21	2	4,652	0	0	0	0	0	0	***4,675***
Hhlds	2,674	0	0	0	0	0	8,016	0	0	***10,691***
Inds	8,268	0	1,300	0	0	0	0	0	0	***9,568***
NBFI	5,496	0	0	0	0	0	0	0	0	***5,496***
NRH	2,747	0	0	0	0	0	0	0	0	***2,747***
RH	5,084	0	0	0	0	0	0	0	0	***5,084***
Total	**28,843**	**667**	**7,240**	**6,884**	**-353**	**27,544**	**9,597**	**0**	**0**	

5.4.2.3.2 Notes and coins

As shown in Table 5-11, banks, households and NBFI hold more cash. As aggregate consumption increases, demand for bank notes increases; therefore, banks increase their holding of cash to service the increasing demand for cash. Households also increase their cash holding as consumption increases. This links to the withdrawal of bank deposits by households, as seen in Table 5-10.

Table 5-11: Flows in notes and coins (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	Total
Banks	0	0	0	0	0	0	0	0	0	***0***
SARB	335	0	0	0	155	0	0.4	0	0	***490***
Fgn	0	0	0	0	0	0	0	0	0	***0***
Govt	0	0	0	0	0	0	0	0	0	***0***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	0	0	0	0	0	0	0	0	0	***0***
NBFI	0	0	0	0	0	0	0	0	0	***0***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	**335**	**0**	**0**	**0**	**155**	**0**	**0.4**	**0**	**0**	

5.4.2.3.3 Equity

As shown in Table 5-12, flows in equity vary across the agents as interest rates fall. Households increase their holding of equity in NBFI by R16,8bn and reduce that held

in industries and the housing industry by R1,5m and R881m respectively. We see this as a substitution of physical assets (property) with financial instruments since they are relatively attractive. NBFI reduce equity held in industries but increase that held in banks and the rest of the world. The government increases equity in industries, SARB and the rest of the world, while commercial banks only increase equity in industries. The rest of the world increases equity assets in commercial banks, industries and NBFI.

Table 5-12: Equity flows (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	*Total*
Banks	0	0	2,934	0	-67	0	963	0	0	***3,830***
SARB	0	0	0	3,368	0	0	0	0	0	***3,368***
Fgn	0	0	0	42,181	0	0	8,070	0	0	***50,251***
Govt	0	0	0	0	0	0	0	0	0	**0**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	890	42	8,524	28,301	-1,506	0	-881	0	0	***35,370***
NBFI	0	0	24,691	0	16,753	0	0	0	0	***41,444***
NRH	0	0	0	0	-2,747	0	0	0	0	***-2747***
RH	0	0	0	0	-214	0	0	0	0	***-214***
Total	***890***	***42***	***36,149***	***73,850***	***12,219***	***0***	***8,152***	***0***	***0***	***131,302***

5.4.2.3.4 Bonds

The fall in interest rates leads to an increase in the price of bonds, as discussed in section 2.2.4.4. This prompts agents to hold more local bonds as high prices become enticing. Table 5-13 shows that the government issues R59,5bn worth more bonds, constituting 80% of additional bonds in the market. Foreign-issued bonds make up only 10% of the total additional bonds issued; however, the rest of the world increase their holding of South African bonds significantly.

Table 5-13: Bond flows (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	*Total*
Banks	0	0	1084	0	0	409	593	0	0	***2,086***
SARB	0	0	0.1	0	0	0	0	0	0	***0***
Fgn	1,149	5,462	0	0	0	0	1,180	0	0	***7,791***
Govt	8,556	253	22,505	0	0	0	28,234	0	0	***59,548***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	2,285	0	2,045	0	0	0	-261	0	0	***4,068***
NBFI	0	0	504	0	51	0	0	0	0	***555***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***11,989***	***5,715***	***26,138***	0	***51***	***409***	***29,746***	0	0	***74,048***

5.4.2.3.5 Gold and special drawing rights

SARB and commercial banks hold more gold, as shown in Table 5-14. From investor's point of view, low interest rates are not appealing; therefore, we consider this a shift in investment decisions.

Table 5-14: Change in gold and special drawing rights (Rm)

	Banks	SARB	Fgn	Govt	Hhlds	Inds	NBFI	NRH	RH	*Total*
Banks	0	0	0	0	0	0	0	0	0	***0***
SARB	0	0	0	0	0	0	0	0	0	***0***
Fgn	102	623	0	0	0	0	0	0	0	***725***
Govt	0	0	0	0	0	0	0	0	0	***0***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	0	0	0	0	0	0	0	0	0	***0***
NBFI	0	0	0	0	0	0	0	0	0	***0***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***102***	***623***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***725***

5.4.3 The impact of expansion of SARB assets in summary

Expansion of SARB assets by 1% leads to positive short-run effects across the board. GDP improves by 0.45%, stimulated by an increase in investment as the cost of capital reduces. This leads to increases in the rest of the components of expenditure on GDP, with household and government consumption moving together aligned to the model closure assumptions. An increase in imports draws down the overall GDP as it contributes negatively to domestic production, as shown by the GDP expenditure equation E-2.7 [$GDP = C + I + G + X - M$].

All industries considered in this research show an increase in output as investment increases. The construction, cement, and real estate industries reap the most benefits from the increased investments compared to the rest of the industries. In terms of production, the real estate industry has the least increase in production, leaving construction and cement as the top winners.

The overall increase in aggregate demand triggers an increase in consumer prices while at the same time prompting an increase in employment in the short run. In the long run, all components of GDP expenditure move towards the baseline. A blend of lacklustre performance by exports, public and private consumption in the long run, and investment contraction prompts a gradual reduction in GDP expenditure. This, as interest rates rise to the baseline, prompting an increase in the cost of borrowing, thus reducing the purchasing power, restricting consumption and investment, consequently reducing overall spending.

5.5 Summary

This chapter discussed the results of the two simulations. A-priori expectations were listed to show what was anticipated prior to the results. These expectations were primarily based on the BOTE and the underlying theory and, to some extent, on the results of the standard UPGEM model. The results of both simulations were aligned with the expectations and the theory.

For the first application, a decrease in monetary inflows into South Africa led to acquisition of fewer liabilities by industries and subsequently, a slump in investment. This was primarily due to a surge in the cost of investment financing, which discouraged investments. Decreased investment adversely affected the GDP, leading to decreased private consumption as employment levels reduced. Public consumption and international trade also reduced, owing to increased costs of acquisition of liabilities.

In the second application, an increase in SARB assets stimulated a reduction in interest rates, thus encouraging investment. The reduced cost of borrowing led to increased acquisitions of liabilities. Increased liabilities for industries had a positive impact on investment, and this directly pushed the GDP upwards. Increased GDP stimulated employment and increases in factor incomes, which in turn encouraged consumption.

6 CONCLUSIONS & FUTURE RESEARCH

6.1 Research summary

CGE modelling is an important and well-suited tool for economy-wide assessment of the impact of policies. Most of the literature has approached CGE from conventional ways that only consider the real side of the economy. However, emerging developments on how financial aspects of the economy may impact real variables, at least in the short to medium term, as illustrated by the Global Financial Crisis in 2008, dictate the incorporation and integration of both financial and real mechanisms in the analytics. A knowledge base on hybrid CGE modelling is gaining traction globally and paving the way for improvements in the CGE modelling landscape.

This research aimed to unpack and apply the dynamics of financial CGE modelling. Specifically, it contextualised CoPS-style financial CGE modelling to South Africa. In doing this, it made the following specific contributions.

- added to the existing body of knowledge and application of hybrid CGE modelling;
- created a unique base data that will be useful for application of financial CGE modelling going forward; and
- applied the CGE financial model (through simulations) to assess the impact of monetary policy in South Africa.

Additionally, this research has created an opportunity for further research and improvements on the hybrid CoPS-style CGE modelling.

The research considered nine financial agents and five financial instruments. The agents were SARB, commercial banks, the rest of the world, government, industries, non-bank financial institutions, households, reproducible and non-reproducible housing industries. The studied instruments included notes and coins, deposits and loans, bonds, equity and gold and special drawing rights.

The study explored theoretical aspects of CoPS-style CGE modelling. Specifically, it highlighted the behavioural aspects of the financial agents in relation to acquisition of liabilities and accumulation of financial assets. The theory revealed that financial

resources and rates of return play a critical role in decisions about investment in financial instruments. It further distinguished that in optimisation, liability agents are primarily concerned about acquiring financial instruments at minimum costs, while asset agents mostly care about maximising returns on their financial assets.

Two simulations were run to show CoPS-style financial CGE application within South Africa's context. The first simulation was a reduction in monetary inflows by 1%. This simulation was a proxy for the credit rating downgrade. The results of this simulation show that reduced monetary inflows adversely impact the economy. The increased risk associated with the credit ratings downgrade deters investment, leading to a contraction in the GDP, reduced employment, and less public and private consumption. These results are consistent with those of the standard UPGEM model; however, UPGEM-F is more informative as it provides further nuances on financing. Specifically, the results show that the increased risk due to the credit ratings downgrade leads to increased interest rates, which deter borrowing. Industries acquire fewer liabilities, thus prompting restrictions on investment. The theory of UPGEM-F links the acquisition of liabilities by industries directly to investment and GDP. Besides the impact on production, low investment levels impose further difficulties on business expansions and employment. The reduced employment is consistent with decreased household consumption and acquisition of fewer liabilities such as loans. These nuances are not obvious from the standard UPGEM model but are important for policy decisions.

The second simulation was an expansion of SARB assets by 1%. This was an equivalent of expansionary monetary policy. The results of this simulation augur well for the economy. The cost of investment reduces, thus stimulating investment. This leads to an increase in GDP, employment, aggregate consumption and international trade. Industries acquire more liabilities and stimulate investment. Similarly, households acquire more liabilities and accumulate more assets, thus stimulating consumption. These linkages between the real and financial sectors are not evident from the standard UPGEM model; hence the financial module becomes imperative.

6.2 Conclusions

The following conclusions may be drawn from this research:

UPGEM-F adds value to the standard UPGEM model. The results of UPGEM-F are consistent with those of UPGEM but are more nuanced and provide much-needed insights into the link between the real and financial economies. This is the missing link in conventional GCE modelling. Besides agents' behavioural aspects, which may easily be observed from standard UPGEM models, UPGEM-F provides further details on the financing mechanisms within the economy and how these mechanisms loop back to the real economy.

A downgrade in the credit ratings has a negative effect on the economy. The decrease in creditworthiness and monetary inflows from the rest of the world resulted in a contraction of 0.43% in the economic output. This was mainly driven by reduced investment, which contracted by 0.58% as investors became risk-averse. Employment decreased by a relatively high percentage (0.79%) compared to investment and GDP, primarily due to reduced investment.

An increase in the interest rates amidst decreasing monetary inflows creates a negative feedback loop in the economy. While increasing the interest rate may be considered the best counter-reaction to deterred investments following a downgrade in the credit ratings, it constrains access to credit and limits production. From the results, the increase in interest rate implied the escalated cost of finance and credit to businesses and households. This induced layoffs and reduced consumption.

A decrease in monetary inflows reduces financial acquisitions. Financial agents accumulated relatively fewer assets and liabilities following a reduction in monetary inflows. Lenders became cautious about issuance of credit amidst uncertain economic conditions; hence, all financial institutions reduced assets and liabilities significantly. Similarly, relatively fewer liabilities were issued because of the reduced ability to service liabilities.

An increase in SARB assets is an equivalent of expansionary monetary policy; hence, it increases liquidity in the financial system.

The expansionary monetary policy encourages acquisition of liabilities and accumulation of assets. The interest rates decreased with an increase in money supply, thus encouraging borrowing and investment. Relatively, more liabilities and assets were acquired by financial agents as more financial resources became available. The net effects of acquisitions included a wider current account deficit and savings by households and the government.

