A Vector Error Correction Model of the South African Banks Stock Prices

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Abstract

This paper investigates the long-run equilibrium relationships between selected economic fundamentals and banks' stock prices in South Africa between 2010 and 2018. It further evaluates the predictive power of these stock prices on the economic growth. Johansen co-integration tests, vector error correction models and granger causality tests were utilised. The findings revealed that in the long run, each bank's stock price is co-integrated with two macroeconomic indicators. Industrial production has a long run positive effect on all the banks' stock price, except one where the impact is negative. Exchange rate also has an ambivalent outcome. However, M2 and export constantly exhibited a long run but a negative effect. Furthermore, there is no dynamic co-movements between banks stock prices themselves, suggesting greater diversification despite these banks' monopoly position. Finally, South African Banks Index has a co-integrating relationship with industrial production and exchange rate. While the index does not as a stand-alone unidirectionally cause the two variables, it jointly with industrial production granger causes exchange rate, implying an effective but weak predictive power. In a short run, only industrial production has a statistically significant positive or negative relationship with banks' stock prices, corroborating its equivocal effect. Money supply, exchange rate and export have no significant explanatory influence.

Key words: Banks stock prices; Johansen Co-integration; Vector Error correction; Impulse response function; Granger causality; South Africa.

JEL Classification:

Introduction

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The idea that change in stock price is attributable only to new information whether macroeconomic, political or other future cash flows and discount rates, has since been questioned (Cutler, Poterba and Summers, 1988). Using the asset pricing theory perspective or a more intuitive approach, several studies have examined the effect of economic variables on stock markets (proxied by major local stock market indexes). To some extent, the predictive power of stock markets on the economic growth has also been the subject of enquiries. However, studies have mostly been country-levels researches. Industry-level exploration, specifically on such key economic players as banks is worth carrying out. The reason is, any depression in this industry can trigger macroeconomic consequences as there would then be banks run, tightening of credit supply, exacerbation of cyclical down turn, decelerations of investment, production and assets price (Calomiris, 2008). A systemic crises such as the 2007-2008 global financial crisis is an example. As a reminder, banks and stock markets are important contributors of economic growth (Beck and Levine, 2002); (Pradhan *et al.*, 2014); (Valickova *et al.*, 2013); (Fufa and Kim, 2018). Banks act as intermediaries between depositors and borrowers, provide liquidity, loans, derivatives contracts, insurance, wealth management, investment banking. For funding purpose, they also issue structured credits products such as CDOs and create off-balance sheet vehicles to transform pool of assets into liquidity via securitization (Berger *et al.*, 2016). Moreover, banks' lending ability is key in the transmission of a country's monetary policy as it can define the degree of impact of the monetary policy on the economy (Peek and Rosengren, 2013). Since banks are at the centre of the development of an economy and stock prices reflect future performance, it is important to determine the macroeconomic components that trigger the most changes in banks stock prices and test the predictive power of these stock prices on long and short run state of an economy. This paper aims at filling the gap by extending the existing literature to one of the BRICS countries, South Africa, with focus on long run relationships via vector error correction model and Granger causality. Available studies related to the first part have looked at diverse other contexts, focused on only the short run relationships essentially using multiple regression analysis. The predictive power of stock prices on economic growth aspect has been examined elsewhere and in South Africa but not based on South African banks stock prices.

As a contextual overview[i], the South Africa stock market was incorporated in 1887, initially to raise funds for the growing need of investments in the mining sector in South Africa (Hassan, 2013). The SA stock market is since the spearhead of the stock exchanges in Africa and the 19th in the world by market capitalization. Key historical period in the development of the South African Stock market include the year 1963 when the stock exchange joined the World Federation of Exchanges(WFE). In the late 1970s, the exchange developed into a centre for all securities trading. In the 1980s, the promulgation of Stock Exchanges Control Act was issued and the South Africa bond market was launched. In the 1990s, foreign entities were able to trade on the Exchange and the bond market was detached from the Exchange to form the Bond Exchange. The main participant on the latter is the South African government with the highest volume of bonds issued. Over the same period, an automated trading platform substituted the open outcry trading floor and later on, the Insider Trading Act was enacted. In the 2000s, the Securities

Services Act replaced the Stock Exchange Control Act and the Financial market control Act. JSE acquired the South Africa Futures Exchange in 2001 followed by the implementation of the FTSE/JSE Africa Index series in 2002. Also, the Social Responsibility Index was added on the Exchange to account for the environmental, economic and social responsibility. In 2012, as a BRICS member, South Africa launched the trade in benchmark equity derivatives in each BRICS's member local currencies and Exchanges. Later in 2015, the FTSE/JSE Responsible Investment Index series was launched. Today, around 400 companies trade on the SA Stock Exchange with two key benchmark indices which are the FTSE/JSE All Share Index accounting for 99% of market capitalization and the FTSE/JSE Top 40 Index (JSE, 2019)[2].

