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An empirical study on Banks profitability in the KSA: A co-integration approach

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This study aims to give the analysis of the determinants of banks' profitability in the Kingdom of Saudi Arabia (KSA) over the period 1999-2007. This paper investigates the co-integration and causal relationship between return of assets (ROA) and return of equity (ROE) of Saudi banks. The analysis employs Augmented Dickey Fuller (ADF) test, Johansen's cointegration test, Granger causality test. Analyzing the cointegration and other tests on Saudi Arabian banking sector over the study period, the relationships between the two variables are examined. The empirical results have found strong evidence that the variables are co-integrated.

Key words: Banking, bank profitability, return on assets, return on equity, co-integration, KSA.

INTRODUCTION

In the last two decades, economists have developed a number of tools to examine whether economic variables trend together in ways predicted by theory, most notably co-integration tests. Co-integration methods have been very popular tools in applied economic work since their introduction about twenty years ago. However, the strict unit-root assumption that these methods typically rely upon is often not easy to justify on economic or theoretical grounds. The multivariate testing procedure of Johansen (1988, 1991) has become a popular method of testing for co-integration of the $I(1)/I(0)$ variety, where $I(1)$ and $I(0)$ stand for integration of orders one and zero, respectively. In the Johansen methodology, series are pre-tested for unit roots; series that appear to have unit roots are put into a vector auto regression from which one can test for the existence of one or more $I(0)$ linear combinations.

Utilizing the co-integration and error correction models on all Saudi's banks over the study period, various potential internal and external determinants are examined to identify the most important determinants of profitability. Co-integration methodology has been extensively used market efficiency, which states that no asset price should

be forecastable from the prices of other assets. The market efficiency, which states that no asset price should be forecastable from the prices of other assets. The Johansen (1988) method of testing for the existence of co-integrating relationships has become standard in the econometrics literature.

Since unit-root tests have very limited power to distinguish between a unit-root and a close alternative, the pure unit-root assumption is typically based on convenience rather than on strong theoretical or empirical facts. This has led many economists and econometricians to believe near-integrated processes. Near-integrated and integrated time series have implications for estimation and inference that are similar in many respects.

Co-integration, however, simply requires that co-integrating linear combinations have lower orders of integration than their parent series. Granger (1986), Granger and Joyeux (1980) and Hosking (1981), where continuous orders of integration from the real line are considered, the case where there exists an $I(d - b)$ linear combination of two or more $I(d)$ series has become known as fractional co-integration.

The co-integration approach is one of the recent methodologies employed to identify the determinants of profitability in banking. It enables the estimation of a relationship among non-stationary variables by revealing the long-run equilibrium relationship among the variables.

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This paper will help to determine the most important factors of profitability in Saudi Arabian banks, and is supposed to help banks' stakeholders especially the managers and regulatory authorities to improve the sector soundness by boosting the impact of positive factors and lessening the impact of the negative factors.

A good econometric practice to always include tests on the co-integrating vectors to establish whether relevant restrictions are rejected or not. If such restrictions are not tested, a non-zero co-integrating rank might mistakenly be taken as evidence in favour of co-integration between variables. This is particularly relevant when there are strong prior opinions regarding which variables "have to" be in the co-integrating relationship. Unit root tests are performed on univariate time series in order to test the order or integration. If individual time series are found to be integrated of same order after the unit root tests, then these variables may be co-integrated. Co-integration deals with relationships among the group of variables where each has a unit root. Application of co-integration test in the estimation of money demand were analyzed by Johansen and Juselius (1990) and Dickey, Thansen and Thornton (1991)

The purpose of this paper is to investigate the effect of deviations from the unit-root assumption on the determination of the co-integrating rank of the system using Johansen's (1988, 1991) maximum eigen value and trace tests. The paper will contribute towards the existing literature by interrogating the determinants of profitability of Saudi Arabian bank's using a co-integration approach. First, we test for the stationary roots using augmented Dickey-Fuller test, then the Johansen's unit root test and Granger causality test are applied to these variables.

The paper is divided into five sections. Section 2 will describe about the previous existing literatures, Section - 3 will give a complete description about the methodologies of the various tests performed in this paper, and Section 4 contains the empirical results, finally Section-5 concludes with a short summary.

