AN ANALYSIS OF THE LONG RUN COMOVEMENTS BETWEEN FINANCIAL SYSTEM DEVELOPMENT AND MINING PRODUCTION IN SOUTH AFRICA

STEPHEN MAYOWA AJAGBE

STUDENT NO: 607A3565

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SUPERVISOR: DR. ABEL EZEOHA

DECLARATION

Except for references specifically indicated in the text, and such help as has been acknowledged, this thesis is wholly my own work and has not been submitted to any other University, Technikon or College for degree purposes.

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STEPHEN MAYOWA AJAGBE

ABSTRACT

This study examines the nature of the relationship which exists between mining sector production and development of the financial systems in South Africa. This is particularly important in that the mining sector is considered to be one of the major contributors to the country's overall economic growth. South Africa is also considered to have a very well developed financial system, to the point where the dominance of one over the other is difficult to identify. Therefore offering insight into the nature of this relationship will assist policy makers in identifying the most effective policies in order to ensure that the developments within the financial systems impact appropriately on the mining sector, and ultimately on the economy. In addition to using the conventional proxies of financial system development, this study utilises the principal component analysis (PCA) to construct an index for the entire financial system. The multivariate cointegration approach as proposed by Johansen (1988) and Johansen and Juselius (1990) was then used to estimate the relationship between the development of the financial systems and the mining sector production for the period 1988-2008.

The study reveals mixed results for different measures of financial system development. Those involving the banking system show that a negative relationship exists between total mining production and total credit extended to the private sector, while liquid liabilities has a positive relationship. Similarly, with the stock market system, mixed results are also obtained which reveal a negative relationship between total mining production and stock market capitalisation, while a positive relationship is found with secondary market turnover. Of all the financial system variables, only that of stock market capitalisation was found to be significant. The result with the financial development index reveals that a significant negative relationship exists between financial system development and total mining sector production. Results on the other variables controlled in the estimation show that positive and significant relationships exist between total mining production and both nominal exchange rate and political stability respectively. Increased mining production therefore takes place in periods of appreciating exchange rates, and similarly in the post-apartheid era. On the other hand, negative relationships were found for both trade openness and inflation control variables. The impulse response and variance decomposition analyses showed that total mining production explains the largest amount of shocks within itself. Overall, the study reveals that the mining sector might not have benefited much from the development in the South African financial system.

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TABLE OF CONTENTS

LIST OF TABLES

TEXT TABLES

APPENDIX TABLES

LIST OF FIGURES

TEXT FIGURES

APPENDIX FIGURES

CHAPTER ONE

INTRODUCTION

1.1 CONTEXT OF THE RESEARCH

Economic development is one of the key foundations on which nations are built. In the modern world where competition is fierce among nations to be leaders of the world economy, achieving financial development at a steadily growing rate has become paramount. After highlighting the importance of such growth, the question of how to attain progressive economic development then arises. Inasmuch as factors such as government spending, investment, imports, and exports form a large part of economic performance, it is obvious that these cannot be achieved in the absence of an efficient financial system. This therefore underscores the importance of having a well functioning financial system. Financial systems have become more complex over the years, both in their structure and functionality thereby causing a debate as to which of the aspects of financial systems best facilitate economic development. As pointed out by Allen and Gale (2001), Levine (2002), Chakraborty and Ray (2006), and Luintel *et al.* (2008), a long-standing debate for more than a century continues on the respective contributions of both the stock market-based system and the bank-based system to economic growth, as well as on which of these two systems fosters a more suitable environment for economic growth.

The above-mentioned point has led to numerous studies surrounding the issue of financial system development and economic growth, however varying results make the superiority of one over the other more difficult to determine. The question regarding the dominance of one financial system over the other makes it interesting to test their individual impacts on economic growth. No doubt, not all sectors of an economic system have equal access to the financial systems. In the case of banks, for instance, it is generally believed that the willingness of banks to finance business activities is highly influenced by the economic sector in which the prospective borrower operates. Also, the level of contribution of a particular sector to a country's economy determines the level of attention it attracts from both lenders and investors. It is therefore possible that the impact of financial development equally varies across sectors, with some economic sectors possessing larger effects and being more attractive to lenders than others. Despite the importance of this latter issue, very little empirical evidence currently exists that explains the relationship between a country's financial system development and it's most critical

economic sector. This thesis, using the case of South Africa's mining sector, strives to close this research gap.

1.2 MOTIVATION FOR THE STUDY

The overall South African financial system is one which is composed of both strong banking and stock market systems, in the form of the four big banks, as well as the Johannesburg Stock Exchange. Considering that each one of these satisfies the ways in which a financial system channels its activities to growth, the importance they both have on the South African economy is paramount. The banks play a major role in pooling savings and conducting an effective payment system which eases the flow of funds around the economy, having regard to the fact "an efficient payment system helps to reduce transaction and information costs, and financial risks and increases reliability and speed of exchanges" (Aziakpono, 2008: 22). The foregoing assertion underscores the importance of having a well functioning banking system in South Africa, without which the economy would come to a standstill.

The stock exchange on the other hand constantly lists the performance levels of South African companies, offering timely information on each. The stock exchange makes it possible for companies to list and trade their shares in both the primary and secondary markets that exist. In doing this, it thereby provides the necessary tools and the opportunity for potential investors to invest in those companies that meet their investment preferences, and at the same time making it possible for companies with growth potential to develop (Goodspeed, 2007). This underscores the importance of the financial system being conducted in an efficient and well managed manner, as the failure to do this would create the "lemons market" effect where profitable companies are blurred, giving rise to the possibility of misplaced investments.

The question of which system fosters an environment for economic or sector growth then arises, as South Africa poses a unique economic environment and opportunity where both systems have strong foundations and make vital contributions to the overall economic growth of the country. The mining sector in South Africa has been a major contributor to the economy of the country for over a century. This sector has maintained significant ties with the financial system over this period, and according to Yartey (2008: 10), the development of the Johannesburg Stock Exchange (JSE) was as a direct result of the discovery of gold in the country in 1886, which lead to a boom in both mining and financial companies. These ties are still visible in the present times as the mining sector still accounts for over 40% of the market capitalisation in the JSE Securities

Exchange (Akinboade *et al.,* 2010: 137). The performance of both the stock markets and mining sector would obviously depend on the existence of a well functioning banking system which would form the link between the two by providing an efficient payment system through which investors and companies can trade. The mining sector has also been a major private sector supplier to the people of South Africa, and therefore it would also be interesting to test if there are links between the credit banks supply to the private sector and the development of the sector.

By testing the relationship that each of the financial systems has with the growth of this leading sector, some policy directions can be provided to assist in answering the question regarding the relative contribution of each of the financial systems. This study can also provide insight into the existence of a composite index that captures the movement of the entire financial system. Previous studies have mostly considered the financial systems individually, and therefore this index would provide a basis for testing the joint impact of financial system development on growth. Such a composite index can be derived using Principal Component Analysis (PCA). According to Nellis (1982: 345), the PCA is a method which, given a collection of correlation coefficients for a set of variables, allows the detection of a relationship, such that the data is reduced to a set of factors, less in number than the variables. Nellis, (1982: 346) goes on to add that it is interpreted as the single best summary of linear relationship exhibited in the data, therefore this would reflect the single best relationship between both the banking system variables and the market system variables.

1.3 OBJECTIVES OF THE STUDY

The broad objective of the study is to analyse the role of the entire financial system in fostering growth in the productivity of the mining sector in South Africa. More specifically, the research aims to achieve the following objectives:

- To determine the possible long run relationship that the South African banking system may have on the growth of the South African mining sector.
- To determine the possible long run relationship that the South African stock market system may have on the growth of the South African mining sector.
- To determine whether a relationship exists between the South African financial system as a whole and the growth of the mining sector.

1.4 METHODS OF THE RESEARCH

For the empirical analysis, the study makes use of data that reflect the changes within the mining sector, stock market, and banking system performances respectively. Monthly data was collected based on their availability from the Thompson data stream, IMF financial statistics, the World Bank and data from the South African Reserve Bank, spanning a period from 1988 to 2008. This period was selected because it offers the opportunity to observe the relationship through the stages of South Africa's political transition.

The study aims to utilise mining sector statistics of real economic activity of total mining production to reflect mining sector growth. With regard to stock market performance, a stock market capitalization ratio will be determined, as this is considered a measure for stock market size. In addition to this, stock market secondary market turnover ratios will also be determined. Lastly, for banking sector performance, credit to private sector and liquid liabilities (M2) will be considered, as they offer an indication of overall size of banking sector. In addition to the individual variables, the study will also make use of control variables such as trade openness, nominal exchange rate and inflation, as these capture the effects of imports, exports, exchange rate, and prices on the performance of the mining sector. A dummy variable is also used to attempt to capture the effects of the change in South Africa's political regime pre- and post - independence.

In investigating the relationship between each financial system and mining sector development, cointegration and vector error correction model (VECM) based on the maximum likelihood approach are used. This application of a cointegration model is aimed at testing for the long-term relationships between each type of financial system and the mining sector, and can therefore determine the relationships between each system and the growth of the mining sector on a long-term basis. The study also investigates the relationship between the entire financial system and the growth of the mining sector. The proxy for the entire financial system is derived through the use of a principal component analysis (PCA).

1.5 ORGANISATION OF STUDY

This study will be organised into six chapters. The next chapter reviews both the theoretical and empirical literature available on financial systems and their contributions to economic growth as contained in known existing studies around the world. This chapter will be divided into two main sections; the first will provide a conceptual and theoretical framework of the financial system, whilst the second will review the empirical literature that exists on the relationship between financial system development and economic growth. Chapter Three provides a brief overview of both the stock market and banking developments, as well as changes that have occurred in the mining sector of South Africa. Chapter Four presents the econometric methodology used in this study. This includes Principal Component Analysis (PCA), cointegration analysis and Vector Error Correction Method (VECM). The results of the study are presented in Chapter Five. Chapter Six concludes the study, and also offers policy recommendations, as well as limitations and suggestions on areas for further research.

CHAPTER TWO:

THEORETICAL ISSUES AND LITERATURE REVIEW

2.1 INTRODUCTION

This chapter examines the theoretical and empirical literature that exists on financial systems, and their possible relationships with economic growth in South Africa. The focus of this chapter will be firstly to highlight what constitutes a financial system, after which the concept of how financial system development eventually translates to economic growth is highlighted with the aid of a growth model. Key issues investigated are the different roles banks and stock markets play, and implications these have for economic performance. This chapter concludes by reviewing empirical literature which has tested the above mentioned relationship, as well as identifying the variables used in conducting those studies. The literature is further categorized based on cross sectional and time series data. To begin the chapter the financial system as a whole will firstly be defined, before narrowing down to the types of financial systems that form the core of this study.

2.2 THE FINANCIAL SYSTEM: A CONCEPTUAL OVERVIEW

The financial system consists of the specialized financial markets, financial intermediaries, and numerous other financial institutions that carry out financial decisions of households, businesses, and governments (Goodspeed, 2007: 4). A well functioning financial system plays a vital role in the growth of any economy, as through their efficient management, funds are allocated to maximise potential output. Allen and Gale (2001: 1) highlighted that there are two main approaches when considering the financial system: firstly that which considers how agents interact through financial markets; and secondly, how they interact through financial intermediaries such as banks and insurance companies. The financial system operates through the interactions of four elements, namely: lenders and borrowers, financial institutions, financial instruments, and financial markets.

2.2.1 Lenders and Borrowers

Of these two players, lenders are those who provide savings, or surplus units, whilst borrowers are those who utilize savings, also referred to as deficit units. The purpose of the financial system is predominantly to channel funds from these surplus units to the deficit units (Allen and Gale, 2001: 1). As pointed out by Goodspeed (2007: 5), lenders and borrowers can be categorized into four sectors, namely:

- Households – individuals, families, and sometimes non-corporate and non-profit businesses. The household sector is primarily a net saver, and therefore provides loanable funds to the other three sectors, though individual households can also act as net users.
- Corporate – non-financial companies: primarily net users.
- Government – central and provincial, as well as local authorities: primarily net users.
- Foreign – individuals and institutions in the rest of the world: primarily net users.

The transfer of funds from surplus units to deficit units takes place either through direct or indirect financing. Direct financing being where the needs of a lender in terms of risk, return and liquidity directly match those of the borrower in terms of costs and term to maturity. This method of financing often takes place via a financial market broker, as this eases communication between lenders and borrowers. Indirect financing on the other hand is one that takes place via financial intermediaries, which create two types of financial instruments: one for lenders and the other for borrowers (Goodspeed, 2007: 6).

2.2.2 Financial Intermediaries

Financial intermediaries are financial institutions which facilitate the flow of funds from lenders to borrowers, and they include:

- Banks – institutions which accept deposits from lenders and make them available to borrowers.
- Insurance companies – institutions which receive contractual savings from lenders and invest in shares and other securities, also perform the role of diversification of risk.

- Pension and provident funds – perform functions similar to those of insurance companies by re-investing funds from households into shares and securities.
- Unit trusts – a fund that invests in securities, and in return issues units which it may repurchase.
- Mutual funds – invests funds gathered from many small investors in shares, bonds, and other financial claims. In this fund, each investor will be entitled to a proportional claim on the assets of the fund.

2.2.3 Financial Instruments

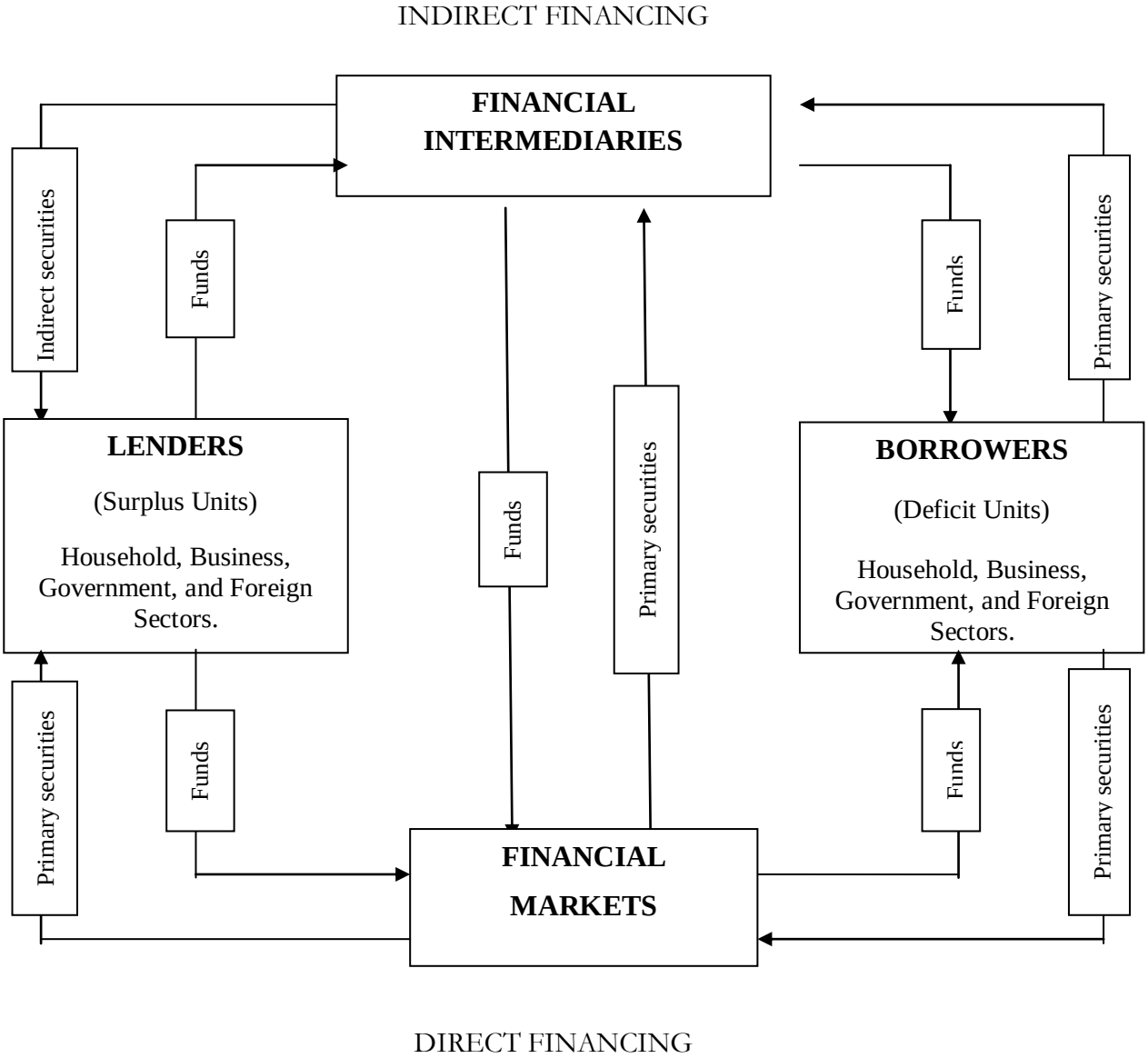
As defined by Goodspeed (2007: 6), financial instruments are "promises to pay money in the future in exchange for present funds i.e, money today." Financial claims can be categorised into indirect and primary securities, these can further be categorised as marketable or non-marketable instruments. Marketable instruments are usually issued by corporate and government sectors, and can only be traded in secondary markets. On the other hand, non-marketable instruments usually involve the household sector, directly relate only to the issuers of the instrument, and cannot be traded in the secondary market.

2.2.4 Financial Markets

Financial markets do not exist as physical locations, but are rather a link of networks that work together to match needs of buyers with sellers. Financial markets can be defined as "the institutional arrangements, mechanisms and conventions that exist for the issuing and trading of financial instruments" (Goodspeed, 2007: 7). Financial markets consist of cash and derivatives markets, spot and forward markets, primary and secondary markets, and financial exchanges and over-the-counter markets.

After briefly identifying the elements of financial systems, it is also of importance to observe how the flow of funds and instruments occurs between the elements, and this is done with the aid of the flow diagram below:

Figure 2.1 Flows of Funds and Financial Instruments



Source: Goodspeed (2007: 5)

2.3 THEORETICAL FRAMEWORKS FOR THE FINANACIAL SYSTEM AND GROWTH LINKAGE

The role of financial systems development in economic or sector growth has always been of major interest to policy makers. First and foremost it is important to clearly define the functions of a financial system, as these are the channels through which financial intermediation occurs, thereby initiating the growth process. The widely agreed ways that financial systems impact on growth are provision of payment systems, corporate governance, pooling of savings and mobilisation of savings, efficient resource allocation, and minimization of market risk. This section shows how the performance of these roles ultimately affects growth.

As pointed out by Montiel (2003) and Aziakpono (2008:16), the assumption is that economic growth can occur through total factor productivity and the accumulation of productive factors. According to Montiel (2003), there are three mechanisms through which financial intermediation can affect growth, and these are as follows:

- The more efficiently funds are allocated amongst competing investment projects, the more the productivity of the capital stock, and the more the total factor productivity.
- The lower the cost of intermediation, the higher the amount of investments that will take place given the amount of savings. This is based on the assumption that savers and investors together share the burden of intermediation costs.
- The higher the returns to investment, and the lower the cost of intermediation, the higher the net return to saving, and thus the higher the incentive to save.

The simple model shown below as presented by Montiel (2003), illustrates the interactions between these three mechanisms. Assume that two kinds of capital produce aggregate output, and these are shown as K_1 and K_2, under the conditions of constant returns to scale, thereby resulting in an aggregate production function as follows:

$$Y = F(K_1, K_2), \tag{2.1}$$

Total capital available in the economy is given by:

$$K_1 + K_2 = K, \tag{2.2}$$

And this changes over time according to the amount of investment undertaken in each period:

$$\Delta K = I. \tag{2.3}$$

The investment as represented above is a factor savings, therefore aggregate saving is closely linked to the level of output:

$$I = \sigma_s Y. \tag{2.4}$$

In this equation, the cost of financial intermediation is $(1 - \sigma)$, therefore it represents the resources absorbed into the process of providing intermediation services.

In linking the above relationships to growth, let $\Theta = K_1/K_2$. This will mean equation (2.1) is now written as:

$$Y = F(\Theta, 1) K2 = F(\Theta, 1) K / (1 + \Theta) + A(\Theta) K, \tag{2.5}$$

where $A(\Theta) = F(\Theta, 1) / (1 + \Theta)$. This means that the change in Y over time is:

$$\Delta Y = A(\Theta) \Delta K = A(\Theta) \sigma_s Y.$$

or:

$$\Delta Y / Y = A(\Theta) \sigma_s. \tag{2.6}$$

The financial sector can increase its capital stock (A) by allocating funds to their most productive uses, therefore the value of Θ that maximizes A is shown as:

$$f'(\Theta) / (1 + \Theta) - f(\Theta) / (1 + \Theta^2) = 0,$$

or:

$$f'(\Theta) = f(\Theta) - f'(\Theta) \Theta,$$

and this is the result if financial institutions identify the marginal product of capital in alternative uses, and direct funds to the projects that promise the most potential. If the financial system operates efficiently, it is also in a position to increase σ, and finally the combination of high returns on investment and low costs of intermediation will result in higher returns for savers and in turn increase savings.

The simple model presented above is an illustration of how an efficiently managed financial system can eventually promote growth. The next section considers the specific ways in which the different aspects of the financial systems contribute to growth.

2.4 A BRIEF LOOK AT VIEWS ON FINANCIAL SYSTEM DEVELOPMENT

In considering the relationship between financial systems and growth, it is vital to understand the theories that surround the management of financial systems. In doing this, it is important to firstly, identify the different aspects that exist and analyse their core roles, before narrowing down to the debate of which system better facilitates the goal of achieving growth. Financial structures are built around four competing theories, namely; the bank-based, the stock market-based, the financial services, and the law and finance systems. These are discussed briefly below.

2.4.1 Bank-based Financial System

The foundations of the bank-based financial system are laid on the key roles of banks in an economy, and as pointed out by Luintel *et al.* (2008: 3), it aims to stress and address the shortcomings of the stock market-based system. In addition to this, the authors mentioned that banks appear to be in a better position to finance efficient developments than markets, as banks are able to avoid market failures as a result of the fact that they are better equipped to strategically allocate resources. Aziakpono (2008: 22) pointed out the importance of an efficient payment system within an economy as this assists in reducing financial risks, as well as increasing reliability and speed of exchanges. The above mentioned contribution is a function carried out primarily by banks, and Aziakpono (2008: 22-23) explains how this function offers individuals an efficient alternative to the more time consuming barter system of exchange. In addition to this, an efficient payment system offers the opportunity for specialization, and therefore makes possible productivity improvement and in turn growth. Further addressing issues which are poorly dealt with by stock markets, banks are in a position to gather information more efficiently, as opposed to markets which reveal information publicly and reduce the incentives for investors to seek information. A direct result of this is that it gives rise to information asymmetry problems (Luintel *et al.,* 2008: 4). This means that banks can reduce the information asymmetry problems that arise because of the long-term relationships that are formed with clients, and in so doing also address moral hazard problems.

2.4.2 Stock Market-based Financial System

Stock market-based systems similarly aim to highlight and address weaknesses of banks. Levine (2002: 398-400) noted that efficiently managed stock market systems offer profit incentives for investors, enhance corporate governance, and efficiently provide the opportunity for risk management and diversification. With regard to offering profit incentives for investors, the stock market-based system provides readily accessible information about the listed companies to investors, from which they are able to determine profit maximising projects in which to invest. As far as the opportunity for risk management and diversification is concerned, investors are able to diversify their portfolios, and in so doing are able to minimise the risks that they face. Boyd and Smith (1998) highlighted that countries tend to become more stock market-based as they move through the stages of development. More attention will be paid to roles that the stock markets play later in the chapter when focus is placed on both stock markets and banks.