On the economic level, South Africa economic growth post-global financial crisis has been subdued to external and domestic constraints. The commodities which accounted for 61% of merchandise exports and 10.9% of GDP, was subjected to the end of the commodity super cycle and China's economy slow down. Between August 2011 to December 2015, the prices of metal exports such as iron ore, gold and platinum dropped by 76.9%, 39.3% and 52.3%. The decline indirectly affected capital flows, investment in the mining industry, consumption specifically in the rural areas, and profits(World Bank, 2016). Other external factor that adversely impacted the South Africa economy is the slowdown of China's economy. According to the World Bank assessment, 12.6% of exports from South Africa and 15% of imports amounting a total of $28 billion trade flows between China and South Africa compared to only 2.7 and 2% in 1995. The contraction of China economy lead to a cut in the demand of commodities and triggered the slump in the prices. Domestically, uncertainty and debates over laws on investors rights, agricultural trade between South Africa and the United States and political instability up until a new government was appointed, deteriorated investors' confidence. Furthermore, a severe drought caused by the climatic phenomenon called El Nino, affected the agricultural sector (World bank, 2016). Challenges remains. South Africa is not strongly integrated into the global value chains coupled with the trap of high inequality and poverty that sparks tensions over resources, corruption, crime and discourage investment. For 2018, GDP was expected to rise from 1.3% in 2017 to 1.4 in 2018 and 1.8 in 2019. Private investment was also anticipated to grow due to the government assurance to debt stabilization(World Bank, 2018). Unfortunately, during the first two quarters of 2018, the economy was in recession (GDP at -2.7% and -0.5% respectively). It's only thank to an improvement during the last two quarters (+2.6% and +1.4%) that the year 2018 ends with a 0.8% GDP growth (Stat SA, 2019).

Literature review

[2] Source of all this: https://www.jse.co.za/about/history-company-overview

The literature defines stock prices as the expected discounted dividends. It is formulated as it follows: P=(E(c))/k, where c is the dividend stream and k, the discount rate (Chen, Roll and Ross, 1986). These authors also demonstrated that real and nominal forces can change expected cash flows. As an example, they contended that a change in the expected level of real production would have an impact on the current real value of cash flows. In addition to Chen et al's study, several other studies also use the Arbitrage pricing theory, Capital asset pricing model or simple intuitive financial theory to justify and interpret the effect of macroeconomic variables on stock prices. Following (Chen, Roll and Ross, 1986) and more specifically (Maysami and Koh, 2000), simple and intuitive financial theory allows us to expect a correlation between selected economic variables such as industrial production, exchange rate, M2, export and South African banks' stock prices. On the other hand, following (Cole, Moshirian and Wu, 2008), we can hypothesize that banks' stock price will have predictive power on the economic growth in the study approximated by industrial production and exchange rate.

2.1 relationship between selected macroeconomic variables and banks' stock price

(AL- Shubiri, 2010) investigated the economic factors that affect the movement of 14 Jordanian commercial banks stock prices listed on the Amman Stock Exchange. Multiple regression and data from 2005 to 2008 were utilised. The results showed that GDP has a significant and positive impact, while inflation and interest rate have a negative but only on specific years.

(Kasman, Vardar and Tunç, 2011) focused on the impact of interest rate and foreign exchange rate on the changes in the return of 13 Turkish banks stock prices on the Istanbul Stock Exchange. OLS and GARCH statistical techniques were employed. Data from 1999 to 2009 revealed that both variables have a negative and significant influence on banks' stock return.

In the same vein, (Arshad *et al.*, 2015) focused on commercial banks' stock prices determinants listed on the Karachi Stock Exchange using linear multiple regression. Data covered the period 2007 to 2013 and revealed that only interest rate significantly but negatively affect stock price. GDP was found to have no impact.

(Enow and Brijlal, 2016) examined the impact of firm specific determinants on 14 listed companies on the Johannesburg Stock Exchange, using multiple regression analysis. Their findings suggest that price to earnings ratios and earning per share positively affect stock prices.

(Pradhan and Dahal, 2016) investigated the impact of firm specific and macroeconomic variables on 14 Nepalese commercial banks from 2003 to 2014 using multiple regression. GDP, inflation and money supply were tested. The author concluded that GDP outperformed other inflation and money supply variables, with a positive and significant impact. Inflation and money did not show a consistent significance in all the equations.

(Rjoub, Civcir and Resatoglu, 2017) examined the effect of micro and macro-economic variables on the Turkish banks' stock prices. Fixed panel data analysis and Dumitrescu and Hurlin panel granger causality test was utilised to analysed the data taken from 1993 to 2015. Money supply

was found to have a positive relationship with stock prices, while interest rate had a negative effect. Industrial production coefficient showed a positive sign but was not significant. A unidirectional causality was also determined between interest rate and stock prices and a bidirectional causality for money supply.

(Bhattarai, 2018) cumulated firm specifics and macroeconomic variables impact on Nepalese commercial banks and insurance companies' stock prices. Multiple regression analysis and data from 2009 to 2015 were utilized. Results revealed that inflation rate and money supply negatively affect stock prices. Conversely, exchange rate and GDP growth rate have a positive impact.

(Ndlovu *et al.*, 2018) looked at how macroeconomic variables affect stock returns on the Johannesburg stock exchange. Using VECM Granger causality technique on quarterly data from 1981 to 2016, they found that interest rate, money supply growth and inflation are positively related to the share price in the long run and exchange rate negatively. They also observed that exchange rate and interest rate unidirectionally cause changes in share price and M3.

