Banking Subsector Output and Real GDP Growth in the United States: A Time Series Analysis

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Abstract:

This study investigates which variables in the banking subsector in the United States may have a statistically significant relationship with Real GDP. Taking into consideration the Bureau of Economic Analysis method of calculating banking output from 2004, this study carefully evaluates key variables that contribute to the banking sector and whether these key variables are statistically significant in any way that can help guide investors, policymakers, and the government in the growing challenge to maintain economic stability in the United States. This study found that there was a statistically significant relationship between Tier 1 Risk Based Capital and Real GDP in the United States among other results that can be researched/tested further.

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1.0 INTRODUCTION

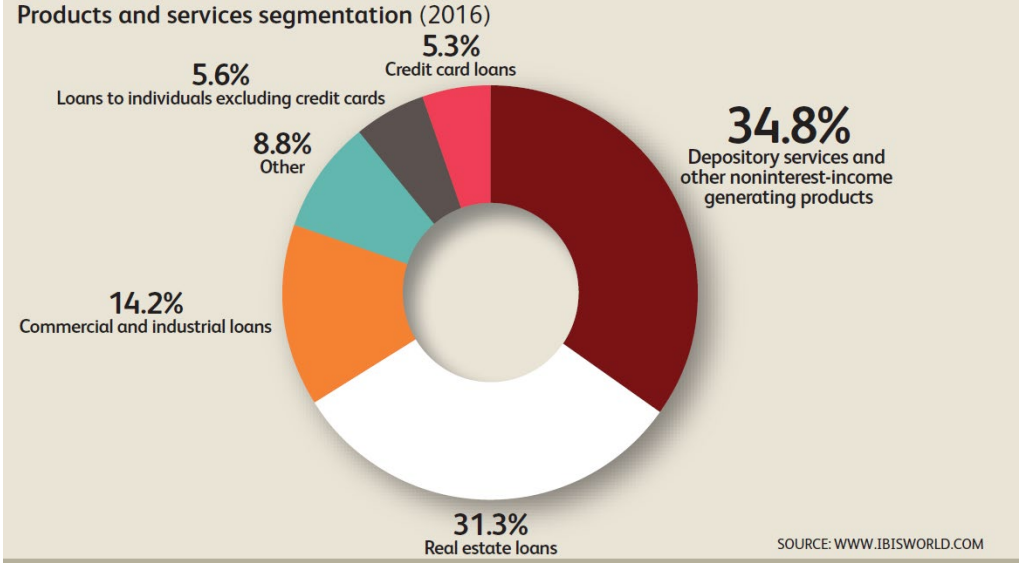
Banking sector stability has often been linked with speculation over the ability to maintain growth trends in core Gross Domestic Product worldwide. As such, many research studies have been conducted to understand the important variables that capture the banking sector's critical role in facilitating credit intermediation and the liquid transfer of capital among multiple counterparties. Liquidity and ease of access to capital is vital to an economy's functionality and we witnessed a devastating freeze in credit markets during 2008, where the whole financial system was on the brink of failure due to a general lack of adequate risk management systems. (i.e. taking on excess leverage that posed hidden risks)

This study aims to enhance understanding of the Bureau of Economic Analysis method of calculating banking sector output and additionally draws upon aggregate banking sector metrics in the United States to seek out if they have any impact on Real GDP. From a policy perspective, this analysis is important to consider since the ability of firms to produce output in the United States economy relies on access to capital and the ability of banks to supply that capital without putting strain on their own internal operations. The relevance of this study is that the banking sector acts as a backbone to the core economy and a platform for businesses to use as support for capital investment and savings. There are many important qualitative factors that are not covered in this analysis that can positively/adversely affect the banking subsector, namely governmental regulations and provisions. Despite not covering these critical factors, the study is expected to yield some key takeaways that policymakers can use as a screen to gauge the level of critical relationships among banking sector variables and real GDP in the United States.

2.0 BANKING SUBSECTOR OVERVIEW

The pie chart in Figure 1 is part of the 2016 year in review for the banking sector in the United States as provided for by IBISWorld. Note, the depository services and other noninterest-income generating products are a critical component banking subsector output. This study selected variables based on the structure of the 2004 BEA calculation of banking output and also other financial statement composition line items. Figure 2 on the next page shows the path of net interest income for banks on the aggregate level since the first fiscal quarter of 1984. There are signs of non-stationarity and this is a key issue that is addressed later when running statistical tests in the EVIEWS platform.