2.4.3 Financial Services

The financial services theory follows in line with bank-based and stock market-based systems, and it simply advocates the financial services that are provided by financial systems. "Financial services are crucial to new firm creation, industrial expansion and economic growth" (Luintel *et al.,* 2008: 4), and as a result incorporates both bank-based and stock market-based systems. This therefore means that it pays very little attention to the differences between the two, and rather focuses on the financial services that are provided. Luintel *et al.* (2008: 4) added that rather than the source of finance, more emphasis is placed on the creation of an environment where financial services are efficiently provided. The financial services theory therefore focuses on the improvement of whatever financial systems are in place, be it bank or stock market-based. Also, Levine (2002: 401) noted that in this view of management, the argument of which financial system better facilitates growth is overshadowed by the need for efficient provision of the essential financial services.

2.4.4 Law and Finance

This view of financial system emphasizes the role of the legal system in an economy, as it is governed by laws that create an environment which nurtures economic growth, as well as monitor the financial system as a whole. Allen and Gale (2001: 2) further highlighted the importance of the legal system by pointing out that it determines which contracts are feasible, the kinds of governance mechanisms to be used for corporations, and what restrictions can be placed on securities. This approach therefore suggests that rather than the type of system that is put in place, the primary focus should be on the development of that system as a result of efficient governance.

In as much as the literature suggests four views to financial systems, it is apparent that both the bank and the stock market-based systems contribute in whichever system is adopted. The other two which are not explicitly based on these two systems, namely the financial services and the law and finance approaches still do revolve around banks and markets, thereby highlighting that the success of an economy is still primarily based on them. As a result of this observation, the need to understand how each of them addresses the roles of a financial system remains paramount. In addition to this, knowledge of which performs these better also remains of major importance. The next sub-section offers a look into how these two systems perform the fundamental functions of a financial system, and ways in which they differ.

2.5 MARKET-BASED, BANK-BASED DEBATE

The long standing debate that exists about the growth nurturing capabilities of bank-based and market-based systems can be further understood by examining the ways in which both bank and stock market-based systems perform the function of a financial system. This section aims to explain in detail how each system performs the functions pointed out earlier in this chapter.

2.5.1 Stock-market based Financial System

Firstly, we address the issue of corporate governance. This role is performed effectively by stock markets because it maintains the possibility of hostile takeovers of those companies which do not maintain a satisfactory performance (Charkraborty and Ray, 2006: 2). With the constant availability of up-to-date information, "bullish" firms with the intention to expand are able to identify the weaker firms which can be taken over. This contributes to economic growth in two

ways: firstly it creates a competitive environment amongst firms, and therefore induces high performance levels from firms in an attempt to avoid being taken over; and secondly, it ensures that only the strongest firms remain in the economy, as the weaker firms are quickly taken over by the stronger ones, therefore stimulating growth of the economy.

Pooling of savings is the process of creating a pool of funds from which mobilization and resource allocation takes place, a function that forms a vital part of financial intermediation. This in market terms is referred to as liquidity, and this aids in the attraction of investors, who through their involvement further improve the liquidity within a financial system. The efficient allocation of these pooled savings forms the major foundation on which economics is built, and as such is a vital role. This is quite simply the directing of resources to those areas which will put them to the best use. Failure to do so would result in an economic outcome that falls short of the economy's potential. Stock market systems provide potential investors with vital information needed for investment purposes. From this information investors are then able to decide which firms they feel possess growth potential or best promote the goals that they aim to attain.

The efficient allocation of resources goes hand in hand with the mobilization of these resources i.e. savings. This idea stems from the fact that the primary source of investment funds is savings from savers, and this is then converted to possible investment funds for those who wish to invest. Aziakpono (2008: 23) noted that this role allows for the savings of individuals to be invested in economically viable projects, and as a result assist in increasing the expected returns on savings, and also diversify the risks associated with individual projects. These savings are expressed as s in equation (2.6), and it is closely linked to the level of investment I, as it is expected that the pooled savings would dictate the amount of investments that would be made in the economy, and the output in the economy hence $I = \sigma s Y$ in equation 2.4.

After ensuring that sufficient savings are pooled and efficient investments made, it is therefore important to ensure that these investments carry as little a risk as possible, thereby introducing the role of risk management. This role relates directly to diversification, in the sense that the more diversification occurs, the less the risk that will be faced by an investor, and vice versa. As highlighted by Naceur and Ghazouani (2007: 299) financial systems which provide the opportunity for portfolio diversification provide the potential for high returns as investors invest in projects with potentially high returns, which in turn contribute to growth.

The provision of information by stock market systems again forms the foundation for performing this role, as this information provides investors with the opportunity to invest in a

number of companies which they feel are performing on a satisfactory level, or promote the goals that the investor would like to see achieved. Investors are able to manage risk by diversifying their portfolios, meaning that they invest their funds in a number of companies, thereby allowing that changing market conditions do not risk all funds, as would be the case when investments are placed in much fewer companies, or even more so if in one company.

The roles highlighted above of the stock market system shows how growth is nurtured under this financial system. However, considering the focus of this paper which is to also investigate the manner by which a banking system also carries out these roles; the following sub-section will be investigating the banking system.

2.5.2 The Bank-based Financial System

Both the banking system and stock market system share a common ground in the sense that they perform the corporate governance role by collecting and processing information which assist in the process of allocation. Bencivenga and Smith (1993) pointed out that monitoring costs are reduced as a result of banks offering this service, which in turn leads to reduced credit rationing. Moral hazard occurs in the absence of corporate governance, and bank monitoring is able to resolve this at the level of the firms to which they lend. The cost of intermediation by banks is also represented by $(1 - \sigma)$ in the growth model.

The role of pooling savings is carried out efficiently by the banking system, as this forms part of the basic functions of banks. Individuals deposit their surplus funds as savings in banks, and these funds create a pool of funds from which resource allocation and mobilization of savings can occur. These savings are again represented as s in the growth model and are proportional to investment and eventual growth. As far as efficient resource allocation is concerned, the banking system is able to achieve this by developing long-term relationships with clients, and in so doing, is able to identify those clients that possess the potential for growth. In addition to this, the banks are able to encourage innovations by those clients to which resources are directed, and in turn create the opportunity for growth as was mentioned earlier. In addition to this, Aziakpono (2008: 23) mentioned that financial intermediaries are able to increase the quality of their allocations by ensuring that funds are directed towards those projects which offer the highest marginal product of capital. Charkraborty and Ray (2006: 3) added that banks adopt a more "hands-on" approach in satisfying this role, as they also possess a monitoring capacity on their clients, and as a result are in a position to make more informed decisions in allocating resources.

They went on to add that in contrast to the stock market systems "arm's length" approach, the banks are therefore efficient in resource allocation.

Efficient risk management, again as in the case of a stock market system is vital. Bank systems are able to perform this role by directing funds to portfolios which they have seen to be profitable (Howells and Bain, 2005). In so doing, banks are able to perform their intermediary role of being the link between public funds and worthwhile investments which are potentials for the end goal of economic growth.

From the roles of financial systems as highlighted above, it can be said that both systems are well equipped to facilitate growth, hence this has led to the debate of which of these two systems perform the roles better, roles which can lead to the growth of the entire economy, or individual sectors. This debate has therefore formed the key focus of this study.

After a broad overview of financial systems, understanding the theories surrounding them, and the roles they play in the economy, the question of which of the two main financial systems performs better towards the goal of growth in the economy can now be addressed. To provide a view on this, the next section will then review a selection of empirical literature with regard to this query, and in so doing, begin to offer a picture on which of the financial systems seems to dominate over the other, or whether the possibility for co-existence exists.

2.6 EMPIRICAL EVIDENCE ON THE RELATIONSHIP BETWEEN FINANCIAL SYSTEMS AND ECONOMIC PERFORMANCE.

As pointed out by Allen and Gale (2001), Levine (2002), Chakraborty and Ray (2006), and Luintel *et al.* (2008), a long-standing debate for more than a century exists on the respective contributions of both the stock market-based system and the bank-based system to economic growth. According to Naceur and Ghazouani (2007: 299), empirical study of the relationship between financial sector development and economic growth began with a paper by Goldsmith (1969). The aim of the paper was to determine the effects of finance on economic growth, and whether a mixture of banks and stock markets in the same economy impact on economic growth, however the study by Patrick (1966) investigated the relationship between financial development and economic growth in underdeveloped countries. This study discovered that a relationship exists between the number and variety of financial institutions as well as their proportions of both money and total financial assets, and the process of economic growth over

time. The study further sought to determine the causal direction between these at both a theoretical and empirical level.

From that time on a number of studies have been devoted to studying the issue of financial development and economic growth, and a number of approaches have been used which all achieve the common goal of identifying the nature of the relationship. Several studies have been conducted to determine the relationship between only one of the two financial systems and economic growth. However, this empirical survey will also consider those which have investigated the dichotomy between the bank and stock market based systems, rather than on only those which have investigated only one of the two financial systems. In addition to this, studies which have also attempted to provide an indicator of the performance of the entire financial system will also be considered. The decision to only review studies which fall under these categories is as a result of that being the direction of the current study, which are more specifically to provide an insight into the impact of financial system development in the unique case of South Africa which possesses both types of financial systems, and also to provide insight into the effect of the entire financial system using a composite index. The following sub-sections cover a broad range of studies that have fallen under the chosen categories, and which also highlight the contributions that have been made at country, cross country or at regional levels. In the cause of reviewing the literature, it was observed that the literature can be grouped broadly under two groups, namely; Cross-Sectional Panel data and Time Series approaches.

It was further observed that the studies which used cross-sectional panel data made use of the Vector Autoregressive (VAR), Generalised Method of Moments (GMM), and Vector Error Correction (VECM) methods to determine the existence of cointegration between the variables. No clear pattern was observed from these cross sectional studies, neither was there a pattern observed under the test methods used. This will be observed in further detail in the sub-section on cross-sectional panel studies. Similarly with the studies under time series data, the VAR, GMM, VECM, and Principal Component Analysis (PCA) methods were those that appeared. From these studies it became clearer that both the VAR and VECM methods are the most utilised. Though the results were mixed under the time series approach, a pattern was observed which indicated that the relationship between financial system developments and growth does exist, with the direction of causality being predominantly from economic growth to financial system development, as will be seen in the time series sub-section.

With regard to the variables used, both the cross-sectional panel data studies and the time series data studies have a variety of variables used, however the common pattern that emerged in this

regard was that the variable representing economic growth was per capita GDP. As far as the variables representing banking and stock market sectors are concerned, a wider variety of variables were utilised. However, for stock market development, the most common variable that was utilised was market capitalisation, while for bank sector variables; bank credit to the private sector was the most common variable. The other variables used for these sectors will be discussed further in the subsections to follow.

2.6.1 Cross-Sectional Panel data Studies

A number of researchers have conducted cross-sectional panel data studies, and will be reviewed in this sub-section. We begin this category was conducted by Atje and Jovanovic (1993). The research set out to investigate the impacts of financial system development on the level or growth rate of economic activity in 40 countries over the period between 1980 and 1988. The study made use of the ratio of credit extended by private and government banks to GDP as a measure of banking system development, and the ratio of annual value of all stock market trades to GDP as a measure of stock market development. The study found that there is a larger effect on economic growth from stock market development than there is from the banking system development.

Similarly, Levine and Zervos (1998) investigated the relationships that exist between economic growth and both the stock market and the banking financial systems for 42 countries between 1976 and 1993. The study made use of stock market liquidity, size, volatility, and integration with world capital markets as stock market indicators. On the other hand, the value of loans made by commercial banks and other deposit-taking banks to the private sector as a ratio of GDP (Bank Credit) was used as an indicator of banking system development. With regard to an indicator for economic growth, the study made use of real per capita GDP growth, real per capita physical capital stock growth, productivity growth, and the ratio of private savings to GDP. Using cross-sectional regressions, the study confirmed views that financial markets provide important services that influence growth, and that the services provided by stock markets differ from those provided by banks. In addition to this, the study also found that stock market size, volatility, and international integration are not robustly related to economic growth.

In a similar study evidence is provided to the contrary of that which suggests that financial system development promotes economic growth. Ram (1999) conducted an extensive research which investigated the relationship between financial system development and economic growth

for the country specific analysis and cross-country levels. The variables used to measure financial system development and economic growth were the ratio of liquid liabilities to GDP, and real GDP per capita respectively. For the individual country analysis, data was collected from 95 countries for the period between 1960 and 1989, whilst for the cross-country analysis; data from 83 countries were used over the same sample period. The results showed that for the individual countries, the predominant correlation between financial system development and economic growth is negligible or weakly negative, and is in sharp contrast to that of the cross-country correlations between the same variables. The results also showed that individual country estimates of a basic multiple-regression growth model also do not exhibit positive correlation between financial system development and economic growth. In addition to this, for the cross-country analysis, when the regression structure is allowed to vary across three subgroups (Low-growth, Mid-growth, and High-growth), a huge parametric heterogeneity is focused at, and there is a negative to negligible relationship between financial system development and economic growth.

Yet another study which provided evidence contrary to that which suggests that financial system development leads to growth is that by Dawson (2003). The paper observed 13 Central and East European Countries (CEECs) between 1994 and 1999, using liquid liabilities as an indicator for financial system development, and GDP as an indicator for economic growth. The results revealed that financial system development has an insignificant effect on economic growth.

Finally we review a study by Naceur and Ghazouani (2007) on 11 Middle East and North African (MENA) countries, with data spanning from 1979 to 2003 to determine the relationship between stock markets, banks, and economic growth. The study made use of estimations of a dynamic panel model with GMM estimators. The indicators used included growth of per capita GDP as a measure of economic growth; stock market capitalisation to GDP ratio, value traded variable, and turnover ratio to measure stock market development; and credit to private sector divided by GDP, and liquid liabilities of the financial system divided by GDP to measure banking system development. The results revealed that there was no significant relationship between banking and stock market development and growth. The study also found that the relationship between banking system development and economic growth was negative after controlling for stock market development, and therefore the underdeveloped nature of the financial systems in the MENA region was probably a major factor for this result.

2.6.2 Time Series Country Specific Studies

On the other hand, numerous studies have also been conducted using time series data. This section begins by reviewing the study by Arestis *et al.* (2001) which focused on five developed countries between 1968 and 1998. The paper made use of the ratio of stock market value to GDP as an indicator of stock market system development, the ratio of domestic bank credit to nominal GDP as an indicator of banking system development, and real GDP as an indicator of economic growth. The results revealed that although banks and stock markets together might be able to foster economic growth, the contribution of the banking system outweighed that of the stock market system.

In a similar study Ghirmay (2004) focused on 13 sub-Saharan African countries over a 30 year period. The study was conducted using a vector autoregressive framework based on cointegration and error-correction models among cointegrated variables. Using increases in GDP as a measure of economic growth, and credit level to private sector as a measure for financial development, the results revealed that the cointegration analysis provided evidence of the existence of a long-run relationship between financial system development and economic growth in almost all (12 out of 13) of the countries. With respect to the direction of long-run causality, the results showed that causality ran from financial system development to economic growth, in eight of the countries. At the same time, evidence of bidirectional causal relationships was found in six countries. The findings implied that African countries could accelerate their economic growth by improving their financial systems.

We then reviewed a study by Thangavelu and Ann Beng Jiunn (2004) which considered the case of Australia, covering a period between 1960 and 1999. The study made use of real GDP per capita as a measurement of economic growth, while on the other hand it used bank claims on private sectors to nominal GDP, domestic bank deposit liabilities to nominal GDP, and equities turnover to nominal GDP to create a measure for financial system development. Through the use of a vector autoregressive model, the findings showed that there was evidence of causality from economic growth to the development of the financial intermediaries. On the other hand, development in the financial markets caused economic growth but there was no evidence of any causality from economic growth to equity markets.

Hondroyiannis *et al.* (2005) focused on the case of Greece, using data that covered the 1986 to 1999 period, they find amongst others that for that country, both the banking system and the stock market systems had the potential to contribute to economic growth. The study used value

of commercial bank credit to the private sector as a percentage of GDP to measure the ability of the banking system to induce economic growth, and total market capitalization as a percentage of GDP to measure stock market size. Using vector autoregressive models, the study showed that in the long run there was bi-directional causality between financial system development and growth, but the flow of causality from financial systems to economic growth was minimal, and in addition, the effect of the banking system was larger than that of the stock markets.

Shan (2005) carried out research to investigate whether financial system development led to economic growth. The research used data from 10 countries within the Organization for Economic Co-operation and Development (OECD) and China between 1985 and 1998. Based on vector autoregressive approach, the study utilized variance composition and impulse response function analysis to analyse the relationships between variables. Economic growth was measured as the rate of change in real GDP, investment as the rate of change in total capital expenditure, productivity as the rate of change in total productivity, and financial development as total credit. The results of variance composition showed that at best, weak support was found for the hypothesis that financial system development leads economic growth and even in cases where some evidence was found, rather than being a major factor, financial system development was simply a contributing factor.

In a related study, Liu and Hsu (2006) reviewed the role of financial system development in economic growth. The research focused on the economies of Taiwan, Korea, and Japan from 1981 to 2001 using the generalized method of moments and Principal Component analysis. For banking system variables, the study used the ratio of money stock to GDP, private credit, and commercial-central bank (a ratio which showed the degree to which commercial and central banks allocated deposits from the public), while for market system variables it used market capitalization, turnover, and stock return. The results showed that high investment had accelerated economic growth in Japan, while high investment to GDP ratio did not necessarily lead to better growth performance if investment had not been allocated efficiently, e.g. in the Taiwan and Korea cases. The study also found that finance-aggregate index had positive effects on Taiwan's economy, but had negative effects on other countries, and stock market development had positive effects on Taiwan's economic growth.

Liang and Teng (2006) investigated the case of China between 1952 and 1998 to determine the relationship between financial system development and economic growth. The study made use of a multivariate vector autoregressive framework, in which growth was measured by the real GDP per capita, and financial system development were measured by bank credit ratio and the

deposit liabilities ratio. The results found that there was a unidirectional causality from economic growth to financial system development, and these conclusions departed distinctively from those in the previous studies.

This section is concluded by the study of Baliamoune-Lutz (2008). The paper considered the case of Algeria, Egypt and Morocco, making use of four indicators to measure financial system development. These are: the ratio of deposit money bank claims on domestic non-financial real sector to the sum of deposit money bank and Central Bank claims on domestic non-financial real sector; the ratio of deposit money bank assets to GDP; ratio of liquid liabilities to GDP; and the ratio of private credit by deposit money banks and other financial institutions to GDP. The study used the purchasing-power-parity value of real GDP per capita as a measure of economic growth. Analysis of this data was conducted using cointegration and VECM, and the findings revealed that there was a long-run relationship between income and each financial development indicator, except credit to the private sector in Algeria, whilst on the other hand, evidence on direction of causality is mixed based on the Granger causality tests.

2.6.3 Studies Involving Sector Development

As mentioned earlier, the majority of studies involving financial system development involve the link to economic growth; however a few studies have investigated the relationships that exist between financial systems and other factors that influence economic growth. The first study reviewed in this section is a study by Beck and Levine (2002) which investigated whether having a bank or a market-based system mattered in industry growth and capital allocation. The study covered 42 countries and 36 industries, and they utilized data from 1976 to 1998, and used panel data sets to examine the relationship between financial structure and both industry growth and creation of new establishments. The indicators used were those of financial structure, financial development, the legal system, and industrial growth. The results show that the level of efficiency of the legal system and overall financial development boosts industrial growth, though the type of financial system in place (either the bank-based or market-based) did very little to change this impact.

The first study in this section is a study by Diekmann and Westermann (2010). The study tested the hypothesis that financial sector development is an essential factor behind economic growth in the German context; however the distinguishing factor with this study was that it considered several key sectors of the German economy. The study made use of data from the mining,

industrial, agricultural, traffic and home services sectors from 1870 to 1912. The study found that all the sectors were significantly affected by shocks from the banking system, with the strongest link evident in non-tradable goods producing sectors such as home services, agriculture and traffic.

2.6.4 Brief look at the South African Case

With specific reference to South Africa, not many studies have been conducted with regard to the links between financial system development and growth. However what is common is a situation where South Africa is involved in cross country studies. Though more recent studies which investigate the country specific case of South Africa have begun to emerge, the impact that financial system development has on individual sectors is yet to be extensively examined empirically.

Allen and Ndikumana (2000) conducted a study spanning from 1970 to 1996, focusing on the Southern Africa Development Community (SADC). The study made use of credit to the private sector, volume of credit provided to banks and liquid liabilities, as well as a combination of all three to serve as banking system development indicators, and on the other hand market capitalisation and value of traded shares were used as indicators of stock market development. With regard to an indicator for economic growth, real per capita GDP was utilised. The findings of the study revealed that there exists a significant positive relationship between financial development and per capita GDP growth in the region.

This study formed the major empirical literature available on South Africa until the study by Aziakpono (2008), which although did not explicitly investigate the relationship between the specific links between the South African financial systems and the country's economic growth, paid some attention to financial development and economic performance of the Southern Africa Customs Union (SACU). The study investigated whether domestic financial institutions become relevant in promoting economic growth through the integration of countries in unions such as the Southern African Customs Union and the Common Monetary Area. The study found that financial intermediation was still important in such countries, though lesser developed countries would still have to strengthen their financial systems in order to make optimal gains from such integrations.

As mentioned earlier, more recent studies are beginning to consider the country specific case of South Africa. One such study is that of Gondo (2009) which tested the effects of South Africa's financial system development on its economic growth based on a time series empirical growth model. The study compensated for simultaneity bias in the financial system regressors by using indices for political and economic polarisation, together with income tax as identifying instruments. The study made use of data from 1970 to 1999, and found that credit extension to the private sector, and stock market liquidity together have a progressive impact on economic growth, though in the short-run liquid liabilities impact negatively on economic growth. The study also found that institutions and the type of regulatory environment contribute to both financial system development and economic growth.

Another such study is that of Odhiambo (2010) who studied the dynamic causal relationship between stock market development and economic growth in South Africa. This used three proxies as measures for stock market development, namely stock market capitalisation, stock market traded value and stock market turnover, while GDP per capita was used to measure economic growth. The empirical analysis was done using the Autoregressive Distributed Lag (ARDL-Bounds) testing procedure on data sets spanning 1971 to 2007. The study found that when stock market capitalisation is used as a proxy for stock market development, Granger-causality is found to run from economic growth to stock market development. However, when the stock market traded value or stock market turnover are used, stock market development seems to Granger-cause economic growth. The overall conclusion of the study was that the causal flow is dominant from stock market development to economic growth irrespective of short-run or long-run estimations.

The current study in many ways resembles the above mentioned studies, however they differ in the sense that the core objective of this study is to investigate the contributions of the South African financial system development over a period where the country underwent changes in both its political and economic environment, to the development of a vital sector in the country's economy. The political changes pertained to those which took place in the country's democratic system, whilst those in the economic environment pertained to financial liberalisation, and recessionary pressure due to increasing unemployment, inflation, and lack of foreign investment.

2.7 CONCLUSION

This chapter explored the different types of financial systems that exist, different approaches as to financial system management, the ways in which each of them perform their roles and empirical literature grouped under broadly tested categories. After reviewing the literature, it is clear that there is no clear evidence of the domination of one type of financial system over the other, but how does this narrow down to the South African case?

The studies by Allen and Ndikumana (2000), and Aziakpono (2008) investigated the impact of financial system development on economic growth on regional levels and found that financial intermediation was still relevant for economic growth, mainly amongst the more developed countries in the Union, South Africa being one of them. These studies however did not explicitly investigate the effects of each of the financial systems in the country specific case of South Africa. Gondo (2009) addressed this issue. He found that there was a general positive relationship between the development of the financial systems and economic growth in South Africa. Odhiambo (2010) also found there to be a causal relationship which flows from stock market development to economic growth.

Based on the empirical evidence at the regional and in a country specific case, we can infer that there is a positive relationship between the development of the financial systems and economic growth. Therefore the next step is to investigate how the developments of the financial systems interact with the development of individual sectors within the economy. The mining sector is one such sector, and considering its contributions to the South African economy, it would be interesting to test how this sector is influenced by financial system developments. The next section offers an insight into the developments which have taken place within the financial systems and the mining sector, and begins to map out the possible relationships which we expect to find between them.