2.2 Banks' stock prices predictive power of economic growth

(Hawati, Noreha and Aisyah, 2005) examined the predictive power of the Malaysian stock market measured by the Kuala Lumpur Composite Index for the country's economy activity proxied by industrial production index. The author used data from 1980 to 2004, which he divided into sub-periods. From the Johansen cointegration and ARDL bounds tests, results revealed no long run relationship between the variables but for one of the sub-period, economic activity has a short term impact on stock market.

(Foresti, 2007) looked at whether there is bidirectional predictive power between stock market prices and short/long-term macroeconomic growth in the USA. By applying the Granger causality test on quarterly data from 2000 to 2005, they found that stock market prices, proxied here by Standard's and Poor Index, reliably predict growth (GDP) but the reverse was not conclusive.

(Cole, Moshirian and Wu, 2008) looked at the relationship between bank stock return and future economic growth. Using dynamic panel data from 36 developed and emerging markets and GMM techniques, they found that bank stock returns have a positive and significant impact on future GDP growth. Data covered the period 1973 to 2001.

(Pilinkus and Boguslauskas, 2008)focused his study on the Lithuanian market from 1999 to 2008 and looked at whether there are bidirectional causal relationships between the Lithuanian stock market and a group of economic variables using the granger causality method. The results revealed that depending on the variable, there are unidirectional and bidirectional causal relations between the two groups of variables.

(Cooray, 2010) explored whether stock markets lead to economic growth. Using cross-sectional data for 35 developing economies, found that when policy measures are taken to increase the size, liquidity and activity improve economic growth.

(Croux and Reusens, 2013) employed the granger causality test in the frequency domain to search whether the domestic stock prices could predict the future of economic activity of the G-7 countries with data from 1991 to 2010. The methods used consisted in using Granger causality test. They found that slowly fluctuating components of the stock prices have a strong predictive power, while the rapidly fluctuating components do not have any impact.

In South Africa, (Mpofu, 2014) examined the relationship between stock markets, measured by the FTSE-JSE All Shares Index and GDP growth in South Africa using Vector Autoregressive model (VAR). Data covered the period 2001 to 2014. Results did not show any significant predictive power of GDP for future stock market growth.

(Tiwari *et al.*, 2015) carried out a causality analysis in frequency domain via VAR model between stock prices and India economic growth with data from 1993 to 2011. The results revealed a unidirectional causality between stock prices and industrial production in the long run but no business cycle causality from both directions when they used a non-conditional model.

(Adam, 2015) explored the relationship between stock price index and economic growth measured by the changes in GDP in the Indonesian context. Using the univariate causal model LVAR on data from 2004 to 2013, they found a positive and significant relationship between the 2 variables.

(Plíhal, 2016) examined the causality relationship between the Germany stock market and macroeconomic variables. Data covered the period 1999 to 2015 and the granger causality test. The author found that stock market index proxied by the DAX, granger causes industrial production and interest rate, that there is a bidirectionally between stock market and money supply.

(Akpolat, 2016) looked at the long-run cointegration and causality relationship between the Turkish stock market and its real GDP, taking into account multiple unknown structural breaks. Data collected from 1998 to 2014 were analysed Maki cointegration test and Toda-Yamamoto Granger causality test. They found a one-way causality from the Turkish stock market index to real GDP and the index as a leading indicator of its long-run growth.

(Coşkun *et al.*, 2017) studied the relationship between the Turkish capital market components such as the stocks, corporate and government bonds markets, and the economic growth over the period covered 2006 to 2016. Among the findings, the evidence showed that the aggregated index of some sub-components (mutual pension funds, stocks and corporate bonds) of the capital market positively impacted the economic growth.

(Dhanessar, 2017) investigated whether the performance of the sovereign yield curve spread and share index could predict recession and inflation in Trinidad and Tobago. Employing Receiver

Operating Characteristic analysis and probit model, they found that the spread between short term and long-term treasury rates has a strong predictive power of recession while stock price has a limited power both for recessions and inflation.

(Sayed, Auret and Page, 2017) investigated the causal relationship between All share index, Industrial index, resource index, financial index versus GDP and Industrial production using Granger causality test. The analysis of data from 1998 to 2016 uncovered the fact that the JSE All Share acted as a leading indicator of economic activity in South Africa. Furthermore, there is a unidirectional causality between the market segmentation proxies and macroeconomic variables.

(Fufa and Kim, 2018) investigated the relationship between stock markets, banks and economic growth. Following the World Bank income classification, they grouped a more homogenous countries such as high-income countries European and non-European countries on one side and lower middle-income countries on the other side. The purpose was first, to test whether the link between financial development and economic growth will be stronger among homogenous groups. Data covered five-year-averaged non- overlapping period. Using the Generalised method of moment technique to analyse the data, the results confirmed that financial system contributes to economic growth. However, stock market liquidity has a more significant effect on MICs' economic growth (including South Africa). Also, non-European countries benefit only from stock market liquidity while European HICs benefit from bank credit.