Investment is highly responsive to expansionary monetary policy. Compared to other components of expenditure on GDP, investment was relatively the most responsive to expansionary monetary policy. It increased by 1.2% while imports increased by 0.64%, government and household consumption by 0.46%, and exports by 0.11%.

Investment is strongly linked to the construction sector and related industries. The construction, cement and real estate industries were the biggest beneficiaries of the expansionary monetary policy and the subsequent increase in investment. Households acquired more equity in housing, and property developers acquired more liabilities to expand developments.

Expansionary monetary policy increases the economic output and employment. The GDP and employment increased by 0.45% and 0.86%, respectively, following the expansion of SARB assets. Importantly, the economic activity increased across all sectors despite the dominance of construction and related industries.

The modelling mechanism through which the above conclusions were drawn is as important as the findings themselves. It allows for a more in-depth and realistic simulation of policy shocks linked to financial markets and instruments.

6.3 Future research

This research has created a foundation for further work and improvement on the application of CoPS-style financial CGE modelling in South Africa. The following areas have been identified for future research.

Database improvements: This research developed a unique data base for financial CGE modelling in South Africa. The focus was on five financial instruments: i) notes and coins, ii) deposits and loans, iii) equity, iv) bonds, and v) gold. There is room to expand the data with a different set of instruments or reconfigure some of the instruments considered in this research, depending on the available data. This reconfiguration could include splitting securities into different portfolios instead of aggregating them under bonds. Similarly, additional agents could also be considered. For example, industries could be split into more artificial industries - small, medium and large. This could give new insight into the behavioural aspects of these industries under different closure settings.

Data improvements are likely to emerge from the forthcoming global 2025 System of National Accounts framework, which will feature comprehensive SUT structures that integrate environmental and economic databases. This integration will prompt development of new national accounts datasets that could be used as the base for improved modelling.

Policy simulations: The study focused on the impact of a credit rating downgrade and expansion of SARB assets. This leaves room for other areas of policy simulation to be explored. The scope for integrating financial aspects and the real economy remains wide and open for further exploration. For instance, monetary policy analytics are much needed now, as global financial resilience becomes central to policy discussions. The African Development Bank hosted meetings in May 2024 to discuss innovative solutions for debt management in Africa. These solutions require models such as UPGEM-F to map scenarios that can form the base for finance-related policy discussions. There are ongoing discussions on credit guarantees, which can be

supported by research and models that include credit guarantees as part of the financial instruments.

Scope improvements: This research focused on the nine agents described in the content. These included the two housing agents that have not been fully explored in the current research. Given the inequality levels in South Africa, especially the discrepancies within the housing industry, the scope of the financial CGE modelling could be expanded to focus largely on housing to inform policy.

Other scope improvement areas could include the changes in the financing models for the different economic agents. Additionally, applications could be expansion to other areas of monetary policy. For example, the impact of increases or decreases in reserve requirements and negative interest in excess reserves and could be explored through UPGEM-F.

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8 APPENDIX

8.1 APPENDIX – Sets

This appendix presents the sets used in the model. Included in the appendix are the detailed industry descriptions.

COMMODITIES

1) Agriculture
2) Forestry
3) Fishing
4) CoalLignite
5) MetalOres
6) CrudeGas
7) OthMining
8) ElecGas
9) Food
10) BevTobacco
11) TextFoot
12) WoodPaper
13) PrintPublish
14) CokeOven
15) PetroRef
16) Nuclear
17) Chemicals
18) Rubber
19) Plastic
20) Glass
21) Cement
22) OthNonMet
23) IronSteel
24) OthMetalEqp
25) ElecMach
26) RadioTV
27) TransEquip
28) Furniture
29) OthManuf
30) CoalGen
31) NucGen
32) WindGen
33) HydroGen
34) SolarPVGen
35) SolarCSPGen
36) GasGen
37) OtherGen
38) ElecSupply
39) Water
40) Construction
41) Trade
42) HotelRestau
43) TransSrv
44) PostTeleSrv
45) FinanceSrv
46) InsuranSrv
47) OthFinSrv
48) RealEstate
49) OthBusiness
50) GenGov
51) Education
52) HealthSoc
53) OthSrv

INDUSTRIES

1) Agriculture
2) Forestry
3) Fishing
4) CoalLignite
5) MetalOres
6) CrudeGas
7) OthMining
8) ElecGas
9) Food
10) BevTobacco
11) TextFoot
12) WoodPaper
13) PrintPublish
14) CokeOven
15) PetroRef
16) Nuclear
17) Chemicals
18) Rubber
19) Plastic
20) Glass
21) Cement
22) OthNonMet
23) IronSteel
24) OthMetalEqp
25) ElecMach
26) RadioTV
27) TransEquip
28) Furniture
29) OthManuf
30) CoalGen
31) NucGen
32) WindGen
33) HydroGen
34) SolarPVGen
35) SolarCSPGen
36) GasGen
37) OtherGen
38) ElecSupply
39) Water
40) Construction
41) Trade
42) HotelRestau
43) TransSrv
44) PostTeleSrv
45) FinanceSrv
46) InsuranSrv
47) OthFinSrv
48) RealEstate
49) OthBusiness
50) GenGov
51) Education
52) HealthSoc
53) OthSrv

OCCUPATIONS

1) Managers
2) Professional
3) Technicians
4) Clerks
5) Service
6) Agric
7) Crafts
8) Operators
9) Elementary
10) Domestic
11) Unspecified

MARGINS

1) Trade
2) Transport services

SOURCE

1) Domestic
2) Import

ASSET AGENTS	**LIABILITY AGENTs**
1) Banks	1) Banks
2) CB	2) CB
3) Fgn	3) Fgn
4) Govt	4) Govt
5) Hhlds	5) Hhlds
6) Inds	6) Inds
7) NBFI	7) NBFI
8) NRH	8) NRH
9) RH	9) RH

Industry descriptions

No.	56UPGEMF_Industries	No.	String
1	I1_fieldcrop	1	I0101: Growing of cereal grains incl rice, wheat, maize and sugar cane, and other field crops [SIC 1111]
2	I1_fruitveg	2	I0102: Growing of vegetables, horticultural and nursery products [SIC 1112]; Growing of fruit, nuts, beverage and spice crops incl growing of grapes and manufacture of wine at the same location [SIC 1113]
3	I1_livestock	3	I0103: Farming of live animals incl dairy farming [SIC 112]; Mixed farming [SIC 113]; Other agricultural services [SIC 114]; Hunting and related services [SIC 115]; Production of organic fertilizer such as compost [SIC 116]
4	I1_forestry	4	I0104: Forestry, logging and related services [SIC 12]
5	I1_fishing	5	I0105: Fishing, operation of fish hatcheries and fish farms [SIC 13]
6	I2_coal	6	I0206: Mining of coal and lignite [SIC 21]
7	I2_metalore	7	I0207: Mining of gold and uranium ore [SIC 23]; Mining of iron ore and other non-ferrous metals incl platinum [SIC 24]
8	I2_othmining	8	I0208: Extraction of crude petroleum and natural gas [SIC 22]; Other mining and quarrying incl diamonds [SIC 25]; Service activities incidental to mining of minerals [SIC 29]
9	I3_meat	9	I0309: Manufacture of meat and meat products incl operation of slaughterhouses and preservation of meat [SIC 3011]
10	I3_fish	10	I0310: Manufacture of fish and fish products [SIC 3012]
11	I3_fruitveg	11	I0311: Manufacture of fruit and vegetables [SIC 3013]
12	I3_oilsfats	12	I0312: Manufacture of oils and fats from vegetable or animal materials [SIC 3014]
13	I3_dairy	13	I0313: Manufacture of dairy products incl milk, butter, cheese and yoghurt [SIC 302]
14	I3_grain	14	I0314: Manufacture of grain mill products, starches and starch products and prepared animal feeds [SIC 303]
15	I3_bakery	15	I0315: Manufacture of bakery products incl bread, cakes, pastries and biscuits [SIC 3041]
16	I3_sugar	16	I0316: Manufacture of sugar incl raw sugar cane and syrup [SIC 3042]
17	I3_cocoa	17	I0317: Manufacture of cocoa, chocolate products and sugar confectionary [SIC 3043]
18	I3_othfood	18	I0318: Manufacture of other food products nec incl pastas and coffee [SIC 3044-3049]
19	I3_beverage	19	I0319: Manufacture of alcoholic beverages [SIC 3051-3052]
20	I3_softdrink	20	I0320: Manufacture of soft drinks and mineral water [SIC 3053]
21	I3_tobacco	21	I0321: Manufacture of tobacco products [SIC 306]
22	I3_textiles	22	I0322: Manufacture of textiles and clothing apparel [SIC 311-315]
23	I3_leather	23	I0323: Manufacture of leather and leather goods incl tanning and dressing of leather [SIC 316]
24	I3_footwear	24	I0324: Manufacture of footwear products of any material incl leather, rubber, plastics or textile materials [SIC 317]
25	I3_wood	25	I0325: Manufacture of wood and wood products [SIC 321-322]
26	I3_paperpub	26	I0326: Manufacture of paper and paper products [SIC 323]; Publishing [SIC 324]; Printing and services related to printing [SIC 325]; Reproduction of recorded media [SIC 326]
27	I3_petroref	27	I0327: Manufacture of coke oven products incl asphalt materials for road building [SIC 331]; Manufacture of refined petroleum products incl liquid or gaseous fuels, lubricating oils and petroleum jelly [SIC 332]
28	I3_othchem	28	I0328: Manufacture of nuclear fuel and other radioactive elements [SIC 333]; Manufacture of basic chemicals and other chemical products incl pesticides, paints and pharmaceuticals [SIC 334-335]; Manufacture of man-made fibres [SIC 336]
29	I3_rubber	29	I0329: Manufacture of rubber products incl tyres and tubes [SIC 337]
30	I3_plastic	30	I0330: Manufacture of plastic products [SIC 338]
31	I3_glass	31	I0331: Manufacture of glass and glass products [SIC 341]
32	I3_nonmetal	32	I0332: Manufacture of other non-metallic mineral products incl ceramic and cement [SIC 342]

33	I3_ironsteel	33	I0333: Manufacture of basic iron and steel (SIC 351]; Casting of iron and steel and other non-ferrous metals [SIC 353]
34	I3_nonfmetal	34	I0334: Manufacture of basic precious and non-ferrous metals incl gold, silver, PGMs and alumina [SIC 352]
35	I3_othmetal	35	I0335: Manufacture of structural and fabricated metal products [SIC 354-355]; Manufacture of general and special purpose machinery [SIC 356-357]; Manufacture of household appliances and office and computing machinery [SIC 358-359]
36	I3_elecmach	36	I0336: Manufacture of electrical machinery and apparatus incl electric motors, insulated wire and cables, primary batteries and lighting equipment [SIC 36]
37	I3_radtvins	37	I0337: Manufacture of radio, TV and communication equipment, medical appliances, optical instruments, photographic equipment, watches and clocks [SIC 37]
38	I3_transeqp	38	I0338: Manufacture of transport equipment incl motor vehicles, parts, trailers, boats, trains and aircraft [SIC 38]
39	I3_othmanuf	39	I0339: Manufacture of furniture and other product groups nec incl jewellery, sporting goods and toys, recycling of metal and non-metal waste and scrap [SIC 39]
40	I4_elecgas	40	I0440: Generation and distribution of electricity, manufacture and distribution of gas, steam and hot water supply [SIC 41]
41	I4_water	41	I0441: Collection, purification and distribution of water [SIC 42]
42	I5_construc	42	I0542: Construction and construction related services [SIC 50]
43	I6_trade	43	I0643: Wholesale and commission trade [SIC 61]; Retail trade [SIC 62]; Sale, maintenance and repair of motor vehicles and retail trade in automotive fuel [SIC 63]
44	I6_accom	44	I0644: Hotels, other short-stay accommodation, restaurants and bars [SIC 64]
45	I7_landtrns	45	I0745: Land transport incl passenger and freight services via road and rail [SIC 71]
46	I7_airtrns	46	I0746: Air transport incl passenger and freight services [SIC 73]
47	I7_othtrns	47	I0747: Water transport services [SIC 72]; Supporting transport activities incl cargo handling, storage and warehousing, activities of travel agencies [SIC 74]
48	I7_postcomm	48	I0748: Post and telecommunication services [SIC 75]
49	I8_finance	49	I0849: Financial intermediation services [SIC 81]; Insurance, medical aid and pension funding services [SIC 82]; Other financial intermediation services [SIC 83]
50	I8_realest	50	I0850: Real estate activities incl buying, selling, renting, managing and developing of residential dwellings and non-residential buildings [SIC 84]
51	I8_rentmach	51	I0851: Renting of machinery and equipment incl agricultural, construction, transport and personal equipment [SIC 85]
52	I8_othbus	52	I0852: Computer and related IT activities [SIC 86]; Research and development [SIC 87]; Other business service activities [SIC 88]
53	I9_gengov	53	I0953: Public administration and defense activities by general government [SIC 91]; Sanitation activities, sewage and refuse disposal [SIC 94]
54	I9_educat	54	I1054: Private education services [SIC 92]
55	I9_health	55	I1055: Private health and social work services incl hospital, medical, dental, veterinary activities and day care centres [SIC 93]
56	I9_othsrv	56	I1056: Other service activities incl professional organisations and sporting activities [SIC 95-99]

8.2 APPENDIX – The Basedata

This appendix presents the datasets used in the model. The first set of tables shows the basic flow matrices. This is followed by margin matrices and taxes .