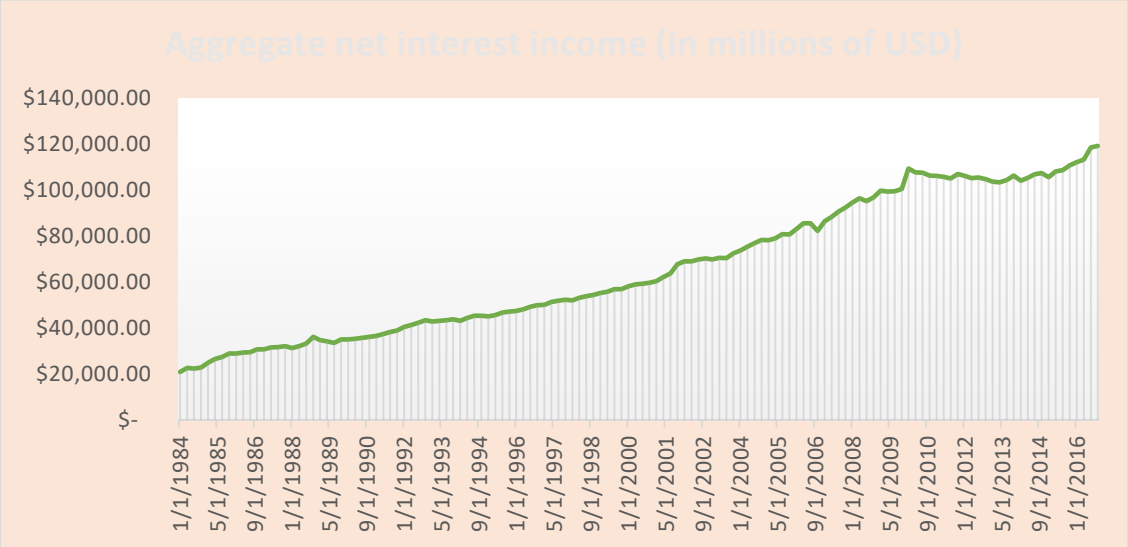
Figure 1: 2016 Banking Subsector Year in Review



Source: IBISWorld

As can be seen when analysing the distribution above, 65.2% of the banking subsector is made up of loan products, which are easily the largest and most lucrative asset on a bank balance sheet. The latter are funded by a portion of the other 34.8% (depository services), while the bank also holds capital against the percentage of deposits borrowed and lent out. In addition, the Board of Governors of the Federal Reserve System also enforce reserve ratio requirements for banks.

Figure 2: Aggregate Net Interest Income (QBP)



Source: FDIC

3.0 LITERATURE REVIEW

The financial sector is considered by many to be the most significant contributor to growth and stability in the United States due to facilitation of credit. There is an evolving need for currency and access to capital for consumers, institutions, and governments to invest and to spend to achieve long run objectives. Commercial banking in 2016 was estimated to generate a total of $117 billion in profit and there were a total of 5,318 businesses (Costa, 2017). The financial sector provides liquidity, a marketplace for the exchange of goods and services with the underlying support of currency, and many other critical functions to keep industries communicating and flowing efficiently. Harker et al. (1999) argue that for smaller economies, the financial sector can be even more significant than that of the US because of its reliance on raising capital to stimulate economic activity. In a third study we can look to the relationship between banking sector stability and real output growth as presented by Jokipii and Monnin

(2013), where it is determined that banking sector stability had a direct impact on Federal Reserve forecasts of GDP in subsequent periods. In order to get a better idea of economies that rely on banking and financial services, it is prudent to consider economies that rely much more on exports or commodities as fuel for growth. Resource dependent economies promoted through the banking sector can lead to less diversification and can create more risk (Kurronen, 2015). When reflecting on this point it is critical for policymakers and regulators to evaluate their respective economies to avoid scenarios where there is too much reliance on a particular good or service that is the sole source of stimulus. For example, if we consider Chile or Venezuela we know that they are commodity dependent nations focusing on copper and oil respectively and a direct hit to those commodities will adversely affect GDP. Marcelin and Mathur (2016) discuss reliance on the greenback in countries where the financial sector is not mature and developed. "Dollarization" as described by Marcelin and Mathur (2016) plays an important role in foreign lending. Foreign lending makes up a sizable portion of domestic bank balance sheets, so charge offs in that arena may result in weaker domestic GDP. In addition, Oulton (2000) contemplated the inaccuracy of factoring in capital gains generated through financial sector aggregate trades into the calculation of real GDP.