(Pan and Mishra, 2018) considered the effect of the Chinese stock market on its economy. They used the autoregressive distributed lag model. Evidence showed that there is a long run negative relationship between share market and real economic but relatively little impact. The findings also showed no effect in the short run.

(Chandrashekar *et al.*, 2018) investigated the short run, long run equilibrium and causality relationships between stock prices and macroeconomic variables in India and Brazil from 2000 to 2016. Using the Johansen-Fisher co-integration test, they found that stock prices, inflation, industrial production, real exchange rate and interest rate are co-integrated in the long run. Using OLS technique, they determined a positive impact of industrial production and exchange rate on stock price, but no significant impact of inflation and interest rate. The authors also found a short run unidirectional causality link from stock returns to inflation, industrial production, interest rate and real exchange rate.

Selected economic variables, South African banks' stock prices and economic growth: hypothesized relations

Our paper first looks at macroeconomic variables and banks stock prices. It further examines banks stock prices' predictive power of economic growth in a country where it has not been done before.

According to studies by (Aye *et al.*, 2015) and (Ngondo and Khobai, 2018), real exchange rate volatility has a negative impact on export in South Africa. The depreciation of South African Rand against US dollar has been steady over the past decade with some sporadic respite with the advent of the actual presidency. Therefore, cheaper and contracted volume of goods exported implies less cash inflow for banks as key intermediaries. We then expect a negative relationship between export, as well as exchange rate and banks' stock prices. As for M2, the volume has gradually increased throughout the period. We therefore hypothesize a positive relationship between M2 and banks stock price. Regarding industrial production, several studies found a positive impact on stock prices, while some others reach a different result, leading to the conclusion that industrial production has an ambiguous effect. As for government bond yield, the bond exchange market is essentially occupied by the South African government bonds. South Africa went through a long period of economic downturn. It is of common knowledge that in that case, bond market is more dynamic as investors are looking for safe heavens at the expenses of stock market. We can then hypothesize that banks' stock price will have a negative impact on government bond yield. Trade during the period studied has followed a sawtooth pattern. We can hypothesize that the relationship between banks share price and trade could be either positive or negative

Data

Data are monthly time series from January 2010 to October 2018. Closing monthly banks stock prices were requested from the Johannesburg Stock Exchange. Six banks were selected for the study on the basis that they trade on Johannesburg Stock Exchange. They also hold the monopoly in the industry with more than 90% of market share in the country. These banks are: ABSA bank (ABSA), Standard Bank of South Africa (STBK), FirstRand bank (FRBK), Nedbank (NDBK), Investec bank (INVBK) and Capitec bank (CPTBK). Macroeconomic variables were derived from the South African Reserve Bank's website. They are composed of Industrial production (IP), money supply (M2), exchange rate (EXR) and export (EXP). To evaluate the predictive power of banks' stock price on economic growth, we used the South African Banks index(J835 Index) over the period studied. J835 Index was then used in the right hand of the regression equation as the main variable of interest. Data description is as follows:

Table 1: Description of the data

	Data series	Description	Source
1	J835 Index	Month-end closing value of J835 SA Banks Capital Index	Johannesburg Stock Exchange
2	ABSA Group Limited	Month-end stock closing price	Johannesburg Stock Exchange
3	STANDARD Bank Group Limited	Month-end stock closing price	Johannesburg Stock Exchange

4	NEDBANK Group Limited	Month-end stock closing price	Johannesburg Stock Exchange
5	FIRSTRAND Limited	Month-end stock closing price	Johannesburg Stock Exchange
6	INVESTEC Limited	Month-end stock closing price	Johannesburg Stock Exchange
7	CAPITEC Bank Holdings Limited	Month-end stock closing price	Johannesburg Stock Exchange
8	Export	Monthly total export Index(all items)	South African Reserve Bank
9	Exchange rate	Month-end Rand per US Dollar. Weighted average of the banks' daily rates based on the banks' foreign exchange transactions.	South African Reserve Bank
10	M2	Monthly Short term and medium- term deposits (including saving deposits) with the monetary banking institutions	South African Reserve Bank
11	Manufacturing	Monthly Total production indices	Stat SA

Econometric methodology

This study examines the link between macroeconomic variables and banks' stock prices, then the predictive power of these price using different econometric models. The vector error correction model (VECM), which is derived from Vector autoregressive model (VAR), Granger causality estimators and impulse response function. The VAR model is appropriate when the phenomenon under study has an impact with a lag (Gujarati, 2003) and macroeconomic factors are known to reverberate throughout the economic system with a lag.

First, data were transformed in a log form to ease the interpretation of the results in terms of elasticity. Descriptive statistics showed that certain variables departed from normal distribution. However, with a greater than 30 or 40 number of observations, non-normality did not affect the inferences (Ghasemi and Zahediasl, 2012).