Previous studies

Despite the fact that an extensive literature on savings behavior, there are no many studies, which focused primarily on the factors that determine the level of deposits made by various categories of depositors at the commercial banks. These studies, however, concentrated mainly on private and household savings and not on the business and government sectors. Lambert and Hoselitz (1963) were among the first researchers to compile the works of others on savings behaviour. They extended the works of researchers who studied the savings behaviour of households in Sri Lanka, Hong Kong, Malaysia, India, Philippines. Snyder (1974) and Browning and Lusardi (1996) also presented a similar study which reviewed

micro theories and econometric models.

Loayza et al. (2000b) listed papers and publications of the saving research project of a particular country and gave general reference in this area. Thereafter, lots of work has been done on this area (Cardanes and Escobar, 1998; Rosenzweig, 2001; Kiiiza and Pedreson, 2001; Athukorala and Kunal, 2003; Dadzie et al., 2003; Ozcan et al., 2003; Athukorala and Tsai, 2003; Qin, 2003; Hondroyiannis, 2004) have studied the savings behavior of a particular country. A large empirical literature was developed on the cross country comparison, which was contributed by Doshi (1994), Masson et al. (1998), Loayza et al. (2000a), Agrawal (2001), Anoruo (2001), Sarantis and Stewart (2001), Cohn and Kolluri (2003), Ruza and Montero (2003).

The first works on co-integration methods were first studied by, Wallace and Warner (1993), Malley and Moutos (1996) that co-integration-based tests of foreign exchange market efficiency (Cardoso, 1998; Bremnes et al. 2001; Jonsson, 2001; Khamis and Leone, 2001; Bagchi et al. 2004). Studies arguing the stationary of these variables include Song and Wu (1997, 1998), Taylor and Sarno (1998), Wu and Chen (2001) and Basher and Westerland (2006). Sephton and Larsen (1991) showed that inference based on Johansen co-integration tests of foreign exchange market efficiency suffers from structural instability. Cheung and Lai (1993) argued that significant finite-sample bias in the performance of the Johansen test statistics when asymptotic critical values are used for inference in finite samples.

As unit-root tests have very limited power to distinguish between a unit-root and a close alternative, the pure unit-root assumption is typically based on convenience rather than on strong theoretical or empirical facts Stock (1991), Cavanagh et al., (1995) and Elliott (1998) argued that near-integrated processes, which explicitly allow for a small deviation from the pure unit-root assumption, to be a more appropriate way to describe many economic time series. Phillips (1988) concluded that spurious regressions are a problem when variables are near-integrated as well as integrated and presented an analytical discussion Elliott (1998) shows that large size distortions can occur when performing inference on the co-integration vector in a system where the individual variables follow near-unit-root processes rather than pure unit-root processes.

The banks profitability is generally classified into two broad categories, that is, internal and external. The internal factors are in the control and framework of the bank for instance number of employees, investments etc whereas the external factors are out of control and framework of the bank for instance, market share, competition, inflation etc.

Lots of literature has already been developed interrogates the profitability of banks of the particular country in question. Hester and Zoellner (1966) argued

that the balance sheet structure has a significant impact on profitability. Smirlock (1985) found a significant positive relationship between demand deposits and profits. Lambert and Hoselitz (1963) were among the first researchers to compile the works of others on savings behavior. Heggsted (1977) interrogated the profitability of commercial banks and reports that time and savings deposits have negative impact on profitability. Steiner and Huveneers (1994) found similar association while studying overhead expenditure. Bourke (1989), and Molyneux and Thorton (1992) found that capital and staff expenses are positively related to bank's profitability.

Mullineaux (1978) found a positive impact for bank's size on profitability. Studies of Pelzman (1968), Vernon (1971), Emery (1971), Mullineaux (1978) and Smirlock (1985) concluded that regulation have a significant impact on banks' profitability. Emery (1971) examined the effect of competition on banks' profitability and find insignificant association between the two variables. Smirlock (1985) further examined the effect of concentration on profitability and the findings of these studies were mixed and inconclusive. Demirgüç-Kunt and Huizinga (1998) concluded that the well-capitalized banks have higher net interest margins and are more profitable.

Keynes (1936), despite arguing the quantitative importance of the interest rate effect, believes that in the long run substantial changes in the rate of interest could modify social habits considerably, including the subjective propensity to save. The importance of the rate of interest on consumption, many researchers using various methodologies tried to establish the strength of relationship between these two elements. Wright (1967), Taylor (1971), Darby (1972), Heien (1972), Juster and Watchel (1972), Blinder (1975), and Juster and Taylor (1975) in their studies found an inverse relationship between interest rate and consumption. Modigliani (1977) based on his works and after seeing evidence on the effect of interest rate on consumption concludes that the rate of interest effects on demand, including the consumption component, are pervasive and substantial.

