A global balancing act: South Africa's susceptibility to economic crises

HJ Cockeran

iD orcid.org/0000-0002-9304-1922

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Supervisor: Prof WF Krugell

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Student number: 21099537

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"I will say of the LORD, He is my refuge and my fortress: my God; in him will I trust."

Psalms 91:2 KJV

I express my deepest gratitude to:

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- To all my loved ones, friends, and family: thank you for your support and understanding.

SUMMARY

Title

A global balancing act: South Africa's susceptibility to economic crises

Motivation

The recent financial crises indicated that countries are susceptible to external shocks. Global imbalances have become a central point of discussion in the cause of financial crises (see among others: Obstfeld & Rogoff, 2009, Merrouche & Nier, 2010, Borio & Disyatat, 2011, Obstfeld, 2012). Persistent large imbalances raise two main concerns. The financial flows required to finance the large and sustained deficits may become less easily available. This could trigger a disorderly adjustment. Sustained large trade imbalances could also call for increased protectionist trade measures, if the domestic industry does not adjust successfully to the import competition. A main concern with the imbalances is whether the current pattern of global imbalances is sustainable, and also which factors would lead to, accelerate or delay the reversal thereof. The sustainability of the imbalances is also of concern as the duration of the imbalances has increased with the increase in the imbalances (IMF, 2008). The study of imbalances is therefore of significance as imbalances are a main source of crises. Being able to measure and monitor these imbalances may therefore assist in predicting crises and possibly to prevent crises from occurring.

Objectives

The overall aim of this study was to determine the susceptibility of South Africa to economic crises and how imbalances might contribute to such crises. This was investigated by determining the resilience of the South African economy to withstand external shocks, and whether there are early warning indicators that would be useful in predicting severe crises for South Africa.

In order to achieve this aim, the following specific objectives were specified:

Manuscript 1— South Africa's susceptibility to financial crises
- Extend a resilience indicator developed by Rojas-Suarez (2015) to the case of South Africa.

- Determine the South African economy's resilience to external shocks before and after the 2008 global financial crisis.
- Compare South Africa's resilience to that of its emerging market peers before and after the 2008 global financial crisis.

Manuscript 2— Economic resilience: the usefulness of early warning indicators for South Africa

- Apply a set of vulnerability indicators, proposed by (Röhn, Sánchez, Hermansen, & Rasmussen, 2015), to the case of South Africa.
- Apply the Bry and Boschan (1971) algorithm and determine severe recessions for South Africa for the period 1970–2015 using GDP per capita.
- Apply the signalling approach, an early warning indicator method, to the vulnerability indicators.
- Determine the usefulness of these vulnerability indicators in predicting severe crises for South Africa by calculating various performance measures.

Method

Manuscript 1— South Africa's susceptibility to financial crises

- Following Rojas-Suarez (2015:17), we constructed a simple indicator of countries' resilience to financial crisis consisting of 7 indicators.
- We constructed this resilience indicator for South Africa and 22 of its emerging market peers.
- It is a relative measure of resilience among countries in a particular sample.
- We could therefore compare the resilience of South Africa against the other 22 countries both before and after the 2008 global financial crisis.

Manuscript 2—Economic resilience: the usefulness of early warning indicators for South Africa

- A set of vulnerability indicators, proposed by (Röhn, Sánchez, Hermansen, & Rasmussen, 2015), is applied to the case of South Africa.
- The Bry and Boschan (1971) algorithm is applied to GDP per capita of South Africa for the period 1970–2015 in order to identify severe recessions.
- The signalling approach is then applied to the indicators; and
- Various performance measures are calculated to determine the usefulness of the indicators in predicting severe recessions for South Africa.

Results and Conclusions

The results and conclusions of the two manuscripts prepared for this dissertation are as follows:

Manuscript 1—South Africa's susceptibility to financial crises

In the first manuscript, the susceptibility of the South African economy to external shocks was determined using a resilience indicator proposed by Rojas-Suarez (2015). The findings were that:

- South Africa became less resilient to an external shock than many of its emerging market peers.
- South Africa lost 6 positions on the resilience index ranking between 2007 and 2013.
- South Africa is, therefore, less resilient after the global financial crisis of 2008, and more vulnerable to an external shock than most comparable emerging market economies.

Manuscript 2—Economic resilience: the usefulness of early warning indicators for South Africa

The second manuscript evaluated the usefulness of early warning indicators in predicting severe recessions for South Africa. The results demonstrated that:

- 14 vulnerability indicators were found to be useful in predicting severe recessions for South Africa.
- These indicators provide a signal on average 8 quarters before a severe recession occurs. This provides adequate time for policymakers to implement changes in order to mitigate or avoid potential severe recessions.
- The following types of imbalances provided the most relatively useful indicators: global imbalances, asset market imbalances, and external imbalances.

General conclusion

The recent financial crises indicated that countries are susceptible to external shocks and South Africa has not been an exception. Comparing South Africa's resilience in 2013 to 2007 it can be seen that South Africa's position has worsened by 6 places on the resilience index. It is, therefore, in a worse position to withstand external shocks than before the financial crises. South Africa is also relatively worse off than most of its 22 emerging market peers included in this study, ranking 20th out of 23 emerging market countries.

In order to protect South Africa from severe crisis we can use early warning indicators, or vulnerability indicators, to warn of an imminent severe recession. From this study 14 indicators

were found to be useful in predicting severe recessions for South Africa. These indicators also issue a warning signal on average 8 quarters before a crisis occurs. This leaves adequate room for policymakers to implement changes in order to avoid a crisis or mitigate the consequences if a crisis is to occur. The conditional probability for these 14 indicators is relatively high. If a signal has been issued there is an 11%–33% probability of a severe recession occurring, depending on the indicator having issued the signal.

Being aware of the fact that South Africa is less resilient than many other emerging market economies, it is important to monitor indicators useful in signalling crises, such as the 14 indicators identified in this study. These may be used to affect policy changes in order to avoid costly financial crises.

Keywords

Financial crisis; Early warning indicators; Global imbalances; Macroeconomic resilience; South Africa; Signalling approach, Severe recessions

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PREFACE

This dissertation is written in article format and consists of one peer-reviewed published and one publication ready for submission original research manuscripts. Chapter 1 includes the objectives for the entire study and each article. The two articles can be found in Chapters 2 and 3, entailing abstracts, introductions, methods, results, conclusions and appropriate referencing formats according to the specific peer-reviewed journal's guidelines. In order to ensure consistency throughout the dissertation, the Harvard referencing style as prescribed by *The Journal of Economic and Financial Sciences* has been used for the entire dissertation. Chapter 5 consists of the main findings and conclusions, as well as the study limitations and recommendations for future research.

The first article, namely: *South Africa's susceptibility to financial crises*, has been published in *The Journal of Economic and Financial Sciences*. A working draft of this article was presented at the *2015 bi-annual conference of the Economic Society of South Africa*.

The second article, namely: *Economic resilience: the usefulness of early warning indicators for South Africa*, will be submitted to an accredited journal for review. Preliminary findings of the results were presented at the *7th International Conference on Social Sciences*.

The supervisor agreed on co-authorship and gave consent for the use of these articles as part of the final dissertation. The first author was solely responsible for literature searches, all data analysis, interpretation of results, as well as planning and writing of the articles and the entire dissertation.

STATEMENT BY AUTHORS

Herewith follows each author's contributions to the study, manuscripts, and entire dissertation:
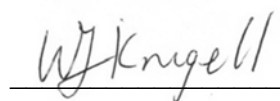
Mr HJ Cockeran	Main author — Responsible for the initial planning and proposal of the master's study and articles, data collection, statistical analysis, interpretation of results, and writing of the articles and entire dissertation.
Prof WF Krugell	Supervisor — Supervised the planning and writing of the articles and entire dissertation. Provided support, guidance and expertise intellectual input.

Herewith is a statement of the co-author verifying his contribution to the study and giving permission that the article may form part of the dissertation.

> *"I hereby declare that my role as indicated above is representative of my contribution to the study and/or dissertation. I approve the manuscript and give my consent that this manuscript may be published as part of the dissertation for the degree Master of Commerce of Mr Henry John Cockeran."*

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Prof WF Krugell

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CHAPTER 1

Introduction and Objectives

1.1 Background

The 2008 global financial crisis had an impact on the entire world economy, with some countries affected more severely than others. The causes of the global financial crisis are multiple with various explanations at a microeconomic and macroeconomic level. Microeconomic explanations include the fast spreading financial innovations (financial instruments), insufficient regulation and governance before the crisis, which resulted in substantial risk-taking, and the eventual overleveraging of the financial system. At a macroeconomic level it is argued that the crisis was a result of global imbalances which caused large flows of capital globally and which led to a perceived low-risk global financial market (Bracke & Fidora, 2012).

Global imbalances have become a central point of discussion in the cause of the financial crises. According to Llewellyn (2006), global imbalances are indicative of global financial risks as any large imbalance may result in disruptive adjustments in the domestic and global financial markets and affect long-term interest rates and financial stability. Bracke and Fidora (2012) state that, since the 1990s the global economy was known for a calm financial market with low long-term interest rates. Advanced economies ran current account surpluses, while the developing economies and emerging markets posted current account deficits. During this same period an increase in financial imbalances was observed. This included an increased current account deficit of the United States and an increased current account surplus of the emerging economies of Asia. During the mid-2000s, the global economy was experiencing positive growth prospects, this while global investment and savings rates fell. This widened the global current account imbalances to unprecedented levels, while long-term interest rates remained steady at low levels (IMF, 2006).

This situation does not follow conventional wisdom. Advanced economies should be accumulating surpluses, enabling them to lend to the developing economies (Lucas, 1990). A few economists argue that there will be a sufficient number of developing economies which will continue to finance the current account deficits of the developed economies in order to increase their export-based economic growth (Dooley, Landau & Garber, 2003). A large number of economists however, argue that the ever growing deficits, specifically the US current account deficit, pose a large threat which needs to be addressed.

Financial imbalances are closely linked to global financial stability and have systemically important causes (Obstfeld, 2010). These imbalances affect the transfer of real resources between countries (Llewellyn, 2006). This is evident by the shift in the transfer of goods and services from lower income countries to high income countries. An example of such a relationship is that between the United States and China. The world's manufacturing industry has shifted from the industrialised countries, such as the Unites States, Europe and Japan, to countries in Asia, such as China, Malaysia and Korea (Llewellyn, 2006).

Global financial integration has been evolving rapidly during the past few decades. The financing of imbalances between countries has been used as evidence of growing financial integration (Obstfeld, 2010). Financial integration also made it easy for deficit countries, such as the United States, to finance their external net borrowing. But it has also enabled the ease of spreading risky assets through securitisation — a main cause of the 2008 financial crisis. Aloui, Aïssa and Nguyen (2011) used copula functions to determine cross-market linkages and found strong evidence of dependencies between Brazil, Russia, India and China (the BRIC countries), and the United States. There were also stronger dependencies for markets dependent on commodity prices than for finished-goods markets aimed at exporting.

Global imbalances were pronounced during the financial crisis, and also became evident during the recent fiscal crisis in the Euro area. Holinksi, Kool and Muysken (2012) who have focused on imbalances in the euro area for the period 1992 to 2007, found that there is a large divergence in current account imbalances between the countries within the euro area. They split the euro area into northern and southern countries, with the northern countries being surplus countries and the southern countries deficit countries. They found that the imbalances had occurred without a simultaneous increase in productivity or growth in the deficit countries. The large deficits are therefore argued to be unsustainable, as there is no increase in economic growth or productivity in these countries with current account deficits (Holinksi et al., 2012).

Bluedorn and Leigh (2011) investigated whether reducing fiscal budget deficits would assist in improving external imbalances. The twin deficits hypothesis states that the current account balance and fiscal balance of a country should move in the same direction. Although the twin deficits hypothesis is supported by theoretical models, empirical evidence provides weak or no evidence of such a relationship (Bluedorn & Leigh, 2011). It should also be remembered that an increase in the fiscal deficit will only increase the current account deficit if the fiscal deficit reduces desired national saving (Abel, Bernanke & Croushore, 2008).

The recent financial crises in the United States and the Eurozone, and the effects these crises had on the global economy, indicated that change needs to occur in the global financial system in order to avoid similar crises in future. Global imbalances have become a central point of discussion as the cause of the financial crises. Persistent large imbalances raise two main concerns. The financial flows required to finance the large and sustained deficits may become less easily available. This could trigger a disorderly adjustment. Sustained large trade imbalances could also call for increased protectionist trade measures, if the domestic industry does not adjust successfully to the import competition. This could result in a feeling that the growth benefits of an open economy are not adequately being shared between different social groups (IMF, 2007). A main concern with the imbalances is whether the current pattern of global imbalances is sustainable, and also which factors would lead to, accelerate or delay the reversal thereof. The sustainability of the imbalances is also of concern as the duration of the imbalances has increased with the increase in the size of the imbalances (IMF, 2008).

For the purpose of this study a financial imbalance is defined as a significant and sustained deviation in asset prices or other financial variables from its long-run trend, such as large and persistent current account deficits (Kahn, 2010). Global imbalances reflect many different factors such as saving, investment and portfolio choices (Blanchard & Milesi-Ferretti, 2010). These differences in savings patterns, investment patterns and portfolio choices across countries are good as they reflect a natural difference in development, demographics and other economic fundamentals. They can however also be bad, as they could reflect distortions, externalities and risks at the national and international level. Current account balances reflect a multitude of macroeconomic and financial mechanisms and in a globalised world national current accounts cannot be expected to be balanced (Blanchard & Milesi-Ferretti, 2010). Savings should be utilised where it is most productive and imbalances can therefore be the natural result of differences in saving behaviour, the rate of return on capital, the degree of liquidity or risk of various assets. Imbalances are therefore not necessarily inherently bad, but it is essential to know what factors caused the imbalance and to then act on the causes if necessary.

