The competition –stability nexus of South African Banks.

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by

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DECLARATION

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Linear Zhou 20 June 2017

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ABSTRACT

This study is necessitated by the debate about competition in the banking sector of South Africa based on the dominance of the big four banks and is premised on establishing the effect of competition on financial stability. It is propelled by the reactionary recalibration of fiscal and monetary policies to reinstate system stability owing to post-crises system instabilities which manifested over 1990-2015 in addition to the aggregation of competition indices at country and bank level as well as the misnomer that likens concentration to competition. The research complements existing literature by and inferring the effect of competition on stability, over the duration 1990-2015 and debunking the concentration-competition misnomer. It also maps the competitive terrain of the South African banking market by utilising a two- pronged estimation approach. Initially competition is estimated using a log-transformation method to calculate the Lerner, Adjusted Lerner indices and H-statistic. Followed by, calculation of the Z-Score. The study then uses the results from the three indices to exhaustively affirm monopolistic competition as the predominant competitive environment in South Africa. Using the Z-score and Lerner indices with OLS estimation methods incorporating robust standard errors, the study posits the relationship between competition and stability and suggests that South Africa is inclined towards competition-fragility. These finding are aligned with preceding studies of a similar nature and have implications for policy formulation in addition to adding value to banking theories on banking crises and competition.

The outcomes have connotations for policy formulation, suggesting that while South African Banks are monopolistically competitive, there is room to harness the spill overs from macro-economic indicators of financial health and stability for instance through improved access to finance and bank alliances that will enhance the prospects of Small and Medium Enterprises. In addition, the South African Government through its agency of regulation and supervision is better placed to maintain financial stability armed with the mechanism for setting reforms in a monopolistic competition environment.

Key words

Competition ; Stability ; Lerner ; Panzar-Rosse; Z-Score; Concentration ; South Africa

ACRONYMS AND ABBREVIATIONS

Amalgamated banks of South Africa	ABSA
Federal Reserve Economic Data	FRED
First National bank	FNB
Generalised Method of Moments	GMM
Gross Domestic Product	GDP
International Monetary Fund	IMF
Kwiatkowski, Phillips, Schmidt, and Shin	KPPS
Nedbank Limited	NEDBANK
Ordinary Least Squares	OLS
Organisation for Economic Cooperation and Development	OECD
Panzar- Rosse	P-R
Price Waterhouse Coopers	PWC
Small and Medium Enterprises	SME
South African Reserve Bank,	SARB
Standard Bank Of South Africa	STANDARD
The Global Financial Crisis	GFC

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CHAPTER 1
INTRODUCTION

1.1. CONTEXT & BACKGROUND

A competitive banking sector is the foundation of a sound economy as competitive banking implies efficient allocation in the provision of banking products and services to the savers and borrowers. Hence, a lack of competition among banks is detrimental to the overall performance of the economy in light of their role in the transmission of monetary policy via the leeway banks have on the loans and deposits market.

Financial system stability policy rose to prominence following the Global Financial Crisis (GFC) of 2008 because financial authorities had concentrated on monetary policy issues while liberalising the financial sector and this resulted in more banks and non-bank institutions offering innovative products. The financial stability policy was necessitated by the contagion effect because of the connectivity and reliance of the globalised financial systems among economies the world over as they competed in the lending space.

Africa appeared to be insulated from the severe impact of the GFC because of its predominantly underdeveloped markets and low-key integration with global markets (Kasekende, Ndikumana &Rajhi, 2009). Furthermore, for South Africa, Maredza and Ikhide (2013) reported that the cushioning to the GFC was attributed to the presence of comprehensive regulation and firm macroeconomic policies. South Africa's status as an emerging economy and its global interlinkages were not to be spared (Lin, Edvinsson, Chen and Beding, 2012). The effects of the GFC manifested through declining and negative GDP figures, rising inflation and unemployment, a widening current account budget deficit as well as declining mining and manufacturing indices for the first half of 2009 (Padayachee, (2012); Kasekende, Ndikumana, Rajhi, (2009) & Lin, Edvinsson, Chen, & Beding, (2013)). As a result of the formation of the Financial Stability Review in 2000, the South African Reserve Bank, "SARB" (2004), adopted financial stability reforms (SARB, 2011), whose necessity was amplified in 2014 by the failure then rescue of African Bank. The bank's failure exposed the extent banks competed by taking on riskier unsecured lenders in the of pursuit of lucrative bottom-lines and trading in hybrid financial products, a view attested to by Tabak, Fazio & Cajueiro (2012) in their study of the relationship between bank risk taking and competition. The subsequent bank rescue package was implemented via a precedential regulatory tool, a "bail-in" (IMF, 2014; Reuters, 2014). This meant that taxpayers would no longer shoulder the burden of collapsed institutions but rather that senior debt instruments (the bank's creditors) would incur a 10% haircut on

their liabilities while the largest 5 banks (whose exposure was minimal) would underwrite the recapitalisation of the good loan book of African Bank and shareholders would forfeit their shares (PWC, 2015). Indirectly, this recapitalisation led to investors taking a proportional cut in their investments held with the big five banks. The pervasiveness of competition in the financial services sector and its' all-encompassing effect on consumer welfare, productivity, economic growth and financial stability cannot be ignored.

There is a trade-off between financial system stability and competition among banks. The latter suggests benefits to consumers from efficiency in financial markets resource allocation and pricing while the former portends innovative bank products and reckless risk-taking as institutions seek to boost their bottom line (OECD, 1998). Competition among banks implies rivalry amongst banks in their service and product provisions, which ranges from retail, commercial and offshore to exotics like derivatives with the aim to garner the market share that will lead to the most lucrative bottom line and this may involve taking more risks.

Researchers have pursued corroboration pertaining to the dynamic relationship between competition and bank soundness by checking whether the financial stability of banks increases or decreases when competition is higher. This research focusses on the elements of financial stability that subsumes the buoyancy of a financial system to non-idiosyncratic turmoil while embracing proficient financial intermediation and the alleviation of the financial repercussions of economic disturbances in order to restore confidence in the system, (Financial Stability Review, 2015).

Studies on financial system stability and competition among banks have been conducted in financial systems globally covering, the United States of America, Europe, Mexico, Russia, Australia, Asia and Africa among others. Schaeck and Cihak (2014) attribute regulatory failures or weak market discipline to the instability of financial systems and hence vie for competition amongst banks.

There is overall concurrence on the inconclusive nature of the interaction between financial system stability and bank competition.

1.2. MOTIVATION

This research was premised on a number of motivating factors.

Firstly, the Global Financial Crisis (GFC) of 2008-2009 caused by sub-prime lending with repercussions such as bank closures and loss of savings for investors. These were experienced globally but were less damaging to the South African economy owing to stringent regulation and supervision by the central bank authorities (SARB, 2012).

Secondly, the African Bank's collapse and the subsequent turmoil in the local bank sector leading to losses for investors, institutions and individuals alike owing to the new bail-in rescue approach that was adopted.

Thirdly between 2001-2002 political stirrups that caused shocks to the economy and impacted banks

Fourthly, to date, existing literature on competition among banks in South Africa has not delved into establishing the relationship nor has it covered the period 1990-2015.

1.3. PROBLEM STATEMENT

This research seeks to establish if competition amongst banks may initiate financial instability or at the slightest be a foundation of risk for financial stability for South African banks in light of the following events and their subsequent effects.

1.3.1. EXPANDED PROBLEM STATEMENT

The inconclusive nature of the relationship between bank competition and financial system stability warrants an investigation because;

- Achieving and maintaining financial stability is a goal of public policy (Crockett, 1997), which if ignored has repercussions of negative large-scale effects on consumer welfare, productivity, economic growth and financial stability as a result of bank's activities Padayachee (2012). Policy makers seek to strike a balance between improving the financial system stability while fostering a fair competitive platform for all financial institutions (Anginer, Demirguc-Kunt & Zhu, 2014).
- The new precedents, (bail-in) to rescuing failing banks that the SARB implemented following African Bank's collapse resulted in absorption of the losses by not only institutional but private individual investors as well(IMF, 2014; Reuters, 2014).
- South Africa's concentrated banks with a concentration ratio exceeding 90% (McGregor BFA, 2015) accruing to the big four banks, ABSA, Standard Bank, Nedbank and First National Bank (Verhoef, 2009) begs the question whether the

tendency is for a landscape of collusion (cartel) rather than competition and the resulting impact on financial system stability. By the end of 2015 bank market shares were dominated by the big four banks as illustrated in figure1.

- Globalisation and the birth of hybrid financial instrument has led the debate about bank competition and financial stability as testament to the contagion felt by the Global Financial Crisis as highlighted by Liu, Molyneux, and Wilson (2013), Horvath, Sendler and Weill (2016). Wherein numerous banks suffered losses and were compelled to source capital privately from their governments.
- Studies on financial stability have largely dwelt on establishing the level of efficiency in the banking system in South Africa Ncube (2009) and Mlambo & Ncube (2011) and bank competition globally (Berger, Klapper & Turk-Ariss 2009) or analysing market structures (Simatele, 2015). With respect to competition among South African banks, precedent studies have dwelt on; testing for the level of competition (Simbanegavi et al., 2014), and aggregating competition in a handful of African banks (Hope, Gwatidzo and Ntuli, 2013). In addition, Kapingura, Maredza and Mhishi (2009) established that a conducive competitive environment for increasing bank productivity was and continued to be realised owing to the large size of participants' capital base irrespective of monetary policies in place.

No research has been done in South Africa into the effect of competition among the big four banks and their impact on financial stability covering the period 1990-2015 during which, there was a global meltdown owing to the subprime lending crisis as well as bank amalgamations and bank rescue packages introduced .

1.4. Objectives Of The Study

The study seeks to;

- analyse the two contrasting hypotheses connecting bank competition to stability i.e. Competition-fragility and Competition-stability and place South Africa's predisposition.
- establish if the South African economy's bank system is concentrated and the implications that emanate thereof by using market share , concentration data and literature review.
- ascertain within the banking industry in South Africa,
    - the level and type of competition among banks

- the empirical relationship concerning financial stability, in tandem with competition among banks
- expound on the implications of the stability-competition relationship of banks in South Africa .

Fulfilment of the above objectives will pave way to make recommendations for government policy on banking competition through its agents of regulation and supervision of the financial system in South Africa

1.5. Research Questions

- What is South Africa's predisposition in light of the two contrasting hypotheses of competition fragility and competition stability?
- Regarding the concentration of the South African banking system;
  a. At what level is it concentrated?
  b. Does this level complement or counteract competitiveness?
  c. What is the extent of competition among South African banks from comparison of empirical measures, data and literature?
- What type of relationship exists for South African Banks between financial stability and competition?
  a. Is it positive or negative?
  b. What is the relationship dependent on?
  c. Does competition among the banks initiate instability or at the slightest, act as an impetus of risk for financial stability for South African Banks?

1.6. Theory Of Bank Competition

1.7. Extant Literature centred on the competition amongst banks juxtapose two schools of thought; the competition-stability view against that of competition-fragility (concentration- stability). While there is no common ground on the superiority of each construct, each school is premised on the trade-off between financial system stability and competition among banks. These being efficiency in financial markets resource allocation as well as pricing being the advantage of the latter to the consumer while the former has connotations of innovative bank products as well as reckless risk-taking as institutions seek to boost their bottom line Beck (2008).

1.7.1. Bank Concentration South Africa

According to the OECD (2011), while oligopolistic structures are common in bank systems in many countries inclusive of emerging markets, that structure does not eliminate their competitive tendencies. Hence, while the South African system was and currently still is dominated by the big four banks, which take up more than 90% of market share, they remain competitive.

1.8. Significance Of The Research

In light of the context of this research, this study will be beneficial for these reasons:

It will contribute to the existing scant literature by;

- covering the period 1990-2015 during which a number of crises occurred and impacted the stability of banks.
- empirically investigating the effect of competition among the big four banks and their impact on financial stability
- corroborating the findings on the South African banks' predisposition when it comes to the competitive landscape.
- debunking the concentration – competition misnomer.
- suggesting policy formulations for the agents of regulation and supervision that uphold the monetary policy transmission mechanism in light of the identified competitive environment.

The study will be beneficial to academia and industry for the purposes of research by students and policymaking by agents of regulation and supervision and decision making by bank stakeholders.

1.9. Chronology of Chapters

The write up of this study is organised as follows;

Chapter 2: is the Literature Review, which pays homage to relevant precedent studies.

Chapter 3: is the Methodology, which outlines the methods, and presents the diagnostics used at granular level.

Chapter 4: is the Results section, which presents and discusses the results while aligning the outcomes to previous studies

Chapter 5: summarises the outcomes and highlights the limitations of the study as well as suggesting aligned studies for further research.

The list of references is a guide to the sources cited in the study

The Appendices contains the supporting document that displays tables and graphs described in chapters 3 and 4

CHAPTER 2
LITERATURE

2.1 INTRODUCTION

Researchers have sought to verify the dynamic relationship between competition and bank soundness by checking whether the financial stability of banks increases or decreases when competition is higher. Two schools of thought are juxtaposed followed by a discussion of the bank competition- stability nexus in the world mainly from the developed markets and then moving onto Africa and finally South Africa. The shortcomings of the studies are articulated and the opportunity for a study from a new perspective is delved into. The instruments and models for measuring bank stability as well as bank competition are deliberated as well.

2.2 DISCOURSE IN THEORY

In analysing competition in banks and its' perceived effects, two theories have been proposed with no conclusive common ground realised to date.

There is extant literature supporting the competition fragility view (concentration-stability coined by Tabak, Fazio and Cajueiro (2012) which proposes that in collusive markets, banks enjoy higher premiums and consequently acquire a cushion from crises thus negating any risk taking incentives. In their unique samples of studies, Keeley (1990), Allen and Gale (2000, 2004), Beck, Demirgüç-Kunt, and Levine(2006, 2008), Beck (2008), Beck, De Jonghe and Schepens (2013), Berger, Klapper and Turk-Ariss (2009), Angelov and Asadov (2010), , Soedarmono, Machrouh and Tarazi (2013), Fungáčová, Pessarossi and Weill (2013), Diallo (2015), Horvath, Seidler, and Weill (2016) among others propose that competition decreases market power, reduces profit margins and encourages banks to undertake risky product offerings leading to financial system instability.

In contrast proponents of the competition stability view abound and include Claessens and Laeven (2004), Boyd and De Nicoló (2005), Ariss (2009), Uhde and Heimeshoff (2009), Schaeck and Cihaak (2014). Martinez –Miera and Repullo (2009), Angelov and Assado (2010), Yaldız and Bazzana (2010), Van Leuvensteijn, Sørensen, Van Rixteland Sørensen (2013), Liu, Molyneux and Wilson(2013), Fiordelisi, and Mare (2014), Anginer, Demirguc-Kunt and Zhu (2014) and currently Akins, Li, Ng, Rusticus, (2016) among others. They argue that bank competition is not detrimental to the financial system because it increases

efficiency and enhances the ability of the financial system to recuperate from adverse shocks.

Then there are those who find little interaction between banks' competition and financial system stability, Zigraiova and Havranek (2015), İskenderoğlu and Tomak (2013) and Jeon and Lim (2013).