Alrashdan (2002) found that the return on asset (ROA) is positively related to liquidity and total assets while ROA is negatively related to financial leverage and cost of interest. Naceur (2003) examined the determinants of Tunisian banks' profitability over the period 1980-2000, and found that the capital ratio, loans and stock market development have positive impact on profitability while the bank's size has a negative impact. Hassan and Bashir (2003) stressed on the fact that on the importance of customer and short-term funding, non-interest earning assets, and overhead in promoting profits. They also argued that profitability measures respond positively to increase in capital ratio and negatively to loan ratios.

Haron and Azmi (2004) also investigated the determinants of Islamic Banks across various countries using time series techniques of co-integration and error-correction mechanism (ECM). The study concludes that

liquidity, deposit, asset structure, total expenditures, consumer price index and money supply to have significant impact on profitability while capital structure, market share and bank size to have no impact. Alkassim (2005) examined the determinants of profitability in the banking sector of the GCC countries and found that asset have a negative impact on profitability of conventional banks but have a positive impact on profitability of Islamic banks. They also observed that positive impact on profitability for conventional but have a negative impact for Islamic banking. Liu and Hung (2006) examined the relationship between service quality and long-term profitability of Taiwan's banks and found a positive link between branch number and long-term profitability and also proved that average salaries are detrimental to banks' profit.

METHODOLOGY

The estimation of the long run relationship between the variables, time series properties of the individual variables are examined by conducting Augmented Dickey Fuller (ADF) stationary tests, then the short run dynamic and long run co-integration relationship are investigated by using the multivariate Johansen's co-integration test and Granger Causality test.

Unit root tests

The Augmented Dickey-Fuller (ADF) unit root test method put forward by American scholars Dickey and Fuller is widely used in the academia to examine the stationarity of the time series and determine the integration order of non-stationary time series. Unit root tests are first conducted to establish the stationary properties of the time series data sets. Stationary entails long run mean reversion and determining a series stationary property avoids spurious regression relations. It occurs when series having unit roots are regressed into one another.

The presence of non-stationary variables might lead to spurious regressions and nonobjective policy implications. Augmented Dickey Fuller (ADF) tests are used for this purpose in conjunction with the critical values, which allows for calculation of critical values for any number of regressors and sample size. The ADF model used is describes as follows:

$$\ln Y = \alpha + T + \omega \ln Y_{t-1} + \sum_{i=1}^p \delta \ln Y_{t-i} + \varepsilon$$

$$\Delta \ln Y = \alpha + T + \omega \ln Y_{t-1} + \sum_{i=1}^p \delta \Delta \ln Y_{t-i} + \varepsilon \quad (1)$$

Here Y: variable used for unit root test, α is the constant, T represents the trend, $\omega = p-1$ and ε is the white noise series. The null hypothesis is $H_0: \omega = 0$. If the ADF value of the $\ln Y$ is bigger than the McKinnon value at 5% significant level, the null hypothesis is accepted, which means $\ln Y$ has unit root and is non-stationary. If it is less than the McKinnon value then the H_0 is rejected and $\ln Y$ is stationary. As for the non-stationary series, we should test the stationarity of its 1st difference. If the 1st difference is stationary, the series has unit root and it is first order integration I (1).

Table 1. Basic statistical properties.

Variables	Measurements	Mean (%)	Std. Dev.	Min.	Max.
Determinants of profitability					
ROA	Net Income/ Total Assets	3.24	3.93	0.74	12.56
ROE	Net Income/ Total Equity	16.67	14.03	6.14	47.07

Johansen's cointegration test

According to the co-integration theory, there may be co-integration relationship between the variables involved if they are 1 order integration series, that their 1st difference is stationary. There are two methods to examine this co-integration relationship, one is EG two-step procedure, put forward by Engle and Granger in 1987, the other is Johansen cointegration test (Johansen, (1988); Juselius, 1990) based on Vector Auto Regression (VAR).