Basic flows for intermediate consumption (Rm)

V1BAS	*Dom*	*Imp*	*Total*
Agriculture	101556	8395	109951
Forestry	19346	190	19536
Fishing	4002	159	4161
CoalLignite	69590	3461	73051
MetalOres	114321	9231	123552
CrudeGas	14099	47063	61162
OthMining	22729	69088	91817
ElecGas	24001	2147	26148
Food	84431	10852	95283
BevTobacco	22677	1262	23938
TextFoot	37870	21402	59273
WoodPaper	116319	17870	134189
PrintPublish	31272	3060	34333
CokeOven	12875	8094	20969
PetroRef	38779	28195	66973
Nuclear	11377	6841	18218
Chemicals	165040	87395	252435
Rubber	13980	8276	22256
Plastic	47484	12137	59621
Glass	9996	2279	12275
Cement	31568	1281	32849
OthNonMet	30943	8939	39882
IronSteel	95245	23864	119110
OthMetalEqp	37421	172941	210362
ElecMach	34474	18322	52796
RadioTV	20355	43307	63662
TransEquip	50363	56328	106691
Furniture	3046	861	3907
OthManuf	17377	8788	26165
CoalGen	60263	0	60263
NucGen	2276	0	2276
WindGen	230	0	230
HydroGen	2710	0	2710
SolarPVGen	801	0	801
SolarCSPGen	414	0	414
GasGen	432	0	432
OtherGen	2099	0	2099
ElecSupply	80472	468	80940

Water	29851	172	30023
Construction	102522	715	103237
Trade	95972	3996	99968
HotelRestau	24199	8815	33014
TransSrv	263331	29762	293093
PostTeleSrv	178489	11377	189866
FinanceSrv	272290	3240	275530
InsuranSrv	29344	702	30046
OthFinSrv	190992	2017	193008
RealEstate	181793	2677	184469
OthBusiness	594451	24249	618700
GenGov	168858	963	169821
Education	3916	23.1	3940
HealthSoc	68921	1105	70026
OthSrv	133962	9292	143253
Total	***3771126***	***781602***	***4552728***

Basic flows for investment (Rm)

V2BAS	***Dom***	***Imp***	***Total***
Glass	0.093	0.021	0.115
PrintPublish	1.14	0.112	1.25
Rubber	2.21	1.31	3.51
Plastic	8.47	2.17	10.6
OthNonMet	13.6	3.94	17.6
TextFoot	18.8	10.6	29.5
CokeOven	69.6	43.7	113
Nuclear	82.2	49.4	132
PetroRef	207	150	357
OthManuf	1016	514	1529
OthBusiness	8118	331	8449
Furniture	6692	1892	8584
RadioTV	10716	22798	33514
ElecMach	22264	11833	34097
RealEstate	41888	617	42505
TransEquip	58659	65607	124267
OthMetalEqp	29302	135417	164719
Construction	389937	2719	392655
Total	***568993***	***241990***	***810983***

Basic flows for household consumption (Rm)

V3BAS	*Dom*	*Imp*	*Total*
CrudeGas	79.6	266	345
OthMining	128	390	518
Cement	532	21.6	554
Fishing	807	32.1	839
CoalLignite	995	49.5	1045
OthNonMet	1693	489	2182
ElecMach	2297	1221	3518
Glass	3838	875	4714
Plastic	4931	1260	6191
Construction	11196	78.1	11274
WoodPaper	9781	1503	11284
PrintPublish	10363	1014	11377
Forestry	11407	112	11519
Rubber	9182	5435	14617
OthManuf	11532	5832	17364
Furniture	14504	4102	18606
CokeOven	12594	7917	20511
RadioTV	7801	16597	24397
Water	26784	155	26939
OthMetalEqp	6078	28091	34169
ElecSupply	46593	271	46864
GenGov	55813	318	56131
HotelRestau	41655	15173	56829
FinanceSrv	56596	674	57269
Education	60244	355	60600
PostTeleSrv	59718	3806	63525
PetroRef	37852	27521	65373
Chemicals	47059	24920	71979
BevTobacco	79968	4449	84417
TransEquip	41428	46335	87763
Agriculture	83679	6917	90596
OthBusiness	89845	3665	93510
TextFoot	73035	41276	114310
TransSrv	109813	12411	122224
InsuranSrv	121819	2913	124732
OthSrv	122633	8506	131140
HealthSoc	134420	2156	136576
Food	264650	34016	298665
RealEstate	315690	4648	320338
Total	***1989033***	***315770***	***2304803***

Basic flows for exports (Rm)

V4BAS

Water	7.77	CrudeGas	20800
ElecSupply	260	Food	26638
Forestry	331	PostTeleSrv	27224
PrintPublish	784	OthMining	31113
Cement	791	Agriculture	31506
Construction	814	TransSrv	45557
Fishing	1158	HotelRestau	51299
Glass	1217	CoalLignite	68041
HealthSoc	1519	IronSteel	70995
RealEstate	1988	Chemicals	74630
ElecGas	2272	TransEquip	85440
OthNonMet	3016	OthMetalEqp	202771
Plastic	3699	MetalOres	312507
Trade	4555	***Total***	***1255379***
Furniture	4888		
CokeOven	4982		
Rubber	5234		
OthFinSrv	7652		
TextFoot	7777		
RadioTV	9765		
ElecMach	9903		
PetroRef	10340		
Nuclear	11224		
OthBusiness	13293		
BevTobacco	13670		
OthSrv	13768		
InsuranSrv	14351		
OthManuf	18494		
FinanceSrv	19452		
WoodPaper	19654		

Basic flows for government consumption (Rm)

V5BAS	*Dom*	*Imp*	*Total*
GenGov	962315	5583	967898
Total	***962315***	***5583***	***967898***

Basic flows for inventories (Rm)

V6BAS	*Dom*	*Imp*	*Total*
RadioTV	-6507	-14729	-21235
OthMetalEqp	-1714	-8686	-10401
HotelRestau	-6757	-2744	-9501
Chemicals	-5348	-3112	-8460
TransSrv	-6196	-805	-7001
OthManuf	-3721	-2122	-5843
WoodPaper	-4761	-802	-5563
FinanceSrv	-3997	-54.2	-4051
TransEquip	-1085	-1316	-2401
TextFoot	-1199	-737	-1936
PrintPublish	-1366	-145	-1512
Furniture	-1010	-310	-1321
Plastic	-591	-163	-754
Rubber	-431	-278	-709
OthNonMet	-489	-160	-649
CoalLignite	-594	-34.9	-629
ElecSupply	-487	-3.31	-490
ElecMach	-140	-80.2	-220
Cement	-181	-8.29	-190
Forestry	-114	-1.29	-116
Education	-110	-0.715	-111
Fishing	-74.6	-3.26	-77.9
InsuranSrv	-71.6	-1.99	-73.6
HealthSoc	24.4	0.431	24.9
RealEstate	127	1.47	128
Trade	133	6.13	139
Glass	134	33.1	167
Agriculture	224	20.6	244
CokeOven	214	152	367
Food	657	93.6	751
OthSrv	943	73.3	1016
PostTeleSrv	1061	77	1138
CrudeGas	300	1104	1403
Water	1521	10.6	1531

BevTobacco	1739	108	1847
ElecGas	1785	187	1973
PetroRef	1880	1528	3408
Nuclear	2142	1413	3554
OthMining	939	3137	4076
OthFinSrv	5013	55.9	5069
IronSteel	4651	1282	5933
MetalOres	6030	542	6572
GenGov	9801	56.9	9858
OthBusiness	9463	422	9884
Construction	20983	163	21147
Total	***22817***	***-25830***	***-3013***

The margins for intermediate consumption (Rm)

V1MAR	*Dom*	*Imp*	*Total*
Agriculture	10859	895	11755
Forestry	725	6.99	732
Fishing	1218	48.8	1267
CoalLignite	3806	181	3987
MetalOres	65.3	5.27	70.6
CrudeGas	917	3070	3987
OthMining	1473	4507	5980
Food	19793	2545	22338
BevTobacco	9446	521	9968
TextFoot	6714	3852	10566
WoodPaper	27386	4250	31635
PrintPublish	15101	1508	16608
CokeOven	6867	4238	11104
PetroRef	17237	12446	29683
Nuclear	4385	2661	7046
Chemicals	34251	18274	52525
Rubber	2217	1332	3548
Plastic	19257	5051	24308
Glass	2653	617	3270
Cement	13442	538	13980
OthNonMet	6936	1976	8913
IronSteel	26055	6575	32630
OthMetalEqp	5881	27421	33302
ElecMach	6489	3519	10008
RadioTV	2058	4515	6573
TransEquip	12937	14742	27680
Furniture	622	179	802

OthManuf	2105	1052	3157
Total	***260898***	***126525***	***387423***

The margins for investment[1] (Rm)

V2MAR	***Dom***	**Imp**	**Total**
Total	23159	39081	62240
TransEquip	12496	14239	26735
OthMetalEqp	4293	20019	24312
ElecMach	3869	2099	5968
RadioTV	1016	2229	3245
Furniture	1252	360	1613
OthManuf	108	54	162
PetroRef	69.2	50	119
CokeOven	27.6	17	44.6
Nuclear	17.6	10.7	28.3
TextFoot	2.95	1.69	4.64
Plastic	3.17	0.832	4
OthNonMet	2.84	0.809	3.65
PrintPublish	0.508	0.051	0.559
Rubber	0.318	0.191	0.509
Glass	0.023	0.005	0.029
Total	***23159***	***39081***	***62240***

[1] Industries not included have zero entries

Margins for household consumption (Rm)

V3MAR	*Dom*	*Imp*	*Total*
Food	62042	7977	70019
BevTobacco	33312	1839	35151
PetroRef	16826	12148	28974
TransEquip	10642	12127	22769
TextFoot	12949	7429	20377
Chemicals	9766	5211	14977
CokeOven	6717	4145	10862
Agriculture	8948	738	9685
PrintPublish	5004	500	5504
OthMetalEqp	955	4454	5409
Furniture	2964	853	3817
WoodPaper	2303	357	2660
Plastic	2000	525	2524
RadioTV	789	1730	2519
Rubber	1456	874	2330
OthManuf	1397	698	2095
Glass	1019	237	1256
ElecMach	432	234	667
OthNonMet	379	108	488
Forestry	428	4.12	432
Fishing	246	9.83	255
Cement	227	9.07	236
CoalLignite	54.4	2.59	57
OthMining	8.31	25.4	33.7
CrudeGas	5.17	17.3	22.5
Total	***180867***	***62252***	***243119***