Jeon et al. (2013) explain the divergent connection between banking competition and financial stability as hinging on the characteristics of different banks and ascertaining compromise between the interest effect and risk sifting effect being attributable to the non-linear relationship between the two. Likewise in line with Boyd and DeNicolo (2005) they support the competition-stability construct.

2.3 COMPETITION AND STABILITY INVESTIGATIONS

2.3.1 GLOBAL

Numerous studies have delved into the relationship between financial stability and financial competition in both the developed financial systems in Europe, the United States of America, Australia as well as emerging financial markets of Mexico, Russia, Korea, Japan, Turkey, and other Asian countries.

In the United States of America Akins and Rusticus (2016) use pre and post financial crisis evidence to substantiate the competition-fragility view between competition and risk taking and they demonstrate that increased competition among banks is linked to heightened levels of financial instability. Fernandez and Garcia (2015) found that in the Mexican-banking sector the increment in bank portfolio risks is compensated by the benefits on the overall financial system stability. Jeon et al.'s (2013) study of Korean commercial banks and mutual savings institutions evidenced that the non- linear relationship between competition and stability was dependant on bank characteristics because of the compromise in the risk shifting and interest effect affirming the beneficial effect of increased competition on financial system stability. While recent theory and evidence point toward the positive effect of competition on stability Boyd and De Nicolo(2005), Schaek and Cihak (2014), Allen, Carletti, and Marquez(2011) as well as Zigraiova and Havranek (2015) contest this view. Instead, they attribute the divergence in views, evident from moderate publication bias in studies, on the effect of bank competition on financial stability to the data methodology and control variables utilised.

Similarly, Mishkin (1999), stresses that, in concentrated systems, regulators are prone to implement too-big-to-fail policies that encourage risk-taking behaviour by banks.

The discourse regarding the literature on banking and competition is emphasised by Havranek, and Zigraiova (2015). Their research reveals the inconclusive proof for neither financial stability nor competition stability constructs. Furthermore, different countries experience varying degrees of systemic crises and banks in concentrated systems are found to possess higher capital ratios, which compensate the probability of increasingly risky decisions by the bank.

2.3.2 AFRICA

On the African platform Hope, Gwatidzo and Ntuli (2013) implement the Generalised Method of Moments 'GMM' estimation technique to establish the relationship implicit between bank competition and financial sector stability in 10 African banks including South Africa. The Lerner index and Herfindahl Hirschman index proxy competition while stability via the Z-score. They find a case for the competition-fragility view. They postulate that some macro-economic control variables enhance financial sector stability and furthermore call for continent-wide bank alliances. They propose that these measures may enhance the success rate of Small and Medium Enterprises by facilitating access to financial products and services.

2.3.3 SOUTH AFRICA

In South Africa, the literature on the relationship between bank competition and financial stability is scant, though a few studies concentrate on bank competition and efficiency, bank market structures as well as testing for competition while others discuss the concentration-competition discourse.

Ncube (2009) measured the cost to efficiency ratios of 4 large and small banks individually and discovered insignificant incremental changes in efficiency with weakly positive correlations and none of the banks had the upper-hand for bank costs containment nor margin efficiencies.

Mlambo and Ncube (2011) whose studies on financial stability largely dwelt on establishing the level of efficiency in the banking system using the P-R methodology to measure competition revealed that between 1999 – 2008 average bank efficiency portrayed a positive trajectory amidst a deteriorating number of efficient banks thus characterising the industry with monopolistic competition tendencies. This was during a

period when five banks dominated the sector by commanding more than 90% in overall banking assets.

In analysing the South African bank market structures, their inherent competition and performance, Simatele (2015) implements the P-R model as well, and concurs on the view of a monopolistically competitive banking environment and reports that the high concentration ratio attests to this view in addition to which competition in the industry is also increasing.

Simbanegavi et al. (2014) lay the foundation of their studies on the extent of commissions of enquiry that have been set up to in reaction to the concentration of banks in South Africa. They utilise the 'P-R' and Bresnahan methodology as assessment for the presence and level of competition in South Africa and find that while the market exhibits monopolistic competition, policies are needed direly to enhance the sector and increase efficiency.

2.4 ESTIMATION METHODS

With the diversity in competition studies, the calculation thereof also features prominently. Tabak, Fazio and Cajueiro (2012) attribute the use of different methods of estimation of competition to the indirect observability of competition levels essentially because the individual prices of banking products vary as well as the way rival banks respond to each other's actions.

Numerous studies have used different models to test the two hypotheses of concentration-stability versus competition fragility in order to establish if the level of competition among banks has an impact on financial stability, efficiency and even systemic risk. Among these models are the Herfindahl-Hirschman Index "HHI" for market-level measures of competition in Boyd et al.'s (2010) study. The Boone Indicator (2008) which states that competition increases the performance of competent firms thus conveying the magnitude of competition on the competence of efficient banks. Schaeck and Cihak (2014), Nicol´o et al. (2004) and Beck, Demirgüç-Kunt, Levine (2006) use the Concentration Ratio as a market based quantification of competition. Tobin's Q comes in as an indirect quantification of competition and is used by Keeley (1990). The Panzar–Rosse (1987) H-statistic is utilised by Claessens and Laeven (2004), Turk-Ariss (2009), Mlambo and Ncube (2011), Simabanegavi and Greenberg 2009 and Hope et al. (2013). The P-R method is

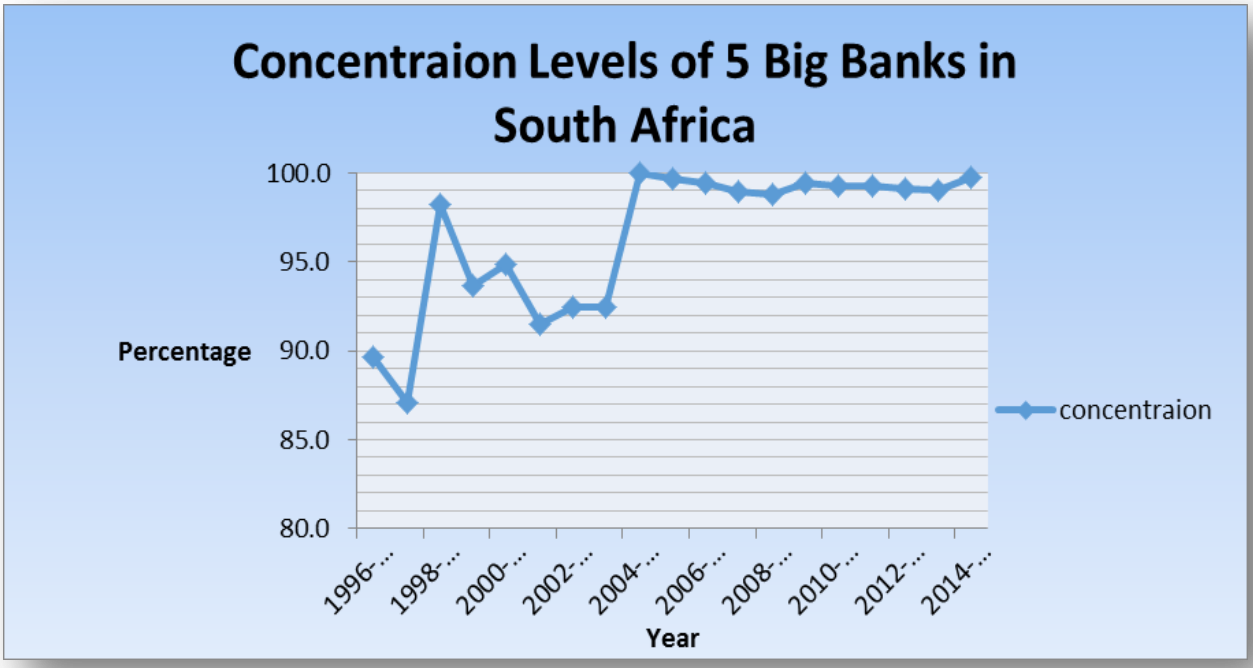
popular for its basis as a non-structural approach where the level of competition is determined by the elasticities of the price variables in the model.

The Lerner index by Abba Lerner in 1934 and implemented by Fiordelisi and Havranek (2015), Diallo (2015) as well as Fungáčová, et al.(2013). The index estimates the bank's market supremacy on a scale between 0 and 1 to reveal the bank's leeway to charge prices exceeding the marginal cost. The two extremes, 0 and 1 denote perfect competition and pure monopoly respectively.

2.5 Concentration And Competition

The concentration level of banks in South Africa aggregates at 96.5% over the period 1996-2014 as measured by asset concentration ratios extracted from the Federal Reserve Economic Data for South Africa FRED(2016). In figure 1 the trend of concentration begins at 89,5% in 1996 and drops to a low of 87% owing to liberalisation of the sector and the entrance of a number of new players especially foreign banks (Claessens & Van Horen, 2011).

Figure 1: Concentration levels of the top banks in South Africa



Source: Federal Reserve Economic Data

From thereon over the next couple of years, a number of financial institution mergers caused concentration to peak in 1998 by 98.2% however, the ensuing 2001-2002 Asian crisis impacted the concentration ratio with a downward trend owing to the continued

growth of market with more players' asset bases taking a knock from dwindling foreign holdings. The ratio levelled out at 92.5% in 2003 going on to attain 100%, an all-time high, in 2004. Even during the 2008-2009 Global Financial Crisis "GFC" the ratio hovered around 98.5% with only a 0.5% decline. The minimal impact is attributed to the implementation of stringent measure by the regulation and supervision authorities at the South African Reserve Bank "SARB" through the Financial Stability Reforms promulgated in 2004. As the market recovered from the GFC and the state relinquished shareholding in banks, Allen and Senbet (2011), the concentration ratio maintained levels above 99% since 2009, refer to figure 1 (p.19).

The misconstrued belief in the banking spheres that bank asset concentration is an indicator of the level of competition is evidenced in previous studies by Okeahalam (2001)as well as Falkena, Davel, Llewellyn, Luus, Masilela and Shaw (2004) and Mckenzie (2013) who have concluded that the South African banking sector is highly concentrated and thus leaving no room for competition. However, Simbanegavi, Greenberg and Gwatidzo (2012) while concurring on the high levels of concentration in the South African financial system, (as shown in Figure 1 p.19) argue that the level of competition in any particular banking sector occurs via an inverse relationship therefore concentration does not necessarily negate competition. In addition, Simbanegavi, Greenberg and Gwatidzo (2015) utilising the Panzar- Rosse "P-R"and Bresnahan methodology went on to identify monopolistic competition as the type of competition in the South African banking sector. In concurrence with Mckenzie (2013) they furthermore attribute these high concentration levels to historical and structural factors and not competition per se.

2.6 MOTIVE FOR STUDY

The aforementioned literature exhibits deficiencies such as the period covered, the aggregation of competition indices at country and bank level as well as the misnomer that likens concentration to competition. The nature of the empirical relationship between bank competition and financial system stability in South Africa warrants an investigation because the precedent studies have not extended over a 25 year gap, (1990-2015), which experienced numerous globally and locally induced crises.

It is propelled by the reactionary recalibration of fiscal and monetary policies to reinstate system stability owing to post-crises system instabilities which manifested over 1990-2015.

Existing literature has aggregated the banking sector at regional as well as country level without assessing at granular level the competition among the big four banks.
In light of these shortcomings, a gap reveals itself in the precedent studies.

2.7 SUMMARY

There is consensus on the discourse about bank competition and financial stability covered in the competition-fragility and concentration-stability theories. Investigations have been conducted at global, regional and country level with numerous econometric estimation methods at play. The concentration competition misnomer is debunked to show that the presence of a concentrated bank system does not absolve the participants or sector from behaving competitively. The deficiencies of the prevailing literature are inherent in the duration as well as aggregation of data.

Chapter 2 has largely explored existing studies in a literature review that covers the discourse in theories and has truncated previous studies from global and regional level to country level. Estimation methods were discussed and additionally the misnomer of concentration as an indicator of competition was dispelled leading to the identification of the gap for this study. The next section deals with the actual data collection, estimation and diagnostic testing of variables with validations for the chosen instruments.

CHAPTER 3
METHODOLOGY

3.1. EMPIRICAL MODEL

The study measures bank stability as a function of bank competition. Detailed description of all variables in the empirical formulation utilised are presented in Table 3.1.

The ensuing regression model below is used to observe the influence of bank competition on financial stability.

$$Stability_t = \alpha + \beta Competition\ Measure_t + \sum_{k=1}^{N} \gamma_{kt} X_{kt+\ e_t} \quad [1]$$

α	is a constant
t	are the index quarters
Competition	is quantified through the Lerner index, and adjusted Lerner as well as Panzar-Rosse in 3 separate models
X	is the composition of N control variables, including the explicit bank and market-associated variables.

3.1.1. STABILITY

The central exogenous variable is bank stability, which is conventionally proxied using the Z-Score index developed by Roy (1952). The bigger the value of the Z-index, infers lesser possibilities of failure.

3.1.1.1. Z-SCORE INDEX

Bank stability is proxied by employing the Z-score, which has been widely used in banking research (e.g. Berger et al., 2009; Uhde et al., 2009; Tabak et al., 2012; Jeon et al., 2013; Schaeck and Cihak, 2014). The abundance of empirical studies utilising this measure attests to its acceptability owing to its ability to measure a bank's soundness and safety. It captures a bank's extent from insolvency hence when there is insufficient equity for recoupment of losses then a bank is deemed insolvent. The Z-score is an inverse measure of the extent of likelihood to default a particular bank is, therefore a larger Z-score represents reduced bankruptcy risk. The Z-score is defined by Jeon et al. (2013) as the aggregate of the ROAs and Capital Ratios in proportion to the standard deviation of the ROAs and is depicted as follows;

$$Z_{score_t} = \frac{ROA_t + CAR_t}{\sigma(ROA_t)} \quad [2]$$

where ;

ROA_t is the Return On Assets for banks in current period t.

CAR_t is the capital-asset (equity/ assets) ratio for banks in current period t.

$\sigma(ROA_t)$ is computed as the standard deviation of return on assets for the banks in current period t.

Owing to its' skewness a log-transformation of the Z-score was utilised thus normalising it to be distributed about the mean 0 as well as to be applicable in the main stability equation.

The index represents an inverse estimate of the odds of default a particular bank faces; therefore, a larger Z-score represents reduced bankruptcy risk.

3.1.2. COMPETITION

An assortment of 3 competition indices will be utilised as a comparison platform for the extent and type of competition among banks in South Africa. These are, the Lerner Index, the Adjusted Lerner index and the Panzar-Rosse H- Statistic.

3.1.2.1. LEARNER INDEX OF MONOPOLY POWER

Implementing the Lerner Index as a competition proxy will be accomplished following Ariss (2009), Anzoategui et al. (2010), Berger et al. (2009), Fungáčová et al.(2010), Jimenez et al. (2010)), Liu et al. (2013) Fiordelisi and Mare (2014), Jeon et al, (2013) and Zigraiova and Havranek (2015) among others. The index assesses the bank's market reign on a scale stretching between 0 and 1 to reveal the bank's extent of legroom to charge prices exceeding the marginal cost. Perfect Competition is denoted by 0, while superior market power is reflected in greater values beyond 0 with 1 signifying a purely Monopolistic banking sector.