For co-integration test, we will conduct the Johansen's multivariate co-integration tests. The Johansen's multivariate co-integration test involved testing the relationships between the variables following vector auto-regression (VAR) model:

$$\Delta \ln Y = \Gamma_i \Delta \ln Y_{t-1} + \Pi \ln Y_{t-1} + B X_t + \varepsilon$$

$$\text{where } \Gamma_i = - \sum_{j=i+1}^p A_j \text{ and } \Pi = \sum_{i=1}^p A_i - I_m \quad (2)$$

Y_t represents $n \times 1$ vector of $I(1)$ variables. Γ and Π are $n \times n$ matrix of coefficients to be tested. B denoted $n \times h$ matrix and X_t denoted $h \times 1$ vector of $I(0)$ variables. Π denoted the rank of the matrix and interrogates the long-run relationships in the variable and is equal to the number of independent co-integrating vectors. If rank of Π is 0, the variables in are not co-integrated.

Johansen developed two test statistics: the trace test and the maximum eigen value test. λ_{trace} statistic tests the null hypothesis that $r=0$ (no co-integration) against a general alternative hypothesis of $r>0$ (co-integration). The K_{max} statistic tests the null hypothesis that the number of co-integrating vectors is r against the specific alternative of $r+1$ co-integrating vectors. The test statistics obtained from λ_{trace} and K_{max} tests are compared against the asymptotic critical values of the two test statistics by Johansen and Juselius.

Granger causality test

The pair wise Granger causality tests are used to examine whether the past value of a series X_t , will help to predict the value of another series at present Y_t taking into account the past value of the previous value of Y_t . The two series are first tested for stationary using the ADF unit root test, followed by the Johansen co integration test before performing the Granger causality test. If the time series of a variable is stationary or $I(0)$ from the ADF test, or if the time series are found to be $I(1)$ and co integrated. The Granger causality test is as follows:

$$X_t = \sum_{i=1}^n \alpha_{x,i} X_{t-i} + \sum_{i=1}^n \beta_{y,i} Y_{t-i} + \mu_{x,t} \quad (3)$$

$$Y_t = \sum_{i=1}^n \alpha_{y,i} Y_{t-i} + \sum_{i=1}^n \beta_{x,i} X_{t-i} + \mu_{y,t} \quad (4)$$

Where X_t is the log of the first variable at time t , and Y_t is the log of the second variable at time t . $\mu_{x,t}$ and $\mu_{y,t}$ are the white noise error terms at time t . $\alpha_{x,i}$ is the parameter of the past value of X , which tells us how much past value of X explains the current value of X and $\beta_{x,i}$ the parameter of the past value of Y , which tells us how much past value of Y explains the current value of X . Similar meanings apply to $\alpha_{y,i}$ and $\beta_{y,i}$.

Empirical Analysis

Data

The data for Saudi Arabia used in this study consists of yearly time series for return of assets (ROA) and return on equity (ROE). All the data was collected by grouping the information collected from 12 most significant banks which work under the supervision of Saudi Arabian Monetary Agency (SAMA), and comprise the overall banking sector of the kingdom. The period of study in this paper is from fiscal year 1999- 2007. Both the ROA and ROE are expressed in (%).

Table 1 described below gives a brief description of the measurements of the variables used for the study.

Unit root test

We test for the presence of unit roots and identify the order of integration for each variable using the Augmented Dickey–Fuller (ADF) (Table 2). The null hypothesis is considered as non-stationary. The test on the variable ROE gave the following result.

The computed ADF test-statistic (-2.777459) is greater than the critical values (-6.292057, -4.450425, -3.701534 at 1, 5 and 10% significant level, respectively), thus we can conclude that the ROE has a unit root that is it is a non-stationary series.

In order to eliminate the heteroskedasticity of ROE and ROA, we take their natural logarithm and define them as $\ln ROE$ and $\ln ROA$. Similarly, ADF tests were conducted on ROA and the logged variables of ROA and ROE differentiated by their order of integration are reported in Table 3. The lag is added to make the residual be white noise, AIC is Akaike Info. Criterion and SC is the

Table 2. ADF test statistics Null Hypothesis: ROE has a unit root Exogenous: Constant, Linear Trend. Lag Length: 1 (Fixed).

	t-Statistic	Prob.*
Augmented Dickey- Fuller test statistic	-2.777459	0.2556
Test critical values:		
1% level	-6.292057	
5% level	-4.450425	
10% level	-3.701534	

*MacKinnon (1996) or Augmented Dickey-Fuller Test Equation Dependent Variable: D(ROE). Method: Least Squares.