Margins for exports (Rm)

V4MAR	*Trade*	*TransSrv*	*Total*
OthMetalEqp	26728	2982	29710
IronSteel	16521	1843	18364
TransEquip	16374	1827	18201
Chemicals	13096	1461	14558
Food	5266	588	5854
WoodPaper	3900	435	4335
CoalLignite	3276	366	3642
PetroRef	3116	348	3464
BevTobacco	3087	344	3431
Agriculture	2895	323	3218
Nuclear	2163	241	2405
CokeOven	1777	198	1975
OthManuf	1770	197	1967
OthMining	1724	192	1916
ElecMach	1548	173	1721
Plastic	1246	139	1385
CrudeGas	1156	129	1285
TextFoot	1097	122	1219
RadioTV	833	92.9	926
Furniture	823	91.8	915
Rubber	679	75.8	755
OthNonMet	565	63.1	629
PrintPublish	314	35	349
Fishing	299	33.4	333
Cement	289	32.3	322
Glass	272	30.3	302
MetalOres	158	17.6	175
Forestry	10.8	1.21	12
Total	***110983***	***12384***	***123367***

Taxes associated with intermediate consumption (Rm)

V1TAX	*Dom*	*Imp*	*Total*
TransSrv	-3970	-449	-4419
Fishing	237	9.44	247
Education	249	1.47	250
Furniture	280	79.3	360
Forestry	630	6.2	636
ElecGas	629	56.2	685
Glass	690	157	847
OthFinSrv	1223	12.9	1236
Water	1437	8.29	1446
HotelRestau	1101	401	1503
Cement	1498	60.8	1559
CoalLignite	1508	75	1583
InsuranSrv	1898	45.4	1943
Rubber	1391	823	2214
MetalOres	2206	178	2385
HealthSoc	2477	39.7	2517
ElecSupply	2746	16	2762
PrintPublish	2652	260	2912
OthNonMet	2342	677	3018
CrudeGas	735	2455	3190
GenGov	3201	18.3	3219
PostTeleSrv	3145	200	3345
OthManuf	2417	1222	3639
RadioTV	1352	2876	4227
ElecMach	2862	1521	4384
Trade	4422	184	4606
FinanceSrv	4730	56.3	4786
OthMining	1185	3603	4789
Plastic	3943	1008	4951
Agriculture	4758	393	5152
RealEstate	6147	90.5	6238
Food	5643	725	6368

IronSteel	5480	1373	6853
CokeOven	4449	2797	7246
TextFoot	4949	2797	7746
Construction	8312	58	8370
WoodPaper	7835	1204	9038
OthSrv	11447	794	12241
Nuclear	9090	5466	14556
OthMetalEqp	2715	12549	15265
BevTobacco	14959	832	15791
Chemicals	10547	5585	16131
OthBusiness	18083	738	18820
PetroRef	12677	9217	21894
TransEquip	10368	11596	21964
Total	***186678***	***71817***	***258495***

Taxes associated with household intermediate consumption (Rm)

V3TAX	***Dom***	***Imp***	***Total***
TransSrv	-1656	-187	-1843
CrudeGas	4.15	13.9	18
CoalLignite	21.6	1.07	22.6
Cement	25.3	1.03	26.3
OthMining	6.69	20.3	27
Fishing	47.8	1.9	49.7
OthNonMet	128	37	165
ElecMach	191	101	292
Glass	265	60.4	325
Forestry	372	3.66	375
Plastic	409	105	514
WoodPaper	659	101	760
Construction	908	6.33	914
PrintPublish	879	86	965
FinanceSrv	983	11.7	995
GenGov	1058	6.03	1064

PostTeleSrv	1052	67.1	1119
Water	1290	7.44	1297
Rubber	913	541	1454
ElecSupply	1590	9.25	1599
RadioTV	518	1102	1620
Furniture	1335	378	1713
OthManuf	1604	811	2415
OthMetalEqp	441	2038	2479
HotelRestau	1896	691	2586
OthBusiness	2733	111	2845
Education	3826	22.6	3849
Agriculture	3921	324	4245
Chemicals	3007	1592	4600
HealthSoc	4831	77.5	4908
CokeOven	4352	2736	7088
InsuranSrv	7878	188	8067
RealEstate	10675	157	10832
OthSrv	10479	727	11206
TextFoot	9545	5394	14939
TransEquip	8529	9539	18067
Food	17687	2273	19961
PetroRef	12374	8997	21371
BevTobacco	52752	2935	55687
Total	***167530***	***41088***	***208618***

8.3 APPENDIX –The Financial Data

This appendix details the financial data used in the simulations. These data include stocks of financial instruments for each agent, at the start and end of 2017. Flows are also included as part of the appendix.

Stocks of financial instruments (Start of 2017)

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
1 Banks	N									
	D	118,984	57,104	354,702	321,942	989,250	1,753,461	149,385		
	B	4,040		19,284			36,602	296,146		
	E			506,588			262,926			
	G									
	T	**123,024**	**57,104**	**880,574**	**321,942**	**989,250**	**2,052,989**	**445,531**	-	-
2 SARB	N	41,605				75,312		32,277		
	D	97,515		10,276	183,988			11,427		
	B	101						100		
	E							228,250		
	G	8,534		32,820						
	T	**147,755**	-	**43,096**	**183,988**	**75,312**	-	**272,054**	-	-
3 Fgn	N									
	D	430,694	61		29,954		60,069			
	B	27,478	547,269		491			237,459		
	E	109,812			6,023		1,273,722	2,972,019		
	G		100,555							
	T	**567,984**	**647,885**	-	**36,468**	-	**1,333,791**	**3,209,478**	-	-

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
4. Govt	N									
	D	1,029	104	182,509						
	B	295,954	7,766	832,535				1,327,824		
	E			13,045						
	G									
	T	**296,983**	**7,870**	**1,028,089**	**-**	**-**	**-**	**1,327,824**	**-**	**-**
5 Hhlds	N									
	D	107,927						21,557		
	B									
	E			299,093						
	G									
	T	**107,927**	**-**	**299,093**	**-**	**-**	**-**	**21,557**	**-**	**-**
6 Inds	N									
	D	1,850,051		150,660						
	B	334,773						765,187		
	E	158,056	6,292	897,280				2,556,067		
	G									
	T	**2,342,880**	**6,292**	**1,047,940**	**-**	**-**	**-**	**3,321,254**	**-**	**-**
7 NBFI	N									
	D		3,054				404,092			
	B			396,595						
	E			1,794,560		5,683,489	315,908			
	G									
	T	**-**	**3,054**	**2,191,155**	**-**	**5,683,489**	**720,000**	**-**	**-**	**-**

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
8 NRH	N									
	D	706,124								
	B									
	E					699,676				
	G									
	T	**706,124**	**-**	**-**	**-**	**699,676**	**-**	**-**	**-**	**-**
9 RH	N									
	D	577,737								
	B									
	E					572,463				
	G									
	T	**577,737**	**-**	**-**	**-**	**572,463**	**-**	**-**	**-**	**-**
Total A		***4,870,414***	***722,205***	***5,489,947***	***542,398***	***8,020,190***	***4,106,780***	***8,597,697***	***-***	***-***
Total L		***4,870,414***	***722,205***	***5,795,606***	***2,660,766***	***428,577***	***6,718,366***	***8,597,697***	***1,405,800***	***1,150,200***
Balances (L-A)		***-***	***-***	***305,659***	***2,118,368***	***-7,591,612***	***2,611,586***	***-***	***1,405,800***	***1,150,200***

Stocks of financial instruments (End of 2017)

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
1 Banks	N									
	D	96,159	60,504	443,584	313,348	1,088,355	1,748,748	158,028		
	B	21,175		19,997			39,425	277,844		
	E			463,025			432,395			
	G									
	T	**117,334**	**60,504**	**926,606**	**313,348**	**1,088,355**	**2,220,568**	**425,761**	-	-
2 SARB	N	41,763				80,114		34,335		
	D	103,042		9,217	180,519			11,192		
	B	101						100		
	E							200,321		
	G	12,701		31,323						
	T	**157,607**	**-**	**40,540**	**180,519**	**80,114**	**-**	**245,948**	-	-
3 Fgn	N									
	D	403,005	59		28,588		98,469			
	B	32,171	525,930		73			268,045		
	E	133,121			4,416		1,601,820	3,737,581		
	G		98,847							
	T	**568,297**	**624,836**	**-**	**33,077**	**-**	**1,700,289**	**4,005,626**	-	-
4. Govt	N									
	D	751	68	202,840						
	B	311,179	7,976	981,353				1,434,998		
	E			7,364						
	G									

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
	T	**311,930**	**8,044**	**1,191,557**	**-**	**-**	**-**	**1,434,998**	-	-
5 Hhlds	N									
	D	112,239								
	B							22,313		
	E			380,760						
	G									
	T	**112,239**	**-**	**380,760**	**-**	**-**	**-**	**22,313**	-	-
6 Inds	N									
	D	1,938,428		237,372						
	B	437,007						826,948		
	E	170,162	6,011	1,142,279				2,443,158		
	G									
	T	**2,545,597**	**6,011**	**1,379,651**	**-**	**-**	**-**	**3,270,106**	-	-
7 NBFI	N									
	D		5,333				441,845			
	B			373,234						
	E			2,284,558		5,978,372	321,409			
	G									
	T	**-**	**5,333**	**2,657,792**	**-**	**5,978,372**	**763,254**	-	-	-
8 NRH	N									
	D	736,710								
	B									
	E					743,340				
	G									
	T	**736,710**	**-**	**-**	**-**	**743,340**	**-**	-	-	-

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
9 RH	N									
	D	602,762								
	B									
	E					608,188				
	G									
	T	**602,762**	**-**	**-**	**-**	**608,188**	-	-	-	-
Total A		***5,152,476***	***704,728***	***6,576,905***	***526,944***	***8,498,370***	***4,684,111***	***9,404,751***	***-***	***-***
Total L		***5,152,476***	***704,728***	***6,932,125***	***2,946,529***	***515,311***	***7,201,365***	***9,404,751***	***1,480,050***	***1,210,950***
Balancs (L-A)		***-***	***-***	***355,220***	***2,419,585***	***-7,983,058***	***2,517,254***	***-***	***1,480,050***	***1,210,950***

Financial Instruments flows in 2017

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
1 Banks	N									
	D	-22,825	3,400	88,882	-8,594	99,105	-4,713	-1,468		
	B	17,135		713			2,823	-18,302		
	E			-43,563			169,469			
	G									
	T	**-5,690**	**3,400**	**46,032**	**-8,594**	**99,105**	**167,579**	**-19,770**		
2 SARB	N	158				4,802		2,058		
	D	5,527		-1,059	-3,469			-235		
	B									
	E							-27,929		
	G	4,167		-1,497						
	T	**9,852**		**-2,556**	**-3,469**	**4,802**		**-26,106**		
3 Fgn	N									
	D	-27,689	-2		-1,366		38,400			
	B	4,693	-21,339		-418			30,586		
	E	23,309			-1,607		328,098	765,562		
	G		-1,708							
	T	**313**	**-23,049**		**-3,391**		**366,498**	**796,148**		
4. Govt	N									
	D	-278	-36	20,331						
	B	15,225	210	148,818				107,174		
	E			-5,681						
	G									
	T	**14,947**	**174**	**163,468**				**107,174**		

		1 Banks	2 SARB	3 Fgn	4. Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH
5 Hhlds	N									
	D	4,312						-21,557		
	B							22,313		
	E			81,667						
	G									
	T	**4,312**		**81,667**				**755**		
6 Inds	N									
	D	88,377		86,712						
	B	102,234						61,761		
	E	12,106	-281	244,999				-112,909		
	G									
	T	**202,717**	**-281**	**331,711**				**-51,148**		
7 NBFI	N									
	D		2,279				37,753			
	B			-23,361						
	E			489,997		294,884	5,501			
	G									
	T		**2,279**	**466,636**		**294,884**	**43,254**			
8 NRH	N									
	D	30,586								
	B									
	E					43,664				
	G									
	T	**30,586**				**43,664**				
9 RH	N									
	D	25,025								

		1 Banks	*2 SARB*	*3 Fgn*	*4. Govt*	*5 Hhlds*	*6 Inds*	*7 NBFI*	*8 NRH*	*9 RH*
	B									
	E					35,725				
	G									
	T	**25,025**				**35,725**				
Total A		***282,062***	***-17,477***	***1,086,958***	***-15,454***	***478,180***	***577,331***	***807,053***		
Total L		***282,062***	***-17,477***	***1,136,519***	***285,763***	***86,734***	***482,999***	***807,053***	***74,250***	***60,750***
Balancs (L-A)		*-*	*-*	***49,561***	***301,217***	***-391,446***	***-94,332***	*-*	***74,250***	***60,750***

8.4 APPENDIX – Nuanced Model Results

This appendix presents the detailed results of the simulations. For each simulation, macro results are presented, followed by flows in financial instruments.