This index has a couple of variants;

The index assesses the bank's market control as being the degree to which banks can charge a price exceeding the marginal cost;

$$\text{learner}_{it} = \frac{P_{it} - mc_{it}}{P_{it}} \quad [3]$$

Where

$P_t is\ a\ Price\ of\ banks\ assets\ in\ total\ expressed\ conventionally\ as\ a\ ratio\ of total\ revenues\ and$

$total\ bank\ assets\ in\ period\ t$

$mc_t\ is\ the\ bank's\ total\ assets' marginal\ cost\ for\ period\ t$

3.1.2.2. ADJUSTED LEARNER INDEX

This index is an efficiency adjusted measure as used by Diallo (2015) from Kotter et al. (2012) and modified because the true extent of market power is not captured accurately by estimated Price – marginal relationship, (P_i; mc_i).

$$Adjusted\ lerner_t = \frac{\pi_t + TC_t + q_t mc_t}{\pi_t + TC_t} \quad [4]$$

Where;

$\pi\ is\ the\ profit\ of\ the\ banks\quad during\ period\ t$

$TC\ is\ the\ total\ cost\ during\ period\ t$

$MC\ shows\ the\ marginal\ cost\ of\ all\ assets\ for\ the\ banks\ over\ period\ t$

$q\ represents\ the\ total\ output\ over\ period\ t$

Both Lerner indices will take on estimates ranging from 0 to 1, (although the Adjusted Lerner Index will be calculated as a percentage and then converted to decimal), It is construed that an estimate falling halfway of the 0; 1 range implies monopolistic competition.

Conventionally following Beck, et al. (2013) marginal costing was estimated via a threefold output trans log cost function with a single output that excludes the time trend as follows;

$$lnTC_t = \alpha_0 + \alpha_1 lnQ + \frac{\alpha_2}{2} lnQ^2 + \sum_{j=1}^{3} \beta_j\ lnP_j + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \delta_{j,k} lnP_j lnP_k + \frac{1}{2}\sum_{k=1}^{3} \gamma_j\ lnQ\ lnP_j + \varepsilon_t \quad [5]$$

Where;

TC_t represents the total costs (i.e. total personnel expenses, other administrative expenses and operating expenses), and

Q is the total assets as a proxy for the banks' single output

P1, P2, and P3 represent the values of the inputs used in the production system:

P1 is the rate of labour (i.e. personnel expenses divided by total assets);

P2 is the value of physical capital (i.e. other administrative expenses added to other operating expenses divided by total fixed assets); and

P3 is the value of loaned out funds (i.e., interest overheads divided by the summation of total deposits and money market funds).

t is the period covered by the cost function

$\alpha, \beta, \delta \; and \; \gamma$ are coefficients to be approximated from $lnTC_t$

ε_t is the error term

From the translog cost function $lnTC_t$, derivation of the marginal cost was computed as follows:

$$MC_t = \frac{TC_t}{Q_t} + \left[\hat{\alpha}_1 + \hat{\alpha}_2 lnQ + \sum_{J=1}^{3} \hat{\gamma}_J lnP_J\right] \quad [6]$$

where MC_t was obtained and then substituted to calculate both the Lerner Index and Adjusted Lerner Index for the banks at time *t,* therefore yielding the dynamic change in market control across banks over a period.

3.1.2.3. PANZAR-ROSSE H-STATISTIC

The Panzar-Rosse H-Statistic "P-R" advanced by Panzar and Rosse (1987), was founded on a condensed revenue or price model. It is utilised to test the type of competition, if any, among the South African Banks.

Studies in South Africa utilising P-R to approximate the competitive tendencies of a market frequently implement a revenue model inclusive of control variables like total assets which proxy bank size Simbanegavi et al.(2014), Hope et al.(2013) as many also prefer to approximate a price model instead.

In this study, the revenue form will be utilised in order to focus on the banks' core intermediation functions, which yield interest as their revenue. Robustness checks using Total Revenue instead of Interest Revenue will be for comparative purposes. The inclusion of bank-specific control variables will curtail distortions of revenue generated from other non –core bank activities. The H-Statistic will be derived through a summation of the coefficients of the price variables from the revenue model. The guideline for the H-statistic

lies on a continuum from below 0 to above 1 i.e. and is construed to imply a Monopoly if H<0, Perfect Competition where H>1 and Monopolistic Competition when 0≤H≤1. The revenue equation will be modified following Bikker, Shaffer and Spierdijk, (2012).
as below;

$$l(IR) = \alpha + (\beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3) + (TASS * LOTA) + (ETA * LOI) + \epsilon_t \quad [7]$$

Where;

P1 is the rate of labour (i.e. personnel expenses divided by total assets);

P2 is the value of physical capital (i.e. other administrative expenses added to other operating expenses divided by total fixed assets); and

P3 is the value of loaned out funds (i.e., interest overheads divided by the summation of total deposits and money market funds).

t is the period covered by the cost function

LOI is income generated from other sources besides interest

TASS is the banks' total assets as a proxy for output

ETA is the bank's total equity to assets ratio to capture risk

LOTA is the banks loanable funds in proportion to the balance sheet.

The H-statistic then follows as below;

$$H_t = (\beta_1 + \beta_2 + \beta_3) \quad [8]$$

Where

$(\beta_1 + \beta_2 + \beta_3)$ are the coefficients of the input prices from the P-R revenue model above.

All variables are log transformed except for ETA.

3.2. VARIABLES

All variables under discussion in the study are listed and defined in Table 3.1.

3.2.1. STABILITY

The fundamental exogenous variable is bank stability which is proxied conventionally using the Z-Score index developed by Roy (1952), and utilised by among others, Schaek and Cihak (2014), Fu, Lin and Molyneux (2014), Uhde and Heimeshoff (2009), Diallo (2015), and Fernandez and Garcia(2015), to measure banks' risk of failure. The bigger the value of the Z-index, infers lesser chances of failure.

Table 3.1: Description, classification and definition of variables

	Variable Classification	Variable Description	Variable Computation and Definition
Dependant Variables	Financial stability	Z- score index	The average ROAs plus Capital Ratios divided by the Standard Deviation of the ROAs. It is an inverse estimate of the odds of default a particular bank faces, therefore a larger Z-score represents reduced bankruptcy risk.
Independent Variables	Competition Measure	Learner Index	The difference between the bank's Total Assets' Price and Marginal Cost divided by the Total Asset Price. The index was promulgated in 1934 by Abba Lerner and measures the bank's market supremacy on a scale between 0 and 1 to reveal the bank's extent of legroom to charge prices exceeding the marginal cost. They take on values between 0 and 1 with 0 denoting perfect competition while superior market power is reflected in greater values beyond 0 with 1 signifying a purely monopolistic banking sector.
		Adjusted Lerner Index	The sum of the bank's profit and total costs but subtracting the marginal cost of a bank's total assets all divided by the sum of the bank's profits and total costs. As implemented by Diallo (2015). Improves on the Lerner by implementing profits instead of revenue to capture the efficiency of cost containment, and based on high numerical values indicative of lower competition levels.
		Panzar-Ross H-Statitistic	Estimating the revenue function with respect to the price of inputs such as, fixed assets labour and borrowing funds while controlling bank-specific variables. The inference is as follows; $H>1$, $0<H<1$ and $H<0$ represent bank environment that are either perfect competition, monopolistic competition or pure monopolies respectively. H is extrapolated as the sum of the coefficients of the price variables
Control Variable	Control	Bank specific	Bank-specific control variables will account for • liquidity risk via the liquidity ratio using cash and payables from other banks to total assets , • credit risk as the credit risk ratio calculated as the loan loss provision to interest income margin and • asset composition incorporated as the ratio of total loans to total assets
		Macro specific	Macro specific variables will account for • economy wide shocks and will range from Growth rate of Gross domestic product, • the ease of doing business with and for banks in South Africa • the extent of political interference or autonomy in banking

3.2.2. COMPETITION

The Lerner index, Adjusted Lerner index and Panzar-Rosse H-statistic are the explanatory variables and also the proxies for bank competition as utilised in similar studies such as Fiordelisi and Havranek(2015), Diallo(2015), Fungáčová, et al.(2013)and Schaek and Cihak (2014)and locally, Hope et al. (2013) and Simatele (2015) respectively.

3.2.3. CONTROL

Building on earlier literature and emulating Fiordelisi and Mare (2014) the inclusion of two types of control variables shown in Table2 will control for spurious regressions..

Table 3.2: List of Macro-specific and Bank-specific sets of control variables

Bank-specific control variables	***macro-specific control variables,***
• the logarithm of total asset (size) as justification for potential scale economies, • equity to asset ratio (ETA) to capture the bank's risk and • Interest overhead to total deposits and money market funds IOTA	• stock market capitalization (SMC), • bank concentration (CON), • the economic freedom index (EFI), • the financial freedom index (FFI), • the real gross domestic product growth rate (GDP) and • governance (GOV) score

Adapted from: Fiordelisi and Mare (2014)

3.3. DATA

Data for the study was collected from numerous sources per Table 3.1

3.3.1. SOURCES

Initially data for banks was retrieved from McGregor Bureau for Financial Analysis (McGregor BFA) in the form of annual bank financial statements, for banks domiciled and operating in South Africa in order to capture the bank specific variables reflected in Table 3.3.

According to The Banking Association of South Africa, (2014) there are currently 17 registered commercial banks in South Africa. Therefore, in light of the period under observation, (1990-2015), whose preference is expounded on in Chapter 2, the initial

filtration resulted in the available 17 banks being reduced to the big four because the period under study was impacted by the availability and consistency of data.

Table 3.3: Variable classification and source

Variable Specifications				
Variable Classification	**Variable Description / Proxy**	**Source**	**Observations**	
			***Frequency**	**Total**
Financial Stability	Z-Score Index	INet Mcgregor BFA	Quarterly	104
Competition Measure	Lerner Index Adjusted Lerner P-R H-statistic	INet Mcgregor BFA (individual bank statements) through calculationsin E-views from Bank specific variables	Quarterly	104
Control				
Bank Specific	Total Assets	INet Mcgregor BFA	Quarterly	104
	Equity To Total Assets			
	Growth Of Assets			
	Bank Deposits To Customer Deposits			
Macro Specific	Stock Market Capitalization (SMC),	World Development Indicators	Quarterly	104
	Bank Concentration (CON)	Federal Reserve Economic Data	Quarterly	104
	Economic Freedom Index (EFI)	www.heritage.org / Fraser institute	Quarterly	104
	Financial Freedom Index (FFI)	www.heritage.org / Fraser institute	Quarterly	104
	Governance (GOV) Score	world bank	Quarterly	104
	GrossDomestic Product Growth Rate (GDP)	Fraser institute	Quarterly	104

★Data was obtained as annual and converted to quarterly through frequency conversion from1990-2015

Secondly macro-economic country level data was collected from a myriad of sources including the World Bank, Heritage Foundation, Freedom house and SARB and Quantec Easy Data as illustrated in Table 3.3.

3.3.2. SAMPLE

The study concentrated on the big four banks owing to elimination of other banks from the sample due to representativeness of data, precisely more so for banks not yet operational in the period 1990-2015, i.e. those with missing bank specific variables such as total revenue. Thirdly, the size of the market brought the sample down from 17 banks

to the largest 4 banks owing to the sheer market size garnered by the top 4 which accounts for over 90% of the total South African Bank Market as reflected in figure 2.

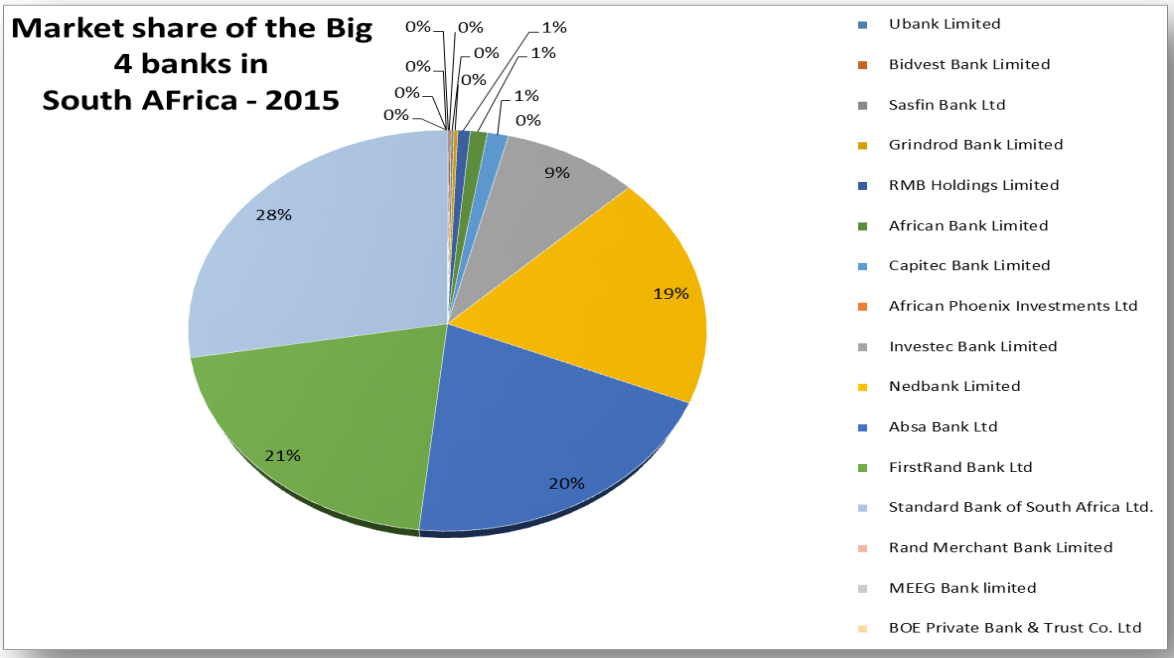


Figure 2: South African Bank Market Share 2015

Source : Calculated from Mcgregor BFA

From Figure 2, by the end of 2015, Standard bank held the leading market share position at 28% with FNB and Nedbank both garnering 21% then followed by ABSA on 19%. These holdings have remained relatively stable since 2013. Investec trails the big four at 9% while Capitec and African Bank held on 1,5% each. The rest of the market accounted for less than 0% market share.

In this environment, the high level of market power wielded would incline the industry to be driven by these major players. These banks are Amalgamated Banks of South Africa, Firstrand National Bank, Standard Bank of South Africa and Nedbank Ltd hereinafter ABSA, FNB Standard and Nedbank respectively.

3.3.3. FREQUENCY

All bank-specific and macro-economic country level data were extracted as annual data over the 1990-2015 period and then extrapolated into quarterly frequency by means of

the Quadratic- Match Average frequency conversion method using E-Views software. The number of observations for the banks and the variables were collected as presented in Table 3.1.

3.3.4. PERIOD UNDER REVIEW

Initially the period covers numerous pre and post crises affecting South African banks.

The period under study is preferred as it is a longer period than other studies because;

- It adequately captures both the pre and post economic shocks and reactionary recalibration of fiscal and monetary policies to reinstate system stability owing to post-crises system instabilities which manifested in the South African financial system caused by the Global Financial Crisis as well as African Bank's collapse and subsequent rescue package over 1990-2015
- Previous studies in South Africa have only covered the period up until 2011 yet after 2011, a number of financial stability reforms have been adopted in an effort to curtail instability in the banking system following contagion experienced as a result of global financial calamities that occurred.