Blanchard and Milesi-Ferretti (2010) make note of three so called "good" imbalances, namely saving behaviour, investment behaviour and portfolio behaviour. Countries with a faster aging population than their trading partners would be expected to save and have current account surpluses in order to plan for the future dissaving which will occur once the labour force has shrunk and the number of retirees increases. A country that has good investment opportunities could

finance a part of their investment through foreign savings and therefore have a current account deficit. A country which has deep and liquid financial markets could attract investors which could lead to its currency appreciating and a current account deficit. In these examples of so called good imbalances it is not necessary to reduce imbalances, as these imbalances reflect the optimal allocation of capital (Blanchard & Milesi-Ferretti, 2010). Imbalances can however be symptoms of underlying distortions or be dangerous itself.

Domestic distortions are an example of "bad" imbalances. High private savings could be a negative as it could indicate a lack of social insurance which forces people to have high savings as a precaution. It could also be the result of poor corporate governance which allows firms to retain and reinvest the majority of their earnings. Booms caused by asset bubbles and overoptimistic future growth outlooks could lead to low private saving. Excessive public borrowing could indicate underlying political tensions. Weak property protection rights or a lack of competition in the financial system can lead to low investment. In these instances policies should be aimed at reducing the underlying distortions which cause the imbalances, rather than the imbalances as the symptom of the distortions.

Systemic distortions could also lead to imbalances. Many emerging economies have run large current account surpluses and accumulated large foreign exchange reserves following the Asian financial crisis (Blanchard & Milesi-Ferretti, 2010). These large foreign exchange reserves have mostly been denominated in US dollars. This reflects the role of the US dollar in international transactions and the US bond market liquidity. A reason for accumulating these large foreign reserves has been that these countries often follow an export-led growth strategy. Blanchard and Milesi-Ferretti (2010) state that this might be a good strategy to follow from the country's perspective especially if the country has a large external debt, but it is at the expense of other countries. If there are many countries forming a significant portion of world trade following this strategy it could become a systemic problem. Advanced economy foreign reserves have also been accumulated for liquidity and insurance purposes by emerging markets (Caballero, Farhi & Gourinchas, 2008). For the individual country it might be a good option, but it is globally inefficient in comparison to alternatives such as credit lines, pooling arrangements and other forms of insurance. Policy should aim to reduce distortions at the systemic level where imbalances are the cause of systemic distortions. Where the causes of balances are good, these causes could interact with other distortions resulting in inefficient or risky outcomes (Blanchard & Milesi-Ferretti, 2010).

Imbalances may develop due to the nature of today's modern financial system. Liberalised financial systems can create an endogenous cycle in which good news may lead to an increase in the demand and supply of credit (Kahn, 2010). As a result of the increase in the demand and supply of credit, asset prices and spending increase. This leads to an increase in optimism and collateral for new loans (Kahn, 2010). This cycle continues until the asset prices and credit supply exceeds the levels which correspond to the initial good news. The bubble then bursts and the cycle reverses leading to a fall in asset prices and deleveraging.

An example of these boom and bust cycles is the dot-com bubble which developed in the late 1990s and burst in 2001 (Kahn, 2010). After the 1998 Asian financial crisis the Federal Reserve aggressively lowered interest rates and increased liquidity in the banking system. The view of the Federal Reserve was that monetary policy could effectively be utilised to limit the negative effects of a bubble when it bursts and that policymakers are not well equipped to identify or counter asset price bubbles as they are forming (Greenspan, 2002). This might have contributed to the build-up in infrastructure technology stock prices. Investors had an optimistic view that the Federal Reserve would be able to counteract the negative effects of an asset price bubble bursting. In the late 1990s investors gained confidence over developments in the internet. This lead to large investments in the information technology industry and stock prices were driven up. After the Asian financial crisis of 1998, interest rates were kept low by the Federal Reserve which contributed to a search for yield. In 2000-2001 the bubble burst and the Federal Reserve again lowered interest rates from 6.5% in 2000 to 1% in 2003 (Kahn, 2010). The Federal Reserve had communicated that interest rates would remain low for a considerable period. Having kept the interest rate this low may have contributed to the 2008 global financial crisis.

This study aims to establish South Africa's susceptibility to economic crises and how imbalances might contribute to such crises. This is done by determining the resilience of South Africa to withstand external shocks by using variables measuring imbalances. Variables measuring various market imbalances are then used to determine if there are variables that are useful in predicting crises for South Africa.

1.2   Problem statement

The South African economy's growth has been accompanied by a large current account deficit, this while many other emerging economies have been enjoying foreign capital inflows. According to Frankel, Smit and Sturzenegger (2007) there are two views. The first view is that the deficit

reflects the rational adjustment to a new equilibrium of permanently higher commodity prices, high investment or previously refrained consumption by a new middle class. The second view is that the boom is unsustainable, perhaps due to a commodity price boom, that consumers do not fully understand their restrictions, or that there is a risk of a sudden stop in the inflow of capital. Due to the second view it is important to keep imbalances sustainable. Capital inflows should be managed such that it minimises the risk and impact of a crisis. To keep the current account deficit from increasing, South Africa will need to have increasing terms of trade (Frankel et al., 2007).

South Africa has to address the challenges of slow economic growth, poverty and inequality in the face of precarious macroeconomic imbalances. This raises the question: how susceptible is South Africa to economic crises? Is South Africa resilient and therefore able to withstand external shocks? Are there indicators that are useful in predicting crises for South Africa?

The answers to these questions are important as they could assist South Africa in identifying areas for improvement in order to become more resilient to external shocks. If there are useful early warning indicators of crises for South Africa, it could signal possible crises for South Africa in order for policy changes to be implemented in order to avoid or mitigate a crisis.

1.3   Aims and objectives

The overall aim of this study was to determine the susceptibility of South Africa to economic crises. Susceptibility is defined as: "the state or fact of being likely or liable to be influenced or harmed by a particular thing" (Oxford Dictionary of English, 2010). A synonym for susceptibility is vulnerability and an antonym is resilience. Susceptibility can therefore be seen as, first, from the viewpoint of South Africa's ability to withstand crises—in other word its resilience to crisis—as its resilience to withstand crisis relates directly to its vulnerability to suffer crises. If the country is less resilient it is more likely to suffer a crisis due to being worse off to withstand crises. Second, it can be viewed from the position of South Africa's vulnerability, or susceptibility, to crisis, specifically investigating vulnerability indicators of crises. This can assist in providing indicators that can signal possible crises in order to implement policy changes to avoid or mitigate the effect of a crisis.

The objectives of this study are, therefore, to determine the resilience of the South African economy to external shocks, and to determine whether there are early warning indicators that would be useful in predicting severe crises for South Africa.

In order to reach this aim, a number of objectives are specified; these include to:

1.3.1 Objectives of manuscript 1: South Africa's susceptibility to financial crises

- Extend a resilience indicator developed by Rojas-Suarez (2015) to the case of South Africa.

- Determine the South African economy's resilience to external shocks before and after the 2008 global financial crisis.

- Compare South Africa's resilience to that of its emerging market peers before and after the 2008 global financial crisis.

1.3.2 Objectives of manuscript 2: Economic resilience: the usefulness of early warning indicators for South Africa

- Apply a set of vulnerability indicators, proposed by (Röhn, Sánchez, Hermansen, & Rasmussen, 2015), to the case of South Africa.

- Apply the Bry and Boschan (1971) algorithm and determine severe recessions for South Africa for the period 1970–2015 using GDP per capita.

- Apply the signalling approach, an early warning indicator method, to the vulnerability indicators.

- Determine the usefulness of these vulnerability indicators in predicting severe crises for South Africa by calculating various performance measures.

1.4 Chapter outline

Chapter 1 provided a background to this study, the research problem and the aims and objectives. Chapter 2 consists of article 1, which aims to determine the resilience of the South African economy to withstand external shocks. In comparison to other emerging markets, South Africa is in a relatively worse-off position after the 2008 global financial crisis. Chapter 3 investigates whether there are vulnerability indicators, or measures of imbalances, which may predict severe recessions for the economy. 14 indicators were found to be useful in predicting severe recessions. The findings are summarised in Chapter 4 and general conclusions are drawn from the study.

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CHAPTER 2

Manuscript 1

Manuscript 1[1] has been published in the peer-reviewed journal:

THE JOURNAL OF ECONOMIC AND FINANCIAL SCIENCES

The JEFS publishes theoretical and empirical research in the field of Economic and Financial Sciences. Manuscripts published in the JEF fall mostly in the areas of auditing, corporate finance, corporate governance, economics, econometrics, financial accounting, financial management, financial planning, investment management, management accounting and taxation in the emerging market field.

Manuscripts	Maximum of 25 pages.
	Should consist of title, abstract, keywords, body of manuscript, and list of references.
Title	Maximum 75 characters in length. Should be descriptive and summarise the most important points of the manuscript.
Abstract	A maximum of 150 words succinctly describing the article and between 5–7 keywords.
Tables and figures	When referring to figures and tables, each figure and/or table should be mentioned in the text in bold typeface and numbered consecutively. Each figure should have a unique caption and should be numbered consecutively in bold typeface. Acknowledge the source below a table or figure. If created by the author(s), please indicate as such.
References	Use the Harvard system of referencing.

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[1] Cockeran, H.J. and Krugell, W.F. (2017). South Africa's susceptibility to financial crises. *Journal of Economic and Financial Sciences*, 10, 69-82.

SOUTH AFRICA'S SUSCEPTIBILITY
TO FINANCIAL CRISES

Henry Cockeran*

North-West University

Waldo Krugell*

North-West University

Abstract

South Africa has to address the challenges of slow economic growth, poverty, and inequality in the face of precarious macroeconomic imbalances — foreign capital is used to fund deficits of savings to investment, of tax income to government spending, and of exports to imports. Just how susceptible does this make the South African economy to an external shock? This paper extends a 'resilience indicator' developed by Rojas-Suarez (2015) and applies it for the first time to the case of South Africa and 22 other emerging market economies. We compared the 2007 values (pre-2008 financial crisis) to the corresponding 2013 values, and found that South Africa has become less resilient to an external shock than many of its peers. South Africa lost six positions on the index ranking between 2007 and 2013. South Africa is, therefore, more vulnerable to an external shock than most comparable emerging market economies.

Keywords

***Mr HJ Cockeran** is a lecturer in the School of Economic Sciences, North-West University, Vaal Triangle Campus, South Africa. [henry.cockeran@nwu.ac.za]

***Prof WF Krugell** is a professor in the School of Economics, North-West University, Potchefstroom Campus, South Africa.

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South Africa's susceptibility to financial crises

HJ Cockeran & WF Krugell

Abstract

South Africa has to address the challenges of slow economic growth, poverty, and inequality in the face of precarious macroeconomic imbalances — foreign capital is used to fund deficits of savings to investment, of tax income to government spending, and of exports to imports. Just how susceptible does this make the South African economy to an external shock? This paper extends a 'resilience indicator' developed by Rojas-Suarez (2015) and applies it for the first time to the case of South Africa and 22 other emerging market economies. We compared the 2007 values (pre-2008 financial crisis) to the corresponding 2013 values, and found that South Africa has become less resilient to an external shock than many of its peers. South Africa lost 6 positions on the index ranking between 2007 and 2013. South Africa is, therefore, more vulnerable to an external shock than most comparable emerging market economies.

2.1   INTRODUCTION

South Africa has to address the challenges of slow economic growth, poverty and inequality in the face of precarious macroeconomic imbalances — foreign capital inflows are required to balance deficits of savings to investment, of tax income to government spending, and of exports to imports. This leaves the economy vulnerable to slowdowns in foreign capital flows. Smit, Grobler and Nel (2014) showed that if current deficits had to be reversed through contractionary policy, the impact on the economy would be severe. In the context of the tapering of quantitative easing in the US, the flow of funds away from emerging markets and rising global interest rates, South Africa has been grouped with the so-called 'fragile five' (Brazil, Indonesia, South Africa, India, and Turkey) and 'suspect six' (Brazil, Indonesia, South Africa, Turkey, Mexico, and Russia) countries. South Africa has, more recently, also been grouped with the so-called 'troubled ten', namely, Brazil, Colombia, Chile, Peru, Russia, South Africa, Singapore, South Korea, Taiwan, and Thailand.

The questions that this paper aims to answer are; Just how susceptible is the South African economy to an external shock?; and How do we compare to emerging market peers? The motivation is clear. Measuring a risk is the first step in managing it. Emerging economies compete for global capital flows and if an economy is seen to be vulnerable, or susceptible to crisis, compared to its peers, it requires hedging by its firms and action by its policymakers. The measures used in the paper aim to capture the capacity to withstand the impact of an external shock, and the room to adjust policy to counteract a shock.

This study extends a 'resilience indicator' developed by Rojas-Suarez (2015) and applies it for the first time to the case of South Africa. We constructed the indicator for South Africa and compared the values before and after the 2008 financial crisis with those of a number of emerging market economies. The key finding is that South Africa has become less resilient to an external shock than many of its peers.

Section 2 provides an overview of the literature on imbalances and indicators of crises. Section 3 explains the resilience indicator developed by Rojas-Suarez (2015) and extends it to the case of South Africa. An overview of the data used for the resilience indicator is provided in section 4, along with the results. Conclusions follow in section 5.

2.2 LITERATURE REVIEW

Macroeconomic imbalances are at the root of crises and measuring imbalances may also indicate vulnerability to crises. The term imbalance, as used in this paper, is defined as a significant and sustained deviation in asset prices or the values of other financial variables from their long-run trend. A large and persistent trade deficit, or current account deficit, is typically seen as a macroeconomic imbalance (Kahn, 2010; Bean, 2003). Global imbalances cannot be reduced to only a large current account deficit in a single country, but are rather a result of various factors such as savings, investment and portfolio choices (Obstfeld & Rogoff, 2005). Global imbalances have important implications for national and international financial markets, their stability, and the level of long-run interest rates (Boissay, 2011; Llewellyn, 2006).