CHAPTER THREE:

OVERVIEW OF THE SOUTH AFRICAN FINANCIAL SYSTEM AND THE MINING SECTOR

3.1 INTRODUCTION

The objective of this chapter is to offer a brief insight into the two South African financial systems. This chapter reviews the performances of both financial systems over the test period, and provides an indication of the expected functions, compositions, frameworks, instruments, challenges, and performance of both financial systems. In addition to this, the chapter also seeks to observe the growth and contributions of the mining sector. This chapter is divided into three sections. The second section investigates historical developments and transformations that have taken place over time in both financial systems, as well as those in the mining sector, while observing the possible trends and correlations that may exist between them. Finally, the third section will conclude this chapter and summarise the key findings from the chapter, and possible conclusions that can be drawn from the study.

3.2 DEVELOPMENTS IN THE FINANCIAL SYSTEMS AND THE MINING SECTOR IN SOUTH AFRICA

The South African financial system, considered one of the leading economies in Africa, and boasts the existence of both a well developed stock market system, as well as banking system. This therefore differs from the common economic situation where an economy is primarily driven by one financial system or the other. The South African mining sector is perceived as the largest in Africa and one of the largest in the world. This sector is also considered one of the major contributors to the overall economy of the country. Both the above mentioned financial systems and the mining sector have been in existence for over a century, and as a result both financial systems have all undergone transformations which have aided each in the specialisation of its craft, while the mining sector has also maintained a strong contribution to the country's economy, and at the same time become a pioneer with regards to development and innovation.

Table 3.1: Mining Sector growth and Macroeconomic Variables

Date	Mining Sector Growth	GDP	Nominal Exchange Rate
1988	0.0293	0.2002	-0.1382
1989	-0.0074	0.2007	-0.0881
1990	-0.0085	0.1515	-0.0326
1991	-0.0096	0.1455	-0.0304
1992	0.0043	0.1212	-0.0267
1993	0.0291	0.1448	-0.0362
1994	-0.0146	0.1314	-0.0510
1995	-0.0074	0.1369	-0.0745
1996	-0.0171	0.1274	-0.1210
1997	0.0207	0.1097	-0.0063
1998	-0.0117	0.0827	-0.1221
1999	-0.0194	0.0960	-0.0909
2000	-0.0143	0.1333	-0.0572
2001	0.0134	0.1061	-0.1459
2002	0.0088	0.1481	-0.2018
2003	0.0404	0.0866	0.2531
2004	0.0367	0.1122	0.1009
2005	0.0121	0.1101	-0.0026
2006	-0.0130	0.1250	-0.0562
2007	-0.0091	0.1413	-0.0941
2008	-0.0562	0.1322	-0.1629

Source: SARB (2010)

Table 3.2: Measures of Financial System Development

Date	Market Capitalisation	Secondary Market Turnover	Total credit to private sector	M2
1988		-0.5188	0.0640	0.1268
1989	-0.0459	0.5347	0.0010	0.0552
1990	0.1747	0.0021	0.0046	-0.0205
1991	0.1342	-0.1884	-0.0008	0.0103
1992	-0.4297	-0.1279	-0.0303	-0.0114
1993	0.6552	0.3713	-0.0418	-0.0923
1994	0.2620	0.6175	0.0343	0.0659
1995	0.1153	-0.1092	0.0359	0.0015
1996	-0.0947	0.6422	0.0284	0.0660
1997	-0.0721	0.5914	0.0304	0.0702
1998	-0.1871	0.4263	0.0777	0.0372

1999	0.5546	0.2813	-0.0082	0.0355
2000	-0.2174	0.0564	-0.0223	-0.0625
2001	-0.2353	0.0207	0.0327	0.0358
2002	0.4117	0.1644	-0.0890	0.0148
2003	-0.0352	-0.1376	0.1048	0.0748
2004	0.3126	0.2385	0.0282	0.0085
2005	0.1042	0.1013	0.0613	0.0452
2006	0.1914	0.4748	0.1186	0.0673
2007	0.0589	0.2308	0.0649	0.0576
2008	-0.3951	-0.0329	0.0033	-0.0122

Source: World Bank and SARB (2010)

In the following section brief insights will be taken into each financial system as well as the mining sector, highlighting these transformations as they have occurred in each, and observing the possible links that exist between them.

3.2.1 Development in the South African Stock Exchange

The South African stock exchange, also referred to as the Johannesburg Stock Exchange (JSE), is currently the largest in Africa, and it also ranks among the top ten in the world.

The JSE came about as a result of a boom in the mining and financial sectors in 1886 following the discovery of gold on the Witwatersrand. Following this, the need for a stock exchange became apparent "to enable the new mines and financers to raise funds for the development of a fledgling mining industry" (Yartey, 2008: 10), and the Johannesburg Exchange was established in November 1887. Over the course of the century that followed, the JSE shifted its location periodically to accommodate its constantly increasing levels of trading. In 1947 the first legislation to govern the operations of the JSE was introduced in the form of the Stock Exchanges Control Act, and thereby enabling South Africa to feature on a more international scene. This was further aided by the country's membership of the World Federation of Exchanges in 1963. With the end of the apartheid era came an increase in confidence of foreign investors, these were supported by amendments to the legislation which changed the way in which stocks were traded and thereby allowing more foreign membership (Yartey, 2008. 10).

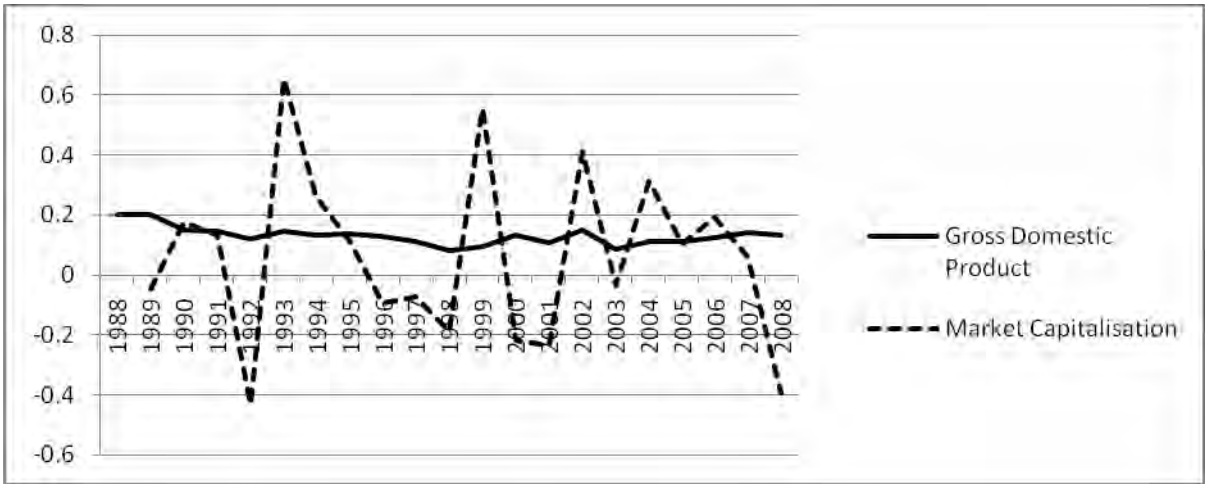
In November 1995, structural changes were made within the JSE in an attempt to loosen the highly regulated environment based on the single capacity rule which the JSE had enforced on

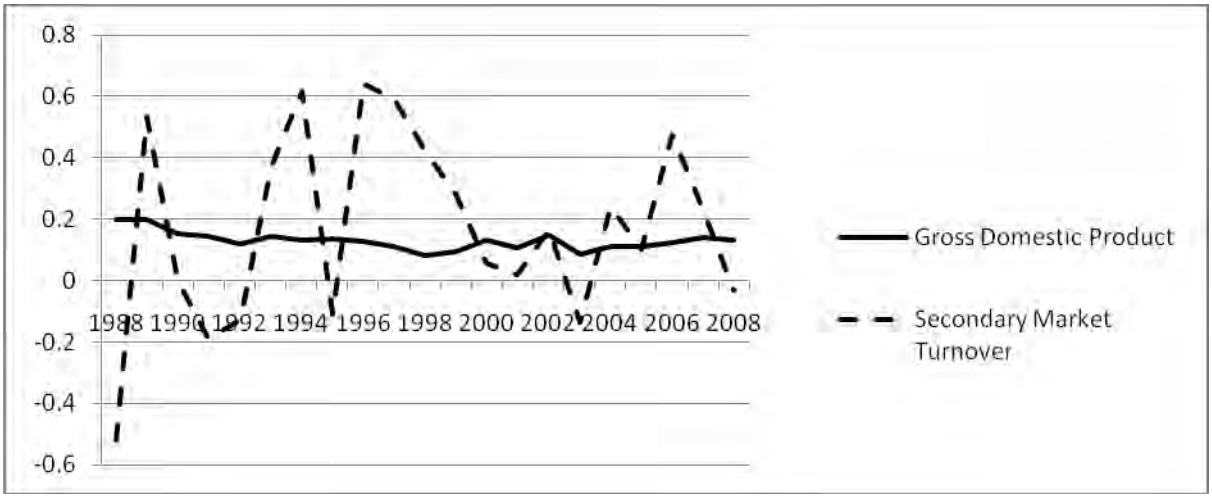
the stock industry in South Africa. This rule had limited member firms to either be brokers or principals in securities trading. Membership in the securities exchange was also limited to South African citizens with unlimited liability, therefore excluding banks, which are limited liability companies (Odhiambo 2010: 1).

Together with the need to compete on the same level as international markets, came the introduction of the automated trading system, the Johannesburg Equities Trading (JET) system in 1996. In this same year, over four million futures contracts were traded, which were valued at US $62 billion. The Bond Exchange of South Africa (BESA) was also licensed to trade under the Financial Markets Control Act, 1989 (Act No. 55 of 1989) in 1996. This granted the listing, trading and settlement of interest-bearing loan stock or debt securities. Within this same period, more than 430 000 stocks with a nominal value above US $704 billion were traded in BESA, and by 2001, the bond exchange was made up of liquidity over 38 times the market capitalisation, making it one of the most liquid markets in the world (Odhiambo, 2010:1).

The JSE later adopted an electronic trading system in 2002, this allowed the JSE to trade more internationally, as well as trade the most liquid securities. The JSE has been a key role player in the African Stock Exchanges Association since its formation in 1993. Currently, the JSE is included in the Morgan Stanley Index and the International Finance Corporation (IFC) Emerging Markets Indices. Its securities also trade simultaneously in Johannesburg, London, New York, Frankfurt and Zurich (Odhiambo, 2010:1).

Figure 3.1: Stock Market Performance and GDP





From observing the growth patterns that exist within the stock markets and GDP, we can see that no clear conclusions can be made regarding a particular relationship which may exist between the two.

3.2.2 Development in the South African Banking System

The South African banking system is one of the leading banking systems in Africa, and over the past ten years, it has further established a well developed system which is comparable to those in many developed countries. The banking system is regulated through a first-rate regulatory and legal framework. This framework ensures that the South African banks are well managed, and utilise sophisticated risk management systems and corporate governance structures to conduct their banking duties (Mboweni, 2004, 1).

The end of the apartheid era marked by the empowerment of a democratically elected government in 1994 saw increased business from international banks in South Africa, which had previously terminated their operations due to the political isolation of South Africa in the mid 1980s. The Banks Act was amended in 1994, and this allowed the representative offices, subsidiaries and branches of international banks to be established in South Africa. Following this, the participation of international banks in the local industry improved significantly from 3% in 1994 to 9.5% of total banking sector assets in October 2004 (Mboweni, 2004: 1).

The South African banking system currently consists of 38 registered banks. Fifteen of these are South African controlled banks, six non-resident controlled banks, 15 local branches of

international banks, and two mutual banks. In addition to this, there are 44 international banks which have authorised representatives in South Africa, but are not permitted to take deposits.

The largest portion of the South African banking system is controlled by five major groups, and these are: Absa group, the Standard Bank group, the FirstRand Bank group, Investec and Nedcor. According to Mboweni (2004: 1) these groups represented 83.8% of the total banking sector assets in 1994, and as of 2004 represented an even greater percentage of 87.4% of the banking sector. The remaining 12.6% of the assets was held by the other 31 banks, excluding the two mutual banks. The number of medium and small banks initially increased between 1994 and 1998, however in 1999, they faced liquidity pressures which eventually led to their exit from the banking sector. The weak performance of medium and small banks continued until 2002 when Saambou bank was placed under curatorship. Throughout this period, 22 banks exited the banking system and the contribution of small local banks decreased from 21.7% in 1994 to 3.1% in 2004.

The two-sided nature of the development of the South African banking sector manifested by way of locally registered banks increasing their operations in other countries, and at the same time international banks expanding their operations in South Africa. This partnership between South African and international banks added further depth and sophistication to the South African market, as well as the development of the South African labour force as the international banks began to tap into the local resources. The international banks also posed formidable challenges to the local market as they introduced more experienced and resourceful techniques which increased the level of competition faced by the local banks. This created an environment of increased pressure which induced several of the local banks to expand their businesses and enter the market with slightly higher credit-risk profiles. As a result, the major banks now currently offer a wide range of services to both individuals and corporate customers (Mboweni, 2004: 2).

The solid foundations on which the South African banking sector is built has aided it to remain fairly stable despite banking crises which have occurred over the years. According to Mboweni (2004: 2) the aggregate balance sheet of all the banks in the South African banking sector grew from R344.6 billion in December 1994 to R724 billion in December 1999. This figure grew further to R1.436 trillion in October 2004. Loans and advances also grew continuously from R270.8 billion in December 1994 to R1.104 trillion in October 2004. The main source of funding for the banking sector is domestic deposits, and these deposits also grew from R241.9 billion in December 1994 to R888 billion in October 2004.

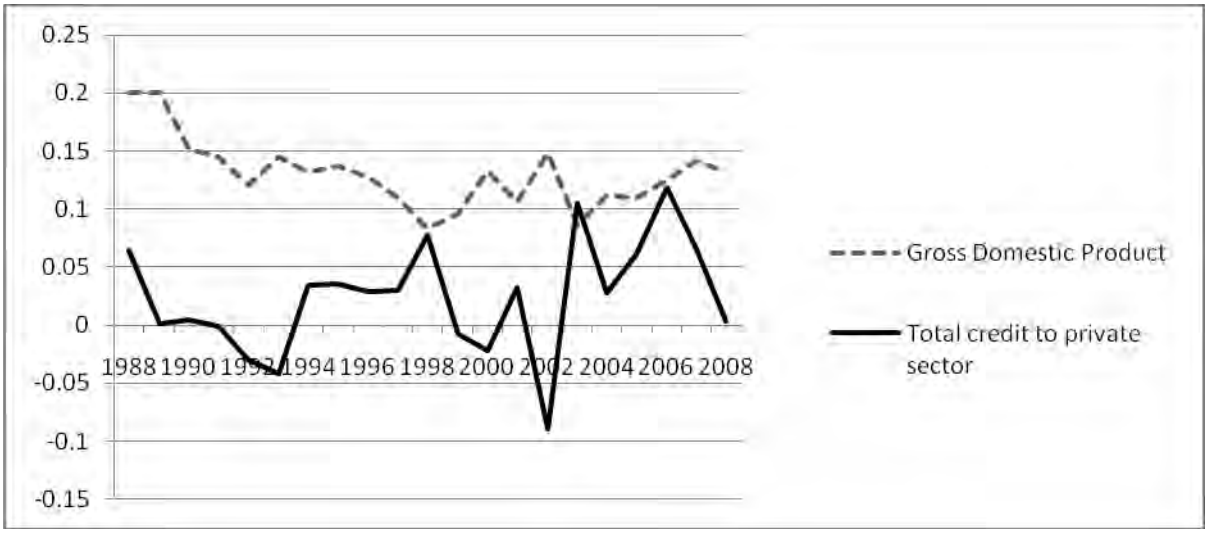
The South African banks had managed to keep the ratio for efficiency (determined by expressing operating expenses as a percentage of total income) below or close to the international benchmark which is 60% up until 1998. This figure increased to 60.2% in 1999 and further increased to 65.2% at the end of 2004. The regulatory authorities of the South African banking sector put emphasis on proper capitalisation, sound risk management procedures and greater disclosure. South Africa currently adheres to the capital adequacy guidelines for banks put in place by the Basel Committee on Banking Supervision. The capital adequacy ratio of the banks stood at 13% at the end of October 2004, thereby meeting the requirement to maintain capital equal to full ratio of 10% of risk-weighted assets implemented by the Registrar of Banks in 2001.

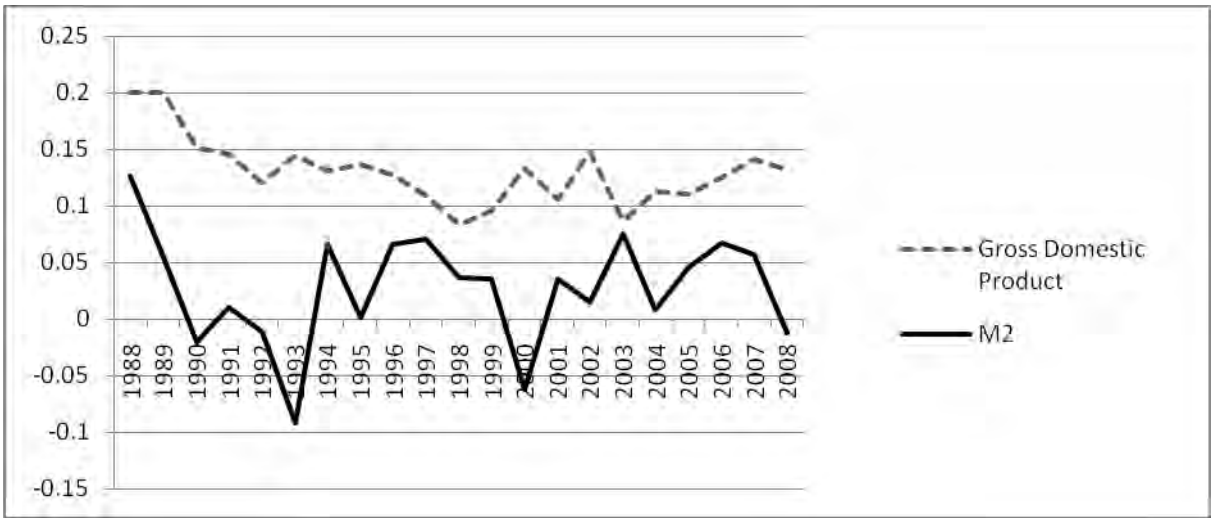
The South African banking system currently implements the "four-pillar" policy which is founded on the banking system having a minimum number of substantial banks i.e. pillars which supports the domestic banking industry. The policy also discourages a merger between any of these pillars. The policy aims to maintain a minimal level of competition within the system in order to keep the spread of risk at a minimum and to ensure that there is prudential and systemic stability which promote confidence within the system. However, considering the importance of a certain level of competition and the need to keep South Africa at par with global changes, challenges and opportunities, there are considerations of allowing international banks to acquire some of the banks which form the pillars (Mboweni, 2004: 4).

In line with global changes, the South African banking system also operates under the New Capital Accord, also known as Basel II. The Basel II accord is primarily concerned with ensuring that banking risks within the system are kept in line with the capital adequacy requirements by enforcing higher supervisory and compliance requirements. This is in an attempt to make sure the banks make their risk management capabilities a major priority. The Basel II accord is also recognised by G10 and non G10 member countries, enabling South Africa to maintain good relations with its trading partners and creating the potential to trade with new partners.

The South African banking system has proven to not only perform the required roles of an efficient financial system, but it has also proven itself able to continuously improve in order to maintain international standards. This has therefore proven to be a major advocate for the increased involvement of international parties as well as increased confidence from within South Africa and abroad.

Figure 3.2: Banking System Performance and GDP





From observing the relationship between the growth patterns of the banking system and that of GDP, we can see that there is a trend suggesting that the growth in GDP leads to that in the banking sector.

3.2.3 Mining Sector Development in South Africa

The South African mining sector came about after the discovery of diamond and gold deposits late in the 19th century. These discoveries aided in the transformation of South Africa from an essentially agricultural economy to a modern industrial one. Mining formed a major part of

South Africa's economy in the 20th century; however the political transformation which took place in 1990 posed many challenges for the mining sector. Many of the structures which had been put into place since the establishment of the sector, such as the corporate and governance structures were now found to be unacceptable to the international investment community who had at this time began to trade again with South Africa, and formed an important part of raising capital for the local companies' projects both within the country and off-shore. Furthermore, the practices within workplaces and their style of management, some of which were as a result of the colonial and apartheid eras were behind international standards. These structures and practices came under intense pressure from the international community, and the country was faced with the need to shed this image which was associated with an exploitative and racially discriminatory regime. This made the need for South Africa to meet modern international standards an absolute imperative (Segal, 2000: 1).

According to Segal (2000: 1), restructuring has taken place and/or is in the process at several levels such as the mining house, the mining company and the workplace. The result of this is a more competitive, more focused and more internationally active industry. World class companies have emerged in gold, platinum, diamonds, coal, ferro-chrome and base metals, and supporting them are world class engineering and other companies.

The South African mining sector is one of the most important in both Africa and the world. This is because it offers a wide variety of quality minerals. It also has the world's largest reserves of chrome, gold, vanadium and manganese, and is the leading producer for almost all of Africa's metals and minerals production (Akinboade *et al.,* 2010: 136). According to Akinboade *et al.,* (2010: 136-137), South Africa supplies 80% of the world's platinum, 80% of the world's known manganese reserves as well as 72% of the world's known chromite ore reserves. Furthermore, in 2005, South Africa was also found to be the ninth-largest producer of aluminium, the largest producer of alumina-silicates, chrome ore and ferro-chromium. In that same year, South Africa was also found to be the second-largest producer of manganese ore and the ninth-largest producer of nickel.

The South African mining sector makes significant contributions to the country's economy which not only comes from mining operations, but also from upstream and downstream activities. It also constitutes what is perceived as the most successful "cluster" in the country's economy (Segal, 2000: 1). The contribution of this sector to the country's economy is also reflected in the direct foreign exchange earnings for South Africa. Gold exports were the main source of the foreign exchange earnings for South Africa in the 1970s and 1980s, and mining

contributed about 14% to the total value added in the country's economy, and in 2007 mining and quarrying contributed about 5.8% to the country's GDP.

During the 1990s, the mining sector directly generated 41% of the country's total exports, which was about the same as the manufactured exports sector. In 1997 mineral exports generated R51 billion, R27 billion of which was generated from the non-gold mineral exports, and which had for the first time in the 20th century, exceeded the value of the gold exports. This not only showed the growth that was taking place within the mining sector, but the growth which was taking place in the entire sector. These statistics still appeared to be undervalued, as they do not include the contributions of processed mineral products, which may have raised the contributions of the mining sector to about 50% of all exports (Segal, 2000: 2). In 2006, precious metals contributed 65% to South Africa's mineral export earnings and 21% of the country's total exports. These contributions underscore the importance of the mining sector to the overall economic growth of South Africa. Perhaps more importantly, the mining sector is also South Africa's largest employer of labour, with around 460 000 employees, with another 400 000 employed by suppliers of goods and services to the industry. Within the sector itself, the gold industry employs the largest number, and is responsible for about 50% of the sector's total employment estimated at around 420 000 people in 2000. The mining sector also has significant ties with South Africa's JSE Securities Exchange as it accounts for over 40% of the market capitalisation in the exchange (Akinboade *et al.,* 2010: 137).