Table 2: Summary statistics

Variable	Mean	Std dev	Min	Max	Obs
SA BK INDEX	8.68	0.29	8.19	9.24	106
ABSA	9.62	0.11	9.40	9.89	106
STBK	9.47	0.21	9.13	9.99	106
NDBK	9.87	0.23	9.37	10.29	106
FRBK	8.19	0.41	7.47	8.89	106
INVBK	8.93	0.30	8.39	9.41	106
CPTBK	10.38	0.71	8.95	11.60	106

EXP	4.47	0.12	4.14	4.62	106
MANUF	4.59	0.07	4.37	4.73	106
M2	14.56	0.18	14.26	14.86	106
EXR	2.34	0.26	1.87	2.77	106

In the next step, Augmented Dicker-Fuller (ADF) and Phillips-Peron unit roots tests were used to test for the stationarity of all the variables (see results in Table 2). Both tests' Ho is that the variable has unit root. The outcome showed that at level, all the variables have unit roots. However, at first difference they all become stationary, meaning integrated of order 1 [*I*(1)].

Table 3: Unit Root tests

	Data in level		Data in first difference	
	ADF tests	PP tests	ADF tests	PP tests
Variable	T-statistics / P-values	T-statistics / P-values	T-statistics / P-values	T-statistics / P-values
LnSA Banks Index	-2.889/0.170	-2.891/0.169	-11.192/0.00	-11.225/0.000
LnABSA BANK SP	-3.171/0.095	-3.214/0.087	-10.700/0.00	-10.82/0.000
LnSTANDARD BANK SP	-2.908/0.164	-2.993/0.139	-11.085/0.00	-11.08/0.000
LnFIRSTRAND BANK SP	-2.462/0.345	-2.381/0.386	-11.412/0.00	-11.59/0.000
LnNEDBANK SP	-2.459/0.347	-2.530/0.313	-9.862/0.00	-9.862/0.000
LnINVESTEC SP	-1.589/0.790	-1.589/0.790	-11.264/0.00	-11.313/0.000
LnCAPITEC SP	-2.376/0.389	-2.374/0.390	-10.513/0.00	-10.551/0.000
LnMANUFACTURING	-2.427/0.363*	-6.644/0.000*	-21.753/0.00	-26.000/0.000
LnEXCHANGE RATE	-2.254/0.454	-2.153/0.509	-12.473/0.00	-12.453/0.000
LnEXPORT	-2.218/0.474	-1.898/0.648	-8.474/0.000	-8.474/0.000
LnGOVERNMENT BOND YIELD	-2.699/0.239	-2.650/0.259	-8.470/0.000	-10.329/0.000
LnM2	-3.635/0.031	-3.711/0.025	-7.002/0.000	-11.115/0.000

(*) A third unit root test with KPSS showed a T-statistics of 0.685 at level (trend eliminated) vs critical values of 0.739(1%level), 0.436(5% level), 0.347(10% level), rejecting null hypothesis of stationarity at 5 and 10% levels. At first difference, KPSS T-statistics equals 0.076. All the other variables are stationary at all levels at first difference.

The purpose of the study being to look at whether there is long run or equilibrium association between selected macroeconomic variables and banks' stock prices, the next step involved testing whether the time series on interest are cointegrated. To do this, the procedure requires the determination of the appropriate lag length, which is the maximum. We then used the Akaike information (AIC), Schwarz information (SC), Hannan-Quinn (HQ), Final Predictor error (FPE) and sequential modified LR test statistics criteria to select the most appropriate lag length for the combination of time series (Table 4). Eviews 10 software provides these options and we chose the lag order selected by most of these criteria. With the knowledge of the suitable lag length, we then used the Johansen Cointegration test to find out which combination of macroeconomic variables and stock prices where cointegrated. A non-cointegration would then imply that only the VAR model can be utilised. Johansen cointegration test were applied on each bank's stock price and statistically adequate economic variables (Table 4). Each bank's stock price was found to be cointegrated with at least one selected macroeconomic variable.

Table 4. Results of Johansen's Cointegration Test

	Lag	Null Hypothesis	Trace Statistic	Critical Value(5%)	P-Values
D[ABSABK-MANUF-EXR]*	4	r=0	51.32	29.79	0.00
		r≤1	18.22	15.49	0.01
D[STANDARDBK-MANUF-M2-GBY]	4	r=0	62.87	47.85	0.00
		r≤1	20.90	29.79	0.36
D[FIRSTRANDBK-MANUF-EXR]	4	r=0	48.93	29.79	0.00
		r≤1	12.96	15.49	0.11
D[NEDBANK-MANUF-EXR]*	4	r=0	54.97	29.79	0.00
		r≤1	17.42	15.49	0.02
D[INVESTECBK-EXR-GBY]	2	r=0	30.04	29.79	0.04
		r≤1	14.12	15.49	0.07
D[CAPITECBK-MANUF-EXR]	3	r=0	38.89	29.79	0.00
		r≤1	5.43	15.49	0.76
D[ABSA-STBK-FIRSTRD-NEDBK-INVESTEC-CAPITECBK]	1	r=0	86.40	95.75	0.18
		r≤1	54.71	69.81	0.43
D[SA BANKS INDEX-MANUF-EXR]	4	r=0	45.00	29.79	0.00
		r≤1	10.57	15.49	0.23

*indicates 2 cointegrating equations. For simplification and given that the first cointegration is the most useful(reference), only one cointegration was analysed when there was an indication of the existence of more than one cointegrating equations. The lag length selection was done based on the positive outcome of at least three of the following lag length information criteria: Akaike, Hannan-Quinn, Final Predictor Error, sequential modified LR test statistic and Schwarz information criteria.