Recent literature on the topics of global imbalances and financial crises argues that the current period of global imbalances differs from past episodes in that: (i) capital flows now stem mostly from emerging markets to industrialised countries, (ii) there exists greater financial interdependence with more integrated global financial markets and more opportunities for international diversification, and (iii) a favourable global macroeconomic and financial environment with high growth rates, low volatility and easy global financing until the 2008 financial crisis (Bracke, Bussière, Fidora & Straub, 2010; Caballero, Farhi & Gourinchas, 2006). Bracke et al. (2010) wrote that a combination of structural and cyclical determinants has led to an increase in global imbalances. Structural factors are related to imperfections in financial markets of rapidly growing emerging economies, which have an impact on the size and direction of global capital flows from emerging to industrial markets. Cyclical factors are related to saving and investment patterns in the private and public sectors.

There is a substantial literature on different economic and/or financial crises. Some authors focus on indicators or predictors of crises, and other aim to measure fragility or vulnerability to crises. The following paragraphs outline the key contributions to this field. Rojas-Suarez's (2015) measures of "resilience" are explained in section 3.

The current account is held by many as the key measure, or symptom, of global imbalances. Many crises have been preceded by large current account deficits: that of Chile in 1981, Finland in 1991, Mexico in 1994, Thailand in 1997, the United States in 2007, Iceland in 2008, and Greece in 2010 (Obstfeld, 2012). Some countries, however, accumulate large current account imbalances without experiencing financial crises. There are also nations that have experienced financial crises without

preceding large current account deficits, such as the banking crises in Switzerland and Germany during 2007–2009.

Frankel and Rose (1996) used the current account balance as percentage of GDP as a measure of vulnerability to external shocks (currency crashes) in emerging markets. They found that large current account deficits did not significantly increase vulnerability to subsequent external shocks. Edwards (2002) supported their conclusion in cases where the current account is not financed by traditional means. However, Edwards (2002) also found that larger current account deficits significantly increase the likelihood of subsequent crises when the current account is financed through traditional means. A key conclusion of his work was that the effects of relatively large current account deficits on financial crises are dependent on the definition of a crisis and the world regions included in the analysis.

Frankel and Saravelos (2010) reviewed the literature on early-warning indicators and found that the current account had some influence in forecasting financial crises, but less so than variables such as international reserves and real exchange rate overvaluation. Gourinchas and Obstfeld (2012) investigated the dynamics of various macroeconomic variables before, during and after different types of financial crises. They distinguished between the experiences of advanced and developing economies during the 2007–2009 financial crisis and the post-1973 crises. They found that current account deficits often precede crises, but that the current account was not statistically significant in forecasting financial crises. Catão and Milesi-Ferretti (2013) studied the determinants of external crises using data from 1970–2011 for advanced and developing economies. In opposition to Gourinchas and Obstfeld (2012), they found that the ratio of net foreign liabilities to gross domestic product, and current account deficits are significant crisis predictors.

In earlier work, Borio and Lowe (2002) conducted a study on indicators of banking crises for developed and emerging market economies from 1960–1999. They found that an increase in the ratio of private sector debt to gross domestic product and a drop in equity prices precede banking crises.

Mendoza and Terrones (2008) reported that (i) emerging market economies experience larger, more persistent and asymmetric fluctuations in macroeconomic variables, (ii) many of the recent emerging market crises were associated with credit booms but that not all such booms end in crisis,

and (iii) credit booms in emerging markets tend to be preceded by large capital inflows, whereas developed economy credit booms tend to be preceded by productivity gains or financial reforms.

Jordà, Schularick and Taylor (2011) studied data from 14 developed economies from 1870–2008 to determine if external imbalances increased the risk of a financial crisis. They found that credit growth is the single best forecaster of financial instability. Credit growth tends to be higher and short-term interest rates lower in the periods preceding global financial crises. Stronger reversals of imbalances and deeper slumps are associated with recessions caused by crises compared with normal recessions.

In summary, the unsatisfying answer is that it depends — different crises have different predictors and it depends on the period and countries involved. The following section proposes an alternative approach: to measure the capacity to withstand an external shock, and the policy room to enact countermeasures — or in other words: measures of the resilience to crises.

2.3   MEASURES OF RESILIENCE TO CRISIS

If the behaviour of certain indicators or variables indicates imbalances and predicts a crisis, one can argue that they may also serve as a measure of resilience to crisis. In this approach we follow the work of Rojas-Suarez (2015:2-3), who describes a country's resilience to external shocks in terms of two aspects:

- First, the capacity to withstand the impact of an adverse external shock, in that it does not result in: (i) a sharp slowdown of economic growth, (ii) a severe contraction in the rate of growth of real credit, or (iii) financial instabilities.

- Second, that the country has the room to adjust policy to counteract the impact of a shock.

Rojas-Suarez (2015) identified several such resilience measures and constructed an index of the resilience of countries to external shocks.

The capacity to withstand the impact of an adverse external shock depends greatly on a country's need for external financing, and its external solvency and liquidity positions. A financial or a trade shock can limit a country's growth prospects, and weaken economic and financial stability. Rojas-Suarez (2015) argues that a country will be more resilient to shocks when the following ratios are small: (i) current account deficit to GDP, (ii) total external debt to GDP, and (iii) short-term external debt to gross international reserves. The current account deficit represents the external

financing need, whereas the two debt ratios are measures of solvency and liquidity. She emphasises the point that full exchange rate flexibility will not resolve liquidity constraints during a crisis — a sharp depreciation will not generate export revenues fast enough (Rojas-Suarez, 2015:7).

The ability to respond to a shock depends on the fiscal and monetary policy stance. Is there scope to implement counter-cyclical policy? Rojas-Suarez (2015) argues that a country will be more resilient to shocks when the ratio of the budget deficit to debt, and the government debt to GDP, are also small. Smaller ratios would leave the fiscal authorities in a better position to undertake counter-cyclical policy, i.e. by increasing government spending or cutting taxes. In a similar vein, if the country is already facing inflationary or deflationary pressure, it will be difficult for monetary authorities to respond. A nation will be more resilient to the shock of inflation decreases within the central bank's target range. Finally, policymakers' ability to respond to crisis will also depend on the presence of credit booms or busts. If a shock results in banking problems, the central bank needs room to manoeuvre and keep interest rates low.

Together, these seven indicators can be used to construct an overall measure of resilience to crisis.

2.4   A RESILIENCE INDICATOR

Following Rojas-Suarez (2015:17), it is possible to construct a simple indicator of countries' resilience to financial crisis. It is a relative measure of resilience among countries in a particular sample. Her analysis focused on a number of Latin American, emerging Asian and emerging European countries. We extend this indicator, for the first time, to the case of South Africa.

The indicator is constructed as follows:

- To make the variables comparable, each one is standardised by subtracting the cross-country mean and dividing by the standard deviation.

- Variables, where an increase in value indicates less resilience (more vulnerability), are multiplied by −1. These include the standardised values of external debt to GDP, short-term external debt to gross international reserves, the deficit to GDP, debt to GDP, and the level of inflation.

- The aggregate indicator value is simply the mean of the values of the seven standardised variables.

- The following seven variables are used in constructing the resilience indicator: the ratio of current account to GDP; total external debt to GNI; short-term external debt to total reserves; fiscal balance to GDP; government debt to GDP; inflation; and domestic credit to private sector by banks. The data series are obtained from The World Bank: World Development Indicators database.

Since it is a relative measure, the countries can then be ranked by the resilience indicator values in 2007 and 2013.
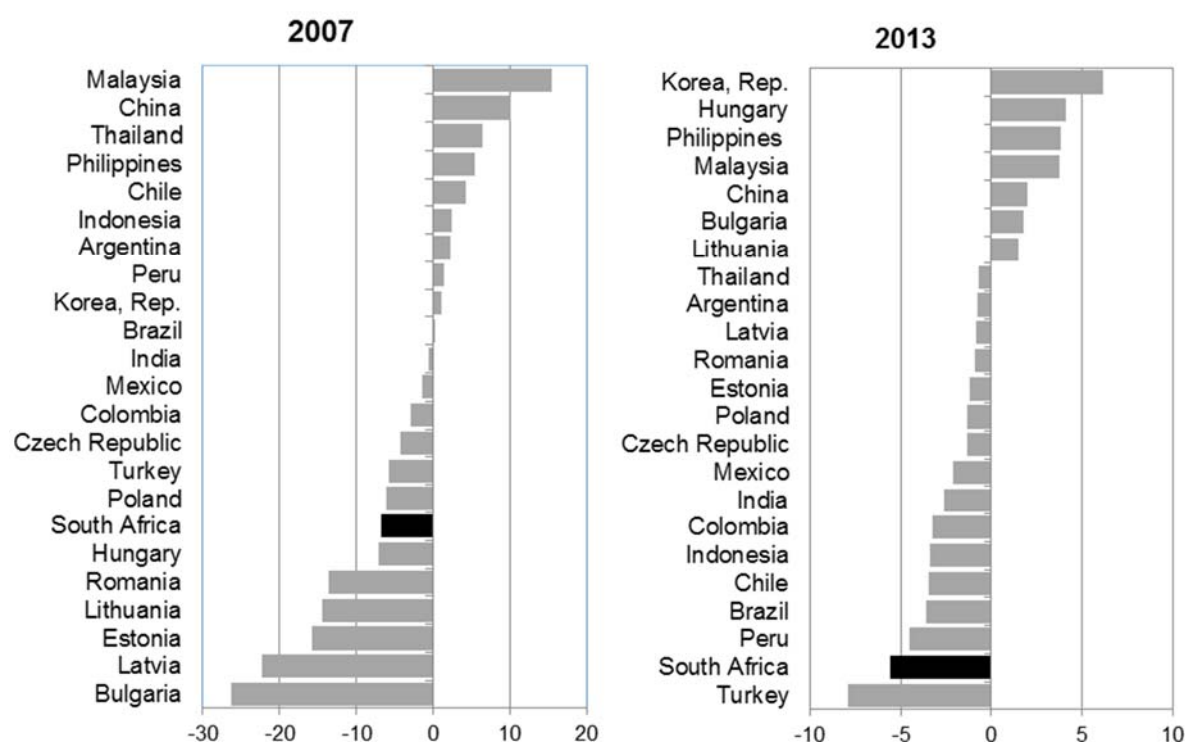
Figure 2-1: Current account balance (% of GDP)

Source: Authors' depiction of data from The World Bank: World Development Indicators.

Figure 2-1 shows the current account balance to GDP in 2007 and 2013. Rojas-Suarez (2015:4) explains that in 2007 emerging European countries had a pressing need for external finance and were poorly positioned to handle the withdrawal of foreign savings that occurred during the 2008 global financial crisis. South Africa's current account deficit was at around 6.7% of GDP in 2007 and improved slightly to a deficit of 5.6% of GDP in 2013. In absolute terms it is clear that the Republic of Korea, Hungary and Lithuania made significant adjustments to reach current account surpluses. Compared to the other countries in this sample, South Africa's relative position worsened. Like the Latin American countries (see Chile, Brazil and Peru), South Africa did not

use the crisis to implement policy adjustments that could have started to address the deficit of savings to investment.

Changes in the countries' external solvency position are shown in **Figure 2-2**. Countries below the 45-degree line increased external indebtedness over the period 2007 to 2013. This includes South Africa where the external debt to GNI increased from around 26% to almost 41%. Rojas-Suarez (2015:5) argues that such a change is relevant for highly indebted countries, which South Africa is not. Estonia, Latvia and Bulgaria are examples of countries with external debt to GNI ratios in excess of 100% whose position improved over the period. In Hungary it deteriorated from 137% to 154% between 2007 and 2013.
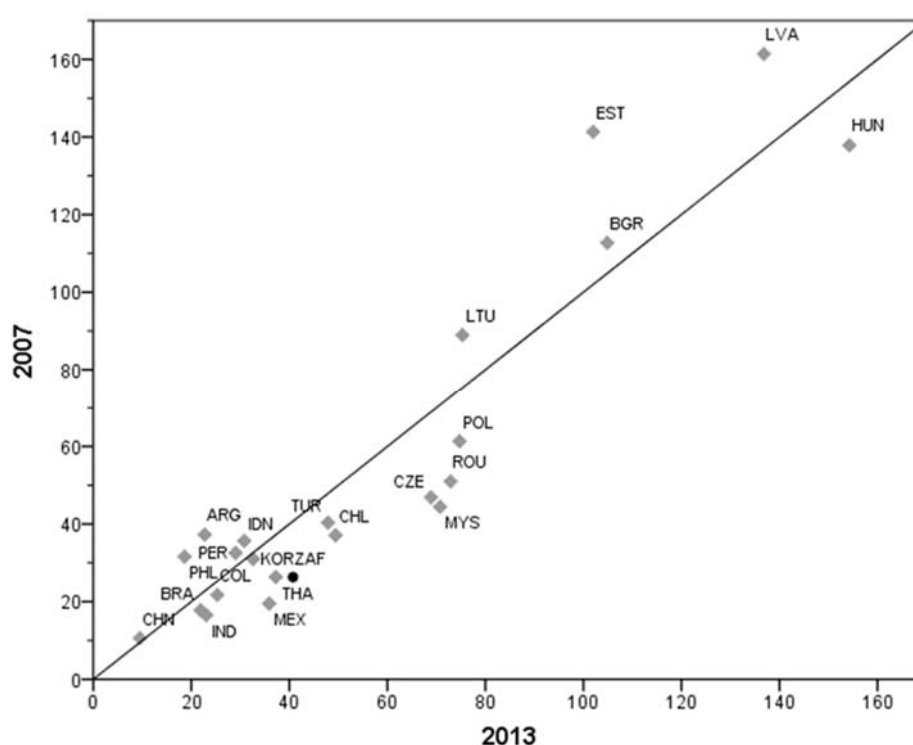
Figure 2-2: Total external debt (% of GNI)

Source: Authors' depiction of data from The World Bank: World Development Indicators.