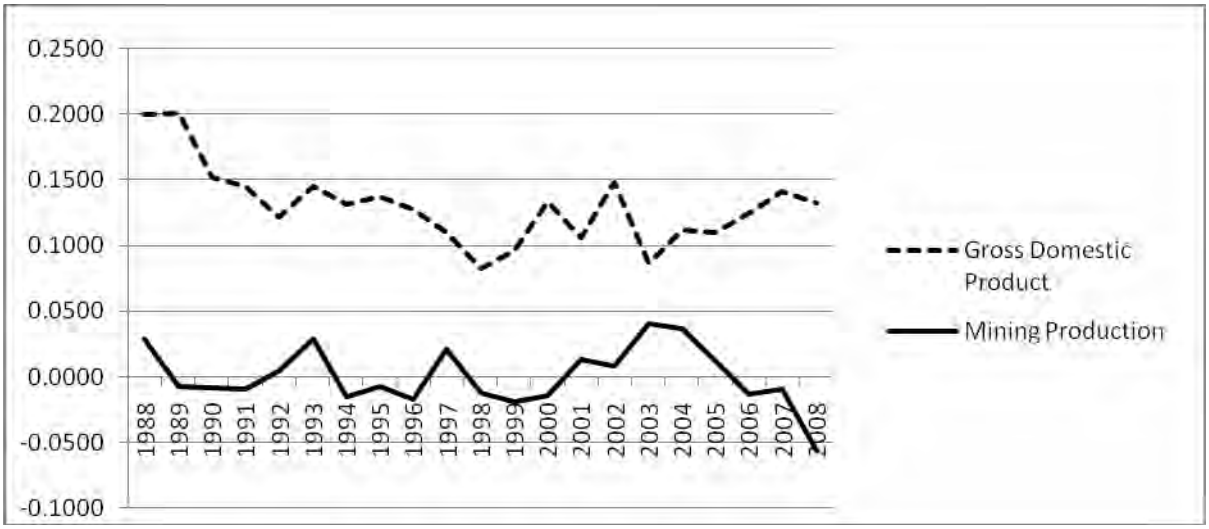
Developments in the mining sector also directly affect South Africa's Millennium Development Goals (MDG), as it is a major private sector supplier of social infrastructure such as schools, clinics and other essential facilities, thereby addressing social issues such as poverty and undernourishment (Akinboade *et al.,* 2010: 137). These developments are also perceived to be significant contributors to the objective of the government to create jobs, regional development within the SADC region, as well providing economic underpinning to the vision of an African renaissance (Segal, 2000: 1).

The mining sector plays a vital role with regard to foreign exchange and international trade. Similarly the major role that the South African mining sector plays in other economies in the region cannot be overlooked. Mining operations often induce foreign investors, and through the development of the South African mining sector, those of the other countries within the region can also develop further and in turn improve both the international trade and foreign exchange situation of those countries (Segal, 2000: 1).

According to Segal (2000: 4), the South African mining sector is also an important part of global mining operations, as it has become globally prominent in three specific areas; technology provision, knowledge-based mining services and specialist mining contractors. South African mining firms are among world leaders in certain areas such as drilling equipment, mining explosives, metallurgical processes and plants, and delivering knowledge-based services to mines around the world. These further indicate how the development of the South African mining sector does not benefit South Africa alone, but also the region, Africa, and indeed the contribution of mining around the world.

Though the share of the mining sector in total exports has fallen over the years, this does not diminished the importance of the sector. Indeed, the fall may actually be in relation to increases in the contribution of the other sectors export. The mining sector has proven its importance to the entire economy of South Africa, and it has also proven that it is indeed connected to the South African financial system. The importance of the mining sector to the South African economy underscores the need to investigate the nature of the relationship which exists between these two, as being able to identify the nature of this relationship will provide indications as to how further development can be aided through the financial systems.

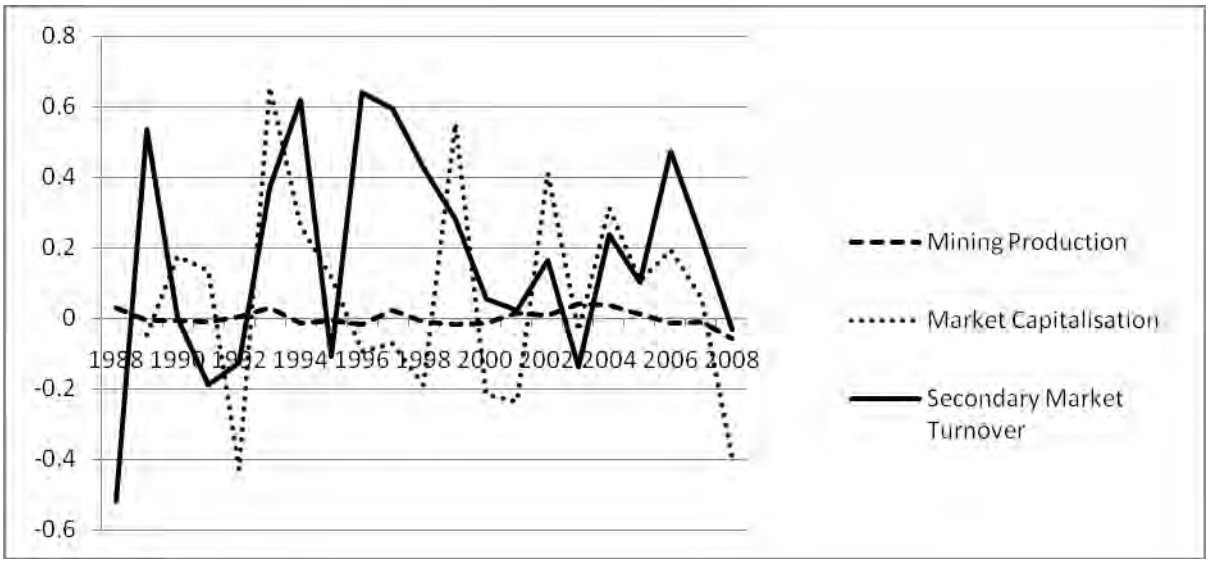
Figure 3.3: Mining Sector Performance and GDP



From the above figure we observe a hint of a trend between the growth of GDP and that of the mining sector. This figure suggests the existence of a possible negative relationship between the changes within GDP and those within the mining sector. This possible negative relationship would therefore suggest that the relationship between the development of the financial systems

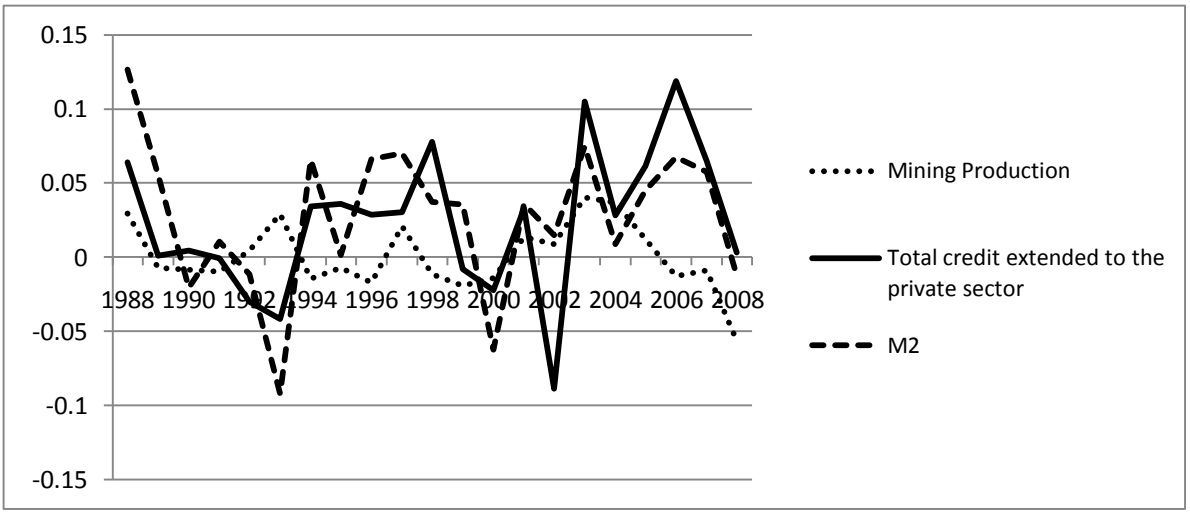
and mining production could be negative, thereby contradicting empirical literature which indicates a positive relationship between financial system development and overall economic growth.

Figure 3.4: Mining Sector Performance and Stock Market Performance



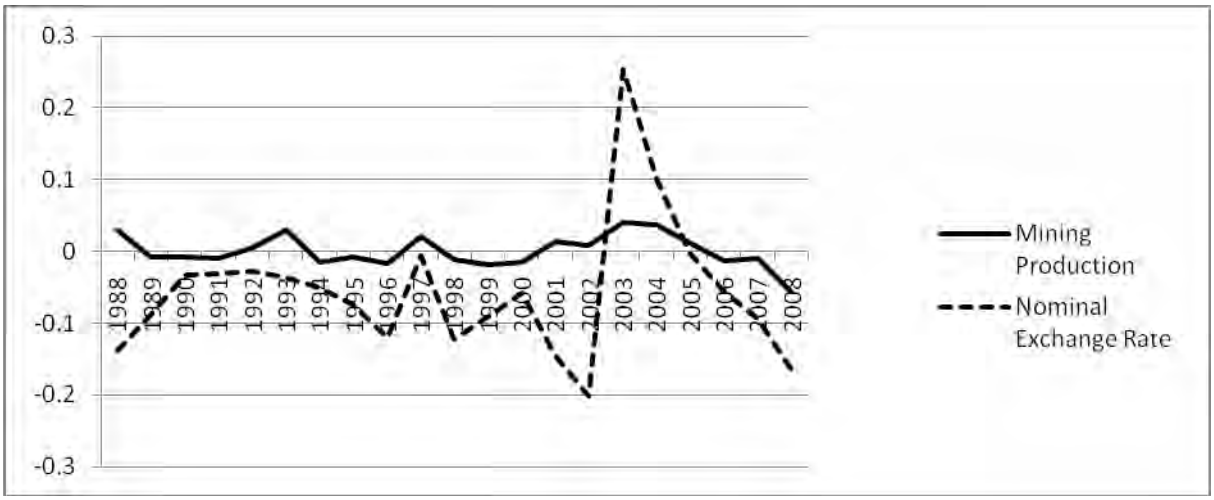
In Figure 3.4, which compares the performance of the stock markets to that of the mining sector, no clear trend can be observed. Both stock market variables appear to have moved mostly together except between 1995 and 1999. There seems to have been a slight indication of a trend, however the existence of this difference between the banking variables makes it difficult to make a clear judgement on whether or not a trend exists.

Figure 3.5: Mining Sector Performance and Banking System Performance



From the above figure which illustrates the growth patterns between the mining sector and the banking system, we are again unable to make a clear assumption on the possibility of a trend between the mining sector and the banking system. The indicators of the banking system seem to show a clear relationship, one which may have been partially compared to the growth of the mining sector in most parts except for the period between 1991 and 1993, where a much clearer divergence is visible.

Figure 3.6: Mining Sector Performance and the Nominal Exchange Rate



Through the course of this chapter, we determined that the performance of the mining sector has a major influence on international trade, and in turn, the exchange rate of the country's currency. Therefore the decision was made to attempt to observe if there were any clear

relationships which exist between the two. From Figure 3.6 presented above, we observe a relationship in most periods, except between 1988 and 1990, and between 2000 and 2002. Considering the existence of these two periods of divergence, we cannot clearly conclude that a positive relationship exists between the two variables.

3.3 CONCLUSION

This chapter has provided an insight into the three areas of the South African economy considered in this study. Section 3.2 discussed the history and development of the South African Stock Market system, the South African Banking system, and the South African Mining sector, discussing how each of them contribute the growth of the South African economy. A number of observations were made from the graphs, and from these we have made certain assumptions and hypotheses on the individual relationships that could exist between changes within specific aspects of financial system development and changes in mining sector production. These will therefore form the basis to which we can compare the results of the empirical analysis in Chapter 5.

After reviewing the role players of the study i.e. the variables which represent the performances of the individual financial systems and the mining sector index, as selected control variables, the next chapter identifies the analytical frameworks which will be used to test the long run relationships that exist between them.

CHAPTER FOUR

THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

4.1 INTRODUCTION

This chapter presents an overview of the model, variable construction, analysis and other relevant steps adopted in investigating the links between financial system development and growth in the mining sector. It also presents the estimation techniques used in detail, as well as the model evaluation tests utilised in this study. This chapter is divided into five sections. Section 4.2 develops a model which will investigate the links between financial system development and mining sector growth. Section 4.3 provides the definitions of the variables and data sources. A detailed review of the estimation techniques used to develop a composite index of the entire financial system and to determine the above mentioned relationship and that follow in section 4.4, while Section 4.5 concludes the chapter.

4.2. DEFINITION OF VARIABLES AND DATA SOURCES

This section provides a discussion of the specification, measurement, and the justification of the variables which are used in estimating the long run relationships between the growth of the mining sector and financial system development in South Africa. In investigating this relationship, the aim is to use proxies which have been widely used in financial development and economic growth studies and of which are readily available in the South African context. Considering the contributions that this study aims to make, the study makes use of data indicating the growth of the mining sector, a sector considered to be one of the most influential to the overall South African economy.

This study follows from the study of Gondo (2009) which made use of credit to the private sector (LCPS), liquid liabilities (LM2), and stock market total value traded (LVTR) to serve as proxies for financial system development because they serve as reflections of the sizes of the respective financial systems in South Africa. In addition to this, this study uses market capitalisation (LMCR) so as to also determine impacts on the growth of the mining sector in South Africa.

The level of credits to the private sector (LCPS) as highlighted by Gondo (2009: 7) offers an indication of the level of activity of the banking sector and other financial intermediaries through the savings-investment channel. Access to credit through this channel stimulates private investment and in turn could increase the levels of growth in the mining sector. The data for this variable was collected from SARB Statistics.

LM2 is made up of currency as well as demand and interest-bearing liabilities of banks and other financial intermediaries, and is therefore the broad measure of financial deepening. Therefore as a measure of liquid liabilities, this study will make use of M2. The data for this variable was collected from SARB Statistics. LMCAP measures the size of the stock market and is equal to the value of listed domestic shares on the domestic exchanges (Levine and Zervos, 1998: 540). The data for this variable was collected from World Bank Statistics. LSMT is equal to the secondary market turnover of trades of domestic shares on domestic exchanges divided by the value of listed domestic shares; therefore it serves as a measure of the liquidity of the stock market (Baltagi *et al.,* 2007). This proxy measures the volume of domestic equities traded on the domestic exchanges relative to the size of the market (Levine and Zervos, 1998: 540). The data for this variable was collected from SARB Statistics.

LOPEN measures the sum of imports and exports as a percentage of nominal GDP (Levine *et al.,* 2000 and Aziakpono, 2004). The data for this variable was computed, but the data for imports and exports was collected from IMF IFS Statistics. LNEX measures the price distortion effects which the nominal exchange rate may have on the mining sector (Aziakpono, 2004: 12). The data for this variable was collected from SARB Statistics.LCPI is commonly used as a measure of macroeconomic stability (Allen and Ndikumana, 1998; Levine *et al.,* 2000 and Aziakpono, 2004). The data for this variable was collected from Statistics South Africa.

Justifications for the choice of these variables and the nature of their impacts on economic growth in general and the mining sector in particular are as discussed in the chapters two and three of this work. Data on all the variables are based on monthly series spanning from 1988 to 2008.

4.3 MODEL SPECIFICATION

Using the simple theoretical framework by Montiel (2003) and considering that lending as the primary function of financial institutions, we can demonstrate how financial system development impacts on growth. First recall that an aggregate production function, as given in equation 2.1 is given as:

$$Y = F(K_1, K_2),$$

We can assume further that K_1 and K_2 represent capital flow from the money and capital market, respectively, and that the financial sector can increase its capital stock by allocating funds to their most productive uses. This would imply that the more capital allocated to a particular sector, through financial intermediation, the more growth that can be recorded in that sector. The change in this capital, however, comes about as a result of investments that take place within an economy; therefore a change in aggregate output is as a result of changes in investment. But evidence as demonstrated in the reviewed literature suggests that, in addition to capital, output can be influenced by macroeconomic factors such as inflation, exchange rate volatility, trade openness, among others. Based on this argument, equation 2.1 into the baseline model for our analysis, as follows:

$$LMP_t = \beta_0 + \beta_1 FD_t + \beta_2 LOPEN_t + \beta_3 LNEX_t + \beta_4 LCPI_t + u_t \quad (4.1)$$

Where,

LMP is the log of the output of the mining sector; FD is the proxy for the entire financial system; $LOPEN$ is the log of ratio of trade openness; $LNEX$ is the log of the nominal exchange rate; $LCPI$ is the log of inflation; and u is the error term

A review of the literature has revealed that market-based investment and development variables include market capitalisation, total value traded, turnover ratio, or a stock market index. On the other hand, bank-based investment and development variables include credit to the private sector, liquid liabilities, and an overall bank development index. The variables which have been predominantly used in studies of this nature have been market capitalisation as a proxy of stock market-based financial system, and credit to the private sector as a proxy for bank-based financial development. Based on the theoretical background, previous literature, and the availability of data in the chosen sample period, market capitalisation, turnover ratio, credit to the

private sector, and liquid liabilities are the chosen proxies for developments in the financial systems, while an index for mining production is used as the proxy for the mining sector. Thus, focusing the different measures of financial system development used in this study, the following relationships are estimated:

$$LMP_t = \beta_0 + \beta_1 LCPS_t + \beta_2 LOPEN_t + \beta_3 LNEX_t + \beta_4 LCPI_t + u_t \quad (4.2)$$

$$LMP_t = \beta_0 + \beta_1 LM2_t + \beta_2 LOPEN_t + \beta_3 LNEX_t + \beta_4 LCPI_t + u_t \quad (4.3)$$

$$LMP_t = \beta_0 + \beta_1 LMCAP_t + \beta_2 LOPEN_t + \beta_3 LNEX_t + \beta_4 LCPI_t + u_t \quad (4.4)$$

$$LMP_t = \beta_0 + \beta_1 LSMT_t + \beta_2 LOPEN_t + \beta_3 LNEX_t + \beta_4 LCPI_t + u_t \quad (4.5)$$

Where,

$LCPS$ is the log of the ratio of credit to the private sector; $LM2$ is the log of ratio of liquid liabilities; $LMCAP$ is the log of the ratio of stock market capitalisation; and $LSMT$ is the log of the ratio of secondary market turnover

Equation 1 investigates the relationships that exist between the mining sector and the entire composite financial system. Equation 2 investigates the relationships that exist between the mining sector and the total credit extended to the private sector. Equation 3 investigates the relationship between the mining sector and M2. Equation 4 investigates the relationship that exists between the mining sector and stock market capitalisation. Equation 5 investigates the relationship between the mining sector and secondary market turnover.

4.4 ESTIMATION TECHNIQUES

This study has chosen to adopt the Johansen technique, as it serves to capture the long run relationship, or lack thereof, in line with the objectives of this study. The review of the relevant literature has also revealed that this is a popular technique among studies of this nature. The Johansen technique is found to provide estimates for cointegrating relationships which may exist between non stationary variables or a mixture of stationary and non stationary variables. This

technique is also able to identify the time series properties which are present in the data, and as a result is suitable for the estimation of models which include time series data (Harris, 1995).

Though the Johansen cointegration technique forms the major part of the analysis, developing a composite index for the entire financial system is a very important step in determining the overall relationship which we aim to test. This composite index is developed through the use of the Principal Component Analysis.

4.4.1 Principal Component Analysis

The Principal Component Analysis (PCA) is one of the factor analytic techniques used to reduce the number of variables, and to detect structure in the relationship between variables. As explained by Jolliffe (2002: 1) "the central idea of PCA is to reduce dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set." It transforms a number of individual outcomes into a new set of variables called principal components which are not correlated but retain most of the variation that was present in the original set of variables.

Nellis, (1982: 345) highlighted that given a collection of correlation coefficients for a set of variables, this form of analysis allows the detection of a relationship, such that the data is reduced to a set of factors, less in number than the variables. Given a set of explanatory variables, PCA assists to select the most important variable or a limited number of variables from the set. Therefore if a common factor captures the relationship between banking system and stock market development variables, then this factor can serve as an index for the entire financial system development, the higher the number of factors, the lower the relationship that exists between the two financial systems.

The general formula for constructing a composite index is as follows:

$$I_i = \sum_{j=i}^{m} w_j x_{ij} \equiv w_1 x_{i1} + w_2 x_{i2} + \cdots + w_m x_{im} \qquad (4.9)$$

where I_i is the composite index of the i^{th} observation or a particular data point, w_j is the weight assigned to the j^{th} variable, x_j after elimination of the scale bias and remains constant over all

observations. Therefore w_j is constant for all the data at a particular data point (x_{1j}, x_{2j}, …, x_{nj}).

The weights, $w = (w_1, w_2, \ldots, w_m)$, are determined by the importance assigned to the variables. The means by which the importance of a variable is determined varies and often has its own logic.

As can be seen from the formula above, there are two major factors that are of importance. These are: the weights assigned to the indicators and the observation values after elimination of the scale bias for the available indicators.

The elimination of scale bias is centred on the fact that usually, variables chosen for any analysis are measured in different units. Therefore it is necessary to convert them into standard comparable units, so as to ensure that the initial scale chosen to measure them does not bias the results. The method adopted in this study to standardise the variable is as follows:

$$x_{i1=} \left(X_{i1} - \frac{X_m}{\sigma}\right) \qquad (4.10)$$

where x_{i1} is the scale free observation, X_{i1} is the original observation and X_m is the mean of the series and σ its standard deviation.

The new series would now be scale free and would have a mean of zero and a standard deviation of unity.

After the bias of measurement is removed from the observations, the vital question of how many PCs adequately account for the total variation in the variables then arises. The criterion on which the importance of the variables was addressed by Jolliffe (2002: 111-112), who highlighted the importance of knowing how many PCs can be taken without serious information loss. Jolliffe (2002: 112) stated that perhaps the most obvious criterion for choosing PCs "is to select a weight (cumulative percentage) of total variation which one desires that the selected PCs contribute, say 80% or 90%," but also pointed out that a sensible cut-off is often in the range of 70% and 90%. This approach to constructing an index is subjective, and the primary determining factor would be the knowledge that one has about a particular data set. Often a weighting above 90% would be appropriate when the PC explained the variation (Jolliffe, 2002: 113).

In most cases though, the analyst does not have the information to determine the relative importance of different variables, and in such cases, the weighting of the variables is done

mathematically through the use of a PCA. The PCA constructs a composite index in such a way that the weights determined such that the sum of the squared correlation coefficients of the index of the constituent variables is maximised (Kendell & Stuart, 1968). This means that weights in $I = \sum_{j}^{m} w_j x_j$ are determined such that $\sum_{j=1}^{m} r^2(I, x_j)$ is maximised. Where $r(I, x_j)$ is the coefficient of the correlation between the index I and the variable x_j.

The weights of the indicators are chosen in such a way that the PCs satisfy two conditions:

i) That the number of PCs is equal to the number of indicators and are uncorrelated.

ii) That the first PC absorbs or accounts for the maximum possible proportion of variation in the set of indicators. This reason highlights the suitability of the PCA to determine a composite index.

Nellis (1982: 346) highlighted that the first PC, is found by maximising the variance that it explains, and is interpreted as the single best summary of the linear relationship exhibited in the data. The second PC is therefore a linear combination of variables that accounts for the most residual variance between the variables after the effect of the first factor is removed; this process is continued through subsequent PCs until the variance in the data is exhausted. However this study makes use of only the first PC, as this serves the purpose of determining a composite index for the entire financial system in South Africa.

Those factors having latent roots greater than 1.0 describe more of the data than any single variable and should be examined most closely. However, the remaining factors (those having eigenvalues less than 1.0) will be obscure and more difficult to identify, and as such are not reported in the results (Nellis 1982: 346). The importance of the eigenvalue is that it expresses the percentage of variation in the set of indicators the PC explains.

The core of the deficiency of the PCA is emphasised by Brooks (2002: 225), stating that there is no theoretical motivation or interpretation of the results of a PCA whatsoever. However, in the context of this study, the PCA is concerned with determining the smallest number of common factors which best account for the correlation across both the banking and stock market systems, as this will serve as a composite index of the entire financial system.