Macros for simulation 1: A benchmarked 1% reduction in monetary inflows.

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
contribution of tech change to GDP	a_cont	0.0	0.0	0.0	0.0	0.0
value of public sector investment	agginv_g	0.0	-1.5	-0.6	-0.5	-0.5
real public investment	agginv_rg	0.0	-0.3	0.3	0.4	0.4
average propensity to consume out of hdy	apc	0.0	-0.4	-0.3	-0.4	-0.6
ratio of total consumption to GNP	apc_gnp	0.0	0.0	0.0	0.0	0.0
average propensity to save out of GNP	aps_gnp	0.0	0.0	0.0	0.0	0.0
average value of a3com	ave_a3com	0.0	0.0	0.0	0.0	0.0
Ave. rate of return in ROW - exo but should relate t ..	ave_ror_row	0.0	0.0	0.0	0.0	0.0
social security benefits	bens	0.0	-0.4	-0.6	-0.7	-0.8
Big budget in foreign currency for foreigners	big_budf	0.0	0.2	0.1	0.1	0.1
change in current account deficit (change)	d_cad	0.0	-1408.2	4510.8	6545.3	7364.3
One in year one, zero in later years (change)	d_dum_year1	0.0	0.0	0.0	0.0	0.0
scalar shifter, K-growth/ROR equation (change)	d_f_eeqror	0.0	0.0	0.0	0.0	0.0
shifter, d_fd_t, start-of-year foreign debt eqn (change)	d_f_fd_t	0.0	0.0	0.0	0.0	0.0
(change)	d_f_gov	0.0	0.0	0.0	0.0	0.0
shifter, p3tot_l, make endog if init sol not for t-1 (change)	d_f_p3tot_l	0.0	0.0	0.0	0.0	0.0
shifter, d_psd_t, make endog if init sol not for t-1 (change)	d_f_psd_t	0.0	0.0	0.0	0.0	0.0
change in foreign debt at start of year (change)	d_fd_t	0.0	0.0	-1408.3	3102.5	9647.8
Scalar shift, expected real internal rate of return (change)	d_fferiror_i	0.0	0.0	0.0	0.0	0.0
change in public sector deficit (change)	d_gov_def	0.0	13608.9	14922.9	21259.3	32042.6
Government saving (change)	d_gov_sav	0.0	-15853.2	-15889.1	-22057.2	-33001.3
change in household savings (change)	d_housav	0.0	-943.8	3980.9	9941.8	18983.6

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
change in rate of inflation (change)	d_inf	0.0	0.0	0.0	0.0	0.0
change in interest on foreign debt (change)	d_int_fd	0.0	0.0	-140.8	310.3	964.8
change in rate of interest on public sector debt (change)	d_int_psd	0.0	0.0	0.0	0.0	0.0
National saving (change)	d_nat_sav	0.0	-16797.0	-11908.1	-12115.4	-14017.8
change in net interest paid by government (change)	d_net_int_g	0.0	0.0	6443.1	13508.0	23572.9
(change)	d_nfa	0.0	0.0	1408.0	-3102.9	-9648.0
inventory demand price index (change)	d_p6tot	0.0	138.0	167.2	170.6	165.6
CAD as a per cent of GDP (change)	d_pc_cad_gdp	0.0	0.0	0.1	0.1	0.1
change in public sector debt, start of year (change)	d_psd_t	0.0	0.0	13608.9	28531.2	49789.9
ratio of govt deficit to GDP (change)	d_r_def_gdp	0.0	0.0	0.0	0.0	0.0
ratio of net tax collected to GDP (change)	d_r_nettax_gdp	0.0	0.0	0.0	0.0	0.0
ratio of st-of-yr public sector debt to GDP (change)	d_r_psd_gdp	0.0	0.0	0.0	0.0	0.0
real interest rate (change)	d_rint	0.0	0.0	0.0	0.0	0.0
real interest rate on public sector debt (change)	d_rint_psd	0.0	0.0	0.0	0.0	0.0
(change)	d_transsa2fgn	0.0	0.0	0.0	0.0	0.0
Value of inventory accumulation (change)	d_val6	0.0	205.6	325.0	354.9	353.1
aggregate tariff revenue (change)	d_w0tar_c	0.0	0.0	0.0	0.0	0.0
tax revenue, export (change)	d_w4tax_c	0.0	0.0	0.0	0.0	0.0
aggregate real inventory changes (change)	d_x6tot	0.0	67.6	157.8	184.3	187.5
balance of trade (change)	del_b	0.0	1408.2	-4651.6	-6235.1	-6399.5
balance of trade/GDP (change)	del_b_gdp	0.0	0.0	0.0	0.0	0.0
shift, sticky nominal wages (change)	del_f_nwage_c	0.0	0.0	0.0	0.0	0.0
shifter, pre-tax labour supply in E_del_f_wage_c (change)	del_f_wage_c	0.0	0.4	-0.7	-0.2	-0.1
allows for equal changes in rates of return (change)	del_r_tot	0.0	0.0	0.0	0.0	0.0
normally shocked from zero to one (change)	del_unity	0.0	0.0	0.0	0.0	0.0
total employment, jobs weighted	emp_jobs	0.0	-0.8	-0.3	-0.2	-0.2

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
total employment, jobs weighted, forecast	emp_jobs_o	0.0	0.0	0.0	0.0	0.0
total employment, wage bill weighted	employ_io	0.0	-0.8	-0.3	-0.2	-0.2
shifter, general production tax	f0tax_i	0.0	0.0	0.0	0.0	0.0
shifter, overall wages	f1lab_io	0.0	0.9	0.3	0.2	0.2
tax shifter, intermediate usage	f1tax_csi	0.0	0.0	0.0	0.0	0.0
tax shifter, investment	f2tax_csi	0.0	0.0	0.0	0.0	0.0
shifter, locks IR/CR ratio when exog	f2tot_i	0.0	-0.2	0.3	0.5	0.5
tax shifter, household usage	f3tax_cs	0.0	0.0	0.0	0.0	0.0
export demand shifter, uniform vertical	f4gen	0.0	0.0	0.0	0.0	0.0
export tax shifter, uniform	f4tax_c	0.0	0.0	0.0	0.0	0.0
shifter, overall government demand	f5gen	0.0	-0.4	-0.2	-0.1	-0.1
shifter, locks G/CR ratio when exog	f5tot	0.0	0.0	0.0	0.0	0.0
Shifter to turn off big-budf equation	f_big_budf	0.0	0.0	0.0	0.0	0.0
shifter, value of emp_jobs_o	f_emp_o	0.0	0.8	0.3	0.2	0.2
shifter, foreign currency import prices	f_pf0cif_c	0.0	0.0	0.0	0.0	0.0
shifter, value of real_wage_c_o	f_rwage_o	0.0	0.0	0.0	0.0	0.0
shifter, ratio of capital to labour tax rates	f_tax_r	0.0	0.0	0.0	0.0	0.0
When exogenous, central bank assets expand with nomi ..	f_w0gdp_rule	0.0	0.7	0.9	0.8	0.8
Ratio baseline nominal wage to policy nominal wage	f_wage_nom_o	0.0	0.4	0.6	0.7	0.8
shifter, overall primary-factor tech change	ff_a1prim	0.0	0.0	0.0	0.0	0.0
shifter, uniform power of tariff	ff_t0imp	0.0	0.0	0.0	0.0	0.0
gross national product	gnpnom	0.0	-1.5	-1.0	-0.9	-1.0
household disposable income	hdy	0.0	-1.3	-0.7	-0.5	-0.4
Household savings	housav	0.0	-0.1	0.4	0.8	1.4
level of govt deficit to GDP ratio	lev_r_def_gdp	0.0	0.0	0.0	0.0	0.0
level of public sector debt to GDP ratio	lev_r_psd_gdp	0.0	0.0	0.0	0.0	0.0

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
net collection of income and indirect taxes	net_tax_tot	0.0	-1.5	-1.0	-0.9	-1.0
other govt rev apart from taxes & interest	oth_gov_rev	0.0	-1.0	-0.8	-0.8	-0.9
imports price index, cif, ZAR	p0cif_c	0.0	-1.2	-1.1	-1.1	-1.1
GDP price index, expenditure	p0gdpexp	0.0	-1.1	-0.8	-0.8	-0.9
GNE price index	p0gne	0.0	-1.1	-0.8	-0.8	-0.9
duty-paid imports price index	p0imp_c	0.0	-1.2	-1.1	-1.1	-1.1
real devaluation	p0realdev	0.0	-0.2	-0.3	-0.3	-0.3
terms of trade	p0toft	0.0	0.2	0.2	0.1	0.1
average capital rental	p1cap_i	0.0	-1.8	-1.0	-0.9	-1.0
average nominal wage	p1lab_io	0.0	-0.4	-0.6	-0.7	-0.8
average land rental	p1lnd_i	0.0	-1.7	-1.3	-1.2	-1.3
index of primary factor cost (excludes tech change)	p1prim_i	0.0	-1.1	-0.8	-0.8	-0.8
price index for gov investment expenditure	p2tot_g	0.0	-1.2	-0.8	-0.8	-0.9
investment price index	p2tot_i	0.0	-1.2	-0.8	-0.8	-0.9
consumer price index (CPI)	p3tot	0.0	-1.2	-0.9	-0.8	-0.9
lagged CPI, usually CPI in year t-1	p3tot_l	0.0	0.0	-1.2	-0.9	-0.8
exports price index	p4tot	0.0	-1.1	-0.9	-0.9	-1.0
government demands price index	p5tot	0.0	-0.7	-0.7	-0.8	-0.8
exchange rate, mid year, $Foreign/ZAR	phi	0.0	1.3	1.1	1.1	1.1
population	pop	0.0	0.0	0.0	0.0	0.0
number of households	q	0.0	0.0	0.0	0.0	0.0
shifter, overall I/K ratio	r_inv_cap_u	0.0	0.0	0.0	0.0	0.0
real wage for consumers	real_wage_c	0.0	0.9	0.3	0.2	0.2
real wage for consumers, forecast	real_wage_c_o	0.0	0.9	0.3	0.2	0.2
	shiftG	0.0	0.0	0.0	0.0	0.0
Ratio of liabilities (e.g. credit-card debt) to consump ..	shifthous	0.0	0.0	0.0	0.0	0.0
	shiftind	0.0	0.0	0.0	0.0	0.0