Figure 2-3 shows the changes in the countries' external liquidity positions. Similar to **Figure 2-2**, countries below the 45-degree line have an increased vulnerability to an external shock — they have more short-term debt or smaller international reserves and would find it difficult to make the payments due right after an adverse shock that limits the access to international credit markets. In this regard South Africa improved its position over the period by accumulating reserves. Short-

term external debt to reserves declined from 73% to 54%. In absolute terms, Latvia and the Republic of Korea made the biggest improvements. Argentina and Malaysia stand out as countries that were substantially more exposed in 2013.
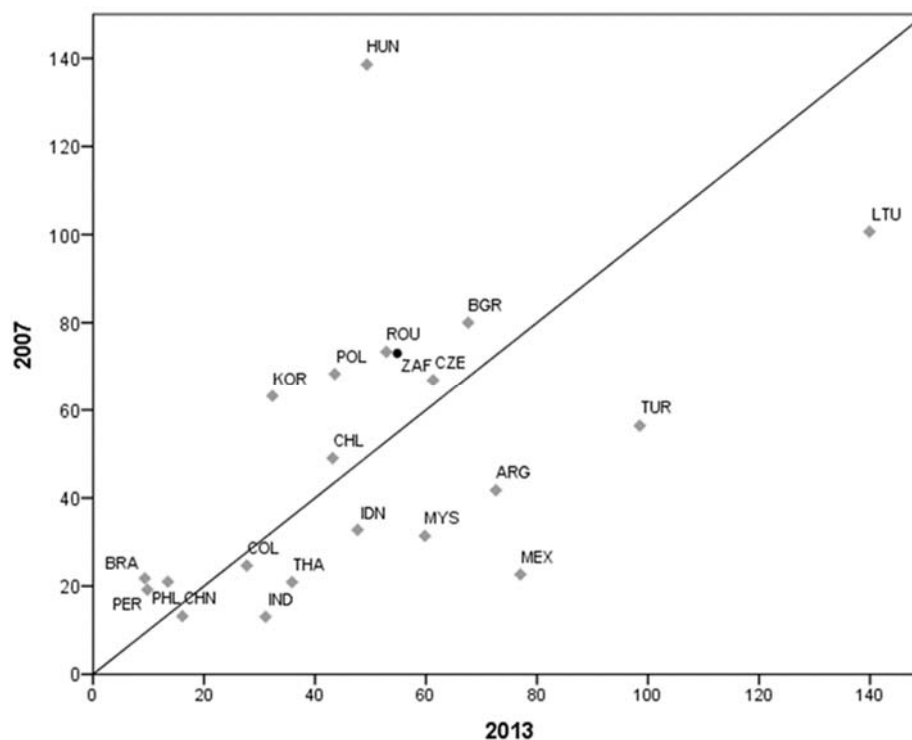
Figure 2-3: Short-term external debt (% of total reserves)

Source: Authors' depiction of data from The World Bank: World Development Indicators.

In sum, when it comes to the capacity to withstand an external shock, South Africa is not badly positioned — the current account deficit is relatively large, but in absolute terms slightly smaller than it was before the 2008 financial crisis. The country is not highly indebted and has improved its liquidity position. What about the ability to respond to crisis?

Figure 2-4 shows the fiscal balance to GDP and it is clear that South Africa had a lot less policy room to manoeuvre policy in 2013 than 2007. The fiscal balance deteriorated from a small primary surplus to a deficit of around 4.5% of GDP in 2013. Increased government spending over the period helped to soften the blow of the 2008 global financial crisis, but the government is now in a position where it needs to consolidate its finances. Austerity measures are in place and tax reform is being investigated. Like in almost all the other countries in the sample, there is limited ability

to respond to a new crisis. Lithuania and Chile experienced the biggest deterioration in absolute terms.
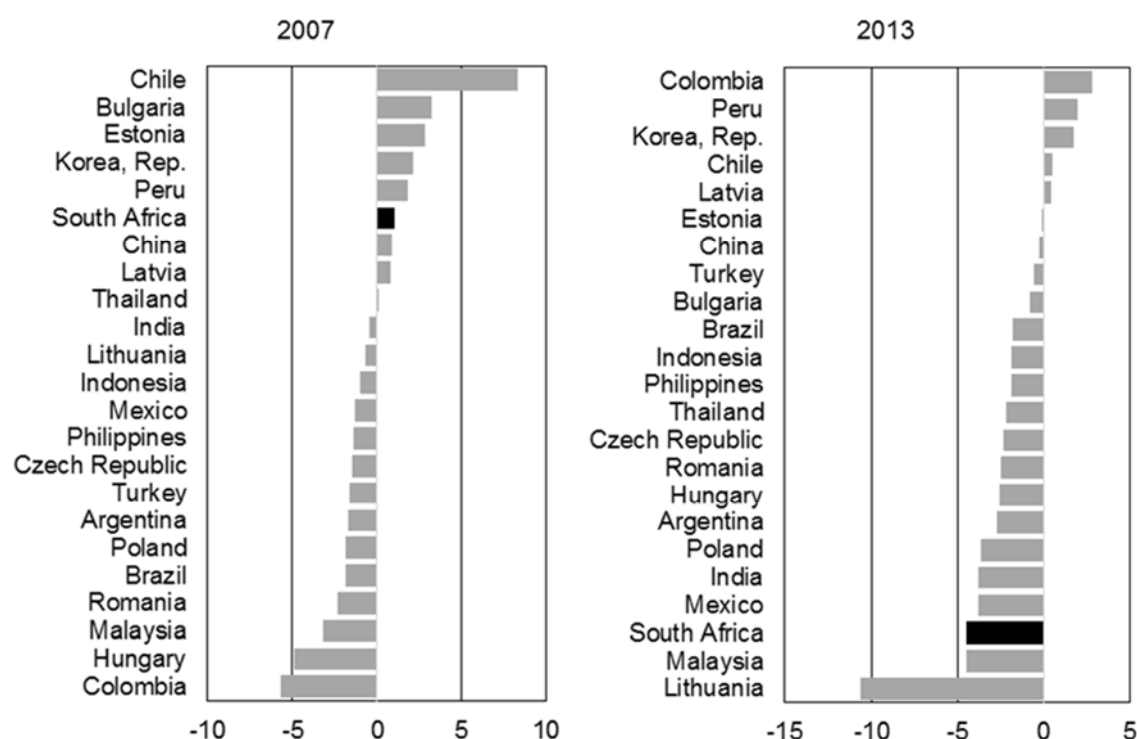
Figure 2-4: Fiscal balance (% of GDP)

Source: Authors' depiction of data from The World Bank: World Development Indicators.

Similar to the fiscal balance, the debt to GDP ratio also speaks to the fiscal authorities' ability to undertake counter-cyclical policy. **Figure 2-5** shows that over the course of the 2008 global financial crisis most countries' position worsened. Only the Philippines, Indonesia and Peru had relatively low ratios of debt to GDP. In the case of South Africa, the debt to GDP ratio worsened from 27 to 45%.
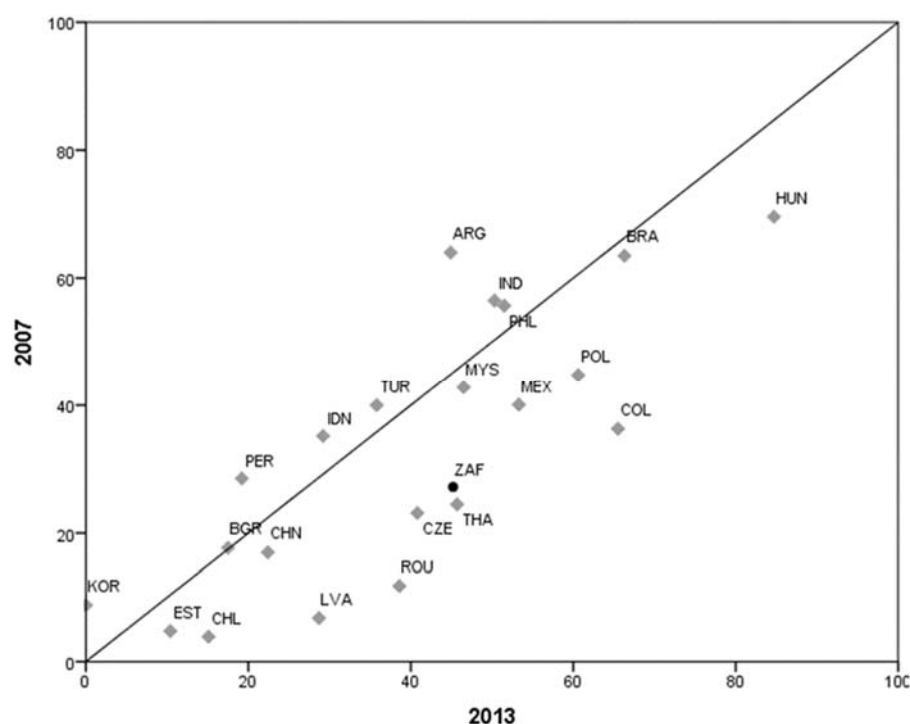
Figure 2-5: Government debt (% of GDP)

Source: Authors' depiction of data from The World Bank: World Development Indicators.

The final two measures of the ability to respond to a crisis are less sophisticated versions of those used by Rojas-Suarez (2015). She used the squared value of the deviation of inflation from its announced target, and a measure of credit booms or busts constructed using the Hodrick-Prescott filter. This paper simply uses the consumer price inflation rate and domestic credit extension to the private sector by banks as a percentage of GDP. In the case of a relatively high inflation rate or a credit boom, monetary authorities may find it difficult to react to an external shock. **Figure 2-6** and **Figure 2-7** show that over the period 2007–2013 inflation in South Africa decreased and domestic credit extension fell, giving policymakers some increased room to manoeuvre.
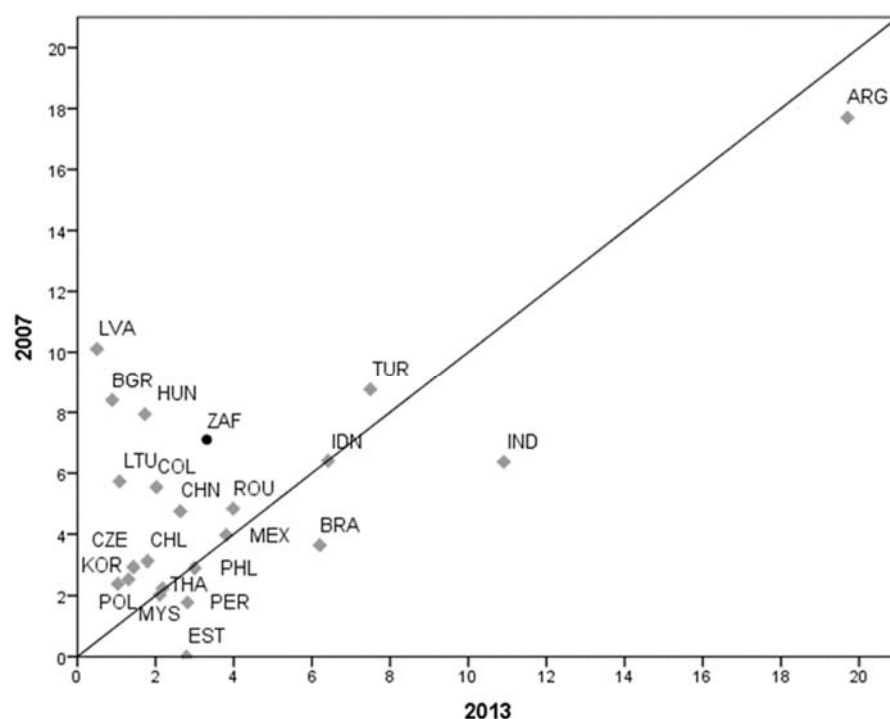
Figure 2-6: Inflation (annual %)

Source: Authors' depiction of data from The World Bank: World Development Indicators.
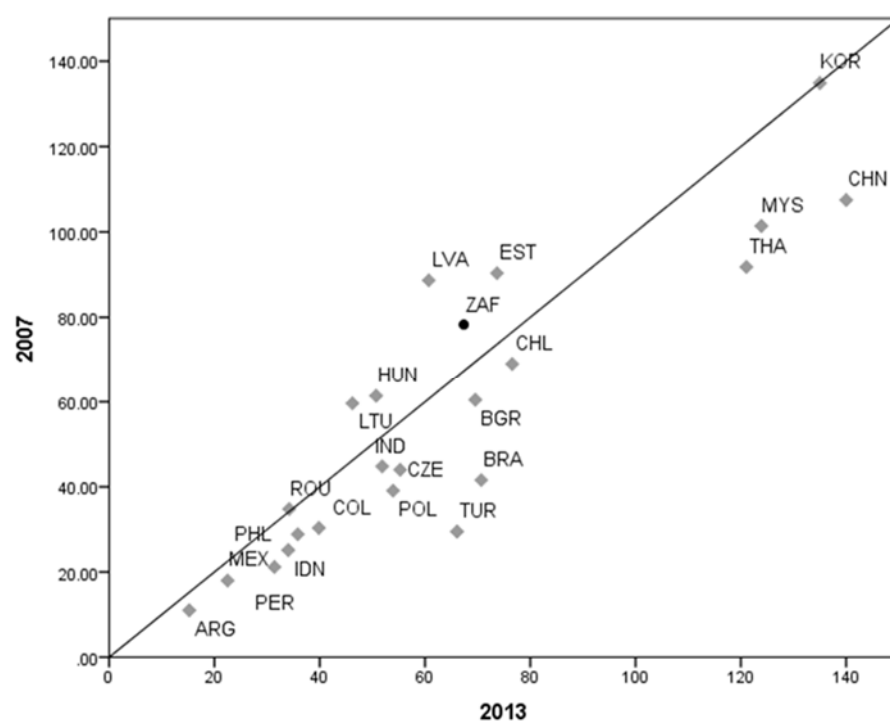
Figure 2-7: Domestic credit to private sector by banks (% of GDP)

Source: Authors' depiction of data from The World Bank: World Development Indicators.