Another problem with the PCA is that there may be difficulties if the composite index intended to be constructed is of variables which are not highly correlated. The method often identifies the

subset of highly correlated variables to make the first component, and assigns marginal weights to poorly correlated subset of variables. If the aim of a study is to construct a single index, this would undermine the poorly correlated set of variables, meaning that the index will be constructed primarily of a highly correlated set of variables, and neglects the set of poorly correlated variables. Considering that there is no dependable method of merging PCs, the set of poorly correlated variables will therefore no longer be utilised in the analysis (Mishra, 2007: 2).

After a composite index for the entire financial system has been constructed, we then make use of the Johansen cointegration method to determine the relationships which exist between the individual financial development variables and the mining sector, as well as between the composite index of the entire financial system and the mining sector.

In conducting the Johansen technique, several steps are followed. The first step is to determine the stationarity of the variables, the next step is to perform cointegration tests which will reveal long run relationships in the variables, and finally residual diagnostic checks are performed.

4.4.2 Unit Root Tests

As mentioned above, the first step in analysing time series data is to test the series for stationarity. A series is said to be stationary if its mean and variance are constant over time, therefore this offers an indication as to the characteristics and behaviour of the data. Considering that most time series data are non stationary and therefore produce spurious results, unit root tests should be conducted before testing for cointegration.

The study uses the Augmented Dickey Fuller (ADF) and KPSS (Kwiatkowski *et al.,*1992) tests to determine the optimal length in the dependent variable. This is done to ensure that there is no serial correlation in the residuals. The ADF test addresses a shortcoming of the Dickey Fuller test of not considering the possibility of autocorrelation in the error term by adding a lagged difference term, and therefore corrects for high-order serial correlation. Even though the above mentioned tests are used to determine the optimal lag length, Brooks (2002: 380) points out that using too few lag lengths will remove all of the autocorrelation and using too many will increase the coefficient standard errors, and will use up the degrees of freedom from the increase in the number of parameters. To address this problem, a number of Information Criteria (IC) such as the Akaike Information Criterion (AIC), Hannan Quinn (HQ), Schwartz's Bayesian Information

Criterion (SIC), and the general to specific procedure as are adopted in this study can be used to ensure that the residual of the ADF regression is white noise.

4.4.3 The Cointegration Framework

One of the conditions for a cointegration test is that the series involved should be integrated of the same order. This is because if the series are stationary at level, a standard regression could be carried out, as there is no risk of spurious regressions.

As was pointed out by Harris (1995: 52), if two variables are cointegrated of order I(1) and the residuals from regressing them are I(0), then the two series are cointegrated. This means that although both series may individually be non-stationary, their linear combination can be stationary. A cointegrating relationship may however only be observed in the long run, as it is possible that the series deviate in the short run, but in the long run regain their trends. This therefore motivates the use of a cointegration approach in this study, as it aims to investigate the possibility of a long run relationship between financial system development and growth in the mining sector.

Testing for cointegration can be divided into two main categories. These are residual based tests and maximum likelihood estimation based on the VAR system. The former category includes the two-step Engle-Granger, and the three-step Engle and Yoo approach, while the latter category includes the Johansen cointegration approach. The Engle-Granger approach has been found to suffer a number of weaknesses, which include the lack of power in the unit root and cointegration tests, simultaneous equation bias, and the inability to perform any hypothesis tests about the actual cointegrating relationships that may exist in the model (Brooks, 2002 395). Even though the Engle and Yoo approach addresses some of the weaknesses of the Engle-Granger approach, it is also unable to perform any hypothesis about cointegrating relationships which may exist.

Considering that the model in this study is multivariate and may contain more than one cointegrating relationship, the Johansen approach is employed. The Johansen approach is able to identify all the cointegrating vectors within a given set of variables and therefore has an advantage over the Engle-Granger and Engle and Yoo approaches which do not test the hypothesis on the cointegrating relationships (Brooks 2002: 395). The vector autoregressive (VAR) based cointegration test using the methodology in Johansen (1991, 1995) is able to

determine if the variables in our growth model possess any cointegrating relationships. The presence of these cointegrating relationships would mean that a vector error correction model can be estimated to test for short run dynamics.

After testing for the order of integration with the unit root tests as explained earlier in this chapter, we then proceed to the Johansen approach, which can be expressed as follows:

Assume a vector: $Y_t = [LMS, LCPS, LOPEN, LNEX, LCPI]$, and assume that the vector has a VAR representation of:

$$Y_t = z + \sum_{i=1}^{p} \prod_i Y_{t-i} + u_t \qquad (4.4)$$

where

z is a (n x 1) vector of endogenous variables,

u is a (n x 1) vector of the white noise error term,

and $\prod_i$ is a (n x n) matrix of coefficients.

The VAR model (4.2) above is turned into a VECM which is expressed as:

$$\Delta Y_t = z + \sum_{i=1}^{p-1} B_i \, \Delta Y_{t-i} + \prod Y_{t-1} + u_t \qquad (4.5)$$

where Y_t is a vector of I(1) variables, ΔY_t are all I(0) variables, Δ is the first difference operator, B is a (n x n) coefficient matrix and $\prod$ is a (n x n) matrix whose rank r determines the number of cointegrating vectors among the variables. The Johansen cointegration test is based on the examination of the $\prod$ matrix. If $\prod$ is of full rank (r = n), it suggests that the variables are level stationary, and if the rank is 0 (r = 0), then there is no cointegration among the variables. But if $\prod$ is of reduced rank (r<n), then there are (n x r) matrices α and β, which can be expressed as follows:

$$\prod = \alpha\beta' \qquad (4.6)$$

where α is a (n x r) matrix which represents the speed with which the system responds to the last period's deviations from the equilibrium relationship while β is a matrix of long run coefficients.

Before proceeding to test the rank of $\prod$, there are two issues which must be addressed. The first is to determine the appropriate lag length of the VAR order. This is also done through the use of the AIC.

The second issue relates to the choice of deterministic assumptions which are required in testing for cointegration. E-views summarises these into five deterministic trend assumptions which are as follows: Assumption 1 assumes that there are no deterministic trends, and the cointegrating equations do not have intercepts; assumption 2 assumes that there is no deterministic trend in the data, but the cointegrating equations have intercepts; assumption 3 assumes that there is a linear deterministic trend in the data, but the cointegrating equations have intercepts; assumption 4 assumes that the level data and the cointegrating equations have linear trends; and assumption 5 assumes that the level data have quadratic trends and the cointegrating equations have linear trends (E-views 5 manual). E-views 5 recommends that assumption 2 be used if none of the series appear to have a trend, assumption 3 when the series have stochastic trends, and assumption 4 if some of the series are trend stationary, which means stationary but non-stochastic. Assumptions 1 and 5 however, are hardly ever used in practice (E-views 5 manual).

The Johansen cointegration approach utilises two likelihood ratio test statistics to test for the rank of the $\prod$ matrix. These tests are the trace (λ_{trace}) and the maximum eigenvalue statistics. These statistics are expressed as follows:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{N} In(1-\hat{\lambda}_i) \qquad (4.7)$$

and

$$\lambda_{\max}(r, r+1) = -TIn(1-\hat{\lambda}_{r+1}) \qquad (4.8)$$

where r is the number of cointegrating vectors, and $\hat{\lambda}_i$ represents the estimated value of the ith order eigenvalue from the $\prod$ matrix. The trace test is one where the null hypothesis is that the number of cointegrating vectors is equal to or less than r, against a general alternative that there is more than r cointegrating vectors. The maximum eigenvalue statistic on the other hand has a null hypothesis that the number of cointegrating vectors is r against an alternative of r +1. This is achieved by conducting separate tests on each eigenvalue (Brooks, 2002: 405). As highlighted by Barnor (2008: 32-33), if the test statistics in both tests are greater than the critical values, then

the null hypothesis that there are r cointegrating vectors will be rejected in favour of the corresponding alternative. The null hypothesis is therefore tested from lower to higher values of r, ending when the null hypothesis cannot be rejected for the first time. This will therefore indicate the existence of a cointegrating relationship between the variables.

Analysing the error correction coefficients forms the basis of the VECM. Therefore in the current study, the coefficient of the error correction terms which correspond to the mining sector in the cointegrating equation will be examined. Therefore α must be examined to see if it is negative and significant, as this will be the indication that ΔY_t is the true cointegrating vector. The error correction coefficient will be regarded as well behaved if it possesses the above mentioned characteristics, and would therefore be a candidate for normalisation.

To confirm which variables are truly endogenous, this study will perform a block exogeneity test to test which of the variables truly influence the growth of the mining sector in South Africa. This test aims to separate variable(s) which have significant impacts on the dependent variable from those that do not. This tests also aids in identifying which variables are most exogenous and which are endogenous, as well as whether financial system development truly influences the growth of the mining sector in South Africa.

4.4.4 Impulse Response and Variance Decomposition

The impulse response analysis investigates the response of the dependent variable to shocks for each of the variables in the VAR model. A unit shock is applied to the forecast error of each variable and the effects are monitored over time. Depending on the sign, magnitude and persistence of these shocks to the growth of the mining sector, the effect of each variable can be determined. According to Brooks (2002: 341), provided that the system is stable, the shock should gradually die away. The Cholesky orthogonalisation approach is applied in this study. This approach takes into account a small sample degree of freedom adjustment when estimating the residual covariance matrix used to derive the Cholesky factor, a technique which is not used by other impulse response approaches (Lutkepohl 1991).

According to Brooks (2002: 342), variance decomposition analysis measures the proportion of movements in the dependent variables that are due to their own shocks, against shocks due to other variables. This means that variance decomposition performed on the VECM could provide information on the relative importance of shocks to the determinants of growth in the mining

sector in explaining the variations in the mining sector. Brooks (2002: 342) added that its own series shocks often explain most of the error variance of the series in a VAR. The Cholesky orthogonalisation approach is also employed in the variance compositions.

4.5 CONCLUSION

The main focus of this chapter is to develop the model and provide detailed insight into the methodologies that will be utilised in addressing the questions which this study sets out to answer regarding the relationship that exists between financial system development and growth of the mining sector in South Africa. Firstly the model was developed, and this was followed by the method which will be used to develop a composite index for the entire financial system highlighting how it was also a suitable method to develop this index. The analytical framework that would be used to investigate the individual long run relationships between mining sector growth and financial development proxies, as well as the relationship between mining sector growth and a composite index of the entire financial system was then developed. This framework is the VAR method based on the Johansen cointegration approach, and therefore advocates that it is a suitable approach to investigate the possibility of long run relationships. After identifying the analytical framework of this study, the next chapter shows the application of these approaches in achieving the goals as set out in Chapter One.

CHAPTER FIVE:

ANALYSIS OF EMPIRICAL RESULTS

5.1 INTRODUCTION

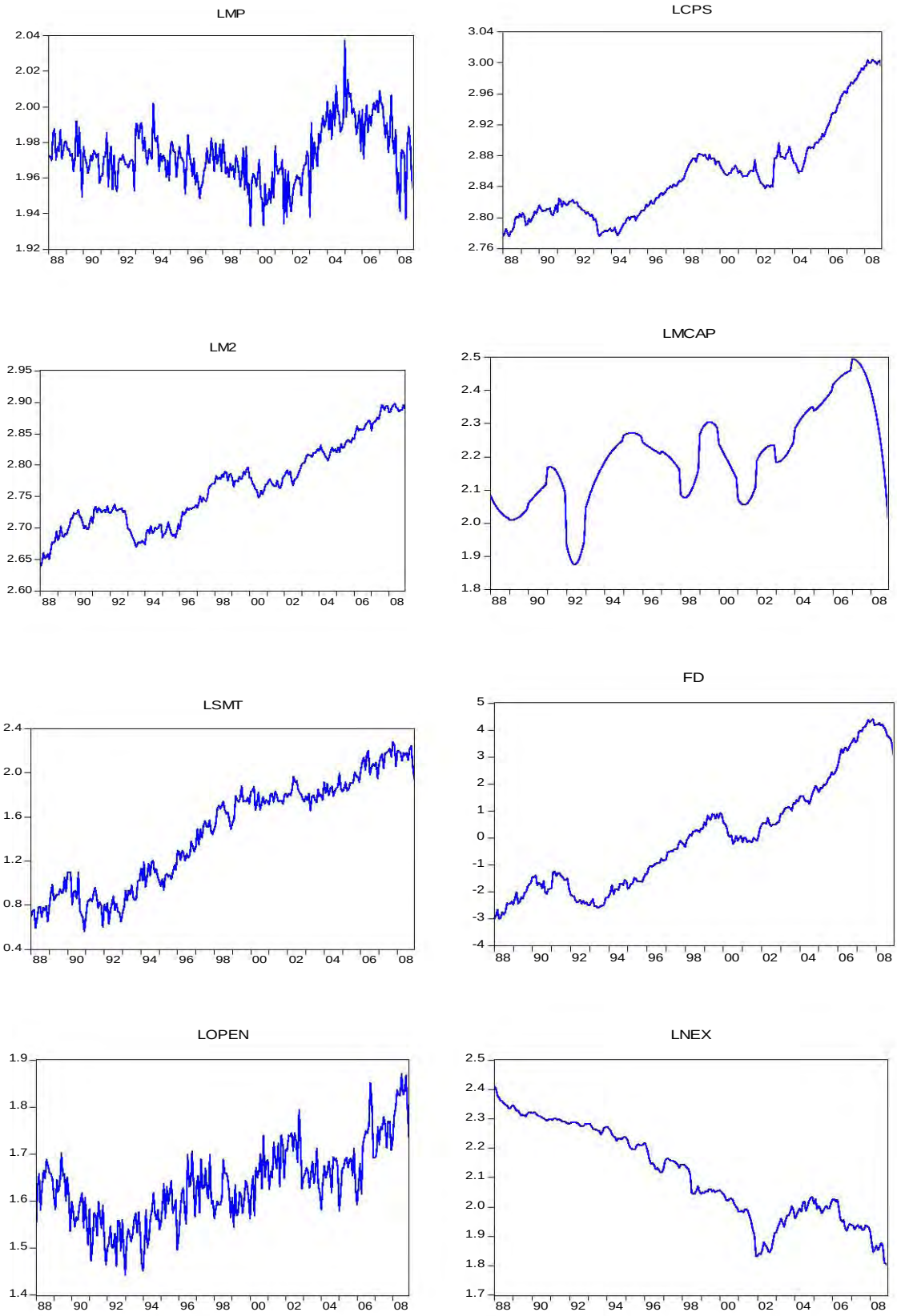
As stated in Chapter One, this study aims to achieve the following objectives: to determine the possible long run relationship that may exist between the growth of the South African banking and stock market systems, and the growth of the South African mining sector respectively; to identify which of these two systems contribute more to the growth of the mining sector; and also to determine the existence of a possible long run relationship between the entire South African financial system and the growth of the mining sector. After reviewing the existing literature, analysing the history and trends of the involved systems and mining sector, and outlining the analytical frameworks, we now apply the identified framework to provide results to the above mentioned objectives.

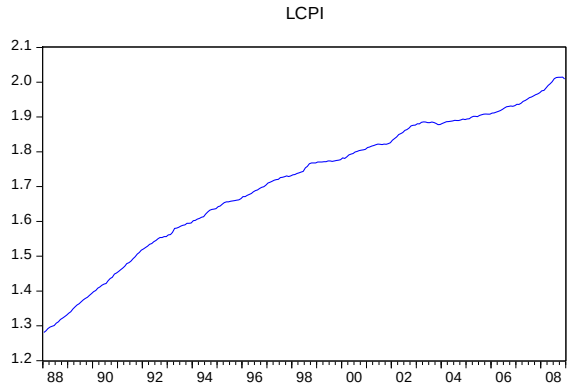
This chapter is divided into six sections, with the first section being the introduction. The second section provides graphical analysis and unit root test results of the data series. The third section applies the cointegration analysis to investigate the long run relationships within the models. This section also discusses the weak exogeneity tests and diagnostic tests. The long and short run interpretations are presented in section four. Section five presents the impulse response and variance decomposition analysis, and section six concludes the chapter.

5.2 UNIT ROOT TESTS

The idea behind performing unit root tests is to check the properties of the data. When performing a cointegration test, it is a requirement that the individual series has a unit root (non stationary at level). As can be observed from Figure 5.1, five variables i.e. CPS, M2, M3, SMT, and FD seem to be trending upwards, while NEX is trending downwards. MP, MCAP, and OPEN seem to fluctuate over time and do not show any clear trends. Due to the lack of conclusive evidence from the graphic analysis, this study goes further to perform a formal unit root test using the Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillip-Schmidt-Shin (KPSS) tests.

Figure 5.1: Graphical Plots





The ADF and KPSS can be estimated with intercept only, and with intercept and trend. Following from Seddighi *et al.* (2000: 267-277), Aziakpono and Obasa (2004: 326-327) and Tsheole (2006: 88-89), regressions are run to determine which assumption will be ideal for this study. The ADF model is given as follows:

$$\Delta X_t = \alpha + \beta_t + \delta X_{t-1} + \sum_{j=2}^{q} \delta_j \Delta X_{t-j+1} + \varepsilon_t \qquad (5.1)$$

Where

Δ is the difference indicator

α is the constant term or the drift

β is the linear deterministic trend (or time trend)

ε is a white noise error term

As highlighted in Tsheole (2006: 88), when the difference term is not included, the ADF model is reduced to a DF (Dickey Fuller) model. Dickey and Fuller (1981, in Seddighi *et al.,* 2000: 272), pointed out that there are three symmetric critical τ_{ij} values, called $\tau_{\alpha\tau}$, $\tau_{\beta\tau}$, and $\tau_{\alpha\mu}$, for testing the drift parameter α and the linear time trend parameter β, under the condition of δ = 0. These condition hypotheses are as follows:

(1) When regression equations of the form (5.1) are used without the difference term:

$H_o : \alpha = 0$ given that $\delta = 0$, if $|t| < |\tau_{\alpha\tau}|$

$H_\alpha : \alpha \neq 0$ given that $\delta = 0$, if $|t| > |\tau_{\alpha\tau}|$

(2) When regression equations of the form (5.1) are used without the difference term

$H_o : \beta = 0$ given that $\delta = 0$, if $|t| < |\tau_{\alpha\tau}|$

$H_\alpha : \beta \neq 0$ given that $\delta = 0$, if $|t| > |\tau_{\alpha\tau}|$

(3) When regression equations of form (5.1) are used without the difference term and the linear trend terms:

$H_o : \alpha = 0$ given that $\delta = 0$, if $|t| < |\tau_{\alpha\tau}|$

$H_\alpha : \alpha \neq 0$ given that $\delta = 0$, if $|t| > |\tau_{\alpha\tau}|$

The results for the testing of conditional hypothesis for unit root for each variable are presented in Table 5.1. this table reports whether or not the variable has drift and/or a deterministic trend, as well as the value at which the null hypothesis was rejected or accepted.

Table 5.1: Conditional Hypothesis Result

Variable	Stochastic trend	Deterministic trend	Intercept Only	Decision rule
LMP	3.452211	0.696421	3.394179	Intercept
LCPS	1.007924	1.471240	-0.576309	None
LM2	2.455020	2.276630	0.911127	None
LMCAP	2.194551	1.019437	2.279552	Intercept
LSMT	2.997841	2.596778	1.516262	Intercept and Trend
FD	-1.105523	1.489327	2.216571	Intercept
LOPEN	2.665683	3.156306	0.415828	Intercept and Trend
LNEX	2.403707	-2.356782	0.506882	Intercept
LCPI	2.847443	1.780159	3.962784	Intercept

In the cases of LCPS, and LM2, we accept the null hypotheses which state that $|t_\alpha| < |\tau_{\alpha\tau}|$ and $|t_\beta| < |\tau_{\beta\tau}|$. The result indicates therefore that these series are non-stationary, as there is

neither a stochastic trend nor deterministic trend in the series. For example, if we consider the variable LCPS with n = 251 observations, we obtain t_α = 1.007924 and t_β = 1.471240. To test the hypotheses (1) and (2) we must compare these t values with the corresponding τ_{ij} critical values from Table 7.9 (in Seddighi *et al.,* 2000: 272). That Table 7.9 reports $\tau_{\alpha\tau}$ (n = 250) as 3.09 and $\tau_{\beta\tau}$ (n = 250) as 2.79, therefore there is neither a stochastic trend (intercept) nor a deterministic trend.

Considering that three of the series have indicated the existence of an intercept, with another three indicating the existence of a trend, the option with intercept and trend in cointegrating vectors would then be adopted. Assumption 4 is used in the estimations as some of the series are trend stationary (Eviews 6 manual: 365). After these tests have been conducted, we can then move on to perform the unit root tests. The results of the unit root test are presented in Table 5.2 where we use both the ADF and KPSS with intercept and trend. The ADF and KPSS tests were performed under the null hypothesis that the variables are not stationary at level against the alternative that they are stable at first differences.

Table 5.2: Summary of Unit Root Tests

SERIES	ADF		KPSS	
	Level	1st Difference	Level	1st Difference
MP	-3.395157	-12.30471[a]	0.402566	0.195478[a]
CPS	0.631223	-6.837275[a]	1.656985	0.230421[a]
M2	-0.859888	-7.715905[a]	1.848367	0.062803[a]
MCAP	-2.295635	-2.785082[c]	1.154142	0.131028[a]
SMT	-1.064767	-15.74505[a]	1.961327	0.098074[a]
NEX	-0.681946	-12.70233[a]	1.93082	0.059475[a]
OPEN	-0.383462	-4.02901[a]	1.504001	0.314199[a]
FD	-0.866857	-6.555532[a]	1.846122	0.084213[a]

Notes: The MacKinnon (1996) (i.e. for ADF test) 1% critical value = -3.456730 and the KPSS (1992) 1% critical value = 0.739. (a) and (c) denote the rejection of the null hypothesis of unit root at the 1% and 10% levels of significance respectively.

The ADF statistic tests the null hypothesis of a unit root, while the KPSS on the other hand tests the null hypothesis that the series is stationary. A rejection of the null hypothesis under the ADF therefore means that the series do not have a unit root, while the rejection of the null hypothesis under the KPSS means there is evidence of nonstationarity or presence of a unit root in the series. The results of the ADF tests in Table 5.2 show that none of the series is stationary in levels, since their test statistics in the second column are smaller than the Mackinnon 1 per cent critical value. However, MP seems to be closer to the stationary boundary. When the series are tested at first difference, they all become stationary suggesting that they are all $I(1)$.

Results based on the KPSS are marginally different from those of the ADF. The KPSS test applied in level fails to reject the null hypothesis of stationarity in MP, while it rejects it with all the other variables. Those that are not stationary at level became stationary in their first differences, in line with the ADF results.

We therefore conclude that eight of the series are first difference stationary $I(1)$ while one is level stationary, $I(0)$, thus the variables are not stationary of the same order. As mentioned in Chapter 4, $I(0)$ and $I(1)$ variables could be cointegrated, and therefore we carry all variables forward to cointegration test.

5.3 COINTEGRATION ANALYSIS

5.3.1. Model Estimation

Having determined that all the variables are non-stationary at level, the next step is to investigate the existence of long run relationships among the variables as specified in the different models in chapter four. The variables LMP, LCPS, LM2, LMCAP, LSMT, LNEX, LOPEN and FD are all entered as endogenous variables. The models are as follows:

Model 1: LMP = f (FD, LNEX, LOPEN, CPI, DUMMY)

Model 2: LMP = f (LCPS, LNEX, LOPEN, CPI, DUMMY)

Model 3: LMP = f (LM2, LNEX, LOPEN, CPI, DUMMY)

Model 4: LMP = f (LMCAP, LNEX, LOPEN, CPI, DUMMY) and

Model 5: LMP = f (LSMT, LNEX, LOPEN, CPI, DUMMY)

When conducting the Johansen cointegration test, it is important to select the optimal lag length which in principle should be the minimum lag length sufficient to eliminate serial correlation in the residuals. Hall (1991) emphasises that if the lag length is too low, serial correlation problems will occur, and if it is too high, it may result in low sample problems.