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
rate of tax on capital income	tax_k_r	0.0	0.0	0.0	0.0	0.0
rate of tax on labour income	tax_l_r	0.0	0.0	0.0	0.0	0.0
aggregate revenue from all indirect taxes	taxindg	0.0	-1.7	-1.1	-1.0	-1.0
income tax revenue	taxrev_inc	0.0	-1.4	-1.0	-0.9	-0.9
contribution of tax carrying flows to change in GDP	tcf_cont	0.0	-0.1	0.0	0.0	0.0
transfers from the government	transfers	0.0	-0.1	0.5	1.1	1.7
scalar shifter, import/domestic twist	twist_c	0.0	0.0	0.0	0.0	0.0
scalar shifter, labour/capital twist	twist_i	0.0	0.0	0.0	0.0	0.0
	vcaptot	0.0	-1.2	-0.9	-0.9	-0.9
value of imports, ZAR, cif	w0cif_c	0.0	-1.6	-1.1	-1.0	-1.0
nominal GDP, expenditure side	w0gdpexp	0.0	-1.5	-1.0	-0.9	-1.0
nominal GDP, income side	w0gdpinc	0.0	-1.5	-1.0	-0.9	-1.0
nominal GNE	w0gne	0.0	-1.5	-0.9	-0.8	-0.9
value of imports plus duty	w0imp_c	0.0	-1.6	-1.1	-1.0	-1.0
aggregate indirect-tax revenue	w0tax_csi	0.0	-1.7	-1.1	-1.0	-1.0
aggregate payments to capital	w1cap_i	0.0	-1.8	-1.0	-0.9	-1.0
aggregate payments to labour	w1lab_io	0.0	-1.2	-0.9	-0.9	-0.9
aggregate payments to land	w1lnd_i	0.0	-1.7	-1.3	-1.2	-1.3
nominal value of other cost ticket payments	w1oct_i	0.0	0.0	0.0	0.0	0.0
aggregate production tax revenue	w1ptx_i	0.0	-1.9	-1.0	-0.8	-0.8
tax revenue, intermediate	w1tax_csi	0.0	-1.6	-1.1	-1.0	-1.1
Value of investment plus inventories excluding Govt invest ..	w2_ind	0.0	-1.5	-0.6	-0.4	-0.4
tax revenue, investment	w2tax_csi	0.0	0.0	0.0	0.0	0.0
aggregate nominal investment	w2tot_i	0.0	-1.8	-0.7	-0.5	-0.5
tax revenue, households	w3tax_cs	0.0	-1.6	-1.1	-1.0	-1.0
aggregate nominal household expenditure	w3tot	0.0	-1.6	-1.0	-0.9	-1.0
aggregate border value of exports, ZAR	w4tot	0.0	-1.5	-1.3	-1.3	-1.3

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
aggregate nominal value of government demands	w5tot	0.0	-1.1	-0.8	-0.8	-0.9
nominal wage	wage_nom	0.0	-0.4	-0.6	-0.7	-0.8
nominal wage, forecast	wage_nom_o	0.0	0.0	0.0	0.0	0.0
import volume index, cif weights	x0cif_c	0.0	-0.4	0.0	0.1	0.1
real GDP, expenditure side	x0gdpexp	0.0	-0.4	-0.2	-0.1	-0.1
real GDP, income side	x0gdpinc	0.0	-0.4	-0.2	-0.1	-0.1
real GNE	x0gne	0.0	-0.4	-0.1	0.0	0.0
import volume index, duty-paid weights	x0imp_c	0.0	-0.4	0.0	0.1	0.1
aggregate capital stock, st-of-yr, rental wgts	x1cap_i	0.0	0.0	0.0	0.0	0.0
aggregate employment	x1lab_io	0.0	-0.8	-0.3	-0.2	-0.2
aggregate land use	x1lnd_i	0.0	0.0	0.0	0.0	0.0
aggregate primary factor use (excludes tech change)	x1prim_i	0.0	-0.4	-0.2	-0.1	-0.1
aggregate real investment	x2tot_i	0.0	-0.6	0.2	0.4	0.4
aggregate real household consumption	x3tot	0.0	-0.4	-0.2	-0.1	-0.1
export volume index	x4tot	0.0	-0.4	-0.4	-0.3	-0.3
aggregate real government consumption	x5tot	0.0	-0.4	-0.2	-0.1	-0.1

Financial instrument flows simulation 1: A benchmarked 1% reduction in monetary inflows

Time t+1

*d_flow[*DeposLoans*](D)*	***Banks***	***SARB***	***Fgn***	***Govt***	***Hhlds***	***Inds***	***NBFI***	***NRH***	***RH***	***Total***
Banks	-989	-515	-4668	-3523	-312	-28362	-1054	0	0	**-39423**
SARB	-1067	0	-93	-1985	0	0	-86	0	0	**-3230**
Fgn	-4174	-1	0	-314	0	-1532	0	0	0	**-6021**
Govt	3	0	-39	0	0	0	0	0	0	**-36**
Hhlds	-2143	0	0	0	0	0	-319	0	0	**-2462**
Inds	-27913	0	-3279	0	0	0	0	0	0	**-31192**
NBFI	0	-59	0	0	0	-8698	0	0	0	**-8756**
NRH	-3058	0	0	0	0	0	0	0	0	**-3058**
RH	-4923	0	0	0	0	0	0	0	0	**-4923**
Total	**-44265**	**-574**	**-8078**	**-5822**	**-312**	**-38592**	**-1459**	**0**	**0**	**-99103**

*d_flow[*Notes*](D)*	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	0	0	0	0	0	0	0	0	0	**0**
SARB	-433	0	0	0	-158	0	-264	0	0	**-854**
Fgn	0	0	0	0	0	0	0	0	0	**0**
Govt	0	0	0	0	0	0	0	0	0	**0**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	0	0	0	0	0	0	0	0	0	**0**
NBFI	0	0	0	0	0	0	0	0	0	**0**
NRH	0	0	0	0	0	0	0	0	0	**0**
RH	0	0	0	0	0	0	0	0	0	**0**
Total	**-433**	**0**	**0**	**0**	**-158**	**0**	**-264**	**0**	**0**	**-854**

*d_flow[*Equity*](D)*	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	0	0	-4872	0	0	-7013	0	0	0	-11885
SARB	0	0	0	0	0	0	-1539	0	0	-1539
Fgn	-1379	0	0	-49	0	-24928	-28718	0	0	-55073
Govt	0	0	-1	0	0	0	0	0	0	-1
Hhlds	0	0	-7028	0	0	0	0	0	0	-7028
Inds	-2450	-73	-15780	0	0	0	-26636	0	0	-44939
NBFI	0	0	-29122	0	-13642	-6327	0	0	0	-49091

NRH	0	0	0	0	3058	0	0	0	0	3058
RH	0	0	0	0	620	0	0	0	0	620
Total	**-3829**	**-73**	**-56803**	**-49**	**-9964**	**-38268**	**-56893**	**0**	**0**	**-165879**

*d_flow[*Bonds*](D)*	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	-218	0	-210	0	0	-639	-1980	0	0	**-3047**
SARB	-1	0	0	0	0	0	-1	0	0	**-2**
Fgn	-333	-4594	0	-1	0	0	-2060	0	0	**-6987**
Govt	1147	34	-189	0	0	0	9028	0	0	**10019**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	-6293	0	0	0	0	0	-8976	0	0	**-15269**
NBFI	0	0	-4758	0	0	0	0	0	0	**-4758**
NRH	0	0	0	0	0	0	0	0	0	**0**
RH	0	0	0	0	0	0	0	0	0	**0**
Total	**-5698**	**-4560**	**-5157**	**-1**	**0**	**-639**	**-3989**	**0**	**0**	**-20044**

*d_flow[*GldSDR*](D)*	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	0	0	0	0	0	0	0	0	0	**0**
SARB	-132	0	-314	0	0	0	0	0	0	**-446**
Fgn	0	-863	0	0	0	0	0	0	0	**-863**
Govt	0	0	0	0	0	0	0	0	0	**0**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	0	0	0	0	0	0	0	0	0	**0**
NBFI	0	0	0	0	0	0	0	0	0	**0**
NRH	0	0	0	0	0	0	0	0	0	**0**
RH	0	0	0	0	0	0	0	0	0	**0**
Total	**-132**	**-863**	**-314**	**0**	**0**	**0**	**0**	**0**	**0**	**-1309**

Time t+4

*d_flow[*DeposLoans*](D)*	***Banks***	***SARB***	***Fgn***	***Govt***	***Hhlds***	***Inds***	***NBFI***	***NRH***	***RH***	***Total***
Banks	-1378.3	-483.24	-359.69	-6036.64	548.42	-35975.53	-845.08	0	0	***-44530.06***
SARB	-263.41	0	9.52	-673.93	0	0	-3.98	0	0	***-931.8***
Fgn	-1030.25	-0.05	0	-106.73	0	-314.57	0	0	0	***-1451.6***
Govt	8.23	0.51	760.41	0	0	0	0	0	0	***769.15***
Hhlds	-5320.54	0	0	0	0	0	-475.75	0	0	***-5796.29***
Inds	-35820.03	0	-208.06	0	0	0	0	0	0	***-36028.09***
NBFI	0	-48.2	0	0	0	-10560.11	0	0	0	***-10608.31***
NRH	-1005.2	0	0	0	0	0	0	0	0	***-1005.2***
RH	-3033	0	0	0	0	0	0	0	0	***-3033***
Total	***-47842.5***	***-530.98***	***202.18***	***-6817.3***	***548.42***	***-46850.21***	***-1324.81***	***0***	***0***	***-102615.2***

*d_flow[*Notes*](D)*	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	0	0	0	0	0	0	0	0	0	***0***
SARB	-106.76	0	0	0	38.59	0	-12.22	0	0	***-80.39***
Fgn	0	0	0	0	0	0	0	0	0	***0***
Govt	0	0	0	0	0	0	0	0	0	***0***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	0	0	0	0	0	0	0	0	0	***0***
NBFI	0	0	0	0	0	0	0	0	0	***0***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***-106.76***	***0***	***0***	***0***	***38.59***	***0***	***-12.22***	***0***	***0***	***-80.39***

*d_flow[*Equity*](D)*	1 Banks	2 CB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	**Total**
1 Banks	0	0	-375.49	0	0	-8895.8	0	0	0	***-9271.29***
2 CB	0	0	0	0	0	0	-71.32	0	0	***-71.32***
3 Fgn	-340.3	0	0	-16.49	0	-5116.77	-1330.92	0	0	***-6804.48***