Finally, we also constructed the overall resilience indicator, the results of which are presented in **Table 2-1**. The table shows the ranking of the countries from most resilient to least resilient in 2007 and 2013.

Table 2-1: National ranking in terms of resilience indicator

Rank	2007	2013
1	Chile	Korea, Rep.
2	Peru	Philippines
3	China	Peru
4	Thailand	Colombia
5	Mexico	China
6	Philippines	Chile
7	Korea, Rep.	Bulgaria
8	Indonesia	Indonesia
9	Czech Republic	Mexico
10	Malaysia	Romania
11	Romania	Czech Republic
12	Brazil	Latvia
13	India	Poland
14	South Africa	Thailand
15	Poland	Brazil
16	Colombia	Malaysia
17	Estonia	Hungary
18	Turkey	Argentina
19	Lithuania	India
20	Bulgaria	South Africa
21	Argentina	Turkey
22	Latvia	Estonia
23	Hungary	Lithuania

Source: Authors' analysis of data from The World Bank: World Development Indicators.

The ranking shows that the emerging countries that were the most resilient to crisis in 2007 were Chile, Peru, Thailand, Mexico, the Philippines, South Korea, Indonesia, the Czech Republic and Malaysia. In this relative ranking, South Africa lay in fourteenth position, just below Brazil and India. The small economies of emerging Europe as well as Argentina were in the worst position for the shock that followed.

By 2013 the ranking changed, but with countries like South Korea, the Philippines, Peru, China, Chile, Indonesia and Mexico still in the top-10 resilient countries. South Africa lost six places to rank twentieth and was, according to this measure, clearly more vulnerable to withstand external shocks than in 2007.
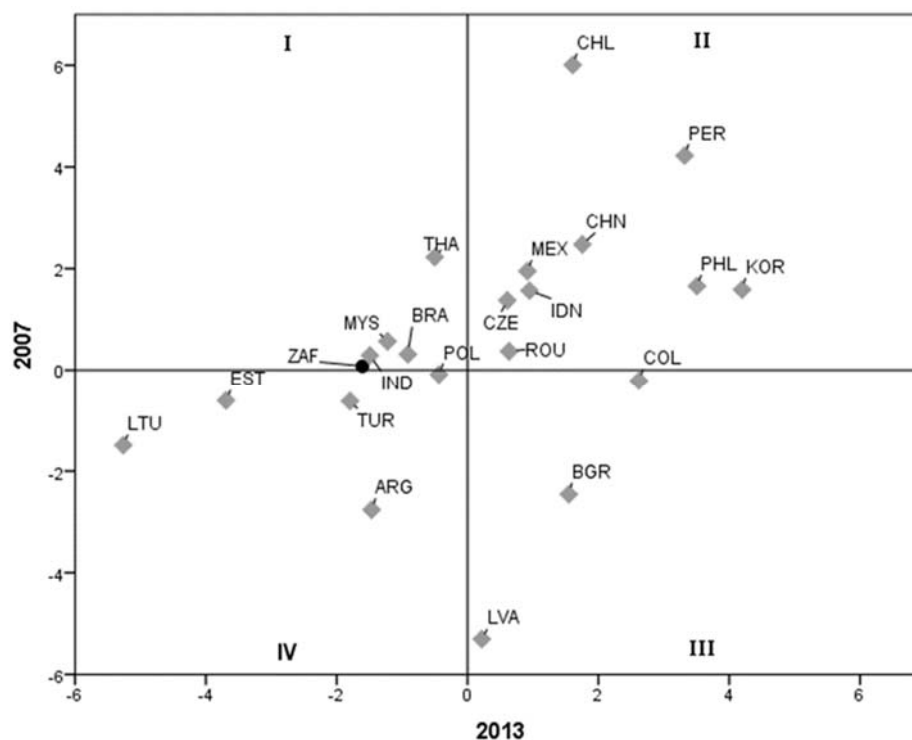
Figure 2-8: National ranking in terms of resilience indicator

Source: Authors' analysis of data from The World Bank: World Development Indicators.

Figure 2-8 shows a plot of the resilience index values with 2007 on the vertical axis and 2013 on the horizontal axis. The index values are constructed relative to the cross-country mean, which implies that positive values indicate greater than average resilience. Countries in quadrant I showed better than average resilience in 2007, but this had declined to below average in 2013. Those countries include South Africa, Brazil and Thailand. The countries in quadrant II were above-average resilient in both periods and include the top-ranked group of 2013, like the Republic of Korea, the Philippines and Peru. Columbia is an example of a country that improved in the resilience ranking from below to above average and it lies in quadrant III along with Bulgaria and Latvia. Quadrant IV shows the countries that showed below-average resilience in both periods. These include Argentina and Turkey.

2.5   CONCLUSION

This study answered the question: how susceptible is the South African economy to an external shock?; and reported on the construction of a resilience indicator based on that devised by Rojas-Suarez (2015) to do so. We extended this indicator for the first time to the case of South Africa. The indicator showed that in 2007 the South African economy was less resilient to an external shock than many of its emerging market peers, ranking in fourteenth position. Over the 2008 global financial crisis period through to 2013 the position worsened, with South Africa ranking in twentieth position. South Africa was therefore much less resilient in 2013 and, so, more susceptible to external shocks. The description of the different indicators showed that when it comes to withstanding an external shock, South Africa is not in a bad position — the current account deficit has been narrowed and the indebtedness and liquidity positions improved. The South African economy seems to be more vulnerable in terms of limited policy room to manoeuvre. This speaks to the current challenges facing policymakers in the face of a possible ratings downgrade:

- slow growth has raised doubts about the government's ability to balance the budget and repay debt in the face of social spending pressures;

- fiscal consolidation and austerity leaves limited room for stimulating growth;

- supply-side shocks (drought and depreciation of the rand) have added to inflationary pressure

- So even with slow growth, demonstrably credible policy requires contractionary measures, leading to slower growth and pressure on the fiscal position.

Measuring resilience may strengthen the hands of policymakers. When it is clear that South Africa is by comparison in a worse position, the difficult choices have to be made. Global capital seeks high returns for low risks and the South African economy needs the inflows.

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CHAPTER 3

Manuscript 2

Manuscript 2 will be submitted to a peer-reviewed journal.

The guidelines to authors from the Journal of Financial and Economic Sciences will be used for this manuscript.

Manuscripts	Maximum of 25 pages.
	Should consist of title, abstract, keywords, body of manuscript, and list of references.
Title	Maximum 75 characters in length. Should be descriptive and summarise the most important points of the manuscript.
Abstract	A maximum of 150 words succinctly describing the article and between 5–7 keywords.
Tables and figures	When referring to figures and tables, each figure and/or table should be mentioned in the text in bold typeface and numbered consecutively. Each figure should have a unique caption and should be numbered consecutively in bold typeface. Acknowledge the source below a table or figure. If created by the author(s), please indicate as such.
References	Use the Harvard system of referencing.

Economic resilience: the usefulness of early warning indicators for South Africa

HJ Cockeran

Abstract

South Africa has to address challenges of slow economic growth, poverty, and inequality in the face of macroeconomic imbalances. The high cost of crises places emphasis on strengthening the resilience of economies. One method to achieve this, is by assessing vulnerabilities that can lead to crises. This paper applies a set of vulnerability indicators, proposed by (Röhn, Sánchez, Hermansen, & Rasmussen, 2015), to the case of South Africa. Following Hermansen and Röhn (2015), the signalling approach is used to evaluate the usefulness of the indicators in predicting severe recessions for South Africa. 14 of the 25 vulnerability indicators applied to the case of South Africa are found to be useful in predicting severe recessions and issue a signal on average 8 quarters before a severe recession occurs.

3.1   INTRODUCTION

The high cost of crises, as demonstrated during the global financial crisis of 2008, has increased interest in early warning indicators. Early warning indicators is a large field with numerous different indicators used for different types of crises. Previous early warning indicator studies are mostly focused on detecting specific types of crises, such as currency crises (Kaminsky, Lizondo & Reinhart, 1998), banking crises (Demirgüç-Kunt & Detragiache, 1998, Demirgüç-Kunt & Detragiache, 2000, Borio & Lowe, 2002, Barrell, Davis, Karim & Liadze, 2010, Drehmann & Juselius, 2014) and credit crises (Alessi & Detken, 2011, Duca & Peltonen, 2013).

This paper has a specific focus on South Africa and builds forth on Cockeran and Krugell (2017). We constructed a resilience indicator from 7 indicators following Rojas-Suarez (2015). This resilience indicator is a relative measure of the capacity to withstand an adverse external shock, and of the policy room to manoeuvre in order to counteract the impact from a shock. It is a relative measure as it compares South Africa's position with 22 other countries before and after the 2008 global financial crisis. The results indicated that South Africa is in a relatively worse off position after the crisis and more vulnerable to a crisis.

In this paper the aim is to determine which measures of the position of the economy are useful early warning indicators of a crisis. It uses a new set of OECD vulnerability indicators (Röhn, Sánchez, Hermansen & Rasmussen, 2015) and follows the approach of Hermansen and Röhn (2015) to identify useful early warning indicators for South Africa. A novelty of this paper is that it focuses on predicting severe recessions, following Hermansen and Röhn (2015), rather than on a specific type of crisis such as currency or banking crises.

The method followed is a signalling approach for 25 variables ranging within the period 1970–2015 for South Africa and the Bry and Boschan (1971) algorithm was used to identify severe recessions. The results, in summary, indicate that there are 14 useful early warning indicators, for a preference parameter of 0.9 that can be used to predict severe recessions for South Africa. The conditional probability for these indicators are also relatively high. If a signal is issued then the probability of a severe recession occurring ranges from 11%–33%. Signals are issued on average 8 quarters before a severe recession, giving policymakers adequate time to implement policy changes to avoid a potential severe recession or mitigate the consequences thereof. These early warning indicators may therefore be useful in predicting severe recessions for South Africa.

Section 2 of this paper provides an overview of the literature on early warning indicators. The method and data used are discussed in section 3, while section 4 discusses the results of this paper. Conclusions follow in section 5.

3.2   LITERATURE REVIEW

Various types of economic crises have been studied with the aim of identifying variables that can predict certain types of crises, such as currency, banking, and sovereign debt crises (Alessi & Detken, 2011, Barrell et al., 2010, Drehmann & Juselius, 2014, Kaminsky et al., 1998, Demirgüç-Kunt & Detragiache, 2000, Duca & Peltonen, 2013). These variables, or indicators, measure imbalances in the economy that could lead to costly economic crises.

An imbalance is described as a significant and sustained deviation in asset prices or other financial variables from its long-run trend. A large and persistent trade deficit, or current account deficit is typically seen as a macroeconomic imbalance (Kahn, 2010, Bean, 2003). A large focus has been placed on the current account as an imbalance. Global imbalances cannot be reduced to only a large current account deficit in a single country, but are rather a result of various factors such as saving, investment and portfolio choices (Obstfeld & Rogoff, 2005). Global imbalances have important implications for national and international financial markets, the level of long-run interest rates, and the stability of financial markets (Boissay, 2011, Llewellyn, 2006).

Milesi-Ferretti and Razin (1996) investigated the sustainability of persistent current account imbalances and to what extent it can be viewed as an indication of a probable crisis. Persistent current account imbalances are often seen as a sign of weakness that implies the need for policy action. Their study argues that economic theory suggests that intertemporal borrowing and lending are natural vehicles for achieving faster capital accumulation, smooths consumption and allows for more efficient capital allocation. They argue, however, that traditional sustainability measures based only on intertemporal solvency ignore the willingness of a country to repay its external obligations and foreign investors' willingness to continue lending to a country.

They examined a list of indicators that may explain the sustainability of external imbalances using the accounting framework to calculate the current account balance. They examined a total of 9 crises for 7 countries and found that some experienced persistent current account deficits without drastic policy changes, some reversed policy which prevented potential external crises and two other countries suffered external crises. They found that the size of the current account deficit is

not necessarily an informative indicator of sustainability. The size of the current account deficit should be viewed together with exchange rate policy and factors such as the level and composition of external liabilities, the degree of openness, the composition of trade and the level of savings and investment (Milesi-Ferretti & Razin, 1996).

Edwards (2005) focuses on two instances of external crises: (i) sudden stops of capital inflows, and (ii) current account reversals. Two policy-related issues were debated in this paper: whether the extent of capital mobility affects a country's degree of vulnerability to external crises; and whether the extent of capital mobility determines the depth of external crises. He analyses the relationship between capital mobility restrictions and external crises using a multi-country dataset. Findings from his study draws into question whether heightened capital mobility has led to an increase in macroeconomic vulnerabilities. Edwards (2005) found no systematic evidence that suggests countries with higher capital mobility tend to have higher frequencies of crises, or tend to face higher probabilities of a crisis occurring than countries with lower capital mobility. However, the results do suggest that once a crisis occurs, countries with higher capital mobility, more often than not face higher costs in terms of growth decline.