	Coefficient	Std. Error	t-Statistic	Prob.
ROE(-1)	-1.999998	0.720082	-2.777459	0.0691
D(ROE(-1))	0.666666	0.509175	1.309306	0.2817
C	79503.43	28800.93	2.760533	0.0701
@TREND(1999)	-730.4994	262.9842	-2.777731	0.0691

R-squared	0.766667	Mean dependent var	-365.2857
Adjusted R-squared	0.533333	S.D. dependent var	0.487950
S.E. of regression	0.333333	Akaike info criterion	0.936212
Sum squared resid.	0.333333	Shwarz criterion	0.905303
Log likelihood	0.723259	Hannan-Quinn criter.	0.554189
F-statistic	3.285714	Durbin-Watson stat.	3.166667
Prob (F-statistic)	0.177334		

Table 3. Results of ADF unit root test.

Variable	ADF-statistic	Critical value (5%)	AIC	SC	Result
ROE	2.777459	-4.450425	0.936212	0.905303	non stationary
ROA	3.403313	-5.416440	5.009090	4.993646	non stationary
LnROE	4.773194	-4.422805	5.739094	5.600269	stationary
LnROA	3.505929	-3.604313	0.073877	0.058422	stationary

Schwarz Criterion.

As shown in Table 3, for the variables of ROE and ROA, the results shows that it is evident that we found the presence of a unit root at conventional levels of statistical significance for the variables of ROE and ROA. To see whether they are integrated of order one $I(1)$ at the 1% level, we performed augmented Dickey-Fuller tests on their first difference. The results of the unit root test show that the first differences of both series are stationary which are found to reject the null hypothesis of unit root. Therefore we can conclude that all series involved in the estimation procedure are regarded as $I(1)$, and it is suitable to make co integration test.

Johansen co-integration test

As proved by previous test the variables under analysis are integrated of order 1 (namely $I(1)$), hence now the co-integration test is performed. The proper way to test for the relationship between ROE and ROA is certainly to

test for a co-integrating equation. In testing co-integration relationships, we use the Johansen and Juselius method of testing. For selecting optimal lag length for the co-integration test, we adopt the Schwartz Information Criterion (SIC) and Schwarz criterion (SC) Criterion. The co-integration tests results performed on the variable ROE gave the following result in Table 4.

Therefore, by applying Johansen test on ROA and ROE series we found the presence of two co-integration vectors. Therefore, by applying Johansen decision rule, we conclude that there are two co-integration vectors for the model. Hence our findings imply that there are stable long run relationships between the two variables i.e. ROE and ROA. The results for the Johansen's test are concluded in Table 5.

Granger causality test

Granger causality test demands that the economic variables should be stationary series. So we need to examine the stationarity of the 1st difference. Hence we test variables LnROE and LnROA so as to observe the

Table 4. Co-integration rank test Series: RETURN_ON_ASSETS____RETURN_ON_EQUITY.
Lags interval (in first differences): 1 to 1.

Unrestricted Co-integration Rank Test (Trace).

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
None*	0.999481	59.43973	15.49471	0.0000
At most 1*	0.604931	6.500857	3.841466	0.0108

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration Rank Test (Maximum Eigenvalue).

Hypothesized No. of CE(s)	Eigenvalue	Max-eigen statistic	0.05 Critical value	Prob.**
None*	0.999481	52.93887	14.26460	0.0000
At most 1*	0.604931	6.500857	3.841466	0.0108

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

** MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b*S11*b=1).

RETURN_ON_ASSETS	RETURN_ON_EQUITY
-0.822234	0.124951
5.992768	-1.617474

Unrestricted Adjustment Coefficients (alpha).

D(RETURN_ON_...	1.767766	0.050167
D(RETURN_ON_...	4.793351	0.530923

1 Co-integration Equation(s):	Log Likelihood	7.359190
Normalized cointegrating coefficients (standard error in parentheses)		
RETURN_ON ...	RETURN_ON_EQUITY	
1.000000	-0.151965	
	(0.00154)	
Adjustment coefficients (standard error in parentheses)		
D(RETURN_ON ...	-1.453518	
	(0.03611)	
D(RETURN_ON...	-3.941259	
	(0.32818)	

Table 5. Results of Johansen's co-integration test.