This study utilizes the five information criteria reported in E-views, which as mentioned in Chapter Four are: the Sequential Likelihood Ratio (LR), the Final Prediction Error (FPE), the Akaike Information Criterion (AIC), the Schwarz Information Criterion (SC) and the Hannan-Quinn Information Criterion (HQ). Although the information criteria reported different lag lengths for all the models, we use a stepwise approach by conducting our cointegration tests starting from the smallest lag and increase until we attain results with good residual diagnostic checks.

As was mentioned earlier, this study makes use of assumption four[1], as this assumption applies to all five models, as determined from the unit root tests. After exploring the information criteria and identifying those which give the best results, different lag lengths have been selected for the different models. A summary of the lag lengths which offered the best results is presented in table 5.3.

Table 5.3 Lag Lengths Selected

Model	Lag Length	LM (χ^2) Statistic	Probability
1	9	29.47873	0.2444
2	9	28.84295	0.2705
3	5	30.76452	0.1969
4	11	29.75382	0.2336
5	11	27.32058	0.3401

Of all the lags which did not show evidence of serial correlation, those presented in Table 5.3 are those which gave the best results under the selected assumption. After establishing that the different models identified one or two cointegrating vectors, the behaviour of the error correction coefficient of the dependent variable (LMP) in relation to other variables in each model was observed.

[1] See (Eviews 6 manual: 365).

Table 5.4 Johansen Cointegration Test

Model		Trace Statistics			Maximum eigenvalues			
		Trace Statistic	Critical Value	Probability	Eigenvalue	Max-Eigen Statistic	Critical Value	Probability
1	r = 0	145.83	117.71	0.00	0.19	51.20	44.50	0.01
	r ≤ 1	94.63	88.80	0.02	0.14	37.49	38.33	0.06
	r ≤ 2	57.14	63.88	0.16	0.09	23.42	32.12	0.39
2	r = 0	149.50	117.71	0.00	0.20	52.93	44.50	0.00
	r ≤ 1	96.57	88.80	0.01	0.14	37.14	38.33	0.07
	r ≤ 2	59.43	63.88	0.11	0.09	22.96	32.12	0.42
3	r = 0	157.53	117.71	0.00	0.21	57.76	44.50	0.00
	r ≤ 1	99.76	88.80	0.01	0.14	38.36	38.33	0.05
	r ≤ 2	61.41	63.88	0.08	0.09	23.55	32.12	0.38
4	r = 0	151.70	117.71	0.00	0.20	53.93	44.50	0.00
	r ≤ 1	97.77	88.80	0.01	0.14	36.56	38.33	0.08
	r ≤ 2	61.20	63.88	0.08	0.11	29.56	32.12	0.11
5	r = 0	131.35	117.71	0.01	0.17	44.60	44.50	0.05
	r ≤ 1	86.75	88.80	0.07	0.11	28.73	38.33	0.41
	r ≤ 2	58.02	63.88	0.14	0.08	21.11	32.12	0.56

Notes: The critical value for the trace tests at the conventional 5% level of significance are 117.71, 88.80 and 63.88 for r = 0, r ≤ 1 and r ≤ 2. The corresponding values for the maximum eigenvalues are 44.50, 38.33 and 32.12.

As highlighted by Thangavelu and Ann Beng Jiunn (2004: 256), the maximum eigenvalue test is preferred to the trace test to correctly identify the number of cointegrating vectors. Johansen and Juselieus (1990: 9) carried on to add that one would expect the power of the trace test to be low because it does not use the information that the last three eigenvalues have been found not to differ significantly from zero. However, one would expect that the maximum eigenvalue test would produce much clearer results. Therefore we proceed to present the results of the maximum eigenvalue test as reported in table 5.4, and in all the models, one cointegrating equation was suggested under assumption four. It should however be noted that in model 3, the maximum eigenvalue test suggested two cointegrating equations, rejecting the null hypothesis of there being one cointegrating equation. We however report only the results from the first cointegrating vector, as those from the second vector were not found meaningful.

Table 5.5: Results of Estimations

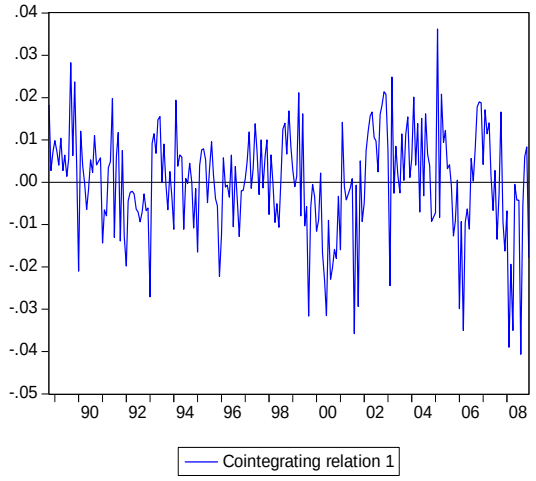
Regression number	(1)	(2)	(3)	(4)	(5)
PANEL 1					
Cointegrating vectors					
Trace	1	2	2	1	2
Max	1	2	1	1	2
Lag Length	8	8	4	11	11
Assumption	4	4	4	4	4
PANEL 2					
Long Run Terms					
CointEq	1	1	1	1	1
LMP	1	1	1	1	1
Constant	-1.82	-1.59	36.12	-4.57	-4.90
FD	0.01 (2.75)**				
LCPS		0.04 (0.52)			
LM2			-2.47 (-1.30)		
LMCAP				0.40	

				(5.13)***	
LSMT					-0.01 (-0.34)
LNEX	-0.18 (-7.83)***	-0.14 (-3.36)***	-2.33 (-2.63)**	-0.37 (-2.94)**	0.14 (1.30)
LOPEN	0.05 (1.14)	-0.09 (-1.33)	-8.78 (-6.90)***	0.74 (3.73)***	0.86 (4.55)***
LCPI	0.16 (3.04)***	-0.09 (-0.21)	-9.31 (-4.96)***	1.16 (4.46)***	0.98 (4.14)***
DUMMY	-2.08 (-0.00)	0.03 (3.98)***	0.73 (3.91)***	-0.17 (-5.82)***	-0.08 (-3.56)***
PANEL 3					
A	-0.43 (-3.03)***	-0.26 (-2.77)**	-0.00 (-1.07)	-0.04 (-1.09)	0.21 (0.56)
Weak Exogeneity	8.49 [0.00]	4.92 [0.03]	1.14 [0.29]	1.22 [0.27]	0.03 [0.56]
Diagnostics					
Serial Correlation	29.48 [0.24]	28.84 [0.27]	30.76 [0.20]	32.04 [0.16]	27.32 [0.34]

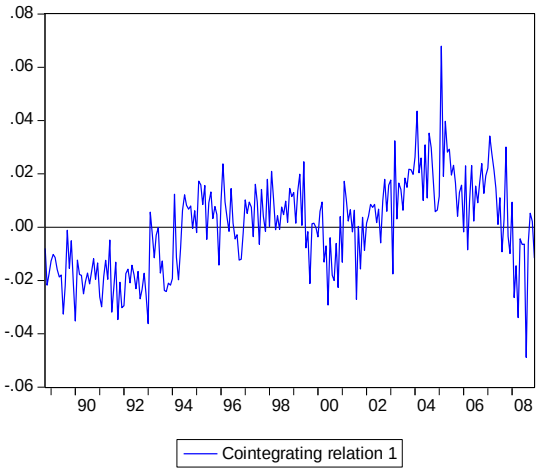
Notes: figures in parenthesis, ( ) are t-values, [ ] are p-values, ***, ** and * indicate significance levels at 1%, 5% and 10% respectively.

Figure 5.2: Cointegration Graphs

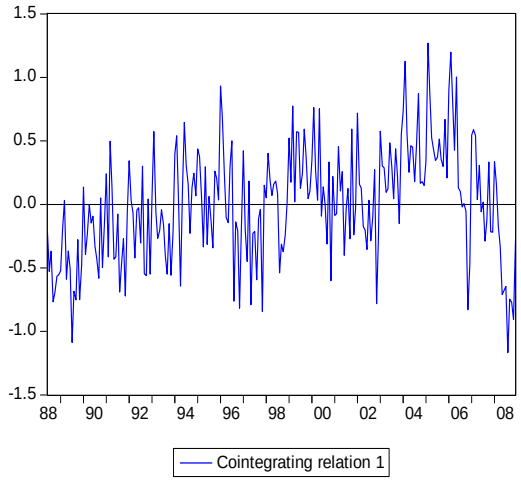
Model 1



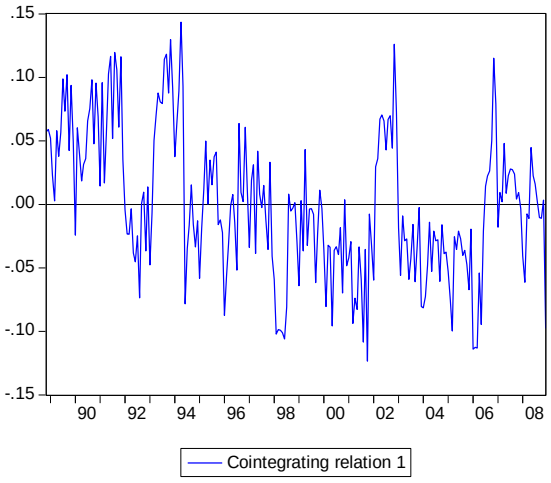
Model 2



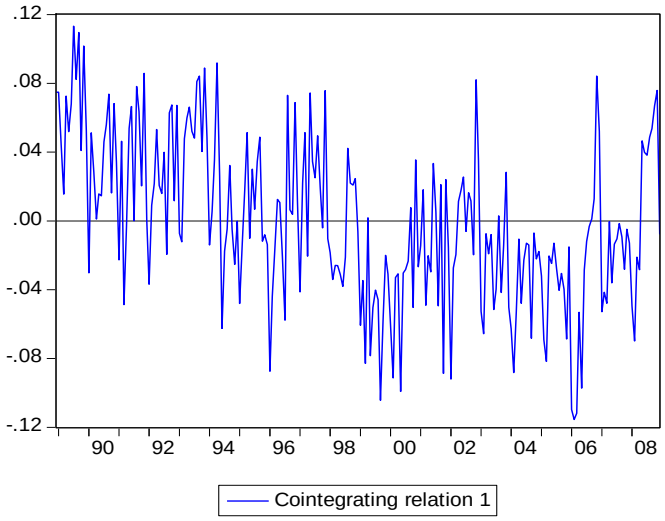
Model 3



Model 4



Model 5



In order to check the true cointegrating relationships in the VECM we analyse the coefficient, α which is normally expected to be negative and significant. The main focus of this study is to investigate the possible relationships which may exist between mining sector growth and financial system development, and therefore we have to investigate the relationships between the parameter of MP and the other variables. The error correction term, α, results show that the error correction coefficient for MP is negative and significant in models 1 and 2 with high t-values of 3.03 and 2.77 respectively, which suggest that LMP equation is the true cointegrating relationship in the vector. For models 3, 4 and 5, the error correction coefficient for LMP is not significant, therefore suggesting that there is no adjustment to equilibrium.

The endogeneity of MP was investigated with the weak exogeneity test. The null hypothesis that MP is weakly exogenous is explored by placing a restriction of zero on the coefficient of MP. The null is rejected in models 1 and 2 at 0% and 3% levels of significance respectively. This shows that MP is truly endogenous, which confirms that MP is indeed a dependent variable in the models. For models 3, 4 and 5, the weak exogeneity test shows that LMP is weakly exogenous as the null was rejected at 29%, 27% and 36% respectively. The explanatory variables in the models were also tested to check if they are weakly exogenous, and the results are reported in table 5.6.

Table 5.6: Weak Exogeneity Results

VARIABLE	**Chi square, probability values and t values ([ ])**									
	MODEL 1	ECM	MODEL 2	ECM	MODEL 3	ECM	MODEL 4	ECM	MODEL 5	ECM
FD	3.87 [0.05]	3.66 (2.28)								
LCPS			10.23 [0.00]	0.15 (4.01)						
LM2					0.91 [0.34]	-0.00 (-1.04)				
LMCAP							0.80 [0.37]	-0.07 (-1.25)		
LSMT									2.13 [0.14]	0.47 (1.63)
LNEX	16.42 [0.00]	0.70 (4.61)	5.26 [0.02]	0.31 (3.13)	0.19 [0.66]	0.00 (0.47)	1.88 [0.17]	0.06 (1.68)	0.09 [0.77]	-0.02 (-0.40)
LOPEN	4.24 [0.04]	-1.32 (-2.74)	0.59 [0.44]	0.36 (1.19)	20.14 [0.00]	0.07 (7.21)	7.93 [0.00]	-0.38 (-3.37)	14.15 [0.00]	-0.59 (-4.25)
LCPI	0.11 [0.73]	-0.01 (-0.38)	6.23 [0.01]	-0.04 (-2.66)	0.02 [0.88]	-9.90 (-0.18)	6.14 [0.01]	0.01 (2.57)	1.30 [0.25]	0.01 (1.31)

The weak exogeneity tests in Table 5.6 above suggest that FD, LNEX and LOPEN are endogenous in Model 1. In Model 2, we find that LCPS, LNEX and LCPI are endogenous. We rejected the null hypothesis in all cases, and the error correction coefficients are significant. In Model 3, LM2, LNEX and LCPI are exogenous. In Model 4, LMCAP and LNEX are exogenous. In Model 5, LSMT, LNEX and LCPI are exogenous. We have failed to reject the null hypothesis in all cases, and the error correction coefficients are not significant.

5.3.2 Diagnostic Checks

As mentioned earlier, diagnostic tests are performed on the residuals to ensure that they are well behaved. As reported in panel 3 of Table 5.5, this study conducted a serial correlation test with the Autocorrelation LM test, which has a null hypothesis that there is no serial correlation. As reported in the results, we failed to reject the null hypothesis of no serial correlation, and this is confirmed by the insignificant probability figures for each model.

5.4 LONG RUN TERMS

The long run parameters in the models are presented in panel 2 of Table 5.5. We begin by interpreting the individual variables which represent the financial systems before interpreting the relationship that exists with the entire financial system.

In Model 2, we test the relationship between LMP and LCPS and find that LCPS has a negative relationship with LMP, with a t-value of 0.52 which is not significant. The insignificance of credit to the private sector as a long run determinant of growth in the mining sector could suggest that the credit to the private sector is directed to other sectors of the economy and not the mining sector. This result therefore contradicts that of Gondo (2009) which found a positive relationship between credit extended to the private sector and economic growth.

In Model 3 where the relationship between LMP and LM2 was tested, we find that M2 has a positive but insignificant relationship with the production in the mining sector. This result suggests that there is a possible relationship between an increase in the level of liquid liabilities, and mining sector performance. However, considering that LMP was found to be exogenous to the model, this result must be interpreted with care. This result confirms our a priori expectation which suggests that there is mostly a positive relationship between M2 and MP.

In Model 4 the relationship between the mining sector and market capitalisation was tested, and we find that there is a negative and significant relationship between the growth of market capitalisation in the stock market sector and the production of the mining sector. This relationship may be an indication that with the growth of the South African stock market, more investment is directed towards the development of the other sectors. This result seems to support our a priori expectation as there was no clear evidence of a positive relationship between MCAP and MP, but however contradicts that of Gondo (2009) which found a positive relationship between stock market liquidity and economic growth.

The relationship between the secondary market turnover and the mining sector was investigated in Model 5. The results suggest that there is a positive but insignificant relationship between the increase in secondary market turnover and the growth of the mining sector. This result also seems to support the potential for a positive relationship discussed in Chapter 3.

Lastly, we refer back to Model 1 where we test the relationship between the index of the entire financial system (FD) and the mining sector, and similar to the cases of market capitalisation, we find that there is a negative relationship which is also significant. This result implies that the growth of the financial system as a whole does not influence the performance of the mining sector.

The influence of nominal exchange rate is found to be significant and it also has a positive relationship with the performance of the mining sector in four of the five models, except for Model 5. This result implies that in these four models, the higher the exchange rate (indicating a strong currency), the better is the performance of the mining sector of South Africa. This relationship is consistent with economic theory as the exchange rate is considered an indicator of growing economy in relation with trading partners.

Trade openness is found to have mixed relationships through the models. Trade openness is found to have a negative relationship with the mining sector in models 1, 4 and 5, with significant results found only in models 4 and 5. This result implies that when there is higher performance from the mining sector, overall trade (imports and exports) in South Africa decreases. This result seems to be inconsistent with findings which have tested the effects of trade openness on economic growth. On the other hand, trade openness is found to have a positive relationship with the mining sector in models 2 and 3, though significant only in Model 3. This positive relationship would imply that the higher the import/export activity in South Africa, the higher the production of the mining sector.

Inflation is found to have a negative and significant relationship with the performance of the mining sector in models 1, 4 and 5. This finding implies that the lower the inflation rate, which is associated with a stable economic environment, the better the performance of the mining sector in South Africa, a finding which is consistent with economic theory. On the other hand, we also find that inflation has a positive relationship with the mining sector in models 2 and 3, with that in Model 2 being insignificant, and that in Model 3 significant.

The dummy variable has provided varying results across the models. It has indicated that there is a positive and significant relationship between the production of the mining sector and the

political liberation of South Africa in models 4 and 5. This finding implies that the production of the mining sector improved post independence of South Africa in 1994. This result is plausible as fewer sanctions on land post-independence meant that there was more potential for the mining sector to grow. In models 2 and 3, this relationship is found to be negative and significant, suggesting that the production of the mining sector decreased post-independence.

5.4.2 Speed of Adjustment and Short Run Terms

As reported in Table 5.5, the speed of adjustment coefficient is correctly signed and significant in models 1 and 2. Following the short run disequilibrium in MP, the error correction coefficients show that the average adjustment is 43% in Model 1 and 26% in Model 2 within a year. However, models 3 and 4 show that the speed of adjustment coefficient is correctly signed, but insignificant, while Model 5 shows a coefficient which is wrongly signed and insignificant. These results imply that there is no adjustment to equilibrium. LMP may not be the true cointegrating equation in models 3, 4 and 5.

5.5 IMPULSE RESPONSE AND VARIANCE DECOMPOSITION ANALYSES

The impulse response function was estimated using the Cholesky approach and the results are reported in Figure A1 in the Appendix. The aim of this test was to investigate the responses of MP to shocks in the other variables. In the models, a one period standard deviation shock on MP produces a large positive impact on itself which is persistent over time.

Next we investigate the relative importance of shocks to each of the other variables in explaining the variations in MP. Similar to the case of the impulse response analysis, we present only the results of changes in MP following shocks to itself, or the other variables, as MP is the main variable we aim to investigate. The results of the variance decomposition for each of the models are presented in Table A3 in the appendix.

In the first model, 77% of the variation in MP is explained by itself after 20 months. This is consistent with the impulse response results. All the determinants account for 23% of the error variance combined, where LNEX explains a significant 15%. The other variables each explain very little of the forecast error variance. FD explains 4%, LOPEN explains 1%, LCPI explains 1%, and the Dummy explains 2% of the forecast error variance of MP after 20 months.

In model 2, LMP explains a similar proportion of 79% of the error variance of itself, while the rest of the variables account for the remaining 21%. The LNEX variable again contributes a significant 13% of the variation in LMP which is similar to the first model. The contribution of LCPS is approximately 0.5%. The variation of LMP explained by the error variance of LOPEN increased to 4% that of LCPI reduced to less than 1%, while that of the Dummy also increased to over 3%.

The results of the variance decomposition analysis in the two significant models have shown that the largest contribution to LMP comes from the LNEX control variable. In Model 1, the financial system index FD was able to account for a more significant portion of LMP than the financial system variable LCPS in model to. This therefore implies that the financial system is more influential as a whole than it is as individual variables.

5.6 DISCUSSION OF RESULTS

The empirical results have been able to provide an opinion on the impact of financial system development on the production of the mining sector. As mentioned earlier, the majority of the studies of this nature investigate the relationship that exists between the development of the financial system and economic growth; this study however investigates how these same financial systems can impact on a particular sector of an economy.

As mentioned in Chapter Two, Montiel (2003) highlighted the mechanisms through which financial intermediation can affect growth, thereby suggesting the presence of a positive relationship between financial system development and economic growth, with causality either moving from financial systems to economic growth or vice versa. This positive relationship supported more often than not by empirical studies, thereby indicating the confirmation of this relationship. However, none of the previous studies considered economic growth as an aggregate of growth in different sectors of the economy. Very few studies have focused on the impact of financial systems in the development of those economic sectors that are considered the engine of growth in a given country (Beck and Levine 2002, and Diekmann and Westermann 2010). It is the scarcity of empirical literature in this area of research that forms the core motivation for the current study.

The results from this study produce mixed results. Using the bank-based measure of financial development, the results reveal a negative relationship between MP and CPS, and a positive

relationship between MP and M2. These two results are however insignificant. This agrees with the findings of Dawson (2003) in the case of central and east European countries, Naceur and Ghazouani (2007) for the MENA, and the cross-country analysis by Ram (1999). These studies consistently report that the relationship between their proxies for banking development and economic growth is non-significant. The results involving the market-based measure also produced mixed results, indicating a negative and significant relationship between MP and MCAP, while indicating a positive and insignificant relationship between MP and SMT. The results with individual measures of the financial system have shown that it is difficult to reach any definite conclusion on the actual relationship between financial system development and growth in the mining sector as three of the four variables indicate insignificant relationships, and three of the four models found MP to be an exogenous variable. However it is difficult to determine which of the two systems contributes more to the development of the mining sector. The results do confirm the earlier conclusion by Levine and Zervos (1998) that the role of the stock market in influencing economic growth differs from that of the banking industry. The most definitive result involving the individual systems is the negative and significant relationship between stock market capitalisation and mining sector growth, therefore suggesting a smaller contribution from the stock market-based system. The negative relationship between stock market and mining sector production can also be explained by the likelihood of shocks in the former affecting activities in the latter (Diekmann and Westermann, 2010).

All the above-mentioned inconsistencies were however corrected in Model 1 which involved a composite index of the entire financial system. In this model we found the existence of a negative and significant relationship between the entire financial system and the production of the mining sector, where MP was also found to be an endogenous variable. This result satisfies the third objective of our study, as we have determined that a negative relationship exists between the development of the financial system and mining sector production in South Africa. This finding however contradicts the findings of Diekmann and Westermann (2010) who found that a positive relationship exists between the development of the financial system and the growth of all investigated sectors in Germany. The mining sector was one of the investigated sectors, however considering that the study was carried out between the late 1800s and early 1900s; it can be argued that the effects of financial system development could have changed, as changes have occurred in both the ways financial systems operate, as well as how the mining sector produces. From this result, we could also assume that the direction of causality, as previously established by Ghirmay (2004) and Arestis *et al.* (2001), runs more from mining sector growth to financial development, than it does from the opposite direction.

Though a clear conclusion cannot be drawn on which of the financial systems impacts more on the growth of the financial system, as those variables which indicate a positive relationship are insignificant, we can however draw a clear conclusion on the impact of the entire financial system on the growth of the mining sector. The result revealed a negative and significant relationship, which is in contradiction with theory, empirical literature and a priori expectations based on the influence of the mining sector on economic growth. However, this confirms our observations from the graphical analysis carried out in Chapter Three which suggested a possible negative relationship between GDP growth and mining sector production, and therefore would suggest a negative relationship between financial system development and mining sector production. A possible reason for this could be that considering that some valuable minerals that are mined in the country are mostly processed and marketed off the shores of South Africa, South Africa may end up probably not enjoying the majority of the profits generated from mining production. Or alternatively there may exist a possible substitution effect between GDP growth and mining sector production, meaning that certain resources are shared by the factors which affect GDP growth, as well as those which affect mining production, and as a result the increase in growth of one may lead to a reduction in the other.