4 Govt	0	0	27.61	0	0	0	0	0	0	***27.61***
5 Hhlds	0	0	-2178.17	0	0	0	0	0	0	***-2178.17***
6 Inds	-3144.28	-61.05	-1001.21	0	0	0	-19257.7	0	0	***-23464.24***
7 NBFI	0	0	-1712.02	0	8335.81	-7681.95	0	0	0	***-1058.16***
8 NRH	0	0	0	0	1005.2	0	0	0	0	***1005.2***
9 RH	0	0	0	0	1081.06	0	0	0	0	***1081.06***
Total	***-3484.58***	***-61.05***	***-5239.28***	***-16.49***	***10422.07***	***-21694.52***	***-20659.94***	***0***	***0***	***-40733.79***
*d_flow[*Bonds*](D)*	1 Banks	2 CB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	**Total**
1 Banks	-303.53	0	-16.22	0	0	-811.07	-1587.38	0	0	***-2718.2***
2 CB	-0.26	0	0	0	0	0	-0.04	0	0	***-0.3***
3 Fgn	-82.24	-464.47	0	-0.27	0	0	-95.45	0	0	***-642.43***
4 Govt	3408.07	59.85	3678.92	0	0	0	18223.65	0	0	***25370.49***
5 Hhlds	0	0	0	0	0	0	0	0	0	***0***
6 Inds	-8075.13	0	0	0	0	0	-6489.93	0	0	***-14565.06***
7 NBFI	0	0	-279.73	0	0	0	0	0	0	***-279.73***
8 NRH	0	0	0	0	0	0	0	0	0	***0***
9 RH	0	0	0	0	0	0	0	0	0	***0***
Total	***-5053.09***	***-404.62***	***3382.97***	***-0.27***	***0***	***-811.07***	***10050.85***	***0***	***0***	***7164.77***
*d_flow[*GldSDR*](D)*	1 Banks	2 CB	3 Fgn	4 Govt	5 Hhlds	6 Inds	7 NBFI	8 NRH	9 RH	**Total**
1 Banks	0	0	0	0	0	0	0	0	0	***0***
2 CB	-32.47	0	32.34	0	0	0	0	0	0	***-0.13***
3 Fgn	0	-87.3	0	0	0	0	0	0	0	***-87.3***
4 Govt	0	0	0	0	0	0	0	0	0	***0***
5 Hhlds	0	0	0	0	0	0	0	0	0	***0***
6 Inds	0	0	0	0	0	0	0	0	0	***0***
7 NBFI	0	0	0	0	0	0	0	0	0	***0***
8 NRH	0	0	0	0	0	0	0	0	0	***0***
9 RH	0	0	0	0	0	0	0	0	0	***0***
Total	***-32.47***	***-87.3***	***32.34***	***0***	***0***	***0***	***0***	***0***	***0***	***-87.43***

Macro results for simulation 2: A benchmarked 1% increase in SARB assets

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
contribution of tech change to GDP	a_cont	0.0	0.0	0.0	0.0	0.0
value of public sector investment	agginv_g	0.0	2.2	0.9	0.5	0.4
real public investment	agginv_rg	0.0	0.9	0.3	0.2	0.2
average propensity to consume out of hdy	apc	0.0	0.4	0.2	0.2	0.3
ratio of total consumption to GNP	apc_gnp	0.0	0.0	0.0	0.0	0.0
average propensity to save out of GNP	aps_gnp	0.0	0.0	0.0	0.0	0.0
average value of a3com	ave_a3com	0.0	0.0	0.0	0.0	0.0
Ave. rate of return in ROW - exo but should relate t ..	ave_ror_row	0.0	0.0	0.0	0.0	0.0
social security benefits	bens	0.0	0.4	0.5	0.5	0.4
Big budget in foreign currency for foreigners	big_budf	0.0	0.0	0.5	0.7	0.8
change in current account deficit (change)	d_cad	0.0	8030.8	1960.4	649.0	1351.8
One in year one, zero in later years (change)	d_dum_year1	0.0	0.0	0.0	0.0	0.0
scalar shifter, K-growth/ROR equation (change)	d_f_eeqror	0.0	0.0	0.0	0.0	0.0
shifter, d_fd_t, start-of-year foreign debt eqn (change)	d_f_fd_t	0.0	0.0	0.0	0.0	0.0
(change)	d_f_gov	0.0	0.0	0.0	0.0	0.0
shifter, p3tot_l, make endog if init sol not for t-1 (change)	d_f_p3tot_l	0.0	0.0	0.0	0.0	0.0
shifter, d_psd_t, make endog if init sol not for t-1 (change)	d_f_psd_t	0.0	0.0	0.0	0.0	0.0
change in foreign debt at start of year (change)	d_fd_t	0.0	0.0	8031.0	9991.6	10640.7
Scalar shift, expected real internal rate of return (change)	d_fferiror_i	0.0	0.0	0.0	0.0	0.0
change in public sector deficit (change)	d_gov_def	0.0	-13216.6	-9757.2	-11566.7	-16671.7
Government saving (change)	d_gov_sav	0.0	16511.6	11136.7	12414.3	17465.2
change in household savings (change)	d_housav	0.0	1380.5	-3630.6	-8026.9	-13588.1
change in rate of inflation (change)	d_inf	0.0	0.0	0.0	0.0	0.0
change in interest on foreign debt (change)	d_int_fd	0.0	0.0	803.1	999.2	1064.1
change in rate of interest on public sector debt (change)	d_int_psd	0.0	0.0	0.0	0.0	0.0

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
National saving (change)	d_nat_sav	0.0	17892.0	7506.1	4387.4	3877.2
change in net interest paid by government (change)	d_net_int_g	0.0	0.0	-6257.5	-10877.3	-16354.0
(change)	d_nfa	0.0	0.0	-8030.8	-9991.5	-10640.6
inventory demand price index (change)	d_p6tot	0.0	-26.3	-28.1	-16.6	5.2
CAD as a per cent of GDP (change)	d_pc_cad_gdp	0.0	0.1	0.0	0.0	0.0
change in public sector debt, start of year (change)	d_psd_t	0.0	0.0	-13216.8	-22974.3	-34541.4
ratio of govt deficit to GDP (change)	d_r_def_gdp	0.0	0.0	0.0	0.0	0.0
ratio of net tax collected to GDP (change)	d_r_nettax_gdp	0.0	0.0	0.0	0.0	0.0
ratio of st-of-yr public sector debt to GDP (change)	d_r_psd_gdp	0.0	0.0	0.0	0.0	0.0
real interest rate (change)	d_rint	0.0	0.0	0.0	0.0	0.0
real interest rate on public sector debt (change)	d_rint_psd	0.0	0.0	0.0	0.0	0.0
(change)	d_transsa2fgn	0.0	0.0	0.0	0.0	0.0
Value of inventory accumulation (change)	d_val6	0.0	60.0	-15.8	-14.5	29.1
aggregate tariff revenue (change)	d_w0tar_c	0.0	0.0	0.0	0.0	0.0
tax revenue, export (change)	d_w4tax_c	0.0	0.0	0.0	0.0	0.0
aggregate real inventory changes (change)	d_x6tot	0.0	86.2	12.3	2.1	23.9
balance of trade (change)	del_b	0.0	-8030.8	-1157.3	350.2	-287.8
balance of trade/GDP (change)	del_b_gdp	0.0	0.0	0.0	0.0	0.0
shift, sticky nominal wages (change)	del_f_nwage_c	0.0	0.0	0.0	0.0	0.0
shifter, pre-tax labour supply in E_del_f_wage_c (change)	del_f_wage_c	0.0	-0.4	0.8	0.1	-0.1
allows for equal changes in rates of return (change)	del_r_tot	0.0	0.0	0.0	0.0	0.0
normally shocked from zero to one (change)	del_unity	0.0	0.0	0.0	0.0	0.0
total employment, jobs weighted	emp_jobs	0.0	0.8	0.1	0.0	-0.1
total employment, jobs weighted, forecast	emp_jobs_o	0.0	0.0	0.0	0.0	0.0
total employment, wage bill weighted	employ_io	0.0	0.8	0.1	0.0	-0.1

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
shifter, general production tax	f0tax_i	0.0	0.0	0.0	0.0	0.0
shifter, overall wages	f1lab_io	0.0	-0.8	0.0	0.2	0.2
tax shifter, intermediate usage	f1tax_csi	0.0	0.0	0.0	0.0	0.0
tax shifter, investment	f2tax_csi	0.0	0.0	0.0	0.0	0.0
shifter, locks IR/CR ratio when exog	f2tot_i	0.0	0.7	0.2	0.1	0.1
tax shifter, household usage	f3tax_cs	0.0	0.0	0.0	0.0	0.0
export demand shifter, uniform vertical	f4gen	0.0	0.0	0.0	0.0	0.0
export tax shifter, uniform	f4tax_c	0.0	0.0	0.0	0.0	0.0
shifter, overall government demand	f5gen	0.0	0.5	0.1	0.0	0.0
shifter, locks G/CR ratio when exog	f5tot	0.0	0.0	0.0	0.0	0.0
Shifter to turn off big-budf equation	f_big_budf	0.0	0.0	0.0	0.0	0.0
shifter, value of emp_jobs_o	f_emp_o	0.0	-0.8	-0.1	0.0	0.1
shifter, foreign currency import prices	f_pf0cif_c	0.0	0.0	0.0	0.0	0.0
shifter, value of real_wage_c_o	f_rwage_o	0.0	0.0	0.0	0.0	0.0
shifter, ratio of capital to labour tax rates	f_tax_r	0.0	0.0	0.0	0.0	0.0
When exogenous, central bank assets expand with nomi ..	f_w0gdp_rule	0.0	-0.6	-0.6	-0.4	-0.3
Ratio baseline nominal wage to policy nominal wage	f_wage_nom_o	0.0	-0.4	-0.5	-0.5	-0.4
shifter, overall primary-factor tech change	ff_a1prim	0.0	0.0	0.0	0.0	0.0
shifter, uniform power of tariff	ff_t0imp	0.0	0.0	0.0	0.0	0.0
gross national product	gnpnom	0.0	1.6	0.6	0.3	0.3
household disposable income	hdy	0.0	1.4	0.4	0.1	-0.1
Household savings	housav	0.0	0.1	-0.3	-0.7	-1.0
level of govt deficit to GDP ratio	lev_r_def_gdp	0.0	0.0	0.0	0.0	0.0
level of public sector debt to GDP ratio	lev_r_psd_gdp	0.0	0.0	0.0	0.0	0.0
net collection of income and indirect taxes	net_tax_tot	0.0	1.6	0.6	0.4	0.3
other govt rev apart from taxes & interest	oth_gov_rev	0.0	1.1	0.6	0.5	0.4
imports price index, cif, ZAR	p0cif_c	0.0	1.1	0.6	0.4	0.3
GDP price index, expenditure	p0gdpexp	0.0	1.1	0.5	0.3	0.3

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
GNE price index	p0gne	0.0	1.2	0.5	0.3	0.3
duty-paid imports price index	p0imp_c	0.0	1.1	0.6	0.4	0.3
real devaluation	p0realdev	0.0	-0.1	0.1	0.1	0.0
terms of trade	p0toft	0.0	-0.1	0.0	0.0	0.0
average capital rental	p1cap_i	0.0	2.0	0.5	0.2	0.1
average nominal wage	p1lab_io	0.0	0.4	0.5	0.5	0.4
average land rental	p1lnd_i	0.0	1.5	0.6	0.4	0.3
index of primary factor cost (excludes tech change)	p1prim_i	0.0	1.1	0.5	0.3	0.3
price index for gov investment expenditure	p2tot_g	0.0	1.3	0.5	0.3	0.3
investment price index	p2tot_i	0.0	1.3	0.5	0.3	0.3
consumer price index (CPI)	p3tot	0.0	1.3	0.5	0.3	0.3
lagged CPI, usually CPI in year t-1	p3tot_l	0.0	0.0	1.3	0.5	0.3
exports price index	p4tot	0.0	1.0	0.5	0.4	0.3
government demands price index	p5tot	0.0	0.7	0.5	0.4	0.4
exchange rate, mid year, $Foreign/ZAR	phi	0.0	-1.1	-0.6	-0.4	-0.3
population	pop	0.0	0.0	0.0	0.0	0.0
number of households	q	0.0	0.0	0.0	0.0	0.0
shifter, overall I/K ratio	r_inv_cap_u	0.0	0.0	0.0	0.0	0.0
real wage for consumers	real_wage_c	0.0	-0.8	0.0	0.2	0.2
real wage for consumers, forecast	real_wage_c_o	0.0	-0.8	0.0	0.2	0.2
	shiftG	0.0	0.0	0.0	0.0	0.0
Ratio of liabilities (e.g. credit-card debt) to consump ..	shifthous	0.0	0.0	0.0	0.0	0.0
	shiftind	0.0	0.0	0.0	0.0	0.0
rate of tax on capital income	tax_k_r	0.0	0.0	0.0	0.0	0.0
rate of tax on labour income	tax_l_r	0.0	0.0	0.0	0.0	0.0
aggregate revenue from all indirect taxes	taxindg	0.0	1.7	0.6	0.3	0.3
income tax revenue	taxrev_inc	0.0	1.5	0.6	0.4	0.3
contribution of tax carrying flows to change in GDP	tcf_cont	0.0	0.1	0.0	0.0	0.0