Up until March 2017, three commissions of enquiry into competitive behaviour among banks have been set up and while two had not yielded any negative findings, more recently exchange rate rigging and tampering by the big four in collusion with foreign banks has been reported by Bloomberg (2017) and Mail &Guardian, (2017). There continues to be a keen interest in the perceived collusive activities of the big four especially because they command a large market share (see Figure 3)

In Figure 3, the combined market share of the big 4 banks surpasses the rest of the market consistently in excess of 90% from 2013 to 2015.

3.1. ESTIMATION

Estimations with Ordinary Least Squares (OLS) regressions for the Lerner index as well as the Adjusted Lerner and the Panzar-Rosse H-statistic were utilised. The study's robust standard error corrections of the HAC Newey West format were centred at bank level. These adjusted for correlation, heteroscedasticity and multicollinearity between banks variables.

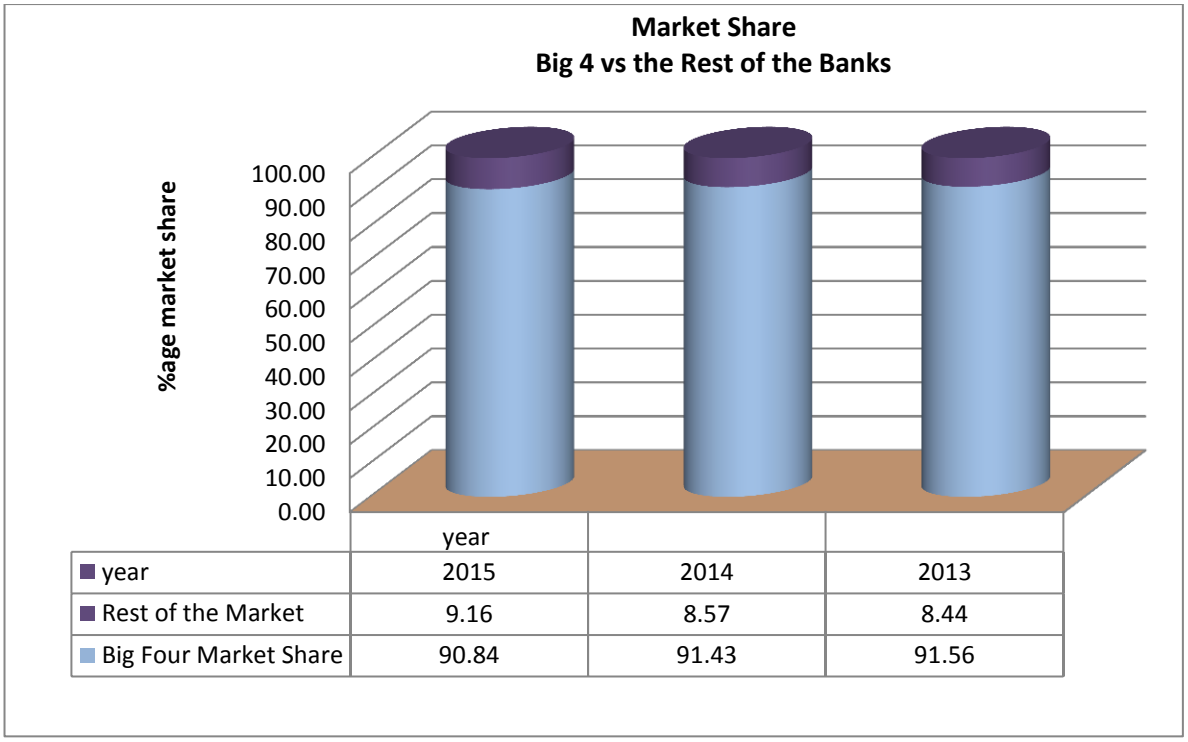


Figure 3: Big four bank's market share 2013-2015 **Source : Calculated from Mcgregor BFA**

Building on earlier literature and emulating Fiordelisi, and Mare (2014) the inclusion of two types of control variables shown in table, (a macro-specific and bank-specific sets of control variables), will reduce the problem of spurious regressions. Bank-specific control variables will control spurious regressions by accounting for liquidity risk, credit risk, and asset composition while macro-specific controls will account for economic factors that affect the banking sector. Summary

The empirical test of competition indices were estimated using the Learner; Efficiency Adjusted Lerner as well as Panzar-Rosse models while the Z-score proxied financial stability. Estimation using Ordinary Least Squares methods with robust standard errors were utilised in a two- pronged estimation approach with a log-transformation method to calculate the Lerner, Adjusted Lerner indices and H-statistic.

The overall model portrays a generally good fit with an R^2 above 70%.

In the entire dataset and for all model calculations, the incidence of heteroscedasticity was controlled for via a two-step method. Initially the series went through differential log transformation and where it was found to be still prevalent was then subjected to

the inbuilt HAC Newy -West method of covariance in OLS, from the results of the Breush-Pagan/Godfrey/Cook–Weisberg statistic of the residual's variance.

3.4. SUMMARY

Chapter 3 has provided an in-depth description of the precise empirical models use to test he competition- stability nexus, defined the individual variables and explained the sampling methods.

Additionally, the chapter has presented control variables that will reduce the prevalence of spurious regressions in estimating the individual models. The subsequent chapter articulates the results from the tests and presents findings.

CHAPTER 4
FINDINGS

4.1. Overall Results

The Efficiency Adjusted Lerner in [4] (Kotter et al., 2012) necessitated by the inaccuracies of Lerner from [3] utilises profits instead of prices and results in an average index of 0.617 when the model is subjected to more stringent inputs against the estimated Lerner index of 0.713. Both outcomes imply a banking sector that is monopolistically competitive.

Table 4.1: Comparison of competition indices over 1990-2015

Comparison of Competition Indicies 1990-2015												
Year	1990	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	
Lerner index	0.922	-0.1470	0.9728	1.1062	0.5261	0.8888	0.6473	0.1929	1.0828	0.8907	0.8244	
Adjusted Lerner index	0.682	0.6856	1.0050	0.6533	0.6750	0.6685	0.6398	0.5459	0.5262	0.5174	0.5173	
Year	2003	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Lerner index	0.7702	0.6441	0.5796	0.6169	1.1199	0.6056	0.3985	0.7598	0.6058	0.8139	0.5850	**0.7131**
Adjusted Lerner index	0.5259	0.5473	0.4608	0.4871	0.5280	0.5885	0.6707	0.7405	0.7798	0.7822	0.6168	**0.6170**

Source: Author's regression output with inputs from variable inputs in Table 3.3

4.2. Diagnostics

In the dataset, a number of diagnostic tests were carried out and corrected for as illustrated in the Appendices A to H. Additionally the variables were subjected to log differencing in order to control heteroscedasticity.

4.2.1. Descriptive Analysis

Initially, all variables in the study are from time series data, which has a random walk tendency that needs to be controlled so that the mean of the data centres on zero. This was done using differenced log transformations and then the output was tested for stationarity utilising the unit root test i.e. Augmented Dicky- Fuller. These test results were further reinforced by the stationarity tests of Kwiatkowski, Phillips, Schmidt, and Shin "KPSS" and thus validating their compliance with OLS variable inclusion criteria. The results are presented in Appendix A; table A1. The decision criteria is based on the

T-Statistic's probability value not exceeding the 10% level. The marginal cost (MC_2), appendix C, a derivative function of LTC was calculated with inputs from the LTC function with only the raw proportion of total costs and the balance sheet to get (TCQ).

Overall, unit stationarity of MC_2 was achieved without log transformation (Appendix A; Table A1.) While minimally positively skewed, the overall normality (Appendix C; Figure C2) of the function is centred on zero with an excess Kurtosis of 16,98070.

A visual inspection of the histogram in Appendix B fig shows a normally distributed LTC series once it has undergone differential log transformation however the excess kurtosis and JB statistics attest otherwise. This can be attributed to the individually skewed variables as well as the outliers present in the data because values were not adjusted for inflation over the period 1990-2015.

From the Log transformed Total Cost (LTC), then the Marginal cost (MC) in equation [6], was calculated and found to be stationary at level in Appendix C.

The Z-score [2] using the learner [3] produced diagnostics in appendix E and was estimated using with bank variable inputs (Q) as well as the MC_2 previously calculated. After log transformation, it was found to be stationary except for total assets TASS while the residuals were normally distributed but with some outliers and an excess kurtosis of 10.28027. High correlation was noted between LOTA and its square which is explained by Figure E3's pattern of both measures in the linear and quadratic form following a distinctly similar pattern but are necessary in the model for an inference of the increased level of the price of borrowed funds.

By inspection of the correlelogram (LTC) in Appendix C, as well as the values of the Q-Statistic across 36 lags. However, the normality JB statistic indicated positively skewed data series.

4.2.2. CORRELATIONS

Following on, the presence of multicollinearity was tested for, and addressed by looking at the overall impact of the individual significance of the independent variables on the overall model. In the case of the LTC model in equation [5], variables dealing with P3, were found to be statistically insignificant (refer to correlation matrix in Appendix B; TableB1). However compared to the other 9 variables overall, , these were not

eliminated as they serve the core of the LTC theory and only affected 3 out of 12, (25%) ,inputs into the LTC model rendering a minimal part of the coefficients of LTC as unreliable.

A correlation of 67%,(appendix C; table C3), was noted between the LTC coefficient inputs product with the price variables and the output function MC_2 which is to be expected as these are the variable costs of the total cost function.

The correlelogram in Appendix C: Figure C4 depicts no serial correlation as all estimates fall within the zero line both above and below.

Serial correlation was tested for on LTC's residuals in Table B4using the Breusch-Godfrey Serial Correlation LM Test and both F and Chi-squared statistics attest to the absence of serial correlation as the p-values are greater than 0.05.

4.2.3. Regression Statistics

From Appendix B; Table B3, the R^2 value at 83% for LTC reflects a well fitted model as only 17% of variability in LTC is attributable to the residuals or other independent variables not accounted for herein

LTC's Z-Score of 76% of is explained by the Lerner index and control variables included as shown in table 4. The variables jointly influence the overall model well with an F-test of 29.27 at p<1%, hence they are highly jointly significant in establishing financial stability. Serial correlation is relatively well accounted for at p<5% however, heteroscedasticity remains prevalent at p<5% but because it has been controlled for with robust standard error corrections, the standard errors were rendered reliable. The model's residuals are highly skewed and do not follow a normal distribution with the Q-Stat stabilising at lag4; suggesting that the financial stability and competition index may not follow a linear pattern.

The Z-score is robust to use of the Adjusted Lerner as it's fit is 75.5% with variables jointly influencing the overall model at p=0.000 and F-test at 28,909956. Serial correlation has a 0.5732 probability of elimination and is thus well controlled with chi-squared of 0.939070. Heteroscedasticity remains prevalent though corrected for.

The P-R (lir) model reveals that 80% of price as well as bank and macro-economic variables explain changes in interest income. The level of competition at 0.6625 is calculated from the price coefficients which are highly significant individually and as well jointly with F-statistic at 78, 33. Serial correlation is controlled for at p=0.4263. The introduction of total revenue reveals that the P-R (ltr) model is robust to alternative forms of banks income as shown by the drastic reduction of the H-statistic to 0,24904 in addition to which the model's overall fit with regressors falls to 66% . Furthermore substantiating the robustness is the joint significance of variables influence on the model falling to 36.85521 while serial correlation is well controlled at p=0.8510.

4.2.3.1. PANZAR- ROSSE H-STATISTIC

The Panzar- Rosse H-statistic is estimated at 0.66205 for South African banks between the period 1990-2015 as illustrated below, in table 5.

With the H-statistic estimated at 0.66205 in the study then monopolistic competition is inferred to have been the prevailing market condition for South African banks between the period 1990-2015 as illustrated in table 5.
The Big 4 banks wield a higher degree of market power with respect to competition in the banking sector.

The P-R H-Statistic's outcome is robust to interest income as well as total revenue as evidenced by the big variation between the 0.66205 and 0.24904. However, the Total revenue model reveals a weak form of monopolistic competition as it tends to 0 which is indicative of perfect competition.

This speaks to the income generating sources that banks are at liberty to benefit from other than the traditional core intermediation; hence, as more sources of income avail themselves to banks the big four will wield the less market power. It is also a testament to the current inroads made by Capitec Bank as a player of note in the last 2 years (see figure1) with a market share of 9%.

Table 4.21: Regression on Panzar- Rosse' H-statistic results

Results Panzar -Rosse 1990-2015				
Variable	Regression on Interest Income(lir)		Regression on Interest Income(ltr)	
	Estimate	S.E	Estimate	S.E
P_1(-1)	0.024348*		0.297171	
		(0.014193)		(0.179810)
P_2	-0.496001***		-0.759546***	
		(0.188427)		(0.165585)
P_3	1.133703***		0.711415***	
		(0.195166)		(0.078724)
ETA*LOI	-4.099998		-1.748299*	
		(1.347677)		(0.900719)
LTASS*LOTA	-0.092066*		-0.046141*	
		(0.026692)		(0.020266)
Constant	9.783515*		5.304624*	
		(1.712852)		(1.305986)
Obs	102		103	
R-squared	80%		66%	
First stage F -test (joint)	78.33649	p=0.0000	36.85521	p=0.0000
χ^2 Serial correlation	1.049272	P=0.4263	0.723522	P=0.8510
χ^2 heteroskedasticity	55.66784	P=0,0000	18.67425	P=0,0000
H-Statistic		**0.66205**		**0.24904**
	* 10% significance			
	** 5%significance			
	*** 1%significance			

Results from both models also reveal that the main catalyst of the H-statistic is the cost of obtaining funds, while the price of labour and capital expenditure both impact the H-Statistic minimally though labour is affected in a negative manner .

The control variables show that there is a negative relationship between interest income and the ratio of other income generating sources and capital assets suggesting that banks in South Africa should increase their equity investment and on non-core intermediation income generating activities although they tend to be riskier thus reducing the level of monopolistic competition in the banking sector. By inference this increases instability via the Z-score index as calculated thus inclining the sector towards the competition-fragility viewpoint that as the risk preferences of banks increase, so too is the burden of risk passed on from the bank shareholders to other external creditors. This implies that an increase in competition among banks will increase financial stability. This study has yielded results analogous with other studies in South Africa, Simatele (2015), Simbanegavi et al., (2014), Mlambo and Ncube (2011), and

Hope et al., (2013) with respect to the case of monopolistic competition for South African banks.

4.2.3.2. LERNER INDEX AND ADJUSTED LERNER INDEX

Both indices are well fitted models at 80% and 60% respectively. The competition indices reflect a positive relationship with financial stability with the adjusted Lerner reflecting a weakly positive influence on stability. This is because profits and not total revenues are used in the estimation and thus reduces the bias created by cost structures that could take up the lion's share of the income. Profits are a better measure of revenue as they are attributable to shareholders. This difference in competition index coefficients can be assigned to high operating expenses for the banks.

Capital expenditure; LNFATA reacts negatively to stability implying that when banks invest more than warranted in fixed assets this may increase instability as this creates illiquidity and depositors may struggle to withdraw funds under the banks' custody , the so- called cash shortages.