The results of this study interestingly draw out the implications of previous South African case studies such as Allen and Ndikumana (2000), Aziakpono (2008), Gondo (2009), and Odhiambo (2010). While the outcome here does not disagree with the results of these studies that financial system development is an important determinant of economic growth, it does show that the impact of financial system development could be minimal in promoting growth in core economic sectors. Contrary to the finding by Odhiambo (2010), the results of this study may suggest that, in the mining sector, the direction of causality is less from the financial system than it is from the mining sector.

Based on the results attained, we can therefore conclude that although the mining sector is considered a major individual contributor to economic growth, the combined contributions made by the other factors which influence economic growth account for a much more significant portion of the positive relationship which empirical studies have found between financial system development and economic growth.

5.7 CONCLUSIONS

This chapter investigated the long and short run relationships which exist between the mining sector and the development of the financial systems in South Africa. We made use of the Principal Component Analysis to construct a composite index for the entire financial system, and after this we tested individual financial system indicators, as well as the entire financial system in relation to the productions within the mining sector. Graphical analysis and unit root tests indicated that the series were non-stationary at level but became stationary after a first difference. In the next step we investigated cointegration, where we found that each of the five LM models had one cointegrating vector. Proceeding to the VECM, short and long run relationships between the financial system variables and MP were evaluated. Weak exogeneity tests then confirmed the endogeneity of MP, followed by diagnostic checks to ensure that all the residuals were well behaved.

LM2 and LSMT showed positive relationships with MP, although neither of them was significant. On the other hand, FD, LCPS and LMCAP showed negative relationships with MP, with those of FD and LMCAP emerging as the significant relationships. The impulse response and variance decomposition analyses showed that MP itself explains most of the forecast error variance, whilst the rest of the variables explain very little of the proportions of variation in MP.

CHAPTER SIX:

SUMMARY OF FINDINGS, POLICY RECOMMENDATIONS AND AREAS FOR FURTHER RESEARCH

6.1 SUMMARY OF FINDINGS

This study set out to investigate the long run relationships that exist between the development of the financial system and the mining sector of South Africa from 1988-2008 using monthly data. This was done to assess which of the financial systems, if any, had a more significant long-term relationship with the mining sector, with the view of giving policy recommendations with regard to which of the two financial systems to concentrate upon when targeting development in the mining sector in South Africa. The study explored a broad range of empirical literature on the relationship between financial system development and overall economic growth, or particular areas of an economy.

In order to address our objectives, two analytical approaches were used. Firstly, we used the principal component analysis to develop a composite index for the entire financial system. Secondly we examined the long run relationships between the financial systems and the mining sector using the Johansen Cointegration approach.

The variables used in the study are: an index for total mining production, proxy for financial development, credit to the private sector, M2, market capitalization and secondary market turnover. The study also included control variables, and these are trade openness, nominal exchange rate and inflation. Cointegrating vectors were found in all five models though only two models showed true cointegrating vectors where LMP was found to be endogenous. In these two models we found that LCPS has a negative but insignificant relationship with LMP, while the proxy for financial development FD has a significant but also negative relationship with mining production. These findings were in contradiction with both theory and empirical literature as both suggest a positive relationship between financial system development and economic growth.

From the results, we noticed that it is difficult to determine which of the two financial systems contributes more to mining sector production, as all but one of the variables delivered insignificant results. However, when we used the composite index of the entire financial system,

we found a negative and significant long run relationship between financial system development and growth in mining sector production, implying that the financial system might not have contributed much in the growth of the mining sector development in South Africa. The result highlights the importance of using the financial system development index in assessing the contributions of both the banking and stock market systems in economic growth. This is as revealed by the variance decomposition analysis which show that in Model 2, the largest contribution to LMP comes from the LNEX control variable; while in Model 1, the financial system index FD accounts for more significant portion of LMP than the individual proxies for financial development. This finding therefore allows us to draw a clear conclusion on the overall contribution of the mining sector to the positive relationships found in previous studies. This therefore suggests that individual or combined contributions of the other influential sectors to economic growth determine a more significant portion of the positive empirical findings.

Among the other macroeconomic factors considered in the model, the results show that the nominal exchange rate has a significant negative effect on the performance of the mining sector; trade openness is found to have mixed results; while inflation has a significant negative effect. The dummy variable presenting political liberation reveals that there is a positive and significant relationship between the production of the mining sector and the political liberation of South Africa, which is an indication that higher mining production might have been induced by improved political atmosphere after independence in 1994.

6.2 POLICY IMPLICATIONS AND RECOMMENDATIONS

This study has a number of policy implications. First, the presence of an overall negative relationship between financial system development and mining sector production implies that financial systems do not necessarily impact sectors within the economy the same way they do when considered as a whole. If this interpretation holds, it suggests that for developments within the financial systems to be felt in the mining sector, these developments have to be concentrated more on those areas within the financial systems which have shown positive but insignificant relationships with mining sector production. The study revealed that LM2 and LSMT showed positive relationships with the growth of the mining sector. These two were found to be the only two with positive relationships, and as a result of their contributions being insignificant, the overall relationship between the entire financial system and the mining sector was found to be negative. Therefore, considering the highlighted importance of the mining sector to overall

economic growth, this study suggests that policy thrusts should be made towards M2 and SMT in order to increase the contributions of these to the overall relationship between the entire financial system and the production of the mining sector.

Second, one of the control variables, nominal exchange rate, showed a strong positive relationship with mining sector production. This implies that for impacts directed specifically towards the mining sector to be felt, monetary policies should focus on appreciating the South African currency, as this holds a strong positive relationship with this major role player in the South African economy.

6.3 LIMITATIONS OF THE STUDY AND AREAS FOR FURTHER RESEARCH

The major limitation of this study was the limited amount of empirical literature on sector specific relationships with financial system developments. This therefore meant that the majority of a priori expectations were according to literature based on the relationships between financial system growth and economic growth rather than on sectoral studies.

This study has revealed that the development of the financial system has a negative relationship with the production of the mining sector in the country specific case of South Africa. As such it has become obvious that considering the a priori assumption which suggests a positive relationship between the development of the financial system and economic growth, that the mining sector is not a very influential part to this assumption. Therefore other sectors in the economy have greater influence on the economy than that of the mining sector. For empirical studies, this study therefore proposes that further research can test what the relationships may be between other influential sectors of the economy and the development of the financial system. This way we can begin to determine which sectors are more influential towards economic growth, and in doing this determine how policies can be adjusted in order to ensure that the maximum possible impact is felt from the development of the financial systems on the influential sectors, and ultimately the entire economy.

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APPENDIX

MULTIVARIATE JOHANSEN COINTEGRATION TEST

TABLE A1: SERIAL CORRELATION TESTS

Model 1:

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 10/14/10 Time: 19:34
Sample: 1988M01 2008M12
Included observations: 250

Lags	LM-Stat	Prob
1	72.34966	0.0000
2	62.26667	0.0001
3	52.51623	0.0010
4	38.97150	0.0371
5	30.45558	0.2077
6	35.68030	0.0766
7	33.97584	0.1084
8	31.48462	0.1735
9	29.47873	0.2444
10	42.33504	0.0165
11	29.71789	0.2350
12	88.33459	0.0000

Probs from chi-square with 25 df.

Model 2

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 10/14/10 Time: 21:03
Sample: 1988M01 2008M12
Included observations: 250

Lags	LM-Stat	Prob
1	68.79683	0.0000
2	69.59396	0.0000
3	67.66138	0.0000
4	37.14041	0.0560
5	24.85838	0.4703
6	42.99343	0.0140
7	22.56442	0.6030
8	34.16595	0.1044
9	28.84295	0.2705
10	28.53437	0.2838
11	31.90082	0.1609
12	77.02947	0.0000

Probs from chi-square with 25 df.

Model 3:

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 10/18/10 Time: 23:10
Sample: 1988M01 2008M12
Included observations: 250

Lags	LM-Stat	Prob
1	70.95933	0.0000
2	51.31288	0.0015
3	63.63023	0.0000
4	32.54025	0.1430
5	30.76452	0.1969
6	39.15858	0.0355
7	42.19774	0.0171
8	40.58690	0.0254
9	34.08799	0.1060
10	34.93479	0.0894
11	37.71696	0.0493
12	83.84312	0.0000

Probs from chi-square with 25 df.

Model 4:

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 10/16/10 Time: 00:05
Sample: 1988M01 2008M12
Included observations: 250

Lags	LM-Stat	Prob
1	88.82211	0.0000
2	76.84805	0.0000
3	61.27557	0.0001
4	29.91215	0.2276
5	22.60392	0.6007
6	38.47678	0.0415
7	29.77952	0.2327
8	24.45834	0.4930
9	32.40203	0.1467
10	32.03809	0.1569
11	29.75382	0.2336
12	163.5538	0.0000

Probs from chi-square with 25 df.

Model 5:

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 10/16/10 Time: 00:11
Sample: 1988M01 2008M12
Included observations: 250

Lags	LM-Stat	Prob
1	85.54514	0.0000
2	79.04959	0.0000
3	53.98981	0.0007
4	44.49062	0.0096
5	47.51512	0.0043
6	39.38701	0.0337
7	38.39996	0.0423
8	39.10713	0.0359
9	28.87936	0.2690
10	47.71642	0.0040
11	27.32058	0.3401
12	100.2783	0.0000

Probs from chi-square with 25 df.

TABLE A2: VECTOR ERROR CORRECTION MODEL RESULTS

Model 1:

Vector Error Correction Estimates

Date: 10/29/10 Time: 01:06

Sample (adjusted): 1988M10 2008M12

Included observations: 243 after adjustments

Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LMP(-1)	1.000000
FD(-1)	0.005782
	(0.00210)
	[2.75007]
LNEX(-1)	-0.176241
	(0.02250)
	[-7.83308]
LOPEN(-1)	0.045238
	(0.03961)
	[1.14208]
LCPI(-1)	0.164695
	(0.05416)
	[3.04078]
DUMMY(-1)	-2.08E-05
	(0.00522)
	[-0.00398]
@TREND(88M01)	-0.001046
	(0.00016)
	[-6.47209]
C	-1.824829

Error Correction:	D(LMP)	D(FD)	D(LNEX)	D(LOPEN)	D(LCPI)	D(DUMMY)
CointEq1	-0.431628	3.655577	0.700273	-1.317494	-0.009497	-0.170078
	(0.14223)	(1.60548)	(0.15195)	(0.48065)	(0.02532)	(0.81384)
	[-3.03469]	[2.27694]	[4.60844]	[-2.74106]	[-0.37508]	[-0.20898]

Model 2:

Vector Error Correction Estimates
Date: 10/29/10 Time: 00:34
Sample (adjusted): 1988M10 2008M12
Included observations: 243 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LMP(-1)	1.000000
LCPS(-1)	0.037092
	(0.07148)
	[0.51889]
LNEX(-1)	-0.138789
	(0.04125)
	[-3.36472]
LOPEN(-1)	-0.090842
	(0.06826)
	[-1.33086]
LCPI(-1)	-0.018239
	(0.08654)
	[-0.21077]
DUMMY(-1)	0.035134
	(0.00883)
	[3.98002]
@TREND(88M01)	-0.000293
	(0.00023)
	[-1.27700]
C	-1.594652

Error Correction:	D(LMP)	D(LCPS)	D(LNEX)	D(LOPEN)	D(LCPI)	D(DUMMY)
CointEq1	-0.256462	0.154313	0.311610	0.363506	-0.041518	-0.919917
	(0.09241)	(0.03849)	(0.09943)	(0.30633)	(0.01563)	(0.52227)
	[-2.77539]	[4.00944]	[3.13410]	[1.18664]	[-2.65649]	[-1.76138]

Model 3:

Vector Error Correction Estimates
Date: 10/29/10 Time: 01:19
Sample (adjusted): 1988M06 2008M12
Included observations: 247 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LMP(-1)	1.000000
LM2(-1)	-2.470971
	(1.89630)
	[-1.30305]
LNEX(-1)	-2.326390
	(0.88541)
	[-2.62746]
LOPEN(-1)	-8.782790
	(1.27214)
	[-6.90394]
LCPI(-1)	-9.305844
	(1.87762)
	[-4.95620]
DUMMY(-1)	0.731040
	(0.18689)
	[3.91164]
@TREND(88M01)	0.026963
	(0.00531)
	[5.07975]
C	36.12394

Error Correction:	D(LMP)	D(LM2)	D(LNEX)	D(LOPEN)	D(LCPI)	D(DUMMY)
CointEq1	-0.003174	-0.001804	0.001563	0.067948	-9.89E-05	0.005816
	(0.00297)	(0.00173)	(0.00330)	(0.00942)	(0.00054)	(0.01635)
	[-1.06721]	[-1.04073]	[0.47300]	[7.20962]	[-0.18311]	[0.35571]

Model 4:

Vector Error Correction Estimates
Date: 10/29/10 Time: 01:34
Sample (adjusted): 1988M11 2008M12
Included observations: 242 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LMP(-1)	1.000000
LMCAP(-1)	0.396209
	(0.07715)
	[5.13581]
LNEX(-1)	-0.367136
	(0.12503)
	[-2.93637]
LOPEN(-1)	0.739531
	(0.19830)
	[3.72931]
LCPI(-1)	1.158801
	(0.26007)
	[4.45575]
DUMMY(-1)	-0.171135
	(0.02940)
	[-5.82177]
@TREND(88M01)	-0.004492
	(0.00073)
	[-6.18709]
C	-4.572182

Error Correction:	D(LMP)	D(LMCAP)	D(LNEX)	D(LOPEN)	D(LCPI)	D(DUMMY)
CointEq1	-0.037157	-0.065836	0.061495	-0.379128	0.014332	0.842132
	(0.03394)	(0.05256)	(0.03652)	(0.11237)	(0.00558)	(0.18491)
	[-1.09481]	[-1.25260]	[1.68390]	[-3.37389]	[2.56922]	[4.55434]

Model 5:

Vector Error Correction Estimates
Date: 10/29/10 Time: 01:45
Sample (adjusted): 1988M12 2008M12
Included observations: 241 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LMP(-1)	1.000000
LSMT(-1)	-0.012064
	(0.03536)
	[-0.34119]
LNEX(-1)	0.137378
	(0.10555)
	[1.30152]
LOPEN(-1)	0.855813
	(0.18828)
	[4.54548]
LCPI(-1)	0.981145
	(0.23689)
	[4.14175]
DUMMY(-1)	-0.083902
	(0.02357)
	[-3.55907]
@TREND(88M01)	-0.002866
	(0.00061)
	[-4.72803]
C	-4.899790

Error Correction:	D(LMP)	D(LSMT)	D(LNEX)	D(LOPEN)	D(LCPI)	D(DUMMY)
CointEq1	0.025030	0.474799	-0.019543	-0.588648	0.009840	0.598704
	(0.04436)	(0.29049)	(0.04842)	(0.13853)	(0.00749)	(0.25158)
	[0.56421]	[1.63448]	[-0.40363]	[-4.24934]	[1.31434]	[2.37975]

TABLE A3: VARIANCE DECOMPOSITION

Model 1:

Variance Decomposition of LMP

Period	S.E.	LMP	FD	LNEX	LOPEN	LCPI	DUMMY
1	0.011501	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.012038	94.50760	0.033599	4.113099	0.031658	1.058742	0.255302
3	0.013028	92.10815	1.792733	4.223025	0.621857	0.904638	0.349597
4	0.013484	89.44824	3.043951	5.710603	0.592211	0.878474	0.326520
5	0.013981	86.43277	3.992615	7.385472	0.898158	0.865441	0.425548
6	0.014554	85.21977	3.822977	8.143457	0.885528	1.041810	0.886459
7	0.014957	83.42202	3.898495	9.343227	1.047060	1.343209	0.945991
8	0.015358	81.16003	3.950355	10.80723	1.321350	1.274096	1.486946
9	0.015635	80.46718	4.593594	10.87315	1.276562	1.354827	1.434684
10	0.015871	79.97003	4.464255	11.54721	1.263726	1.321583	1.433200
11	0.016190	79.30876	4.339428	12.23792	1.299576	1.322640	1.491674
12	0.016495	79.17991	4.180974	12.51927	1.282052	1.286003	1.551788
13	0.016885	78.94544	4.196499	12.71340	1.236223	1.227341	1.681100
14	0.017250	78.82062	4.084117	13.04414	1.192944	1.191089	1.667089
15	0.017630	78.33580	3.974730	13.74535	1.142039	1.151066	1.651013
16	0.017994	77.74667	3.957446	14.28074	1.214305	1.105426	1.695409
17	0.018336	77.57542	3.920040	14.46252	1.229878	1.068933	1.743206
18	0.018723	77.42307	3.807409	14.74608	1.203636	1.053738	1.766066
19	0.019063	77.10706	3.825979	15.05640	1.204345	1.034809	1.771412
20	0.019397	76.90649	3.768122	15.33265	1.209680	1.011615	1.771443

Model 2:

Variance Decomposition of LMP

Period	S.E.	LMP	LCPS	LNEX	LOPEN	LCPI	DUMMY
1	0.011685	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.012235	94.79854	0.090311	3.532714	0.504199	0.499039	0.575198
3	0.013039	94.59639	0.086210	3.667904	0.444349	0.472381	0.732762
4	0.013392	92.59150	0.169322	5.138227	0.794506	0.530888	0.775553
5	0.013882	89.54940	0.157857	6.304068	2.090178	0.905283	0.993213
6	0.014486	88.23519	0.330831	6.497244	2.304721	0.856576	1.775438
7	0.014952	86.29541	0.486906	7.336363	3.182624	0.832145	1.866553
8	0.015389	83.63699	0.463913	8.304583	3.880249	0.955856	2.758413
9	0.015626	83.64794	0.586025	8.232114	3.917856	0.936789	2.679275
10	0.015913	83.10598	0.632693	8.751872	3.801736	0.919789	2.787932
11	0.016392	82.02288	0.601938	9.599543	4.092096	0.867037	2.816508
12	0.016765	81.47304	0.585368	9.949676	4.083207	0.888285	3.020427
13	0.017193	81.00352	0.557344	10.41867	4.043349	0.852752	3.124368
14	0.017550	80.69318	0.537572	10.84873	3.954436	0.828702	3.137388

15	0.017943	80.25343	0.522541	11.50584	3.804857	0.811779	3.101561
16	0.018299	79.60285	0.516774	12.00762	3.898459	0.781429	3.192862
17	0.018630	79.48315	0.500674	12.09521	3.936611	0.755026	3.229325
18	0.018968	79.25040	0.484522	12.32790	3.903369	0.751893	3.281913
19	0.019267	78.98727	0.492667	12.53074	3.960838	0.733549	3.294938
20	0.019570	78.79594	0.477792	12.70470	3.991516	0.712626	3.317426

Model 3:

Variance Decomposition of LMP

Period	S.E.	LMP	LM2	LNEX	LOPEN	LCPI	DUMMY
1	0.011581	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.012052	97.46834	0.044052	1.587685	0.068867	0.621123	0.209936
3	0.012989	97.10434	0.086471	1.788095	0.131441	0.539921	0.349730
4	0.013417	96.70580	0.089205	2.140481	0.123786	0.532110	0.408623
5	0.014090	95.48796	0.183363	2.226370	0.783320	0.820599	0.498389
6	0.015058	95.69309	0.162100	2.185982	0.685936	0.773867	0.499025
7	0.015671	95.12976	0.149889	2.403284	0.938457	0.737326	0.641289
8	0.016341	94.87627	0.147816	2.450647	1.065553	0.734547	0.725166
9	0.016923	94.81943	0.140347	2.511029	1.022293	0.687403	0.819495
10	0.017497	94.64133	0.138290	2.569436	1.115691	0.661665	0.873591
11	0.018068	94.62752	0.146776	2.563574	1.112988	0.629602	0.919543
12	0.018617	94.58700	0.147360	2.582274	1.119327	0.594757	0.969284
13	0.019140	94.52707	0.147288	2.594091	1.159461	0.570754	1.001331
14	0.019657	94.50926	0.153466	2.585736	1.171713	0.543583	1.036243
15	0.020158	94.48537	0.155011	2.588205	1.188379	0.518904	1.064133
16	0.020643	94.46416	0.157348	2.583291	1.209445	0.497263	1.088496
17	0.021123	94.45029	0.162141	2.573843	1.225268	0.475862	1.112598
18	0.021586	94.43820	0.164652	2.568026	1.239668	0.456570	1.132883
19	0.022042	94.42872	0.167811	2.558495	1.255198	0.438600	1.151179
20	0.022489	94.42035	0.171827	2.548642	1.269076	0.421778	1.168323

Model 4:

Variance Decomposition of LMP

Period	S.E.	LMP	LMCAP	LNEX	LOPEN	LCPI	DUMMY
1	0.011746	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.012342	96.00171	0.124642	2.686890	0.050846	1.033493	0.102419
3	0.013257	95.55777	0.682283	2.422169	0.210135	1.012962	0.114682
4	0.013683	94.41200	0.702524	3.568610	0.201869	1.007351	0.107650
5	0.014222	91.09197	2.752650	4.496015	0.592391	0.932766	0.134203
6	0.014927	90.39751	2.516770	4.876815	0.539138	1.106559	0.563213
7	0.015440	88.78539	3.144969	5.485675	0.578768	1.478038	0.527156
8	0.015833	87.38843	3.022342	6.790335	0.550614	1.407234	0.841044
9	0.016225	86.90362	3.358784	6.588904	0.730847	1.513602	0.904241

10	0.016766	85.24857	3.307729	7.260435	1.609243	1.567508	1.006513
11	0.017408	84.48770	3.637074	7.800615	1.517680	1.609161	0.947774
12	0.017826	84.45624	3.547769	7.965169	1.539940	1.584161	0.906718
13	0.018374	84.35070	3.534394	8.265988	1.480426	1.514875	0.853614
14	0.018823	83.98365	3.696283	8.552544	1.444479	1.462481	0.860559
15	0.019248	83.47653	3.692780	9.045210	1.513088	1.428342	0.844053
16	0.019668	83.29815	3.736329	9.322349	1.460281	1.374357	0.808539
17	0.020037	83.38285	3.715085	9.387552	1.406902	1.325451	0.782156
18	0.020430	83.33380	3.589494	9.567433	1.433267	1.322370	0.753633
19	0.020815	83.52853	3.494218	9.584281	1.382640	1.278972	0.731364
20	0.021190	83.46576	3.448798	9.779188	1.334263	1.261099	0.710895