Obstfeld (2012) asks if current account imbalances still matter in a world of deeply integrated international financial markets where two-way financial flows often overshadow the net flows measured in the current account. Obstfeld (2012) came to the conclusion that contrary to a complete markets or "consenting adults" view of the world—that states forward-looking households and firms will generate current account balances consistent with efficient resource allocation—current account balances can signal elevated macroeconomic and financial stresses. Historically large and persistent current account imbalances deserve the close attention of policymakers. Balance sheet mismatches of leveraged entities provide the most direct indication of potential instability. The model applied places focus on international flows, stocks, and budget constraints and incorporated these variables into the current account balance. He makes use of the net international investment position (NIIP) derived from the household budget constraint, government budget constraint and the value of future profits generated by domestic capital. By combining these three constraints Obstfeld (2012) states that the NIIP limits the present value of future net export deficits. He concludes that historically large and persistent current account imbalances deserve the close attention of policymakers and that balance sheet mismatches of leveraged entities provide the most direct indication of potential instability.

The mind-set concerning advanced economies prior to the global financial crisis of 2008 was that developed economies were not nearly as vulnerable as emerging or developing countries. When events proved this notion to be false, the idea still persisted that in the event of a financial crisis, advanced economies are much better at managing the outcome as result of their ability to vigorously implement countercyclical policy (Reinhart & Rogoff, 2013). The recovery, however, consistently proved to be far weaker than most forecasters were expecting and policymakers continued to underestimate the depth and duration of the downturn. Reinhart and Rogoff (2013) claims that economic growth will provide a soft exit, reducing or even eliminating the need for restructuring, suppression or inflation, if policymakers are fortunate.

Shin (2013) focused on the conceptual underpinnings of early warning models. The paper recommends that the procyclicality of financial systems provides a framework for choosing vulnerability indicators. Specifically, three types of early warning indicators are assessed for their relative likelihood of success as early warning indicators. Indicators based on normalised measures of total credit (credit-to-GDP ratio), those based on financial market prices (CDS spreads and implied volatility), and those based on liabilities of financial intermediaries (bank liability ratios). Indicators based on financial market prices are the most viable indicators of concurrent market conditions. They do not leave much time to implement policy changes once a crisis has been identified and are therefore not very successful early warning indicators. The credit-to-GDP ratio is a more successful early warning indicator, although there is doubt about its usefulness as a real-time measure or as a measure that can be applied uniformly across countries. The most successful early warning indicators are those based on banking sector liability aggregates as they can be used in real time.

In November 2008 the G20 group of nations asked the IMF to conduct new early warning exercises (IMF, 2008). This paper was a response to this request. Frankel and Saravelos (2010) give a review of the early warning literature with the aim of determining which variables were consistently proven as statistically significant leading indicators. They conducted an empirical investigation to identify which countries were more susceptible to crisis during the 2008 global financial crisis; and, which financial and economic variables were able to predict the incidence of the financial crisis. Countries were considered more vulnerable in the instance where they experienced large output drops, considerable stock market falls, currency fluctuation (depreciation), and reserve losses. They also identified the following variables as potentially useful but not as robust as the

former variables: lower historic credit growth, larger current account/saving rates, and lower external and short-term debt (Frankel & Saravelos, 2012).

Röhn et al. (2015) discussed the source and nature of potential vulnerabilities that could cause costly economic crises in OECD countries. They conducted a literature review of the early warning literature and lessons learned from the 2008 global financial crisis. From their literature review they propose a dataset of 73 vulnerability indicators to monitor and evaluate country risks in OECD countries. This proposed dataset is grouped according to five domestic areas: the financial sector, non-financial sector, asset market, public sector, and external sector imbalances. They also added a sixth category for international spillovers, contagion and global risks. In a companion paper, Hermansen and Röhn (2015), they tested the usefulness of the proposed dataset of vulnerability indicators in predicting severe recessions and crises in the 34 OECD economies and Latvia for the period 1970–2014. They found that the majority of the indicators were useful, given the availability of sufficiently long time series.

In summary, there exists a large literature on early warning indicators, crises and imbalances. It is difficult to draw universal lessons from the empirical literature as definitions of crises and the severity of occurrence varies broadly across studies (Frankel & Saravelos, 2012). The following section discusses the method and data used to determine the usefulness of the dataset of vulnerability indicators from Röhn et al. (2015) in predicting severe recessions for South Africa.

3.3 METHOD

This paper follows Hermansen and Röhn (2015) in trying to predict severe recessions rather than specific types of economic crisis. Using severe recessions differs from the majority of the early warning indicator literature which focused mostly on a specific type of crisis; namely: currency crisis (Kaminsky et al., 1998), banking crisis (Demirgüç-Kunt & Detragiache, 1998, Demirgüç-Kunt & Detragiache, 2000, Borio & Lowe, 2002, Barrell et al., 2010, Drehmann & Juselius, 2014) or credit crisis (Alessi & Detken, 2011, Duca & Peltonen, 2013).

Severe recessions, defined as a significant drop in GDP per capita, captures a variety of costly economic events. Severe recessions are defined transparently and objectively thereby avoiding potential pitfalls of timing and whether the recession constitutes a recession—an issue discussed in Romer and Romer (2015). The signalling approach (Edison, 2000, Kaminsky et al., 1998, Borio & Lowe, 2002, Behn, Detken, Peltonen & Schudel, 2013) is used to determine the usefulness of

the indicators. The signalling approach offers the advantage that a larger set of indicators may be included compared to using multivariate regression (Hermansen & Röhn, 2015). This is an important advantage as the aim of this study is to assess the usefulness of each individual indicator. A warning signal, which indicates that a crisis may occur in the next 24 months, is issued by an indicator if it deviates from its mean beyond a specified threshold. This threshold is chosen in order to achieve a balance between type I (missing a crisis) and type II errors (falsely signalling a crisis). A loss function is then used in order to obtain an optimal threshold between these errors. An indicator is useful if it results in a lower loss compared to when the indicator is ignored.

The Bry and Boschan (1971) algorithm is applied to GDP per capita to identify peak and trough dates of the business cycle for South Africa over the period 1970–2015. Severe recessions are then defined as recessions with a fall in GDP per capita from peak to trough above the median fall over the entire sample for South Africa.

Figure 3-1 depicts the periods of severe recessions identified for South Africa using the Bry and Boschan (1971) algorithm.
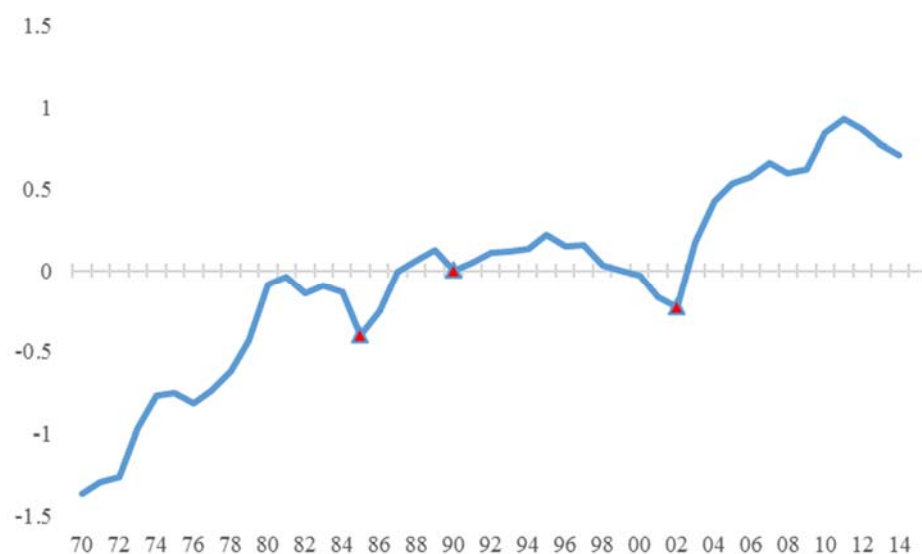
Figure 3-1: South African severe recessions 1970–2014 (log of GDP per capita less median GDP per capita)

Source: Authors' analysis of data from the OECD.

- 1985—South Africa faced a major foreign debt crisis when the government had to declare a standstill on debt repayments totalling more than half of the country's total external debt. This led to a rapid depreciation of the rand (Padayachee, 1988);

- 1990—uncertainty about the future of the economy due to the transition away from Apartheid, high inflation and large deficits on the financial account (Mohr, 2003); and

- 2002—the rand depreciated sharply against the USD in the aftermath of 9/11 and inflation increased to an average of 9.2% (Department of Research and Information, 2013).

The data used in this study were compiled by Röhn et al. (2015) and the dataset is available from the OECD website. The dataset contains 73 vulnerability indicators, covering the financial sector, non-financial sector, asset market, public sector, external sector, and global market imbalances. 25 vulnerability indicators were used to test for their usefulness in predicting severe recessions for South Africa. The other 48 vulnerability indicators were not included, as sufficient data were not available to cover at least half of the severe recessions identified. **Table 3-1** represents the vulnerability indicators used, the original data source, time period covered and the transformations applied to the data.

Table 3-1: Vulnerability indicators

Sector	Indicator	Detailed definition	Source	Time coverage	Transformations
Asset market	Real house prices	Deflated using the private consumption deflator from the national account statistics; index 2010 = 100.	OECD Housing Prices database	1970q1-2015q1	gap 1-3, gr 1-3
Asset market	Residential investment	Gross fixed capital formation, housing; in % of GDP.	OECD Economic Outlook database	1970q1-2015q1	none, gap 1-3, gr 1-3
Asset market	Real stock prices	Broad share price index deflated by consumer price index.	OECD Monthly Economic Indicators	1970q1-2015q1	gap 1-3, gr 1-3
Asset market	Price to disposable income ratio	Nominal house prices to nominal net disposable income per capita; index 2010 = 100.	OECD Housing Prices database	1995q1-2013q4	none, gap 1-3, gr 1-3

Sector	Indicator	Detailed definition	Source	Time coverage	Transformations
Asset market	Price to rent ratio	Nominal house prices to rent prices; index 2010 = 100.	OECD Housing Prices database	2002q1-2015q1	none, gap 1-3, gr 1-3
External	M2 (money and quasi money) to foreign reserves	Money and quasi money (M2) to official foreign exchange reserves ratio.	World Development Indicators	1970-2014	gap 1-3, gr 1-3
External	Current account balance	Current account balance in % of GDP.	OECD Economic Outlook database	1970-2014	none
External	Official foreign exchange reserves	Official foreign exchange reserves in % of GDP.	IMF International Financial Statistics	1970q1-2015q1	none, gap 1-3, gr 1-3
External	Export performance	Exports of goods and services relative to export market for goods and services.	OECD Economic Outlook database	1975Q1-2015Q1	gap 1-3, gr 1-3
External	Foreign currency exposure index	Index of the sensitivity of a country's portfolio to a uniform currency movement by which the domestic currency moves proportionally against all foreign currencies. Index between -1 (zero foreign-currency foreign assets and only foreign-currency foreign liabilities) and 1 (only foreign-currency foreign assets and only domestic-currency foreign liabilities).	Benetrix, Lane and Shambaugh (2015)	1990-2012	none
External	Quantitative foreign currency exposure	Quantitative exposure to a uniform shift in the value of the domestic currency against all foreign currencies. It is calculated as the foreign currency exposure index (see above) multiplied by the sum of foreign assets and liabilities in % of GDP.	Benetrix, Lane and Shambaugh (2015)	1990-2012	gap 1-3, gr 1,3
External	Real effective exchange rate (unit labour costs)	Competitiveness indicator. Relative unit labour costs (ULC) for overall economy and overall	OECD Economic	1996Q4-2015Q1	gap 1-3, gr 1-3

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Sector	Indicator	Detailed definition	Source	Time coverage	Transformations
		weights based on exports of goods.	Outlook database		
External	Real effective exchange rate (consumer prices)	Competitiveness indicator. Relative consumer prices (CPI), overall weights based on exports of goods.	OECD Economic Outlook database	1997Q1-2015Q1	gap 1-3, gr 1-3
Fiscal	Government gross debt	General government gross financial liabilities; in % of GDP.	OECD Economic Outlook database	1970-2014	none
Fiscal	External government debt	Gross government debt in % of GDP	World Bank Quarterly External Debt Statistics; World Bank Quarterly Public Sector Debt	1970-2014	none
Fiscal	Government budget balance	Government net lending; in % of GDP.	OECD Economic Outlook database	1995-2014	none
Global	Global weighted average: Total private credit	Weighted average of private credit indicator (see above) across countries for each quarter; weights defined by nominal GDP at Purchasing Power Parity (PPP).	BIS	1970q1-2015q1	none, gap 1-3, gr 1-3
Global	Global weighted average: Total private bank credit	Weighted average of private bank credit indicator (see above) across countries for each quarter; weights defined by nominal GDP at Purchasing Power Parity (PPP).	BIS	1970q1-2015q1	none, gap 1-3, gr 1-3
Global	Global weighted average: Real stock price index	Weighted average of real stock price index (see above) across countries for each quarter; weights defined by nominal GDP at Purchasing Power Parity (PPP).	OECD Monthly Economic Indicators	1970q1-2015q1	gap 1-3, gr 1-3
Global	Global weighted average: Real house prices	Weighted average of real house prices index (see above) across countries for each quarter; weights defined by nominal GDP at Purchasing Power Parity (PPP).	OECD Housing Prices database	1970q1-2015q1	gap 1-3, gr 1-3

Sector	Indicator	Detailed definition	Source	Time coverage	Transformations
Global	Trade openness	Sum of export and import in % of GDP.	OECD Economic Outlook database	1970q1-2015q1	none
Non-financial	Total private credit	Lending from all sectors (including foreign lending) to private non-financial sector; in % of GDP.	BIS	1970q1-2015q1	none, gap 1-3, gr 1-3
Non-financial	Private bank credit	Lending from domestic bank sector to private non-financial sector; in % of GDP.	BIS	1970q1-2015q1	none, gap 1-3, gr 1-3
Non-financial	Household credit	Lending from all sectors (including foreign) to households and NPISHs; in % of GDP.	BIS	2008q1-2015q1	none, gap 1-3, gr 1-3
Non-financial	Corporate credit	Lending from all sectors (including foreign) to non-financial corporations; in % of GDP.	BIS	2008q1-2015q1	none, gap 1-3, gr 1-3

Source: Author's depiction from Röhn et al. (2015).