Control variables have opposite effects both as bank and macro-specific. variables. The extent of financial freedom LFFI speaks to the ease of doing business with banks in South Africa and as well in addition to how easily funds can be accessed. The more stringent the less stable the environment will be as depositors will prefer to withhold their liquid cash and rather externalise it or use it in a parallel market. Macro variables like GDP Growth (LGDPG)and Stock Market's Capitalisation (LSMC) inverse relationship with stability infer intermediation efficiency as well as economic health because low growth reflects instability and thus the channels of intermediation maybe interfered with or even not functioning efficiently.

The magnitude of the coefficients (-0.000603 and -0.000694) here is minimal evidencing the extent and impact of economy triggers as being almost insignificant in the short term but worthwhile to be noted as the effects are felt in the long-run.

Overall the results speak to the competition-fragility view , wherein some of the control variables at play in our model will boost financial stability and others will be indicators of the extent of stability of a financial system.

Table 4.2.2: Regression of Z-Score on Lerner Index & Adjusted Lerner Index

Results of Stability Regression(Z-Score_Index) 1990-2015				
Variable	Regression on Lerner Index		Regression on AdjustedLerner Index	
	Estimate	S.E	Estimate	S.E
LERNER	1.158633*		0.012062	
		(0.735110)		(0.009283)
LNFATA	-0.20353***		-0.200418	
		(0.055560)		0.058322
TASS	-1.21E-10		-1.59E-10	
		(1.18E-10)		1.14E-10
LOTA	0.374841***		0.386286	
		(0.091970)		0.098982
LOTA^2	0.009364***		0.008989	
		(0.002053)		0.002058
LETA	0.171667		0.173251	
		(0.039213)		0.040192
LGDPG*LSMC	-0.000603***		-0.000694	
		(0.000149)		0.000159
LGOV	0.11632**		0.109721	
		(0.056667)		0.056521
LFFI	-0.159231**		-0.154685	
		(0.073536)		0.075487
LHHI	0.005013		0.005691	
		(0.003885)		0.004025
Constant	-0.123420		0.789445	
		(0.629727)		0.347989
Obs	102		102	
R-squared	76%		75.5%	
First stage F -test (joint)	29.27565	p=0.0000	28.09956	p=0.0000
χ^2 Serial correlation	1.681941	P=0.0402	0.939070	P=0.5732
χ^2 heteroskedasticity	22.8176	P=0,0114	3.434643	P=0,0018
JB Statistic	594.2452	p=0.0000	477.4639	p=0.0000
Qstat	lag 4	p=0.0000	30.932	p=0.0000
	* 10% significance			
	** 5%significance			
	*** 1%significance			

They postulate that some macro-economic control variables enhance financial sector stability and furthermore calling for continent-wide bank alliances as these may enhance the success rate of Small and Medium Enterprises by facilitating access to financial products and services.

4.3. Implications of Findings

The Efficiency Adjusted Lerner in [4] (Kotter et al., 2012) a hybrid of the Lerner from [3] utilises profits instead of prices and results in both outcomes which imply a banking sector that is monopolistically competitive.

The data is generally normally distributed with minimal skewness attributed to outliers as a result of using data that is not adjusted for inflation.

The results are generally acceptable as no serial correlation is detectable at 5% level. However, the model's highly skewed residuals are suggesting that the financial stability and competition index may not follow a linear pattern.

The P-R H-Statistic's robustness to interest income as well as total revenue is indicative of perfect competition and supports the notion of the income generating sources that banks are at liberty to benefit from other than the traditional core intermediation; hence, as more sources of income avail themselves to banks the big four will wield the less market power. It is also a testament to the current inroads made by Capitec Bank at 9%. The main catalyst of the H-statistic is the cost of obtaining funds, while the prices of labour and capital expenditure have minimal impact.

According to Crockett (1997) stability through public policy has been necessitated by numerous advances globally which include among others the voluminous surge in financial transactions, the use of hybrid complex financial instruments ,the contagion incurred as a result of costly calamities in the financial systems from numerous prominently distinct institutions. Banks in South Africa should increase their equity investment and non-core intermediation income generating activities as there is a negative relationship between interest income and the ratio of other income generating sources. This however implies that banks will engage in more risk y behaviour and by inference this increases instability as the burden of risk passed on from the bank shareholders to other external creditors. This implies that an increase in competition among banks will impact financial stability. Henceforth the competition-stability nexus research findings have connotations for policy formulators, professional practioners and the agencies of regulation and supervision.

4.4. SUMMARY

The three models exhibit results that imply a banking sector that is monopolistically competitive. The models were controlled for serial correlation and heteroscedacity and as well for spurious regressions by using control variables. The robustness of bank values to non-interest income explains bank's tendency to engage in risky behaviour for

which they do not undertake ficuciary responsibility as they pass on the risks to other stakeholders thus impacting financial stability negatively. The study finds that in a monopolistically competitive environment, policy formulators, professional practitioners and agencies of regulation and supervision can harness the positive side effects to maintain financial stability.

Chapter 5
Summary, Recommendations & Conclusion

5.1 Summary of findings

While mapping the competitive terrain of the South African banking market and inferring the effect of competition on stability, for the big four banks over the duration 1990-2015, the study has found a case for monopolistic competition under a state of competition- fragility.

These findings are aligned with preceding studies of a similar nature. This study has juxtaposed the competition and stability discourse by describing the competitive environment for South African Banks, estimated competition indices, positioned South Africa's predisposition in the theory of banking competition and posited a competition-stability relationship. Competition indices were estimated using the Learner; efficiency Adjusted Lerner as well as Panzar-Rosse models while the Z-score proxied financial stability. Ordinary Least Squares methods with robust standard errors were utilised.

5.2 Recommendations

The outcomes have connotations for policy formulation, suggesting that while South African Banks are monopolistically competitive, there is room to harness the spill overs from macro-economic indicators of financial health and stability for instance through improved access to finance and bank alliances that will enhance the prospects of Small and Medium Enterprises.

In addition, the South African Government through its agency of regulation and supervision would be better placed to maintain financial stability armed with the mechanism for setting reforms in a monopolistic competition environment.

Merits for the professional practitioners and regulators lie in the utilisation of the models as yardsticks for potential investors in banks as well as for predicting equity prices.

5.3 Limitations of Study

The models assume uniformity of costs and sources of income across the banks.

The values are not adjusted for inflation hence the comparison will biased as financial statement figure have ballooned across the 26-year period covered by the study.

Although heteroscedasticity was controlled for using robust standard errors available such as Differential Logs and HAC Newey West covariance methods, it remained detectable at 1% level.

High chances of Endogeneity of data from banks used for both calculations of the competition index as well as control variables inputs.

5.4 Fulfilment of the research questions and objectives

In light of the context of this research, this study has fulfilled the objectives by covering the period 1990-2015 during which a number of crises occurred and impacted the stability of banks. The study also empirically investigated the effect of competition among the big four banks and found an inverse impact on financial stability. It as well is corroborating the findings on the South African banks' predisposition when it comes to the competitive landscape of monopolistic competition and has debunked the concentration – competition misnomer.

The study has gone on to suggesting policy formulations for the agents of regulation and supervision that uphold the monetary policy transmission mechanism in light of the monopolistic competitive environment.

5.5 Conclusion

Henceforth all research questions have been answered because the research complements existing literature by inferring the effect of competition on stability, over the duration 1990-2015 and debunking the concentration-competition misnomer. It also maps the competitive terrain of the South African banking market by utilising a two- pronged estimation approach. Initially competition is estimated using a log-transformation method to calculate the Lerner, Adjusted Lerner indices and H-statistic. Followed by, calculation of the Z-Score. The study then uses the results from the three indices to exhaustively affirm monopolistic competition as the predominant competitive environment in South Africa. Using the Z-score and Lerner indices with OLS estimation methods incorporating robust standard errors, the study posits the relationship between competition and stability and suggests that South Africa is inclined towards competition-fragility. These finding are aligned with preceding studies of a similar nature and have implications for policy formulation.

The outcomes have connotations for policy formulation, suggesting that while South African Banks are monopolistically competitive, there is room to harness the spill overs from macro-economic indicators of financial health and stability for instance through improved access to finance and bank alliances that will enhance the prospects of Small and Medium Enterprises. In addition, the South African Government through its agency of regulation and supervision would be better placed to conserve financial stability armed with the mechanism for setting reforms in a monopolistic competition environment.

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APPENDICES

Appendix A: UNIT ROOT TESTS.

Variables Diagnostic Tests				
Macro-Specific Variables	**1ST Difference**		**2ND Difference**	
	tests			
	ADF (unit root)	**KPSS (stationarity)**	**ADF (unit root)**	**KPSS (stationarity)**
EFI	-2.871379066623951*	0.2268326585793738***	-6.94489386313608***	0.02821405073090554***
FFI	-3.338051775892384**	0.03147437784267129***	-6.84224758475201***	0.02279033340792126***
GDPG	-3.370189850064194**	0.05920968733324861***	-5.57159757748150***	0.03671185422882583***
GOV	-4.208370575515412***	0.2813296644970669***		
SMC	-3.196619007702629**	0.05118028145325941***	-6.93879419802778***	0.03720654922374221***
Bank-Specific Variables	**tests**			
TC			-4.75210063857562***	0.02568267866433377***
Q			-10.1182040019704***	0.075672587008453***
P1	-2.8789988823908*	0.1472809842228747***	-7.63209385918325***	0.04083653282345643***
P2	-3.608207520020718***	0.145237721610811***		
P3	-3.665119623583387 ***	0.0948614502408493***		
PAT			-6.06888357670390***	0.02833546298086162***
TASS			-10.1182040019704***	0.075672587008453***
P(trev/tass)	-3.348787393568402**	0.06592459815820255***	-11.5794015581256***	0.02911571521726422***
IR	-3.090557117568479**	0.4056422503096507**	-17.2388238149370***	0.0796748887915719***
TEQA			-10.3597160937510***	0.05307508181194911***
HHI (concentration)	-3.405950704017879**	0.0254953212108074***	-4.94844376515045***	0.02392840162555107***
LTREV	-3.889043986584545***	0.06309554824260841***		
LTLTASS	-3.459202366607736**	0.1946680045396793***		

Table A1

Decision to include variables based on fulfilment of unit root tests and stationarity tests using Augmented Dicky Fuller (ADF) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS).

Decision Criteria ADF: tadf>tcrit & KPSS: tkpss<tcrit ***significant @1%, 5% and 10% ,** significant at 5% and 10%, *significant at 10%

Zscore unit root -10.15361613277694 at 1st difference

Appendix B: Log Total Cost (LTC)

Table B1: Correlation Matrix LTC

Correlation Matrix: LTC (log Total Cost)											
	C2*LQ	c3*LQ^2	c4*DLP1	c5*DLP2	C6*DDLP3	c7*DLP1*DLP2	c8*DLP1*DDLP3	c9*DLP2*DDLP3	c10*LQ*DLP1	c11*LQ*DLP2	c12*LQ*DDLP3
C2*LQ	100%	-64%	-19%	13%	21%	-16%	-1%	14%	-12%	5%	-21%
c3*LQ^2	-64%	100%	10%	-7%	-19%	1%	6%	-14%	-14%	-17%	32%
c4*DLP1	-19%	10%	100%	-9%	9%	17%	49%	-4%	-86%	-5%	-4%
c5*DLP2	13%	-7%	-9%	100%	-14%	-1%	0%	-39%	4%	90%	17%
C6*DDLP3	21%	-19%	9%	-14%	100%	-1%	9%	22%	-9%	-16%	-88%
c7*DLP1*DLP2	-16%	1%	17%	-1%	-1%	100%	67%	5%	8%	8%	4%
c8*DLP1*DDLP3	-1%	6%	49%	0%	9%	67%	100%	4%	-42%	0%	-3%
c9*DLP2*DDLP3	14%	-14%	-4%	-39%	22%	5%	4%	100%	2%	-57%	-40%
c10*LQ*DLP1	-12%	-14%	-86%	4%	-9%	8%	-42%	2%	100%	9%	3%
c11*LQ*DLP2	5%	-17%	-5%	90%	-16%	8%	0%	-57%	9%	100%	24%
c12*LQ*DDLP3	-21%	32%	-4%	17%	-88%	4%	-3%	-40%	3%	24%	100%