According to the Granger representation theorem, the relationship between two cointegrated variables can be articulated in terms of error correction mechanism (ECM) (Gujarati and Porter, 2004). The ECM establishes the long run or equilibrium relationship and adjusts for disequilibrium. In other words, it indicates a dynamic co-movement among variables and the adjustment process toward long-term equilibrium (Maysami and Koh, 2000). The error term, also called the equilibrium error enables to link the short-term behaviour to the long-run value of a variable (Gujarati, 2003).

Our baseline VECM regression model can be written as follows:

$$\Delta SP_{\mathrm{t}} = \& + \sum_{\mathrm{i}=1}^{\mathrm{N}-1} \alpha_{\mathrm{i}} \Delta SP_{\mathrm{t-i}} + \sum_{\mathrm{j}=1}^{\mathrm{N}-1} \alpha_{J} \Delta \mathrm{X}_{\mathrm{t-j}} + \sum_{\mathrm{k}=1}^{\mathrm{N}-1} \alpha_{\mathrm{k}} \Delta \mathrm{EF}_{\mathrm{t-k}} + \lambda \, \phi_{\mathrm{t}-1} + \mu_{\tau}$$

Where ΔSP_{t} is the difference in the share price; $\Delta \mathrm{X}$ and $\Delta \mathrm{EF}$ are the economic fundamentals; $\lambda \, \phi_{\mathrm{t}-1}$ is the error correction term with λ the speed of adjustment; μ_{τ} are residuals or impulses or shocks.

The results are as follows in Table 5:

Table 5 Results of the Vector Error Correction Models for macroeconomic indicators and banks stock prices

Estimates	Parameters of the Vector Error Correction Model (VECM)														
	Long-run relationship			*Short-run relationship*											
	SpA	*cp1*	*cp2*	Manufacturing (lag 1-2-3)			Exchange rate (lag 1-2-3)			Export (lag 1-2-3)			M2 (lag 1-2-3)		
VECM for ABSA Bank Stock Price, Exchange Rate(cp1) and Manufacturing(cp2)															
Coefficients	-0.184	1.526	-22.306	-0.233	-0.136	-0.170	0.014	-0.034	-0.088	-	-	-	-	-	-
Standard Error	0.071	0.570	3.959	0.140	0.107	0.096	0.160	0.170	0.158	-	-	-	-	-	-
P-Value	0.010**	-	-	0.097***	0.208	0.077***	0.929	0.840	0.576	-	-	-	-	-	-
R-Square= 0.15; SSR=0.30; LL= 151.03; AIC=-2.72; SC=-2.41; DW=2.03; Observations= 102; Residual diagnostic tests: SC= 84.6% (-1); 68.3% (-2); 13.6% (-3) NT= 8.7% HSK=37.7%															
VECM for Standard Bank Stock Price, Exchange Rate(cp1) and Manufacturing(cp2)															
Coefficients	-0.013	1.208	-25.127	-0.236	-0.138	-0.351	-0.031	-0.021	0.039	-	-	-	-	-	-
Standard Error	0.006	0.661	4.489	0.119	0.093	0.085	0.154	0.164	0.156	-	-	-	-	-	-
P-Value	0.035**	-	-	0.048**	0.141	0.000 *	0.839	0.898	0.801	-	-	-	-	-	-
R^2= 0.18; SSR=0.28; LL= 155.82; AIC=-2.83; SC=-2.55; DW=2.02 Observations= 102; Residual diagnostic tests: SC=71.3% (-1); 70.5% (-2); 28.9% (-3) NT= 30% HSK=71.2%															
VECM for FirstRand Bank Stock Price, Manufacturing(cp1) and M2(cp2)															
Coefficients	-0.007	-75.432	5.511	-0.298	--0.182	-0.260	-	-	-	-	-	-	0.069	-0.481	-0.153
Standard Error	0.003	12.487	2.139	0.147	0.118	0.090	-	-	-	-	-	-	0.598	0.602	0.587
P-Value	0.036**	-	-	0.043**	0.124	0.004*	-	-	-	-	-	-	0.907	0.424	0.794
R^2= 0.13; SSR=0.30; LL= 151.41; AIC=-2.75; SC=-2.47; DW=1.98 Observations= 102; Residual diagnostic tests: SC=94.2% (-1) 39.2% (-2); 18.7% (-3) NT=88.8% HSK=63.7%															
VECM for Nedbank Stock Price, Exchange Rate(cp1) and Manufacturing(cp2)															
Coefficients	-0.072	4.299	-60.899	-0.227	-0.106	-0.240	0.107	-0.103	-0.008	-	-	-	-	-	-
Standard Error	0.040	1.463	9.792	0.118	0.092	0.083	0.150	0.159	0.155	-	-	-	-	-	-
P-Value	0.075***	-	-	0.05***	0.253	0.00*	0.475	0.515	0.957	-	-	-	-	-	-
R^2= 0.13; SSR=0.25; LL= 161.34; AIC=-2.92; SC=-2.61; DW=2.02; Observations= 102; Residual diagnostic tests: SC=62.5% (-1); 36.2% (-2); 6.4% (-3) NT= 40.1% HSK=7.3%															
VECM for Investec Bank Stock Price, Manufacturing(cp1) and Export(cp2)															
Coefficients	-0.036	-366.19	69.536	0.023	0.068	-	-	-	-	-0.263	0.146	-	-	-	-
Standard Error	0.017	60.44	24.279	0.097	0.089	-	-	-	-	0.371	0.372	-	-	-	-
P-Value	0.038**	-	-	0.808	0.440	-	-	-	-	0.478	0.693	-	-	-	-
R2= 0.08; SSR=0.32; LL= 150.77; AIC=-2.75; SC=-2.52; DW=2.01 Observations= 103; Residual diagnostic tests: SC=11.1% (-1); 12% (-2) NT= 37.8% HSK=9.4%															
VECM for Capitec Bank Stock Price, Exchange Rate(cp1) and Manufacturing(cp2)															
Coefficients	-0.002	-16.211	211.332	0.498	0.159	-	0.114	0.019	-	-	-	-	-	-	-
Standard Error	0.001	6.075	35.593	0.130	0.128	-	0.187	0.187	-	-	-	-	-	-	-
P-Value	0.085***	-	-	0.000*	0.212	-	0.542	0.915	-	-	-	-	-	-	-
R^2= 0.15; SSR=0.59; LL= 119.62; AIC=-2.167; SC=-1.962; DW=1.95 Observations= 103; Residual diagnostics tests: SC=23%(-1); 13.7%(-2) NT= 17.8% HSK=23.1%															