Each of the 25 vulnerability indicators is then tested for its full sample period and for each transformation applied. This resulted in 130 transformations. The loss function was then calculated and optimised for each of these 130 transformations.

Steps applied, following Hermansen and Röhn (2015):

Apply Bry and Boschan (1971) algorithm to identify peak and trough dates of business cycles in GDP per capita.

Severe recessions are defined as recessions with a fall in GDP per capita from peak to trough above the median fall over the entire country-year sample.

Use 5 types of domestic imbalances identified by Röhn et al. (2015):

    o   financial sector imbalances;

    o   non-financial sector imbalances;

    o   asset market imbalances;

o   public sector imbalances;

o   external sector imbalances;

For several variables use deviations from a trend. Trends are calculated using:

o   A slowly adjusting one-sided HP-filter (gap1);

o   A faster adjusting one-sided HP-filter (gap2);

o   A 20 quarter (5 year) one-sided moving average (gap3).

o   All three are calculated recursively.

Several indicators are expressed as growth rates:

o   Year-on-year growth rates (gr1);

o   Quarter-on-quarter growth rates (gr2);

o   Cumulated growth rates over the preceding 6 quarters (4 years for annual series) (gr3).

Apply the signalling approach (Kaminsky et al., 1998, Hermansen & Röhn, 2015) to all 130 transformations of the variables.

The signalling approach is a nonparametric method. No assumptions are therefore made about the distribution of the indicators. A shortcoming of this approach is that it does not allow for the usual statistical tests used in parametric methods to determine the statistical significance of the indicators. Another shortcoming is that it does not allow for possible interactions between the indicators as with regression analysis. It does, however, allow for differences in data availability across the indicators which allows us to determine the predictive ability of each indicator individually.

The signalling approach does not impose any assumptions on the distribution of the indicators. The idea is that a good vulnerability indicator will react differently, given its distribution, pre-crisis than in normal times—thereby providing a signal of a forthcoming crisis. A signal is provided when the indicator exceeds a given threshold. This threshold is a percentile of the indicator's distribution. **Table 3-2** explains the matrix according to which the signals are evaluated. A is the number of quarters in which an indicator signals a crisis within the next 8 quarters correctly. B is the number of quarters in which a crisis was signalled, but without any crisis occurring in the next 8 quarters. C is the number of quarters in which a crisis occurred

without any signals. D is the number of quarters in which no signal is issued without any crisis in the next 8 quarters.

Table 3-2: Contingency matrix

	Crisis (within the next 8 quarters)	No crisis (within the next 8 quarters)
Signal issued	A	B
No signal issued	C	D

If a crisis occurs within 8 quarters from the signal being issued, it is considered as correct (Kaminsky et al., 1998). We would prefer to have the most observations in A and D. A threshold has to be set in order to minimise two types of errors. Type I error: a high threshold would lead to few signals with an accompanying risk of missing a crisis. Type II error: a low threshold would increase the number of signals, but also the number of false signals (B). An optimal threshold can be obtained by minimising a loss function from Sarlin (2013) reflecting the two types of errors and the preference for each. It is defined as:

$$L(x) \;=\; \theta \cdot P \cdot T_1 + (1 - \theta) \cdot (1 - P) \cdot T_2$$

$$= \theta \cdot \frac{A + C}{A + B + C + D} \cdot \frac{C}{A + C} + (1 - \theta) \cdot \frac{B + D}{A + B + C + D} \cdot \frac{B}{B + D}$$

$$= \theta \cdot \frac{C}{A + B + C + D} + (1 - \theta) \cdot \frac{B}{A + B + C + D}, \qquad \theta \in [0,1]$$

where the threshold x determines the distribution between $A, B, C,$ and D. The parameter θ is the preference between type I (T_1) and type II (T_2) errors—the relative cost of missing crises versus false alarms. P and $(1 - P)$ are, respectively, the unconditional probability of pre-crisis and normal times. $T_1, T_2,$ and P can be calculated using the in-sample frequencies of $A, B, C,$ and D. The preference parameter was chosen in the range of $\theta \in [0.5 - 0.9]$, since the focus is towards not missing a crisis. The threshold parameter x was optimised by using a grid search in increments of 5 over the range [0,100] over the percentiles of an indicator's distribution.

In order to test the performance of the vulnerability indicators, we use the following performance measures (Sarlin, 2013, Hermansen & Röhn, 2015):

Absolute usefulness:

$$U_a(x) = \min[\theta P, (1-\theta)(1-P)] - L(x).$$

A positive absolute usefulness value indicates that there is a benefit in using the indicator as it results in a loss ($L(x)$) which is less than if the indicator was ignored which would give a loss of $\min[\theta P, (1-\theta)(1-P)]$.

Relative usefulness:

$$U_r(x) = \frac{U_a(x)}{\min[\theta P,(1-\theta)(1-P)]}.$$

Relative usefulness expresses the portion of an indicator's absolute usefulness to its maximum possible usefulness. It is a percentage value and can be used to compare models with different preference parameters.

Adjusted noise-to-signal ratio:

$$aNtS = \frac{B}{B+D} \Big/ \frac{A}{A+C}.$$

It captures the ratio of false alarms (noise) to correctly predicted crises (signals). In order to be a useful indicator its $aNtS$ must be less than 1, as a value of 1 indicates purely random signals.

Conditional probability =

$$\frac{A}{A+B}.$$

The probability that a crisis occurs given that a signal was issued.

Difference probability =

$$\frac{A}{A+B} - \frac{A+C}{A+B+C+D}.$$

The difference probability is the difference between the conditional and unconditional probability of a crisis occurring. A larger difference indicates a good indicator. A negative difference indicates the indicator should not be used as the indicator performs worse than the simple unconditional probability of a crisis.

3.4 RESULTS

Table 3-3 summarises the performance of the individual indicators. The relative usefulness and optimal threshold percentage is reported for each indicator for preference parameter (θ) values of 0.5–09. The preference parameter indicates a policymaker's preference between type I and type II errors. A balanced preference between the two errors is θ=0.5 and a high preference for detecting

severe recessions is θ=0.9. Only the transformations with the highest relative usefulness is reported for each indicator. The top indicators, based on relative usefulness, per preference parameter are highlighted in bold and italicised.

The relative usefulness of the indicators are highest for preference parameters of 0.8 and, especially, 0.9. In line with Hermansen and Röhn (2015), this is because of the low unconditional probability for severe recessions in this sample—an average of 7.35%. The top performing indicators issue a warning signal on average 8 quarters before a severe recession. This gives adequate time for policymakers to implement changes once a warning signal has been issued in order to avoid or mitigate a potential impending severe recession.

Table 3-4 summarises all the vulnerability indicators with positive relative usefulness, including all the performance measures. The global market imbalances performed well overall, with only trade openness not being a useful indicator. The global weighted real stock price index performed the best among the global market imbalances with a relative usefulness of 21% for θ=0.9. The probability of a severe recession, given that a signal was issued, is 24%. The cumulated growth rate of global private credit-to-GDP ratio has a relative usefulness of 18%. The good performance of the global vulnerability indicators indicates the importance of including international events in assessing the vulnerability of a country.

Of the non-financial market imbalances only the gap of private credit-to-GDP and the cumulated growth rate of private bank credit-to-GDP were useful indicators. Credit variables are consistently found to be early warning indicators of financial crises (Borio & Lowe, 2002, Schularick & Taylor, 2012, Taylor, 2012, Jordà, Schularick & Taylor, 2011, Röhn et al., 2015) and are also useful in detecting severe recessions in this study. They are though not under the top indicators based on relative usefulness. This might be due to the focus on severe recessions and not specifically financial crises.

Asset market imbalances performed well overall, with four of the five indicators featuring among the overall top 10 indicators. The quarter-on-quarter growth rate of real house prices has a relative usefulness of 24%. The quarter-on-quarter growth rate of house price-to-disposable-income indicator is the third best indicator overall based on a relative usefulness of 42%. The probability of a severe recession occurring is 20% conditional on a signal being issued. The year-on-year growth rate of residential investment-to-GDP is the second best performing indicator overall, with

a relative usefulness of 44% and conditional probability of 18%. It also has a low noise-to-signal ratio of 35%. The moving average gap of real stock prices has a relative usefulness of 14% and

Table 3-3: Performance of individual indicators

	Direction to be safe	0.5			0.6			0.7			0.8			0.9		
		Transformation	Threshold	Relative usefulness	Transformation	Threshold	Relative usefulness	Transformation	Threshold	Relative usefulness	Transformation	Threshold	Relative usefulness	Transformation	Threshold	Relative usefulness
Non-financial sector imbalances																
Total private credit (% of GDP)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	gap2	90	0.10
Private bank credit (% of GDP)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	gr3	70	0.06
Household credit (% of GDP)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	all	100	0.00
Corporate credit (% of GDP)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	all	100	0.00
Asset market imbalances																
Real house prices	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	*gr2*	*70*	*0.24*
Price to disposable income ratio	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	*gr2*	*80*	*0.42*
Price to rent ratio	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	all	100	0.00
Residential investment (% of GDP)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	*gr1*	*65*	*0.44*
Real stock prices	<	all	100	0	all	100	0	all	100	0.00	*gr1*	*95*	*0.02*	gap3	30	0.14
Fiscal market imbalances																
Government budget balance (% of GDP) *	>	none	100	0	none	100	0	none	100	0.00	none	100	0.00	none	100	0.00
Government gross debt (% of GDP) *	<	none	100	0	none	100	0	none	100	0.00	none	100	0.00	none	100	0.00
External government debt *	<	none	100	0	none	100	0	none	100	0.00	none	100	0.00	none	100	0.00
External imbalances																
Current account balance (% of GDP) *	>	none	100	0	none	100	0	none	100	0.00	none	100	0.00	none	100	0.00
Foreign currency exposure index *	>	none	100	0	none	100	0	none	100	0.00	none	100	0.00	none	100	0.00
Quantitative foreign currency exposure *	>	all	100	0	all	100	0	all	100	0.00	all	100	0.00	all	100	0.00
Official foreign exchange reserves (% of GDP)	>	all	100	0	all	100	0	all	100	0.00	all	100	0.00	gr3	70	0.06
M2 (money and quasi money) to foreign reserves *	>	all	100	0	all	100	0	all	100	0.00	all	100	0.00	all	100	0.02
Real effective exchange rate (consumer prices)	<	all	100	0	all	100	0	all	100	0.00	*gap1,2*	*75*	*0.13*	*gap1,2*	*75*	*0.61*
Real effective exchange rate (unit labour costs)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	gr3	60	0.11
Export performance	>	all	100	0	all	100	0	all	100	0.00	all	100	0.00	*gap3*	*70*	*0.34*
Global market imbalances																
Trade openness (% of GDP)	<	none	100	0	none	100	0	none	100	0.00	none	100	0.00	none	100	0.00
Global weighted average: Total private credit (% of GDP)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	*gr3*	*65*	*0.18*
Global weighted average: Total private bank credit (% of GDP)	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	*gr1*	*40*	*0.17*
Global weighted average: Real stock price index	<	all	100	0	all	100	0	*none*	*95*	*0.04*	*none*	*95*	*0.13*	*none*	*90*	*0.21*
Global weighted average: Real house prices	<	all	100	0	all	100	0	all	100	0.00	all	100	0.00	*gr3*	*85*	*0.12*

* annual frequency

Source: Author's calculations.

Table 3-4: Top indicators per preference parameter with performance measures

	Transformation	Direction to be safe	Threshold	Relative usefulness	Absolute usefulness	Adjusted Noise-to-signal ratio	Type I error	Type II error	Conditional probability	Differenced probability
θ = 0.7										
Global weighted average: Real stock price index	none	<	95	0.04	**0.002**	**0.15**	0.75	0.04	0.33	0.26
θ = 0.8										
Real stock prices	gr1	<	95	0.02	**0.001**	**0.27**	0.83	0.04	0.22	0.15
Real effective exchange rate (consumer prices)	gap1,2	<	75	0.13	**0.01**	**0.23**	0.00	0.23	0.22	0.16
Global weighted average: Real stock price index	none	<	95	0.13	**0.01**	**0.15**	0.75	0.04	0.33	0.26
θ = 0.9										
Real house prices	gr2	<	70	**0.24**	**0.02**	**0.43**	0.33	0.29	0.15	0.08
Total private credit (% of GDP)	gap2	<	90	0.10	**0.01**	0.60	0.00	0.60	0.11	0.04
Private bank credit (% of GDP)	gr3	<	70	0.06	**0.004**	0.61	0.50	0.30	0.11	0.04
Price to disposable income ratio	gr2	<	80	**0.42**	**0.02**	**0.24**	0.25	0.18	0.20	0.14
Residential investment (% of GDP)	gr1	<	65	**0.44**	**0.03**	**0.35**	0.08	0.32	0.18	0.11
Real stock prices	gap3	<	30	**0.14**	**0.01**	**0.65**	0.00	0.65	0.11	0.04
Official foreign exchange reserves (% of GDP)	gr3	>	70	0.06	**0.004**	0.61	0.50	0.30	0.11	0.04
Real effective exchange rate (consumer prices)	gap1,2	<	75	**0.61**	**0.03**	**0.23**	0.00	0.23	0.22	0.16
Real effective exchange rate (unit labour costs)	gr3	<	60	0.11	**0.01**	**0.55**	0.25	0.41	0.12	0.05
Export performance	gap3	>	70	**0.34**	**0.03**	**0.43**	0.33	0.29	0.19	0.10
Global weighted average: Total private credit (% of GDP)	gr3	<	65	**0.18**	**0.01**	**0.51**	0.33	0.34	0.13	0.06
Global weighted average: Total private bank credit (% of GDP)	gr1	<	40	**0.17**	**0.01**	**0.57**	0.00	0.57	0.12	0.05
Global weighted average: Real stock price index	none	<	90	**0.21**	**0.01**	**0.24**	0.67	0.08	0.24	0.17
Global weighted average: Real house prices	gr3	<	85	0.12	**0.01**	**0.45**	0.67	0.15	0.15	0.08

Source: Author's calculations.

conditional probability of 11%. The good performance of the asset market imbalances is in keeping with the literature that finds unsustainable real estate booms often lead to financial crises (Borio & Drehmann, 2009).