Figure B1: LTC individual stationarity

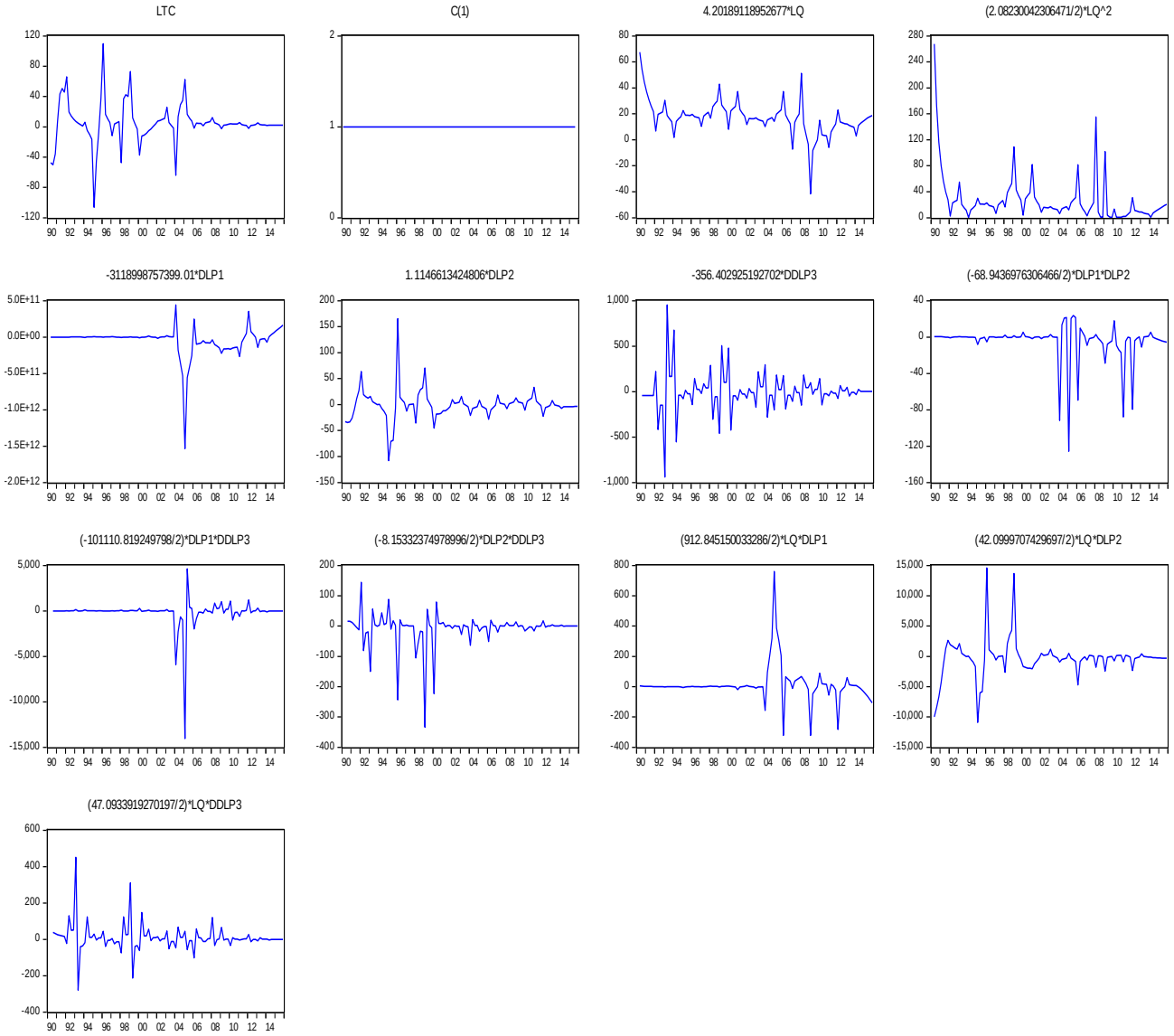


Table B2: Distribution stats LTC

	LTC	C(1)	C2*LQ	C3*LQ^2	C4*DLP2	C5*DDLP3	C6*DLP1*DLP2	C7*DLP1*DDLP3	C8*DLP2*DDLP3	C9*LQ*DLP1	C10*LQ*DLP2	C11*LQ*DDLP3
Mean	5.648732	1	16.51064	24.81334	-0.833209	-3.68172	-4.457722	-184.5917	-8.27347	13.665	-255.7497	9.377831
Median	3.69533	1	16.6531	16.65533	-1.004113	-10.58134	-0.052884	-1.545357	0.179588	0.254772	-106.188	1.509809
Maximum	109.6433	1	54.10965	172.6527	165.0959	954.0753	23.75071	4621.623	144.6696	759.6462	14589.78	450.7951
Minimum	-106.0773	1	-41.5356	9.77E-05	-107.725	-940.0832	-125.7443	-14035.81	-333.6391	-321.6003	-10920.48	-279.6412
Std. Dev.	25.8561	0	12.23384	29.97415	27.5224	214.6555	21.47645	1638.286	56.07877	116.8176	2930.201	75.80427
Skewness	-0.078709	NA	-0.539625	2.838448	1.542407	0.243459	-3.67874	-6.271173	-3.190166	2.68758	1.435193	1.930085
Kurtosis	8.761075	NA	8.218945	12.02791	17.46027	10.40973	17.82362	53.94242	18.09053	20.70587	14.91366	17.45984
Jarque-Bera	139.7788	NA	119.5258	478.6147	920.0065	232.0524	1152.546	11583.19	1129.654	1440.892	631.9837	942.6154
Probability	0	NA	0	0	0	0	0	0	0	0	0	0
Sum	570.5219	101	1667.574	2506.147	-84.15412	-371.8537	-450.2299	-18643.77	-835.6205	1380.165	-25830.72	947.1609
Sum Sq. Dev.	66853.82	0	14966.69	89844.97	75748.28	4607698	46123.77	2.68E+08	314482.8	1364635	8.59E+08	574628.8
Observations	101	101	101	101	101	101	101	101	101	101	101	101

Figure B2: LTC Individual Variables Normality test

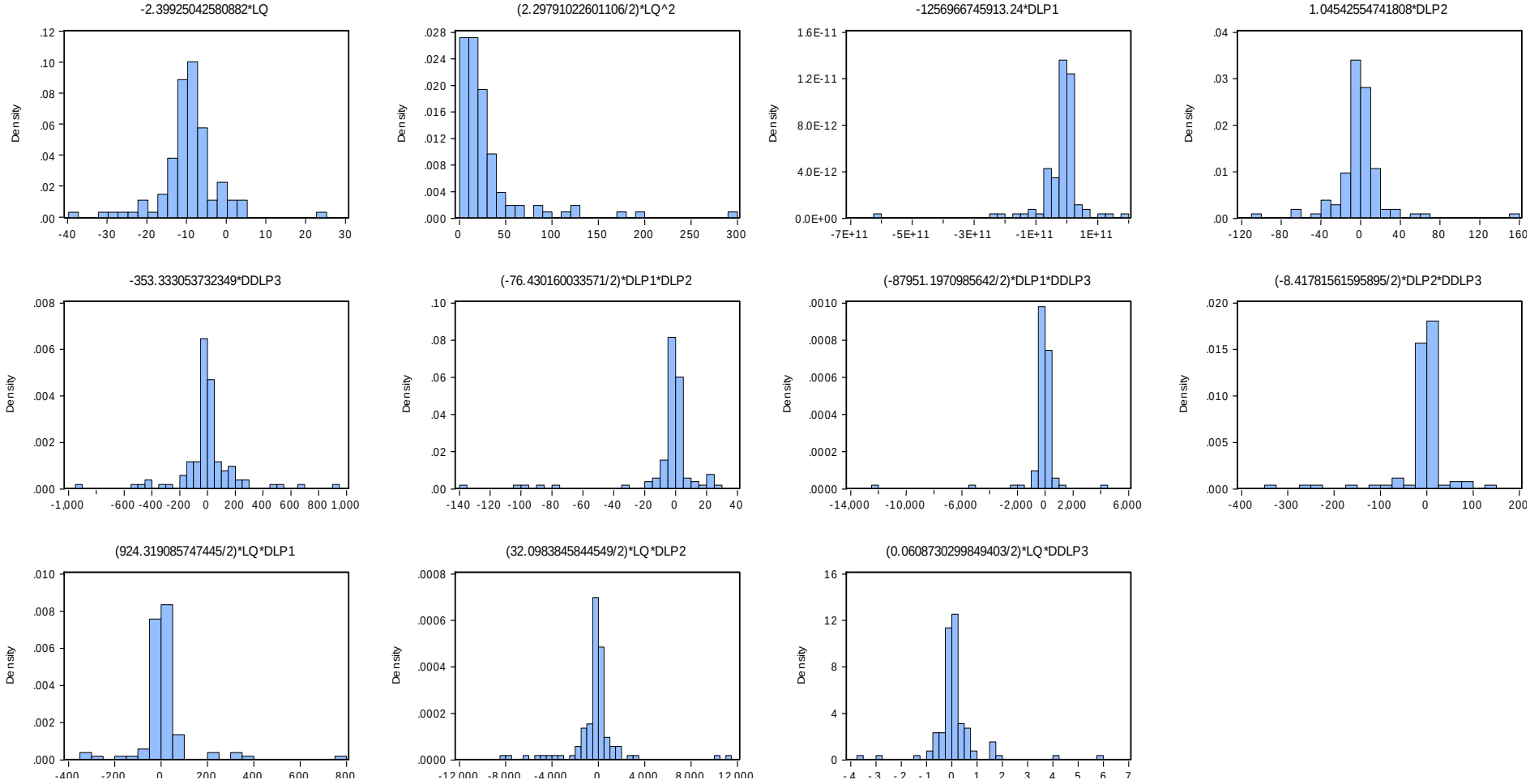


Table B3

Dependent Variable: LTC
Method: Least Squares
Included observations: 101 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West automatic bandwidth = 5.2751, NW automatic lag length = 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-9.410736	2.583746	-3.642284	0.0005
45.031066144135 7*LQ	0.107794	0.024918	4.325973	0.0000
(-0.540771686276078/2)*LQ^2	0.783716	0.348649	2.247865	0.0271
-5.411966860022 12E-10*DLP1	-7.00E+11	1.30E+11	-5.374602	0.0000
0.321852389912304*DLP2	1.298174	0.551743	2.352859	0.0208
0.006942846351045 44*DDLP3	-480.6932	645.7872	-0.744352	0.4586
(0.085064605918885 4/2)*DLP1*DLP2	-139.1335	79.77119	-1.744157	0.0846
(-0.000216567378755 95/2)*DLP1*DDLP3	-281383.7	433513.0	-0.649078	0.5180
(0.110659210105555/2)*DLP2*DDLP3	-8.570398	3.204990	-2.674080	0.0089
(-0.500945118648516/2)*LQ*DLP1	290.1580	70.05040	4.142132	0.0001
(0.007296737461468 54/2)*LQ*DLP2	28.92485	9.799660	2.951618	0.0040
(14.61127870256 3/2)*LQ*DDLP3	0.102014	0.128890	0.791481	0.4308

R-squared	0.830614	Mean dependent var	5.648732
Adjusted R-squared	0.809678	S.D. dependent var	25.85610
S.E. of regression	11.27995	Akaike info criterion	7.795070
Sum squared resid	11324.11	Schwarz criterion	8.105777
Log likelihood	-381.6510	Hannan-Quinn criter.	7.920853

Table B4

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.985011	Prob. F(2,87)	0.3776
Obs*R-squared	2.258540	Prob. Chi-Square(2)	0.3233

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 03/13/17 Time: 17:28
Sample: 1990Q3 2015Q4
Included observations: 102
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.016195	3.224775	0.005022	0.9960
72.3738638139591*LQ	-72.30411	0.014954	-4834.964	0.0000
(-2.20863465360031/2)*LQ^2	2.428535	0.090473	26.84269	0.0000
1597.45742686801*DLP1	-1597.211	0.047157	-33869.81	0.0000
-0.536639501636704*DLP2	-0.258469	0.262934	-0.983020	0.3283
-241.570145979803*DDLP3	241.5866	0.020197	11961.56	0.0000
(-92.8965983633551/2)*DLP1*DLP2	93.08147	0.086335	1078.146	0.0000
(366.535578486794/2)*DLP1*DDLP3	-366.0449	0.425989	-859.2821	0.0000
(1.5885961328452/2)*DLP2*DDLP3	-2.225286	0.163500	-13.61035	0.0000
(103691.483932469/2)*LQ*DLP1	-103691.5	0.000417	-2.48E+08	0.0000
(3.74000471957534/2)*LQ*DLP2	-3.682543	0.016368	-224.9777	0.0000
(19.266084980794/2)*LQ*DDLP3	-19.16694	0.103430	-185.3128	0.0000
LTC(-1)	-0.017175	0.058403	-0.294082	0.7694
RESID(-1)	-1.64E-09	1.38E-09	-1.189946	0.2373
RESID(-2)	-3.16E-10	9.98E-10	-0.316826	0.7521

R-squared	1.000000	Mean dependent var	-1.47E+08
Adjusted R-squared	1.000000	S.D. dependent var	1.38E+09
S.E. of regression	11.28202	Akaike info criterion	7.819351
Sum squared resid	11073.71	Schwarz criterion	8.205377
Log likelihood	-383.7869	Hannan-Quinn criter.	7.975666
F-statistic	1.07E+17	Durbin-Watson stat	1.016963
Prob(F-statistic)	0.000000		

Appendix C: Marginal Cost

Figure C1

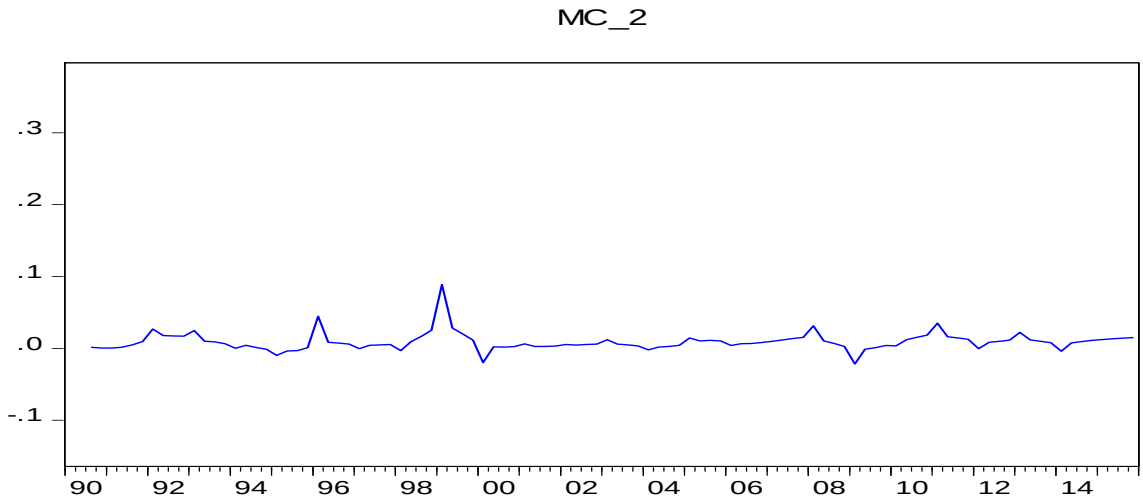


Figure C2

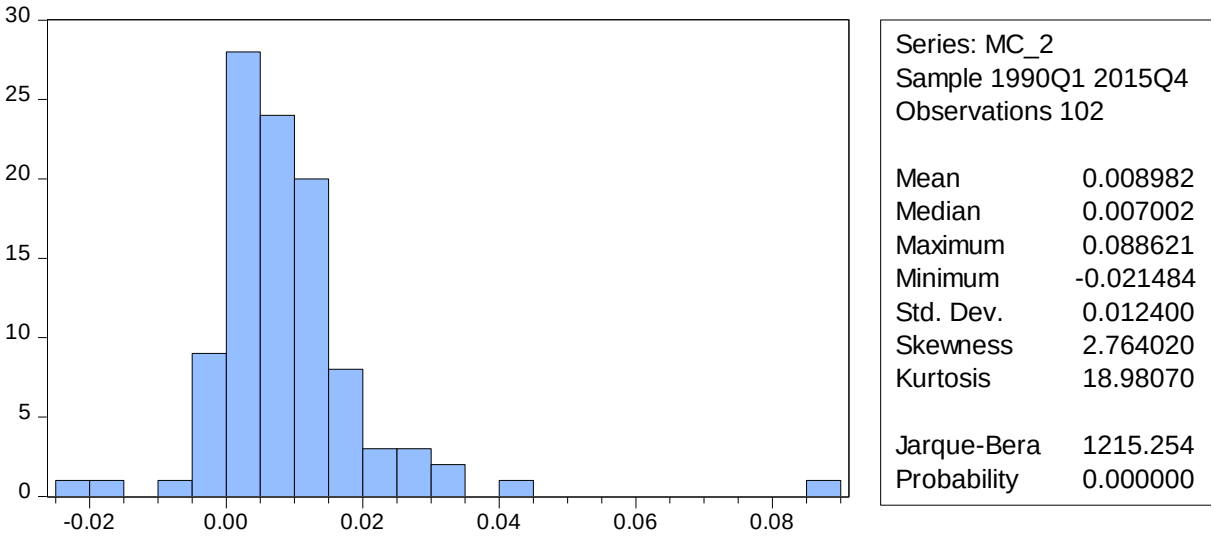


Table C1: MC_2 distribution statistics

	MC_2	TCQ	A1	A2	QP
Mean	0.008982	0.011920	0.067112	0.755808	-0.042779
Median	0.007002	0.010129	0.067112	0.764818	-0.085501
Maximum	0.088621	0.024029	0.067112	2.473707	8.394018
Minimum	-0.021484	0.001192	0.067112	-1.898865	-5.439449
Std. Dev.	0.012400	0.007199	0.000000	0.556605	1.394427
Skewness	2.764020	0.212090	NA	-0.547371	1.564549
Kurtosis	18.98070	1.633652	NA	8.298810	17.49894
Jarque-Bera	1215.254	8.699054	NA	124.4223	935.0443
Probability	0.000000	0.012913	NA	0.000000	0.000000
Sum	0.916180	1.215831	6.845424	77.09244	-4.363484
Sum Sq. Dev.	0.015529	0.005234	0.000000	31.29072	196.3870
Observations	102	102	102	102	102