Eigen-value	t-statistic	Critical value (5%)	Prob.	Null-hypothesis
0.999481	59.43973	15.494771	0.0000	r =0
0.604931	6.500857	3.8841466	0.0108	r ≤1

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level.

causality between ROE and ROA. As the sample of observation for this test is small, we take the lag to be 1. The results of Granger Causality test are shown in Table 6.

Hence by applying the granger causality test to the variables can interpret that ROE is a granger cause to ROA but ROA is not a granger cause to ROE. In other words ROE can affect ROA in put but ROA does not

Table 6. Pairwise Granger Causality Test Sample: 1 9 Lags: 1.

Null Hypothesis	Obs.	F-Statistic	Prob.
LN_ROE_does not Granger Cause LN_ROA_	8	2.93022	0.1476
LN_ROE_does not Granger Cause LN_ROA_		5.63201	0.0637

Table 7. Results of Granger causality test.

Lag	Ho	F-value	P-value	Result
1	LnROE	2.93022	0.1476	Reject Ho
1	LnROA	5.63201	0.0637	Accept Ho

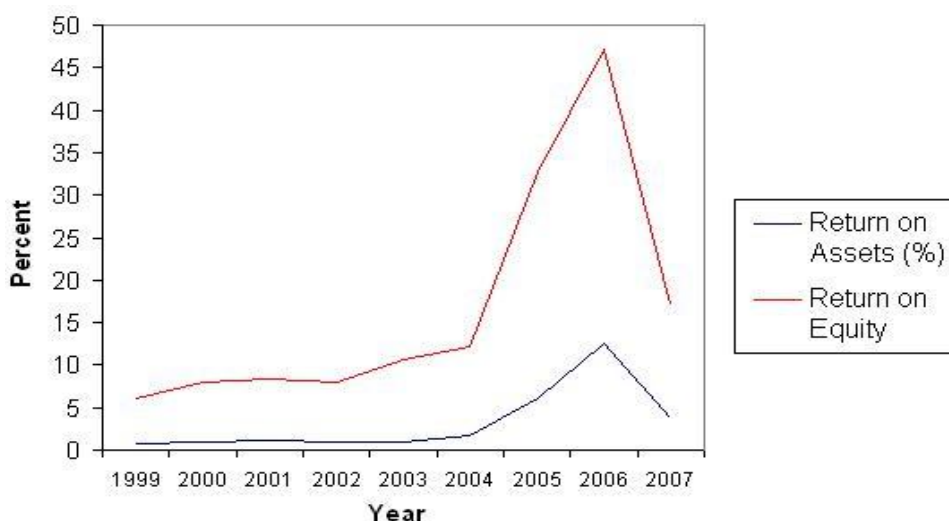


Figure 1. Graphical comparison.

affect the ROE in the Saudi Arabian Banking sector. Therefore, there exist only a one-direction cause-effect relationship between ROE and ROA. The results of the Granger Causality are concluded in Table 7.

To further illustrate the relationship between ROE and ROA in the Saudi Arabian Banking sector, we also conducted a graphical comparison of the two variables over a nine year period. Figure 1 depicts that both the variables show similar kind of trend. The ROA respond immediately to the shock from the ROE and increases from fiscal year 2004-2006, furthermore in the same line of action they also decreased till end of fiscal 2007. Highest returns and lowest returns for both the variables were recorded in 2006 and 2007 respectively.

Concluding remarks

In testing the co-integration and causal relationship between Return on Equity and Return on Assets, the time series model of ADF unit-root test, Johansen co-

integration test, Granger causality test and graphical comparison model are employed. The empirical results have found strong evidence that the variables are co-integrated and feedback.

By applying Johansen decision rule, we found that there are two co-integration vectors for the model. Hence, our findings imply that there are stable long run relationships between the two variables that is ROE and ROA. Furthermore, after the granger causality test to the variables we found that there exist only a one-direction cause-effect relationship between ROE and ROA. The results show that ROE is a granger cause to ROA but ROA is not a granger cause to ROE that is ROE can affect ROA input but ROA does not affect the ROE in the Saudi Arabian Banking sector. By The evidences of long-run unidirectional causality from ROE to ROA implies that sustainable development strategies with higher levels of ROE may be feasible and fast economic growth of Saudi Arabia may be achievable. Additionally, by graphical comparison we found that both the variables were observed having similar kinds of trends over the period of

last nine years.

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