None of the three fiscal market imbalances are useful indicators in this sample. The external market imbalances delivered 4 useful indicators. The gap of the real effective exchange rate in relative consumer prices has a relative usefulness of 61%. This means that it performs 61% as good as a perfect indicator. It has a low noise-to-signal ratio of 23%. If a signal is issued the conditional probability of a severe recession occurring is 22%. Export performance has a relative usefulness of 34% and a conditional probability of 19%. Official foreign exchange reserves-to-GDP and the real effective exchange rate (unit labour costs) are also useful with a relative usefulness of 6% and 11% respectively. As a small open emerging market economy it makes sense that external imbalances can be useful predictors of severe recessions for South Africa. In contrast to some of the literature, the current account balance was not a useful indicator for severe recessions in South Africa.

The results, in summary, indicate that there are 14 useful early warning indicators, for a preference parameter (θ) of 0.9, that can be used to predict severe recessions for South Africa. The conditional probability for these indicators are also relatively high. If a signal is issued then the probability of a severe recession occurring ranges from 11%–33%. Signals are issued on average 8 quarters before a severe recession, giving policymakers adequate time to implement policy changes to avoid a potential severe recession or mitigate the consequences thereof. These early warning indicators may therefore be useful in predicting severe recessions for South Africa.

3.5   CONCLUSION

This paper answered the question: which measures of the position of the economy are useful early warning indicators of a crisis? It used a new set of OECD vulnerability indicators compiled by Röhn et al. (2015) and followed the approach of Hermansen and Röhn (2015) to identify useful early warning indicators for South Africa. A novelty of this paper is that it focused on predicting severe recessions, following Hermansen and Röhn (2015), rather than on a specific type of crisis such as currency or banking crises.

The Bry and Boschan (1971) algorithm was used to identify severe recessions. The signalling approach was then applied to 25 variables ranging within the period 1970–2015 for South Africa.

A loss function, reflecting type I and type II errors and the preference for each, was minimised by optimising for the threshold parameter using a grid search over the percentiles of each transformed indicator's distribution.

The results, in summary, indicate that there are 14 useful early warning indicators, for a preference parameter of 0.9 that can be used to predict severe recessions for South Africa. The conditional probability for these indicators are also relatively high. If a signal is issued then the probability of a severe recession occurring ranges between 11%–33%. Signals are issued on average 8 quarters before a severe recession, giving policymakers adequate time to implement policy changes in order to avoid a potential severe recession or mitigate the consequences thereof. These early warning indicators may therefore be useful in predicting severe recessions for South Africa.

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CHAPTER 4

General findings and Conclusions

4.1   Introduction

The overall aim of this study was to determine the susceptibility of South Africa to economic crises. Susceptibility has as a synonym vulnerability and the opposite is resilience. South Africa's susceptibility is, in this study, therefore investigated from both its resilience to withstand a crisis and its vulnerability to crisis. This was investigated by determining the resilience of the South African economy to external shocks, and whether there are vulnerability, or early warning, indicators that would be useful in predicting severe crises for South Africa.

In order to achieve this aim, the following specific objectives were specified for the manuscripts:

Manuscript 1— South Africa's susceptibility to financial crises

- Extend a resilience indicator developed by Rojas-Suarez (2015) to the case of South Africa.

- Determine the South African economy's resilience to external shocks before and after the 2008 global financial crisis.

- Compare South Africa's resilience to that of its emerging market peers before and after the 2008 global financial crisis.

Manuscript 2— Economic resilience: the usefulness of early warning indicators for South Africa

- Apply a set of vulnerability indicators, proposed by (Röhn, Sánchez, Hermansen, & Rasmussen, 2015), to the case of South Africa.

- Apply the Bry and Boschan (1971) algorithm and determine severe recessions for South Africa for the period 1970–2015 using GDP per capita.

- Use the signalling approach, an early warning indicator method, to the vulnerability indicators.

- Determine the usefulness of these vulnerability indicators in predicting severe crises for South Africa by calculating various performance measures.

4.2   Results

The results and conclusions of the two manuscripts prepared for this dissertation are as follows:

Manuscript 1—South Africa's susceptibility to financial crises

In the first manuscript, the susceptibility of the South African economy to external shocks was determined using a resilience indicator proposed by Rojas-Suarez (2015). The findings were that:

- South Africa became less resilient to an external shock than many of its emerging market peers.

- South Africa lost 6 positions on the resilience index ranking between 2007 and 2013.

- South Africa is, therefore, less resilient after the global financial crisis of 2008, and more vulnerable to an external shock than most comparable emerging market economies.

Manuscript 2—Economic resilience: the usefulness of early warning indicators for South Africa

The second manuscript evaluated the usefulness of early warning indicators in predicting severe recessions for South Africa. The results demonstrated that:

- 14 vulnerability indicators were found to be useful in predicting severe recessions for South Africa.

- These indicators provide a signal on average 8 quarters before a severe recession occurs. This provides adequate time for policymakers to implement changes in order to mitigate or avoid potential severe recessions.

- The following types of imbalances provided the most relatively useful indicators: global imbalances, asset market imbalances, and external imbalances.

4.3   General conclusion

The recent financial crises showed that countries are susceptible to external shocks and South Africa has not been an exception. Comparing South Africa's resilience in 2013 to 2007 it can be seen that South Africa's position has worsened by 6 places on the resilience index. It is, therefore, in a worse position to withstand external shocks than before the financial crises. South Africa is also relatively worse off than most of its emerging market peers, ranking 20th out of 23 emerging market countries in 2013. Important to remember is that the resilience indicator only provides a

relative comparison to other countries at one given point in time. A more robust and continuous method should also be used to measure our resilience, or put differently, our vulnerability to crisis.

The measures in which South Africa performed worse in 2013 compared to 2007 are: the current account balance; external indebtedness; the fiscal balance; and government debt. South Africa performed better in the measures of short-term external debt to reserves by increasing reserves; a decrease in domestic credit extension; and a decrease in inflation. South Africa's ability to react to a crisis is therefore relatively good as inflation is relatively low and domestic credit extension decreased. The fiscal balance deteriorated from a small surplus to a deficit of around 4.5%. The government increased spending to reduce the impact of the 2008 global financial crisis, but not it has to reduce its spending. That is proving difficult currently as government faces increased spending on social grants and free higher education. It has also not generated the expected amount of revenue from taxes and implemented an increase in VAT to increase tax revenue.

Obstfeld (2012) found that many crises were preceded by large current account deficits, although many countries were able to sustain large deficits without experiencing financial crises. Frankel and Rose (1996) and Edwards (2002) found that large current account deficits did not significantly increase susceptibility to external shocks. South Africa's current account deficit as a ratio of GDP is relatively small at 5.6% and improved from 2007 to 2013. South Africa therefore appears not to be more susceptible to a crisis based on this measure. Frankel and Saravelos (2010) found that international reserves have a more significant influence in predicting a crisis. South Africa has increased its foreign reserves and therefore also appears less susceptible using this measure. Overall South Africa is less resilient in 2013 than in 2007, but in terms of withstanding an external shock it is not in a bad position. The concern is rather that South Africa has limited room to implement policy changes.

In order to protect South Africa from severe crisis we can use early warning indicators, or vulnerability indicators, to warn of an imminent severe recession. From this study 14 indicators were found to be useful in predicting severe recessions for South Africa. These indicators also issue a warning signal on average 8 quarters before a crisis occurs. This leaves adequate room for policymakers to implement changes in order to avoid a crisis or mitigate the consequences if a crisis is to occur. The conditional probability for these 14 indicators is relatively high. If a signal has been issued there is an 11%–33% probability of a severe recession occurring, depending on the indicator having issued the signal.

The main mechanisms for implementing policy change are monetary and fiscal policy. New regulations or legislation could also be used. An example of this might be the enactment of the National Credit Act (NCA) no. 34 of 2005. The NCA's purpose was to ensure that consumers were not issued additional credit when already over-indebted, and to ensure that consumers are able to afford the credit granted to them. Enacting legislation such as the NCA could serve to reduce for example the ratio of household credit-to-GDP—a variable under the non-financial sector imbalances. Due to the timeframe allowed it may not be feasible to draft legislation only once a warning signal has been issued, as the time required for drafting, promulgating and enacting would likely be greater than 8 quarters and the effect of such regulation will only be seen after an even greater period of time. It may, however, be valuable in addressing future imbalances.

 The South African Reserve Bank (SARB) sets monetary policy within a flexible inflation-targeting framework. The SARB implements monetary policy by adjusting the repurchase, or repo, rate in order to affect the economy and the price level. The SARB Monetary Policy Committee meet regularly and the repo rate can therefore be adjusted relatively quickly if need be. The SARB can increase the repo rate in order to, for example, increase the cost of credit to dampen borrowing or increase the incentive to save as consumers can earn higher interest rates on deposits and investments. The monetary policy transmission mechanism is, however, characterised by long, variable, and uncertain time lags. The repo rate can therefore be adjusted quickly if a signal is issued, but the effect thereof may take an indeterminate amount of time to reflect in the economy and thereby have an impact on the variables signalling crisis.

National Treasury is mandated to promote the South African government's fiscal policy framework. Fiscal policy is the use of government spending and revenue collection (tax) in order to influence the economy. The government can either implement expansionary or contractionary fiscal policy. Government spending and taxes are set by the government budget which is reviewed annually. Once a warning signal has been issued by an indicator, it may take some time before fiscal policy can be used to address the imbalance. Fiscal policy can be used, for example, to affect fiscal market imbalances. By reducing government spending and/or increasing tax revenue, the ratio of the government budget balance-to-GDP and government gross debt-to-GDP can be improved. Both monetary and fiscal policy can affect the early warning indicators. The mechanism to influence the imbalances might just be less direct in certain circumstances and have an impact less directly by influencing the overall direction of the economy.

Being aware of the fact that South Africa is less resilient than many emerging market economies, it is important to monitor indicators useful in signalling crises. This study has identified 14 indicators which are useful in predicting severe recessions for South Africa for the period 1970–2015. These may be used to affect policy changes in order to avoid costly financial crises. Of these 14 indicators, 6 indicators are domestic and 8 indicators are external. The good news is that policymakers can relatively easily implement changes to affect these variables. Total private credit, private bank credit, residential investment, foreign reserves and real house prices can be targeted in order to mitigate the probability or impact of a crisis. An example of this is the implementation of the National Credit Act of 2007. This directly tightened credit lending and with good timing too. This possibly assisted in dampening the effect of the 2008 global financial crisis on South Africa, together with the expansionary fiscal policy that was implemented.

With an indicator such as real stock prices, the predicament of South Africa is clearer. South Africa has a very well developed financial sector, arguably just as good as or even better than some developed economies. It is therefore easy for South Africa to borrow in foreign markets and for foreign investors to invest in the South African economy. South Africa is much less reliant on foreign direct investment as compared to other emerging or developing markets. The drawback of South Africa's well-developed financial sector is that foreign investment in the economy can be withdrawn very easily as compared to foreign direct investment. In an economic downturn it is usual for foreign investors to withdraw their investments from other markets, especially from the more risky emerging markets such as South Africa. Sudden withdrawals from financial markets may signal a loss in confidence and could trigger further volatility and withdrawal from the economy.

Consistent with the literature in Chapter 1 and Chapter 3, the current account and fiscal market imbalances were not found to be useful in predicting severe recessions for South Africa under the observed time period. Shin (2013) found that early warning indicators based on total credit, financial market prices, and financial intermediary liabilities were relatively more likely to be useful early warning indicators. The real effective exchange rate and export performance are highly useful indicators for South Africa. As a small open economy, South Africa is likely to be affected by shocks to its large trading partners' economies. This is evident from the high usefulness of the global market imbalances indicators, with global house prices, stock prices and credit being useful in predicting severe recessions for South Africa. Asset market imbalances are also useful in predicting severe recessions.

4.4 Limitations and recommendations

A limitation of this study is that the vulnerability indicators were only tested for in-sample performance. The out-of-sample performance, therefore, needs to be tested. With the novelty of testing for severe recession episodes in South Africa for the period 1970–2015, only 3 severe recessions were identified. Further investigation can be done to test whether the use of GDP per capita rather than GDP might have played a role in affecting the determination of severe recessions. The 2008 global financial crisis was not detected as a severe recession in the 2008 period. The effects of this crisis could perhaps only become noticeable in later time periods. The analysis can therefore be repeated by including more recent data. To compare the performance of the vulnerability indicators, crisis episodes can be identified for South Africa from the literature and the performance of the indicators compared to the current study. Multivariate logistic regression analysis can be used as an alternative for the signalling approach. It could also be investigated whether a composite early warning indicator can be constructed from the useful indicators identified in this study.

Policy recommendations include that South Africa should reduce its fiscal and current account deficits. This should increase South Africa's resilience to external shocks. Private credit should be monitored together with real house and stock prices. Policymakers should have adequate time to affect policy changes in order to counteract or reduce the effects of a crisis. South Africa can increase its foreign reserves which may increase its resilience. The two main policy instruments available to counteract crises are the repo rate and fiscal policy. By monitoring the identified indicators and acting when a signal is issued, it should be possible to mitigate the effects of an external shock to South Africa's economy.