Figure C3: MC_2 stationarity

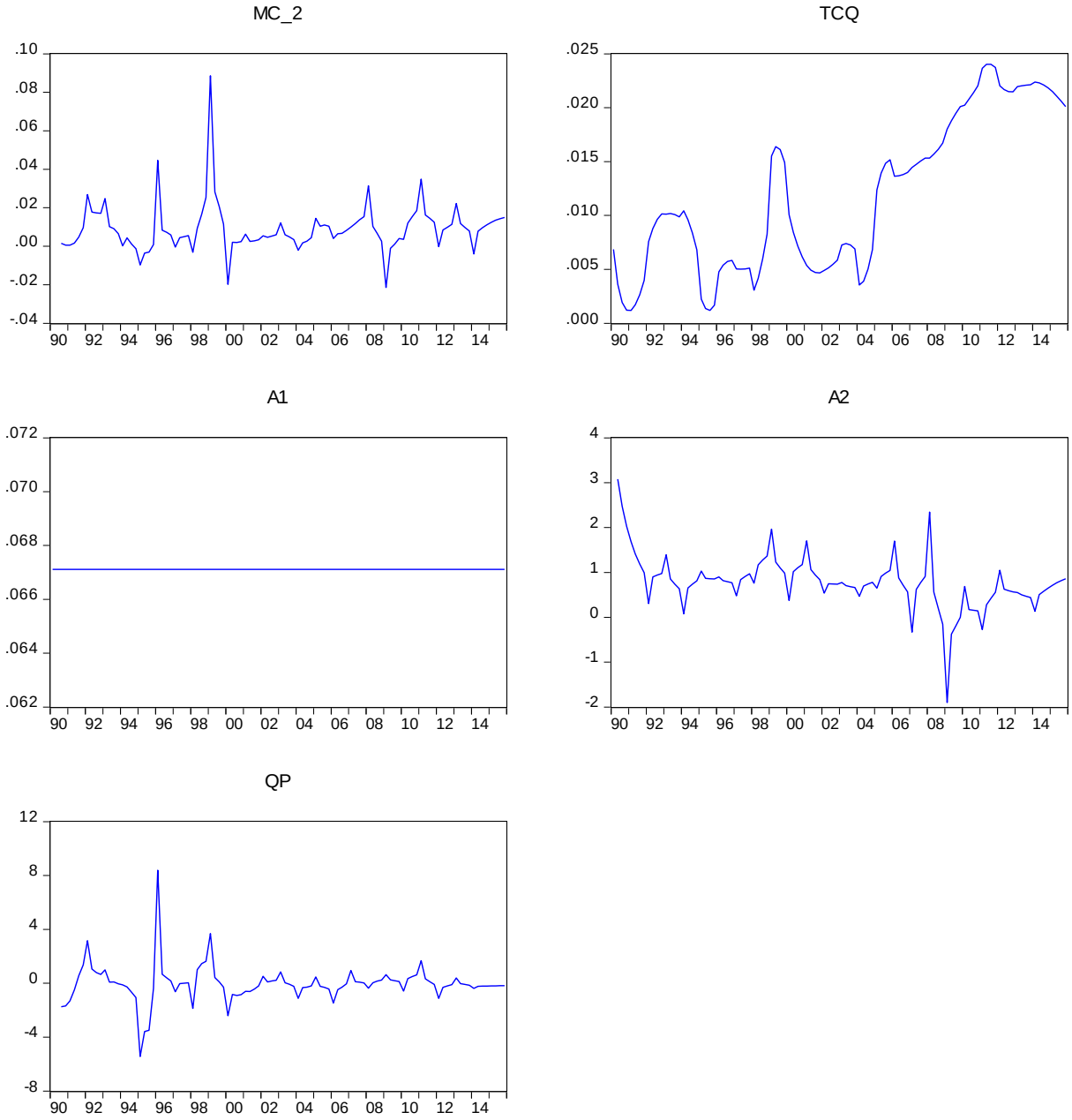
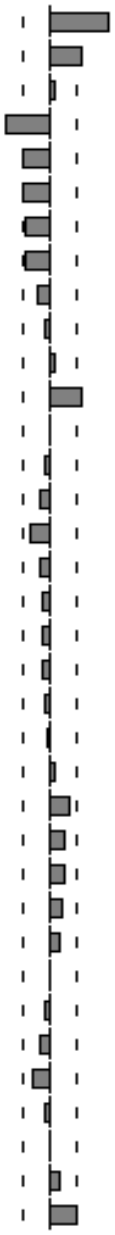


Table C2: MC_2 correlation.

Correlation Matrix: Marginal Cost				
	MC_2	**TCQ**	**A2**	**QP**
MC_2	100%	26%	29%	67%
TCQ	26%	100%	-43%	14%
A2	29%	-43%	100%	-12%
QP	67%	14%	-12%	100%

Figure C4: MC_2 Corelelogram

Sample: 1990Q1 2015Q4
Included observations: 102

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.438	0.438	20.187	0.000
		2	0.244	0.065	26.529	0.000
		3	0.040	-0.110	26.703	0.000
		4	-0.320	-0.398	37.819	0.000
		5	-0.194	0.120	41.934	0.000
		6	-0.202	-0.029	46.439	0.000
		7	-0.177	-0.083	49.924	0.000
		8	-0.178	-0.281	53.488	0.000
		9	-0.084	0.119	54.291	0.000
		10	-0.025	0.014	54.363	0.000
		11	0.027	-0.014	54.447	0.000
		12	0.241	0.124	61.274	0.000
		13	0.008	-0.266	61.280	0.000
		14	-0.043	-0.106	61.504	0.000
		15	-0.075	-0.019	62.197	0.000
		16	-0.145	0.147	64.808	0.000
		17	-0.075	-0.206	65.503	0.000
		18	-0.061	-0.101	65.970	0.000
		19	-0.051	-0.051	66.298	0.000
		20	-0.065	0.053	66.836	0.000
		21	-0.048	-0.151	67.137	0.000
		22	-0.021	-0.064	67.193	0.000
		23	0.027	-0.000	67.289	0.000
		24	0.141	0.042	70.005	0.000
		25	0.102	0.010	71.442	0.000
		26	0.102	-0.011	72.891	0.000
		27	0.088	-0.006	73.980	0.000
		28	0.066	0.022	74.612	0.000
		29	0.003	-0.061	74.613	0.000
		30	-0.039	-0.045	74.834	0.000
		31	-0.069	-0.029	75.555	0.000
		32	-0.122	-0.043	77.799	0.000
		33	-0.045	0.078	78.109	0.000
		34	0.004	0.038	78.112	0.000
		35	0.076	0.042	79.018	0.000
		36	0.197	0.070	85.263	0.000

Appendix D: Zscore

Lerner stationarity

Figure D1

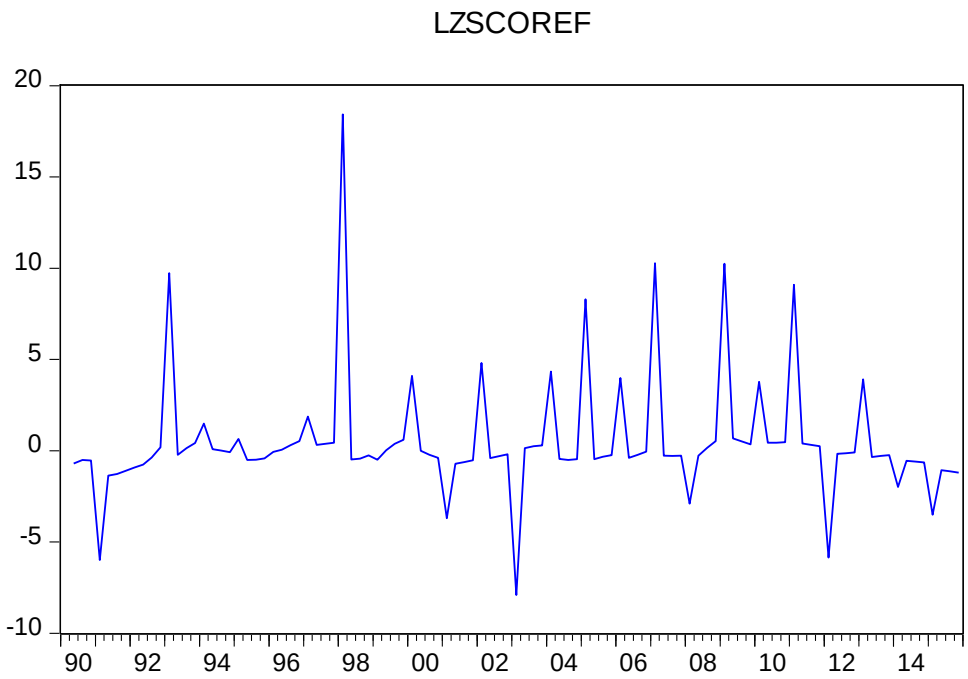
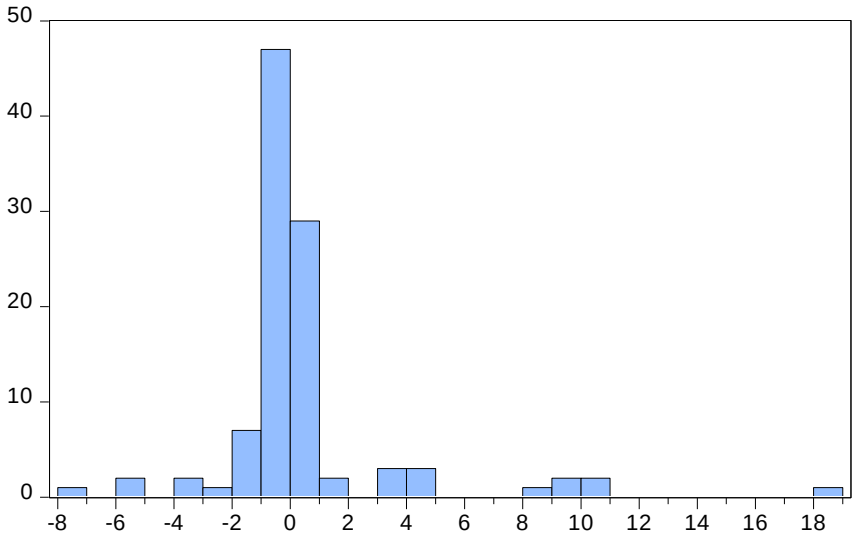


Figure D2

Z- Score Distribution



Series: LZSCOREF	
Sample 1990Q1 2015Q4	
Observations 103	
Mean	0.455540
Median	-0.221864
Maximum	18.42288
Minimum	-7.909178
Std. Dev.	3.249927
Skewness	2.461513
Kurtosis	13.28027
Jarque-Bera	557.5735
Probability	0.000000

Appendix E: Lerner Index

Zscore – Lerner variable Stationarity

Figure E1

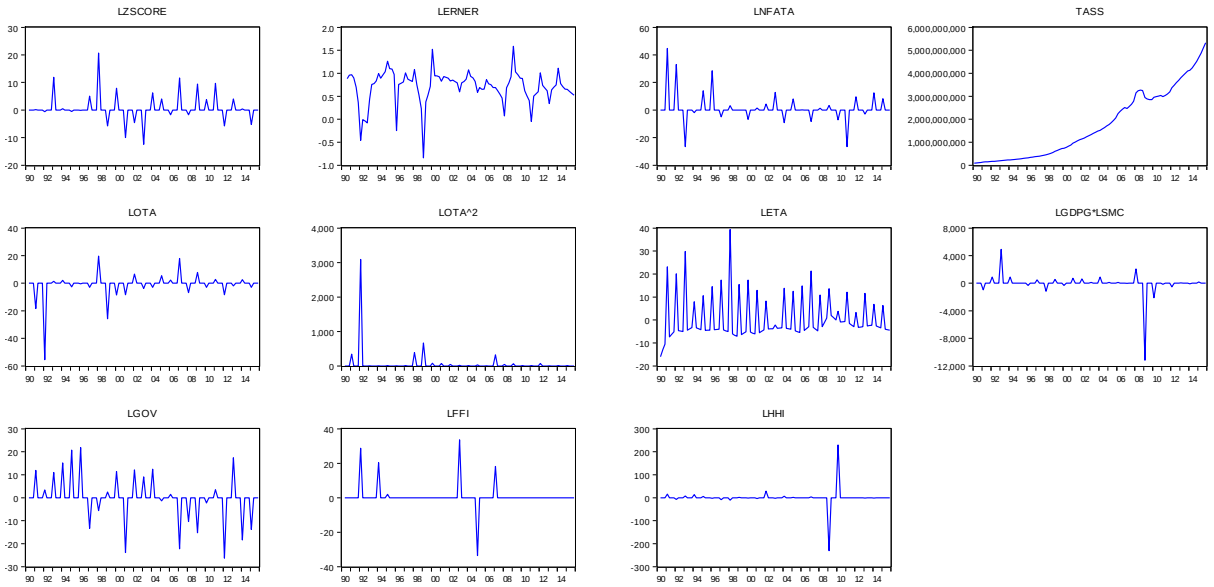
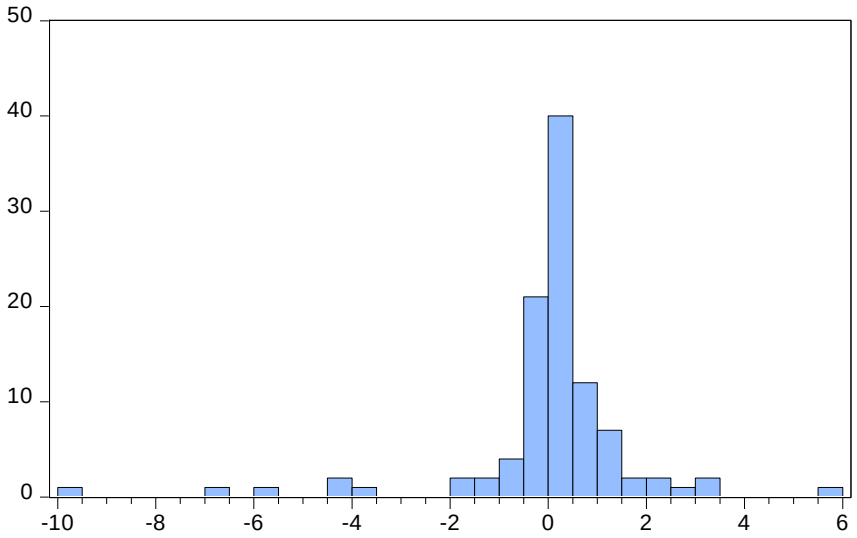


Table E1

Correlation Matrix: Lerner INDEX											
	LZSCOR	LERNER	LNFATA	TASS	LOTA	LOTA^2	LETA	LGDPG*LSMC	LGOV	LFFI	LHHI
LZSCORE	100%	17%	-36%	-4%	38%	3%	51%	-18%	3%	-17%	-12%
LERNER	17%	100%	-7%	-3%	41%	-38%	-6%	-32%	-15%	-12%	-12%
LNFATA	-36%	-7%	100%	-10%	-48%	44%	14%	-18%	11%	18%	-8%
TASS	-4%	-3%	-10%	100%	13%	-14%	-2%	-12%	-23%	-9%	-1%
LOTA	38%	41%	-48%	13%	100%	-78%	-14%	-17%	-14%	-33%	-10%
LOTA^2	3%	-38%	44%	-14%	-78%	100%	37%	5%	1%	46%	-3%
LETA	51%	-6%	14%	-2%	-14%	37%	100%	0%	3%	11%	-7%
LGDPG*LSMC	-18%	-32%	-18%	-12%	-17%	5%	0%	100%	24%	6%	51%
LGOV	3%	-15%	11%	-23%	-14%	1%	3%	24%	100%	9%	18%
LFFI	-17%	-12%	18%	-9%	-33%	46%	11%	6%	9%	100%	0%
LHHI	-12%	-12%	-8%	-1%	-10%	-3%	-7%	51%	18%	0%	100%