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
transfers from the government	transfers	0.0	0.1	-0.5	-0.9	-1.2
scalar shifter, import/domestic twist	twist_c	0.0	0.0	0.0	0.0	0.0
scalar shifter, labour/capital twist	twist_i	0.0	0.0	0.0	0.0	0.0
	vcaptot	0.0	1.3	0.6	0.4	0.4
value of imports, ZAR, cif	w0cif_c	0.0	1.7	0.7	0.4	0.3
nominal GDP, expenditure side	w0gdpexp	0.0	1.6	0.6	0.4	0.3
nominal GDP, income side	w0gdpinc	0.0	1.6	0.6	0.4	0.3
nominal GNE	w0gne	0.0	1.8	0.7	0.3	0.3
value of imports plus duty	w0imp_c	0.0	1.7	0.7	0.4	0.3
aggregate indirect-tax revenue	w0tax_csi	0.0	1.7	0.6	0.3	0.3
aggregate payments to capital	w1cap_i	0.0	2.0	0.6	0.3	0.2
aggregate payments to labour	w1lab_io	0.0	1.3	0.6	0.4	0.4
aggregate payments to land	w1lnd_i	0.0	1.5	0.6	0.4	0.3
nominal value of other cost ticket payments	w1oct_i	0.0	0.0	0.0	0.0	0.0
aggregate production tax revenue	w1ptx_i	0.0	2.1	0.6	0.2	0.2
tax revenue, intermediate	w1tax_csi	0.0	1.6	0.7	0.4	0.3
Value of investment plus inventories excluding Govt invest ..	w2_ind	0.0	2.3	0.9	0.5	0.5
tax revenue, investment	w2tax_csi	0.0	0.0	0.0	0.0	0.0
aggregate nominal investment	w2tot_i	0.0	2.5	0.8	0.4	0.4
tax revenue, households	w3tax_cs	0.0	1.7	0.6	0.3	0.3
aggregate nominal household expenditure	w3tot	0.0	1.7	0.6	0.3	0.2
aggregate border value of exports, ZAR	w4tot	0.0	1.1	0.6	0.4	0.3
aggregate nominal value of government demands	w5tot	0.0	1.2	0.6	0.4	0.4
nominal wage	wage_nom	0.0	0.4	0.5	0.5	0.4
nominal wage, forecast	wage_nom_o	0.0	0.0	0.0	0.0	0.0
import volume index, cif weights	x0cif_c	0.0	0.6	0.1	0.0	0.0
real GDP, expenditure side	x0gdpexp	0.0	0.5	0.1	0.0	0.0
real GDP, income side	x0gdpinc	0.0	0.5	0.1	0.0	0.0

Description	*Macros(D)*	*t*	*t+1*	*t+2*	*t+3*	*t+4*
real GNE	x0gne	0.0	0.6	0.1	0.0	0.0
import volume index, duty-paid weights	x0imp_c	0.0	0.6	0.1	0.0	0.0
aggregate capital stock, st-of-yr, rental wgts	x1cap_i	0.0	0.0	0.1	0.1	0.1
aggregate employment	x1lab_io	0.0	0.8	0.1	0.0	-0.1
aggregate land use	x1lnd_i	0.0	0.0	0.0	0.0	0.0
aggregate primary factor use (excludes tech change)	x1prim_i	0.0	0.5	0.1	0.0	0.0
aggregate real investment	x2tot_i	0.0	1.2	0.3	0.1	0.1
aggregate real household consumption	x3tot	0.0	0.5	0.1	0.0	0.0
export volume index	x4tot	0.0	0.1	0.1	0.0	0.0
aggregate real government consumption	x5tot	0.0	0.5	0.1	0.0	0.0

Financial instrument flows for simulation 2: A benchmarked 1% increase in SARB assets

Time t+1

*d_flow[*DeposLoans*](D)*	*Banks*	*SARB*	*Fgn*	*Govt*	*Hhlds*	*Inds*	*NBFI*	*NRH*	*RH*	*Total*
Banks	829	665	1277	4702	-353	27544	1580	0	0	**36243**
SARB	996	0	11	2183	0	0	0	0	0	**3189**
Fgn	2730	0	0	0	0	0	0	0	0	**2730**
Govt	21	2	4652	0	0	0	0	0	0	**4675**
Hhlds	2674	0	0	0	0	0	8016	0	0	**10691**
Inds	8268	0	1300	0	0	0	0	0	0	**9568**
NBFI	5496	0	0	0	0	0	0	0	0	**5496**
NRH	2747	0	0	0	0	0	0	0	0	**2747**
RH	5084	0	0	0	0	0	0	0	0	**5084**
Total	**28843**	**667**	**7240**	**6884**	**-353**	**27544**	**9597**	**0**	**0**	**80421**
d_flow[*Equity*](D)	***Banks***	***SARB***	***Fgn***	***Govt***	***Hhlds***	***Inds***	***NBFI***	***NRH***	***RH***	***Total***
Banks	0	0	2934	0	-67	0	963	0	0	**3830**
SARB	0	0	0	3368	0	0	0	0	0	**3368**
Fgn	0	0	0	42181	0	0	8070	0	0	**50251**
Govt	0	0	0	0	0	0	0	0	0	**0**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	890	42	8524	28301	-1506	0	-881	0	0	**35370**
NBFI	0	0	24691	0	16753	0	0	0	0	**41444**
NRH	0	0	0	0	-2747	0	0	0	0	**-2747**
RH	0	0	0	0	-214	0	0	0	0	**-214**

Total	**890**	**42**	**36149**	**73850**	**12219**	**0**	**8152**	**0**	**0**	**131302**
d_flow[*Notes*](D)	***Banks***	***SARB***	***Fgn***	***Govt***	***Hhlds***	***Inds***	***NBFI***	***NRH***	***RH***	***Total***
Banks	0	0	0	0	0	0	0	0	0	**0**
SARB	335	0	0	0	155	0	0	0	0	**490**
Fgn	0	0	0	0	0	0	0	0	0	**0**
Govt	0	0	0	0	0	0	0	0	0	**0**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	0	0	0	0	0	0	0	0	0	**0**
NBFI	0	0	0	0	0	0	0	0	0	**0**
NRH	0	0	0	0	0	0	0	0	0	**0**
RH	0	0	0	0	0	0	0	0	0	**0**
Total	**335**	**0**	**0**	**0**	**155**	**0**	**0**	**0**	**0**	**490**
d_flow[*GldSDR*](D)	***Banks***	***SARB***	***Fgn***	***Govt***	***Hhlds***	***Inds***	***NBFI***	***NRH***	***RH***	***Total***
Banks	0	0	0	0	0	0	0	0	0	**0**
SARB	0	0	0	0	0	0	0	0	0	**0**
Fgn	102	623	0	0	0	0	0	0	0	**725**
Govt	0	0	0	0	0	0	0	0	0	**0**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	0	0	0	0	0	0	0	0	0	**0**
NBFI	0	0	0	0	0	0	0	0	0	**0**
NRH	0	0	0	0	0	0	0	0	0	**0**
RH	0	0	0	0	0	0	0	0	0	**0**
Total	**102**	**623**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**725**
d_flow[*Bonds*](D)	***Banks***	***SARB***	***Fgn***	***Govt***	***Hhlds***	***Inds***	***NBFI***	***NRH***	***RH***	***Total***
Banks	0	0	1084	0	0	409	593	0	0	**2086**

SARB	0	0	0	0	0	0	0	0	0	**0**
Fgn	1149	5462	0	0	0	0	1180	0	0	**7791**
Govt	8556	253	22505	0	0	0	28234	0	0	**59548**
Hhlds	0	0	0	0	0	0	0	0	0	**0**
Inds	2285	0	2045	0	0	0	-261	0	0	**4068**
NBFI	0	0	504	0	51	0	0	0	0	**555**
NRH	0	0	0	0	0	0	0	0	0	**0**
RH	0	0	0	0	0	0	0	0	0	**0**
Total	**11989**	**5715**	**26138**	**0**	**51**	**409**	**29746**	**0**	**0**	**74048**

Time t+4

d_flow[*DeposLoans*](D)	***Banks***	***SARB***	***Fgn***	***Govt***	***Hhlds***	***Inds***	***NBFI***	***NRH***	***RH***	***Total***
Banks	1195	786	71	13599	-440	7255	1498	0	0	***23964***
SARB	-70	0	-1	20	0	0	0	0	0	***-51***
Fgn	-193	0	0	0	0	0	0	0	0	***-193***
Govt	26	2	-262	0	0	0	0	0	0	***-234***
Hhlds	1675	0	0	0	0	0	477	0	0	***2152***
Inds	878	0	-182	0	0	0	0	0	0	***696***
NBFI	9509	0	0	0	0	0	0	0	0	***9509***
NRH	357	0	0	0	0	0	0	0	0	***357***
RH	1262	0	0	0	0	0	0	0	0	***1262***
Total	***14639***	***788***	***-374***	***13619***	***-440***	***7255***	***1975***	***0***	***0***	***37462***
d_flow[*Equity*](D)	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	0	0	164	0	-83	0	913	0	0	***994***
SARB	0	0	0	30	0	0	0	0	0	***30***
Fgn	0	0	0	380	0	0	-980	0	0	***-600***

Govt	0	0	0	0	0	0	0	0	0	***0***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	95	-6	-1196	18920	-207	0	-4191	0	0	***13415***
NBFI	0	0	2110	0	-8874	0	0	0	0	***-6764***
NRH	0	0	0	0	-357	0	0	0	0	***-357***
RH	0	0	0	0	-1494	0	0	0	0	***-1494***
Total	***95***	***-6***	***1078***	***19330***	***-11015***	***0***	***-4258***	***0***	***0***	***5224***

d_flow[*Notes*](D)	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	0	0	0	0	0	0	0	0	0	***0***
SARB	-24	0	0	0	45	0	0	0	0	***21***
Fgn	0	0	0	0	0	0	0	0	0	***0***
Govt	0	0	0	0	0	0	0	0	0	***0***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	0	0	0	0	0	0	0	0	0	***0***
NBFI	0	0	0	0	0	0	0	0	0	***0***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***-24***	***0***	***0***	***0***	***45***	***0***	***0***	***0***	***0***	***21***

d_flow[*GldSDR*](D)	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	**Total**
Banks	0	0	0	0	0	0	0	0	0	***0***
SARB	0	0	0	0	0	0	0	0	0	***0***
Fgn	-7	-110	0	0	0	0	0	0	0	***-117***
Govt	0	0	0	0	0	0	0	0	0	***0***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	0	0	0	0	0	0	0	0	0	***0***
NBFI	0	0	0	0	0	0	0	0	0	***0***

NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***-7***	***-110***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***-117***

d_flow[*Bonds*](D)	**Banks**	**SARB**	**Fgn**	**Govt**	**Hhlds**	**Inds**	**NBFI**	**NRH**	**RH**	***Total***
Banks	0	0	61	0	0	108	562	0	0	***731***
SARB	0	0	0	0	0	0	0	0	0	***0***
Fgn	-81	-964	0	0	0	0	-143	0	0	***-1188***
Govt	10825	291	-1267	0	0	0	5867	0	0	***15716***
Hhlds	0	0	0	0	0	0	0	0	0	***0***
Inds	243	0	-287	0	0	0	-1242	0	0	***-1286***
NBFI	0	0	43	0	-27	0	0	0	0	***16***
NRH	0	0	0	0	0	0	0	0	0	***0***
RH	0	0	0	0	0	0	0	0	0	***0***
Total	***10987***	***-673***	***-1450***	***0***	***-27***	***108***	***5044***	***0***	***0***	***13989***