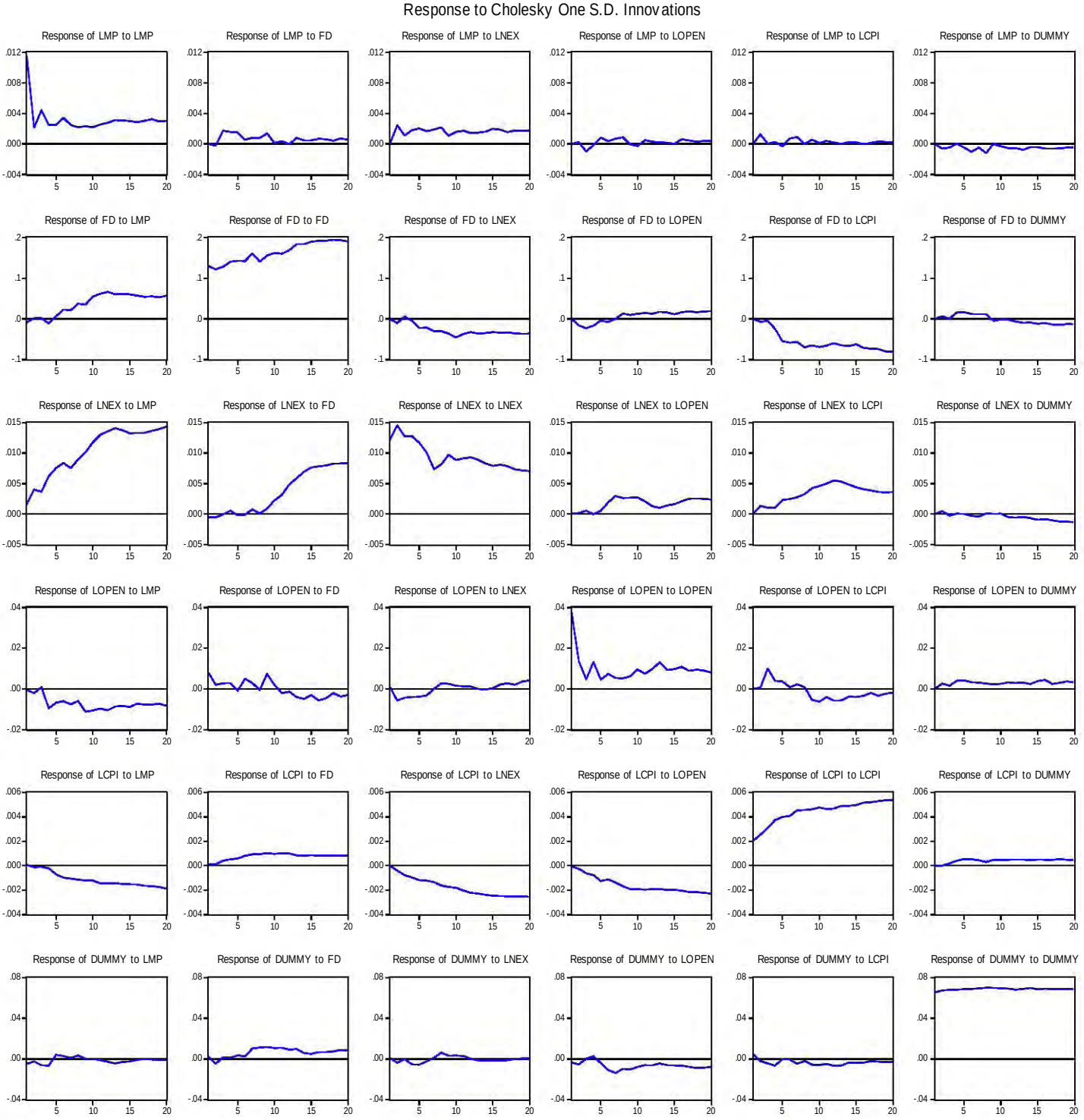
Model 5:

Variance Decomposition of LMP

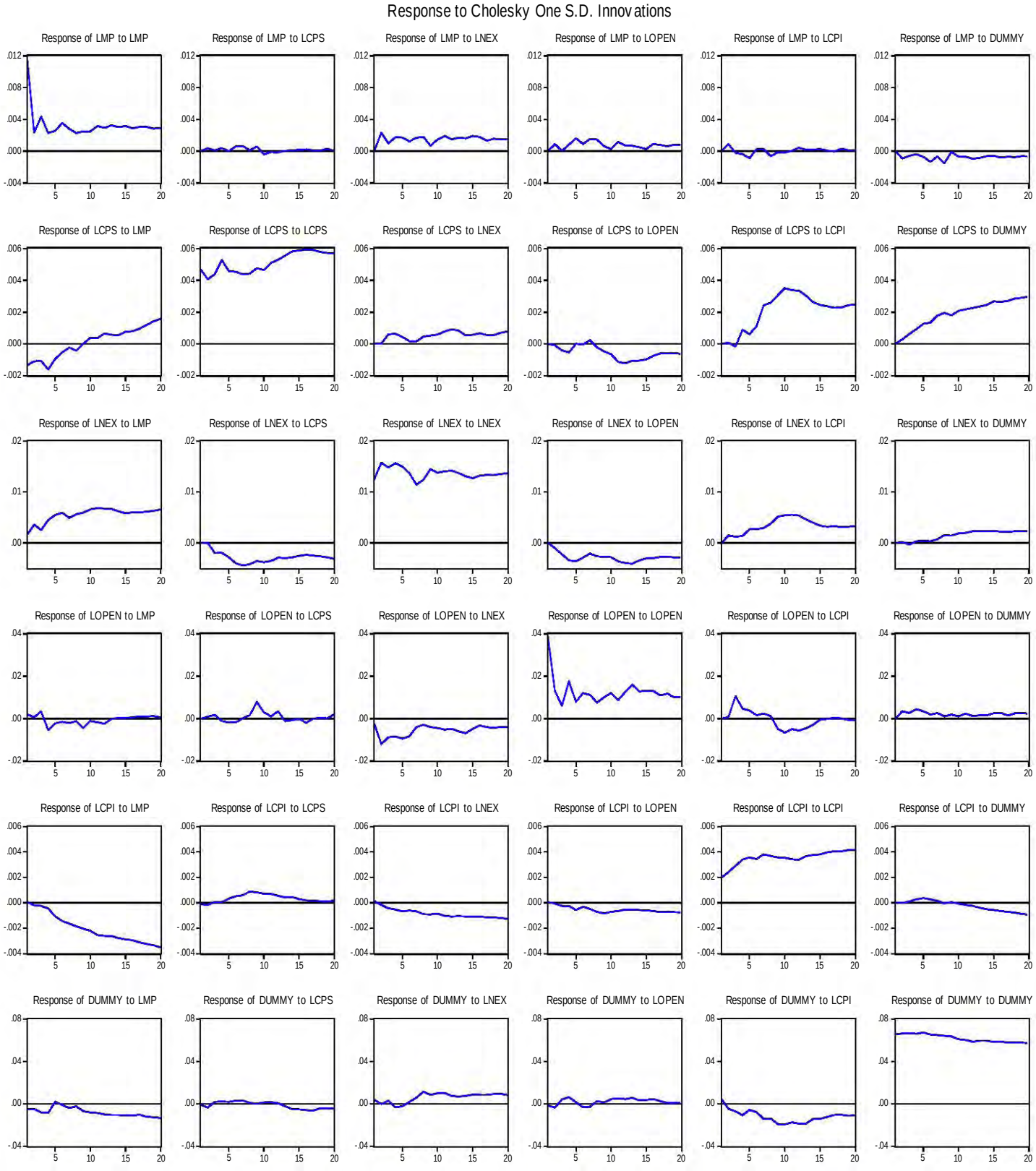
Period	S.E.	LMP	LSMT	LNEX	LOPEN	LCPI	DUMMY
1	0.011688	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.012201	96.36461	0.000222	2.271555	0.569950	0.447145	0.346514
3	0.013327	96.07890	0.360452	1.907785	0.694636	0.424724	0.533507
4	0.013791	94.61335	0.364019	2.887239	0.921317	0.683038	0.531035
5	0.014273	92.56209	0.391885	3.541458	2.182877	0.638229	0.683464
6	0.014997	90.13071	1.971921	3.491415	2.177996	0.854760	1.373201
7	0.015411	89.43933	2.101310	3.782740	2.342551	1.009016	1.325055
8	0.015807	88.26966	2.091020	4.425718	2.234508	0.969207	2.009883
9	0.016114	88.45497	2.018506	4.267877	2.193621	1.126761	1.938264
10	0.016543	87.29070	2.438516	5.050520	2.140125	1.232448	1.847687
11	0.017048	86.75397	2.484126	5.158273	2.391103	1.468142	1.744386
12	0.017564	86.51890	2.549912	5.409321	2.308053	1.546791	1.667025
13	0.018172	86.24623	2.394594	5.910760	2.182593	1.707769	1.558051
14	0.018654	85.81240	2.394746	6.333604	2.073049	1.889323	1.496883
15	0.019124	84.81105	2.669206	6.966005	1.982008	2.085420	1.486313
16	0.019483	84.29570	2.572536	7.475730	2.027084	2.196900	1.432052
17	0.019857	84.15917	2.672541	7.638201	1.982575	2.166221	1.381288
18	0.020234	83.59320	2.895217	8.022276	1.909824	2.238055	1.341430
19	0.020591	83.58387	2.893147	8.072485	1.872886	2.280194	1.297413
20	0.020918	83.53537	2.823893	8.314351	1.819361	2.247942	1.259079

FIGURE A1: IMPULSE RESPONSE

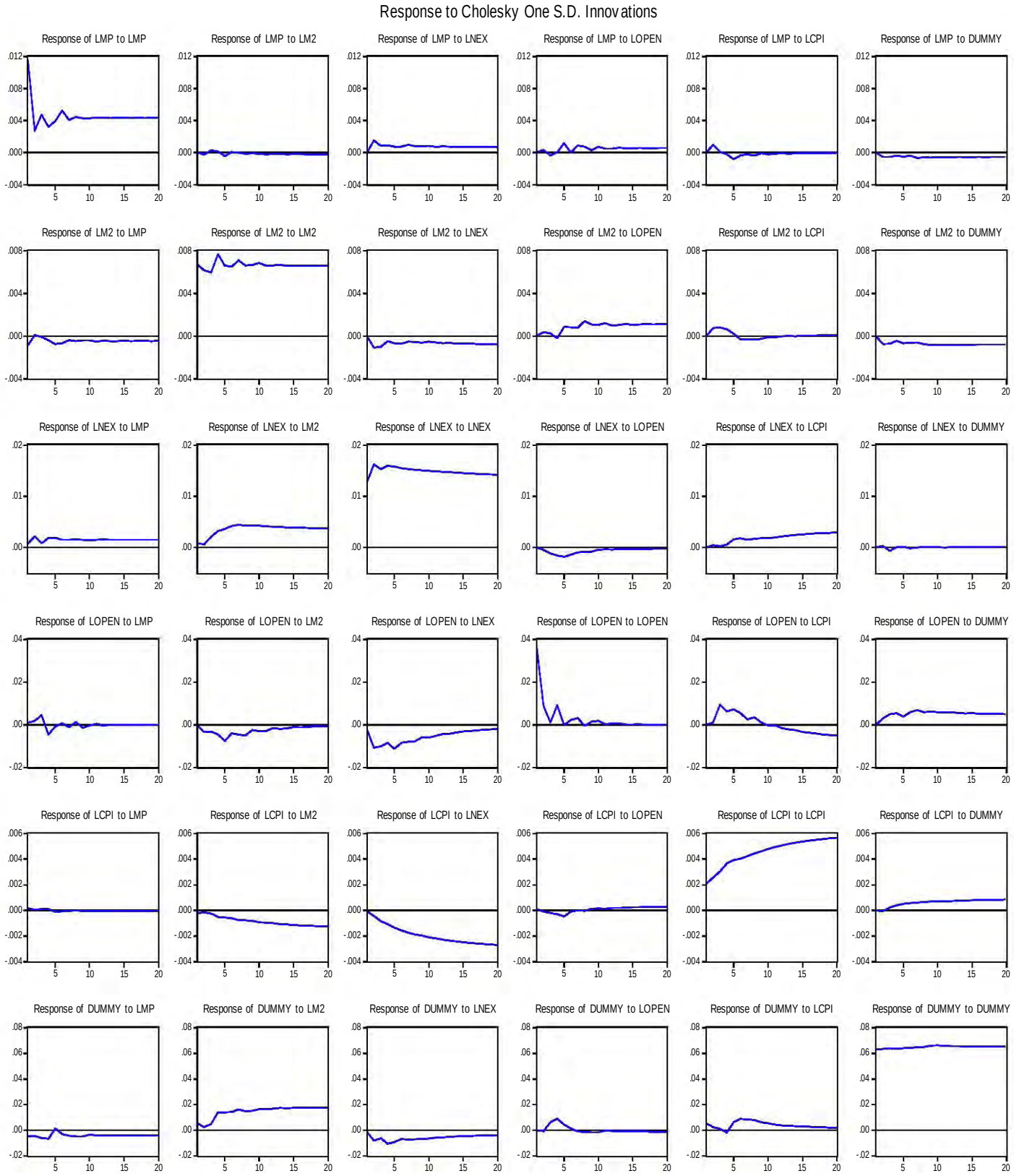
Model 1:



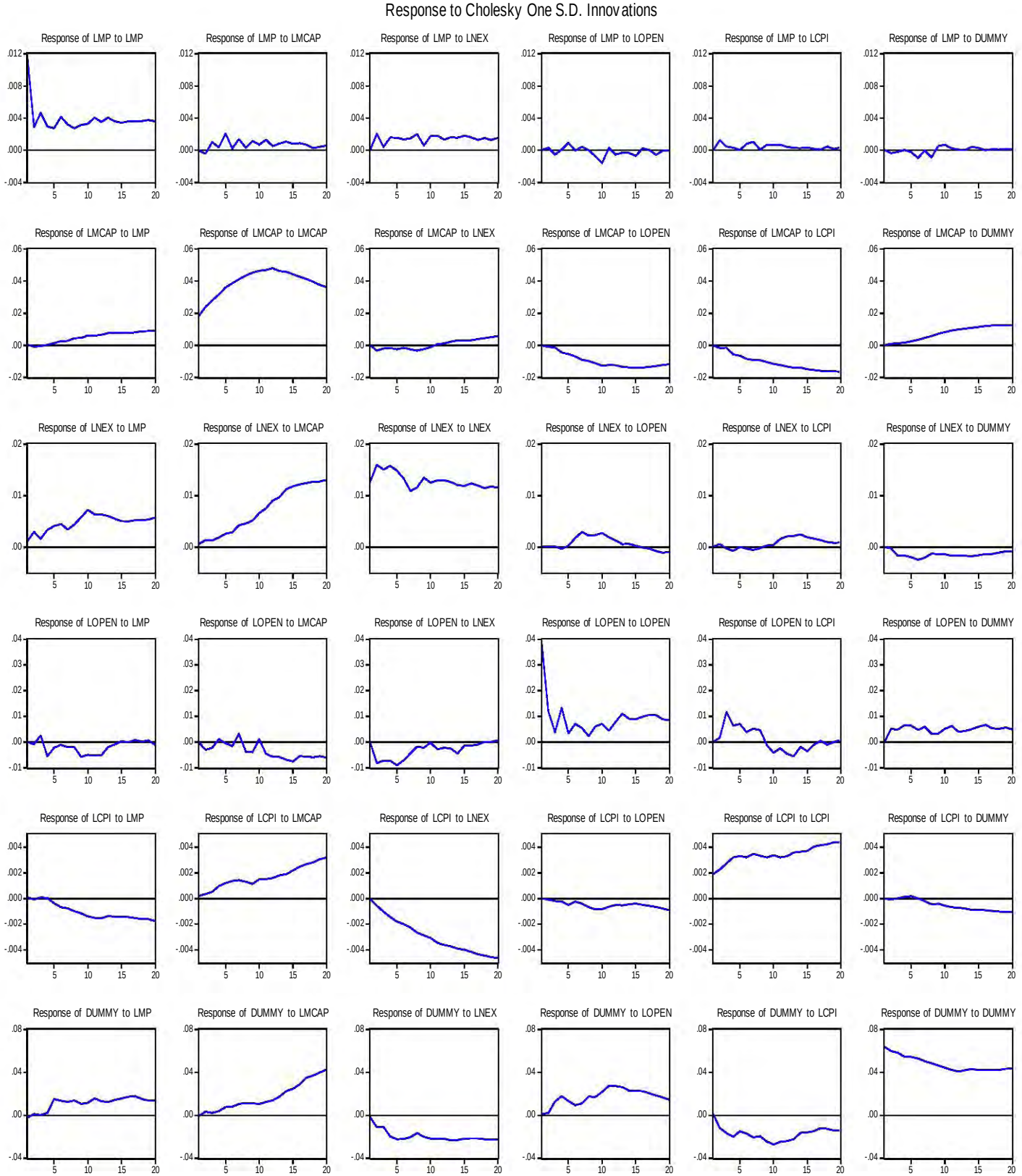
Model 2:


Response to Cholesky One S.D. Innovations
Response of LMP to LMP
Response of LMP to LCPS
Response of LMP to LNEX
Response of LMP to LOPEN
Response of LMP to LCPI
Response of LMP to DUMMY
Response of LCPS to LMP
Response of LCPS to LCPS
Response of LCPS to LNEX
Response of LCPS to LOPEN
Response of LCPS to LCPI
Response of LCPS to DUMMY
Response of LNEX to LMP
Response of LNEX to LCPS
Response of LNEX to LNEX
Response of LNEX to LOPEN
Response of LNEX to LCPI
Response of LNEX to DUMMY
Response of LOPEN to LMP
Response of LOPEN to LCPS
Response of LOPEN to LNEX
Response of LOPEN to LOPEN
Response of LOPEN to LCPI
Response of LOPEN to DUMMY
Response of LCPI to LMP
Response of LCPI to LCPS
Response of LCPI to LNEX
Response of LCPI to LOPEN
Response of LCPI to LCPI
Response of LCPI to DUMMY
Response of DUMMY to LMP
Response of DUMMY to LCPS
Response of DUMMY to LNEX
Response of DUMMY to LOPEN
Response of DUMMY to LCPI
Response of DUMMY to DUMMY

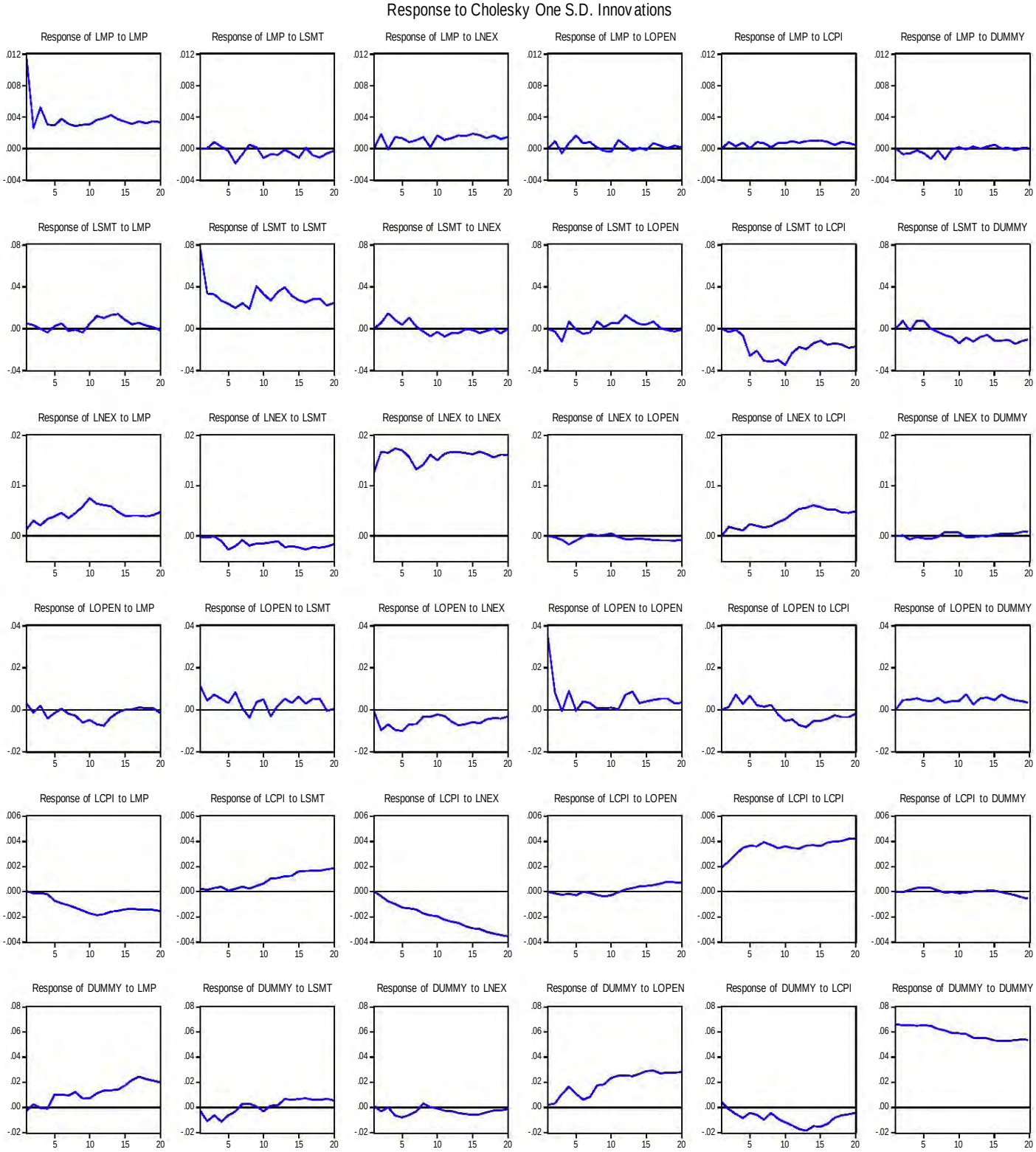
Model 3:


Response to Cholesky One S.D. Innovations
Response of LMP to LMP
Response of LMP to LM2
Response of LMP to LNEX
Response of LMP to LOPEN
Response of LMP to LCPI
Response of LMP to DUMMY
Response of LM2 to LMP
Response of LM2 to LM2
Response of LM2 to LNEX
Response of LM2 to LOPEN
Response of LM2 to LCPI
Response of LM2 to DUMMY
Response of LNEX to LMP
Response of LNEX to LM2
Response of LNEX to LNEX
Response of LNEX to LOPEN
Response of LNEX to LCPI
Response of LNEX to DUMMY
Response of LOPEN to LMP
Response of LOPEN to LM2
Response of LOPEN to LNEX
Response of LOPEN to LOPEN
Response of LOPEN to LCPI
Response of LOPEN to DUMMY
Response of LCPI to LMP
Response of LCPI to LM2
Response of LCPI to LNEX
Response of LCPI to LOPEN
Response of LCPI to LCPI
Response of LCPI to DUMMY
Response of DUMMY to LMP
Response of DUMMY to LM2
Response of DUMMY to LNEX
Response of DUMMY to LOPEN
Response of DUMMY to LCPI
Response of DUMMY to DUMMY

Model 4:


Response to Cholesky One S.D. Innovations
Response of LMP to LMP
Response of LMP to LMCAP
Response of LMP to LNEX
Response of LMP to LOPEN
Response of LMP to LCPI
Response of LMP to DUMMY
Response of LMCAP to LMP
Response of LMCAP to LMCAP
Response of LMCAP to LNEX
Response of LMCAP to LOPEN
Response of LMCAP to LCPI
Response of LMCAP to DUMMY
Response of LNEX to LMP
Response of LNEX to LMCAP
Response of LNEX to LNEX
Response of LNEX to LOPEN
Response of LNEX to LCPI
Response of LNEX to DUMMY
Response of LOPEN to LMP
Response of LOPEN to LMCAP
Response of LOPEN to LNEX
Response of LOPEN to LOPEN
Response of LOPEN to LCPI
Response of LOPEN to DUMMY
Response of LCPI to LMP
Response of LCPI to LMCAP
Response of LCPI to LNEX
Response of LCPI to LOPEN
Response of LCPI to LCPI
Response of LCPI to DUMMY
Response of DUMMY to LMP
Response of DUMMY to LMCAP
Response of DUMMY to LNEX
Response of DUMMY to LOPEN
Response of DUMMY to LCPI
Response of DUMMY to DUMMY

Model 5:


Response to Cholesky One S.D. Innovations
Response of LMP to LMP
Response of LMP to LSMT
Response of LMP to LNEX
Response of LMP to LOPEN
Response of LMP to LCPI
Response of LMP to DUMMY
Response of LSMT to LMP
Response of LSMT to LSMT
Response of LSMT to LNEX
Response of LSMT to LOPEN
Response of LSMT to LCPI
Response of LSMT to DUMMY
Response of LNEX to LMP
Response of LNEX to LSMT
Response of LNEX to LNEX
Response of LNEX to LOPEN
Response of LNEX to LCPI
Response of LNEX to DUMMY
Response of LOPEN to LMP
Response of LOPEN to LSMT
Response of LOPEN to LNEX
Response of LOPEN to LOPEN
Response of LOPEN to LCPI
Response of LOPEN to DUMMY
Response of LCPI to LMP
Response of LCPI to LSMT
Response of LCPI to LNEX
Response of LCPI to LOPEN
Response of LCPI to LCPI
Response of LCPI to DUMMY
Response of DUMMY to LMP
Response of DUMMY to LSMT
Response of DUMMY to LNEX
Response of DUMMY to LOPEN
Response of DUMMY to LCPI
Response of DUMMY to DUMMY