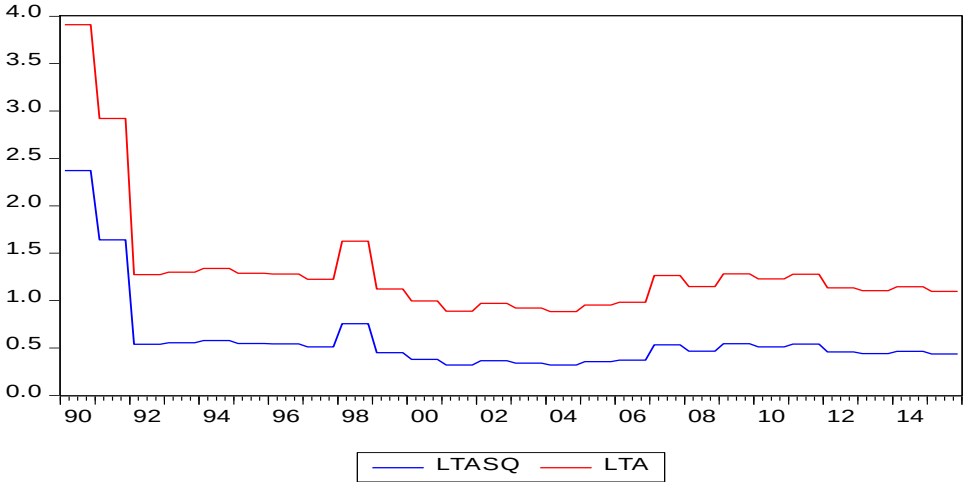
Figure E2



Series: Residuals	
Sample 1990Q3 2015Q4	
Observations 102	
Mean	-1.76e-16
Median	0.155194
Maximum	5.966074
Minimum	-9.868840
Std. Dev.	1.823271
Skewness	-2.275043
Kurtosis	13.91417
Jarque-Bera	594.2452
Probability	0.000000

Figure E3

LOTA^2 VS LOTA



Appendix F: Adjusted Lerner

Figure 1F

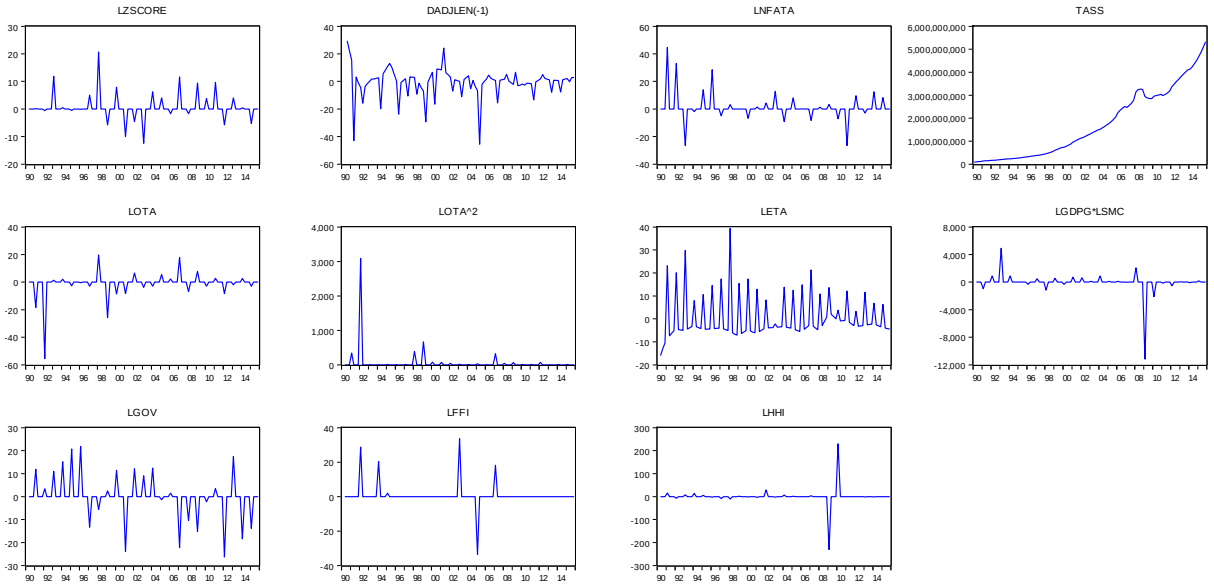


Table.1F

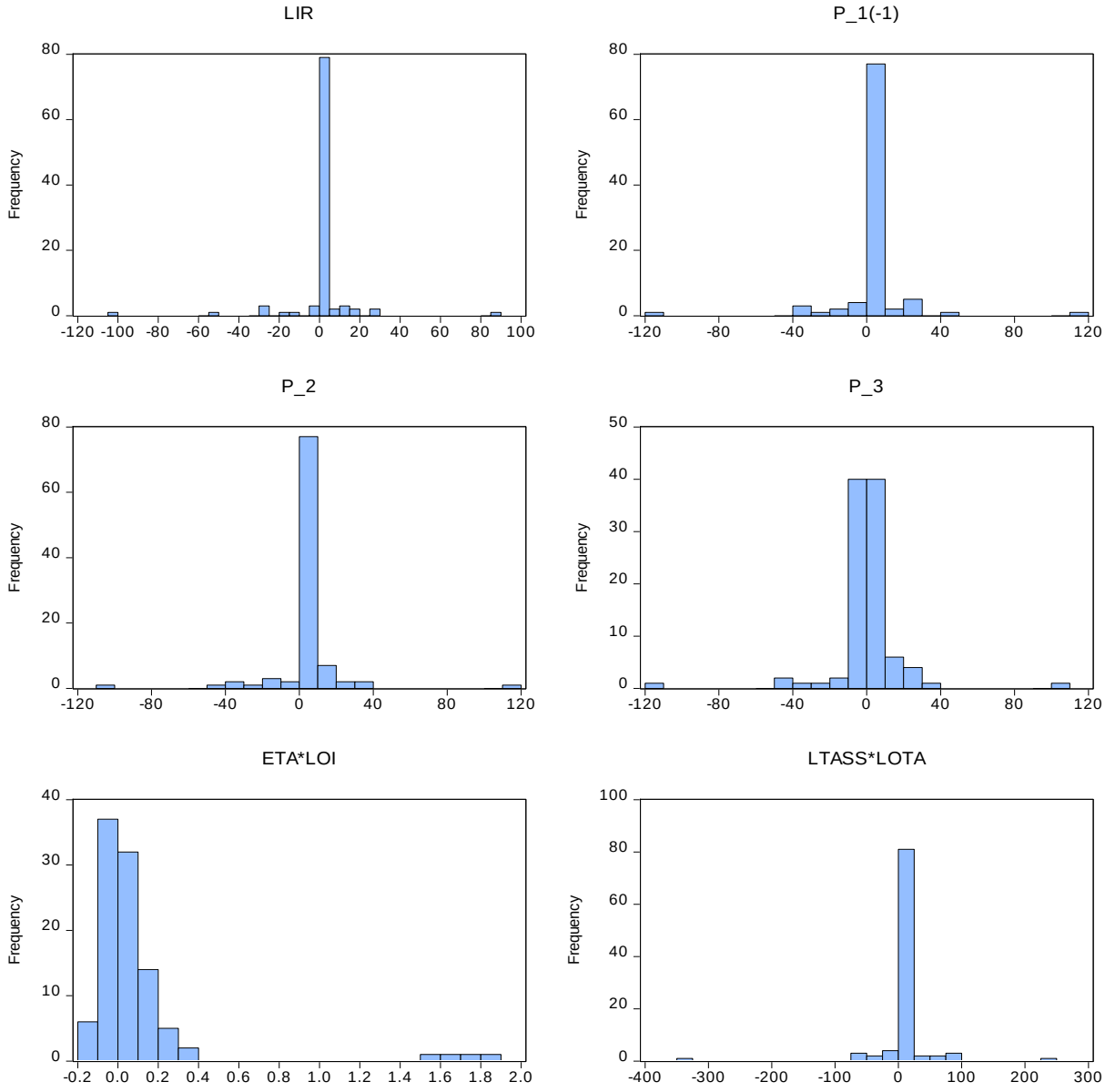
Correlation Matrix: Ajusted Lerner INDEX											
LZSCORE	**1**	**0.0086**	**-0.3596**	**-0.0385**	**0.378581**	**0.0284**	**0.51081**	**-0.18455**	**0.0306**	**-0.1662**	**-0.1202**
DADJLEN(-1)	1%	100%	9%	-1%	-1%	-2%	9%	1%	4%	4%	1%
LNFATA	-36%	9%	100%	-10%	-48%	44%	14%	-18%	11%	18%	-8%
TASS	-4%	-1%	-10%	100%	13%	-14%	-2%	-12%	-23%	-9%	-1%
LOTA	38%	-1%	-48%	13%	100%	-78%	-14%	-17%	-14%	-33%	-10%
LOTA^2	3%	-2%	44%	-14%	-78%	100%	37%	5%	1%	46%	-3%
LETA	51%	9%	14%	-2%	-14%	37%	100%	0%	3%	11%	-7%
LGDPG*LSMC	-18%	1%	-18%	-12%	-17%	5%	0%	100%	24%	6%	51%
LGOV	3%	4%	11%	-23%	-14%	1%	3%	24%	100%	9%	18%
LFFI	-17%	4%	18%	-9%	-33%	46%	11%	6%	9%	100%	0%
LHHI	-12%	1%	-8%	-1%	-10%	-3%	-7%	51%	18%	0%	100%

Appendix G : Panzar- Rosse H- statistic using IR

Table 1G

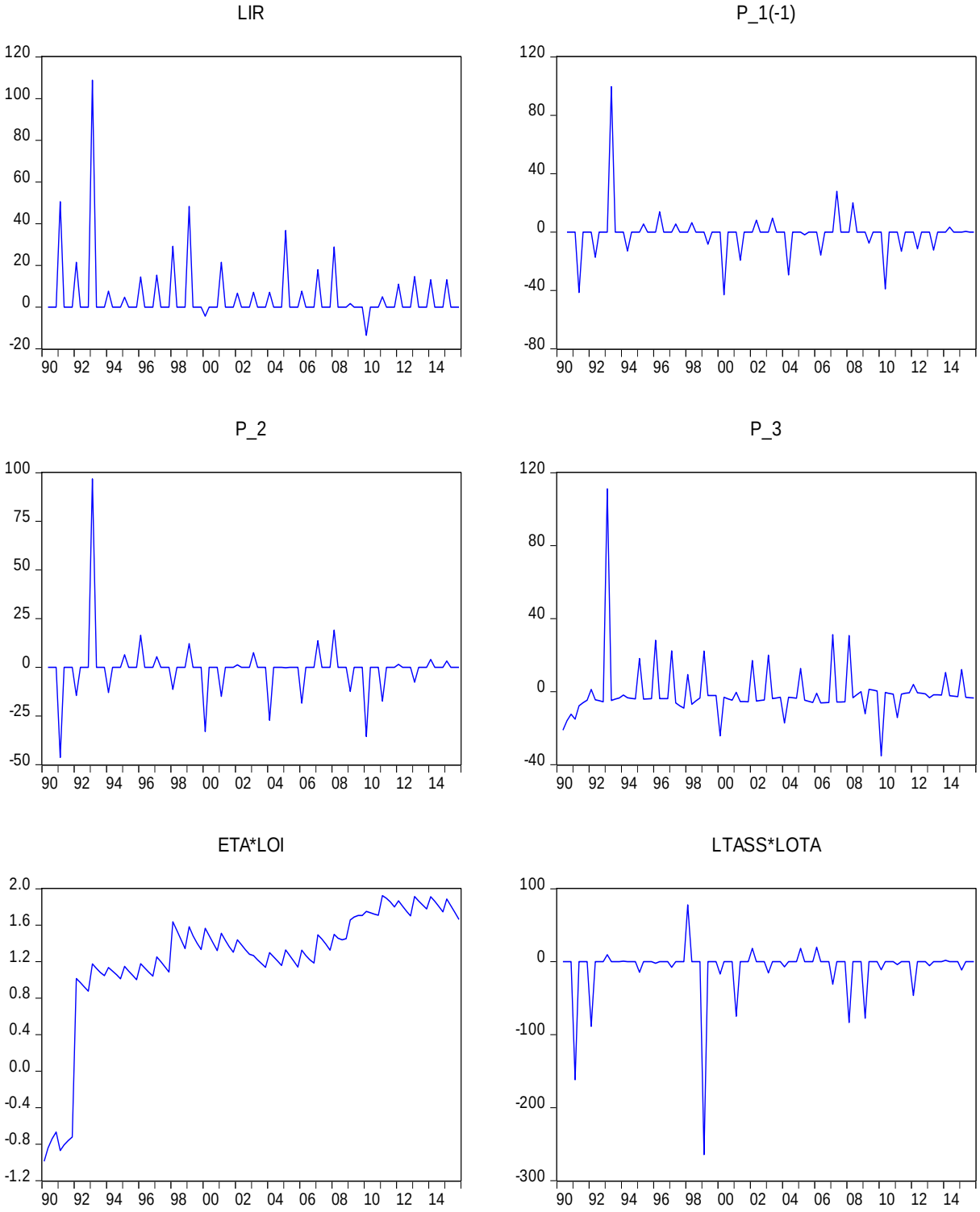
Correlation Matrix: Panzar -Rosse H-Statistic						
	LIR	**P_1(-1)**	**P_2**	**P_3**	**ETA*LOI**	**LTASS*LOTA**
LIR	100%	2%	50%	79%	-9%	-40%
P_1(-1)	2%	100%	0%	0%	5%	-1%
P_2	50%	0%	100%	85%	8%	12%
P_3	79%	0%	85%	100%	10%	-8%
ETA*LOI	-9%	5%	8%	10%	100%	11%
LTASS*LOTA	-40%	-1%	12%	-8%	11%	100%

Figure 1G



Panzar- Rosse H- statistic using IR STATIONARITY

Figure 2G



Appendix H : Appendix G Panzar- Rosse H- statistic using TR

Table .1H

Correlation Matrix: Panzar -Rosse H-Statistic						
	LTR	P_1(-1)	P_2	P_3	LETA*LOI	LOTA*LTASS
LTR	100%	1%	71%	88%	45%	-14%
P_1(-1)	1%	100%	0%	0%	0%	-1%
P_2	71%	0%	100%	85%	16%	12%
P_3	88%	0%	85%	100%	49%	-8%
LETA*LOI	45%	0%	16%	49%	100%	-10%
LOTA*LTASS	-14%	-1%	12%	-8%	-10%	100%