*, ** and *** stand respectively for significance at 1%, 5% and 10% level. These results do not incorporate the second cointegrating equations when it does exist. The reason is because, as recalled by (Maysami and Koh, 2000) "the first eigenvector, which is based on the largest eigenvalue, is regarded as the most useful". Residuals diagnostic tests: SC=serial correlation and Ho is no serial correlation; NT= joint Normality test and Ho is residuals are multivariate normal; HSK= Heteroskedasticity tests and Ho is Residuals are homoscedastic. All the tests results suggest that the regression models are fit.

Long-run relationships analysis

As presented in Table 4, each bank's stock price is co-integrated with two macroeconomic variables and thus jointly exhibit a long-run equilibrium relationship. The convergences are statistically significant at 5% or 10% level (see Table 5). However, the speed of adjustment toward equilibrium differs from one bank to another. Capitec bank and FirstRand bank, for example, exhibited less than 1% of deviation from long-run equilibrium corrected each month, while Nedbank, Investec bank Standard Bank and ABSA are above the 1% with the highest score being held by ABSA bank at 18% of deviations adjusted. It is worth noticing that stock prices of all the banks are not co-integrated among themselves. This outcome suggests that, despite their monopoly position, South African banks are well-diversified.

Individually, ABSA Bank's stock price is cointegrated with industrial production (IP) and Exchange rate(EXR). In the long run, IP has a positive impact on ABSA bank's stock prices, on average, ceteris paribus, while EXR has a negative impact. The previous period's deviation from long-run equilibrium is corrected in the current period at a speed of 18.4%. Standard Bank's and Nedbank's stock prices are cointegrated with industrial production (IP) and Foreign Exchange rate (EXR). In the long run, industrial production (IP) has a positive impact on both stock prices and EXR has a negative effect, on average, ceteris paribus. The disturbance in the previous period is adjusted in the current period at 1.3% and 7.2% speed respectively. FirstRand bank's stock price is cointegrated with industrial production (IP) and money supply (M2). In the long run, IP has a positive impact on FirstRand bank's stock prices, while M2 has a negative impact, on average, ceteris paribus. The previous period's disequilibrium towards long-run equilibrium is adjusted in the current period at a speed of 0.7%. Investec bank's stock price is cointegrated with industrial production (IP) and Export (EXP). In the long run, IP has a positive impact on Investec bank's stock prices and EXP has a negative impact, on average, ceteris paribus. The previous period's deviation from long-run equilibrium is revised in the current period at a speed of 7.2%. Capitec bank's stock price is cointegrated with industrial production (IP) and Exchange rate (EXR). In the long run, IP has a negative impact on Capitec bank's stock prices while EXR has a positive impact, on average, ceteris paribus. The previous period's deviation from long-run equilibrium is adjusted in the current period at a speed of 0.2%.

Short-run relationships analysis

In the short run, industrial production has a negative and significant relationship with ABSA bank, Standard bank, Nedbank and FirstRand stock prices at lag 1 and 3, while the relations were positive in the long run. For Investec, the coefficient is positive at lag 1 and negative at lag 2 but with no statistical significance. As for Capitec Bank, results suggest that IP has a positively related its stock price and statistically significant at lag 1, similarly at lag 2, but not significant. The negative and positive outcomes firstly reflect the ambiguity already revealed in previous studies that Industrial production's explanation of stock price is unclear. Negative outcome corroborated

the findings by (Subiniostis et al, 2011). Other authors such as (Pradham, 2016) found a positive coefficient. Secondly, banks' stock prices seem to respond differently to the changes in industrial production, even though they belong to the same industry and evolve in the same economic environment. (Butt et al, 2010) discovered a similar behaviour in their study on the stock return variation to specific economic variables in the banking and textiles sectors in Pakistan. They concluded that such situation is an opportunity for investor to diversify their risks.

In the short run, exchange rate has a positive impact for ABSA Bank at lag 1, Nedbank at lag 1, Capitec bank at lag 1 and 2. However the effect appears negative for ABSA bank at lag 2 and 3, Standard bank at lag 1 and 2, Nedbank at lag 2 and 3. However, in all these cases, none of the coefficient is significant. Export showed a positive impact on Investec bank's stock price at lag 2 but negative at lag 1. Here, the coefficients are also not significant. With regard to M2, results suggest that there is a positive relationship with FirstRand Bank's stock price at lag 1, but negative at lag 2 and 3. Equally, the coefficients did not show any significance is this case.

The Granger causality analysis between stock prices and economic growth

The granger causality assumed that, given two variables A and B, the current value of B can be explained by the past values of that B as well as that of A. The logic behind the granger causality is that only the past can explain the future. Therefore, a change in A would then precede changes in B and an improvement in B due to past or lagged values of A will lead to the conclusion that A granger caused B (Gujarati, 2003). The unidirectional causality from A to B can be estimated by the following regression:

$$\Delta B_{\mathrm{t}} = \sum_{\mathrm{i}=1}^{\mathrm{n}} \varepsilon_{1\mathrm{i}} A_{\mathrm{t}-\mathrm{i}} + \sum_{\mathrm{j}=1}^{\mathrm{n}} \varepsilon_{2\mathrm{i}} \mathrm{B}_{\mathrm{t}-\mathrm{i}} + \pi_{1\tau}$$

$$\Delta \mathrm{A}_{\mathrm{t}} = \sum_{\mathrm{i}=1}^{\mathrm{n}} \beta_{1\mathrm{i}} A_{\mathrm{t}-\mathrm{i}} + \sum_{\mathrm{j}=1}^{\mathrm{n}} \beta_{2\mathrm{i}} \mathrm{B}_{\mathrm{t}-\mathrm{i}} + \pi_{2\tau}$$

Where π_{τ} is the disturbance. A unidirectional causality between banks stock prices (A) and economic growth measures(B) will be established if the coefficients $\varepsilon_{1\mathrm{i}} \neq 0$ and $\beta_{2\mathrm{i}} \neq 0$ (Gujarati, 2003). The granger causality was estimated to measure the predictive power of banks stock price in determining economic growth.

Table 6 Results of predictive power of Banks Stock price

The Granger causality between SA Banks Index and Manufacturing, Exchange Rate				
			Chi-squares	P-value
Ho: SA Banks Index does not Granger Cause Manufacturing			0.330	0.954
Ho: SA Banks Index does not Granger Cause Exchange Rate			0.391	0.483
Ho: SA Banks Index and Manufacturing do not Granger Cause Exchange Rate			14.15	0.027**
Estimates	Parameters of the Vector Error Correction Model (VECM)			
	Spa	*SA Banks Index*	*Manufacturing*	*Exchange rate*
Coefficients	-0.002	-0.007	0.023	0.001
Standard Error	0.001	0.003	0.004	0.002
P-Value	0.023**	-	-	-
R-Square= 0.15; SSR=0.30; LL= 151.03; AIC=-2.72; SC=-2.41; DW=2.03 Observations= 102				

**significance at 5% level. Residual tests: SC=40.30%(-1); 49.63%(-2), 18.18%(-3). NT=11.3% HSK=19.79%

As can it be observed in Table 6, the results of the unidirectional causality analysis between SA Banks Index and various macroeconomic variables used as proxies of economic growth showed the following: banks stock prices index does not granger causes manufacturing, nor foreign exchange rate. However, there is a joint causality relationship from Banks Index and Manufacturing to foreign exchange rate at a 5% significance level. In this regard, banks' stock price impact economic growth but to lesser extent.

[i] Source of all this: https://www.jse.co.za/about/history-company-overview

Conclusions

The examination of long-run equilibrium relationships between selected economic fundamentals and banks' stock prices demonstrated dynamic co-movements between pairs of economics fundamentals and stock prices. The difference between the speed of adjustments towards equilibrium indicate that stock prices involved in co-integrations with small speed of adjustment may be more volatile than those with higher speed of adjustment. ABSA bank's stock price for example, would be less sensitive to macroeconomic changes than CAPITEC share prices.

Furthermore, co-integration test did not show any long run relationship among banks' stock prices themselves. This implies that, although the South African banking sector is monopolistic, investors can still diversify their portfolio. Macroeconomic variables such as industrial production and export have an ambiguous effect (positive and negative) on stock prices in a short and long run. These outcomes are the more surprising as they occur with participants evolving in the same context. M2 has a negative effect in the long run. However, in the short run, except industrial production, other variables remained statistically insignificant. This suggest that investors are sensitive to changes in only industrial production in the short run but to all the variables selected

in the long run. Also, South African Banks Capital Index in the long run equilibrium framework of this study only showed a limited predictive power of the economic growth.

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