In an analysis Burgess (2011) discusses the intricacies of recording banking sector output and where banks come into play. For example, one of the specific details from Burgess's work is the contribution of banking sector output to the real GDP metric. Deposit and loan spreads are the major factor considered by the central banks and it is becoming increasingly difficult to highlight the overlap between depository institutions and securities firms. (Burgess, 2011). Triplett and Bosworth (2004) comment on U.S service sector productivity and a similar

calculation method to Burgess in 2011 except with more detail orientation towards the BEA (Bureau of Economic Analysis) and how their methods work. Finally, Gordon (1996) continues with some of the problems with banking output calculations and their implications. A couple of the problems covered include price deflators and labor hours of input, which can skew results. These are some of many analyses created to address the banking subsector and its contribution to economic growth.

4.0 DATA AND EMPIRICAL METHODOLOGY

This study uses quarterly time series data from the first fiscal quarter of 1984 to the fourth fiscal quarter of 2016. Data was obtained from the Quarterly Banking Profile report released by the Federal Deposit Insurance Corporation and also from the FRED database of macroeconomic indicators. Sample summary statistics for the data are provided in Figure 3 below. The table only shows three of the seven selected variables mainly due to formatting.

Figure 3: Summary Statistics: A Preview of Selected Variables

View | Proc | Object | Print | Name | Freeze | Sample | Sheet | Stats | Spec

	NET_INTEREST_INCOME_INMI	NETLOANSANDLEASES_INMILL	REAL_GDP_IN_MILLIONS_
Mean	66052.78	4926954.	10555248
Median	59166.24	4482581.	10317850
Maximum	119336.8	9183940.	18869400
Minimum	20876.54	2016231.	3912800.
Std. Dev.	29311.11	2199234.	4462998.
Skewness	0.245983	0.340588	0.194462
Kurtosis	1.631978	1.566803	1.729736
Jarque-Bera	11.62433	13.84928	9.706582
Probability	0.002991	0.000983	0.007803
Sum	8718967.	6.50E+08	1.39E+09
Sum Sq. Dev.	1.13E+11	6.34E+14	2.61E+15
Observations	132	132	132

Source: FRED & Quarterly Banking Profile FDIC (Prepared in EVIEWS)

Figure 3 shows a basic table with summary statistics for all variables used in this study. Some highlights to observe include the standard deviation, skewness, and kurtosis of the variables listed above. After converting the GDP variable to millions of dollars, one of the highlights was that the standard deviation was quite high relative to the other variables. Total Interest Income, which is not listed, had the highest kurtosis of all the variables above the normal value of 3.

There is no linear model format for this study. The variables were all mainly macroeconomic time series variables that needed to be tested for stationarity. Hence, the first step in the analysis process was the Unit Root test to eliminate any trends that might exist in order to keep the distribution normal regardless of time shifts. The next step was to test for cointegration among our variables, which in simple terms is just looking to see if any two variables would converge in the long run irrespective of any short-run deviation that mays occur (i.e mean reversion). The third and final step was to test for causal relationships among our variables via the GC (Granger Causality) test with the main objective being to test whether one time series could accurately forecast another. Empirical results will be discussed in Section 5.

There were 7 variables selected for this empirical research study: Net Interest Income, Net Loans & Leases, Real Gross Domestic Product, Tier 1 Risk Based Capital, Total Interest Expense, Total Interest Income, and Total Noninterest Income. Each were selected in line with the most important items that make up bank financial statements and are aggregate measures recorded on the national level in the United States. The intention was to see what causal relationships, if any, actually existed between the banking subsector and real Gross Domestic Product. All tests were ran as each banking sector variable paired with Real GDP. Thus, 18 tests were run in total, 6 for the Unit Root, 6 for Cointegration, and 6 for Granger Causality.

5.0 EMPIRICAL RESULTS

The empirical results in Appendix A, Appendix B, and Appendix C, Appendix D, and Appendix E are presented in the following order: Unit Root Test, Cointegration Test, and Granger Causality Test. One of the most significant results that needs to be discussed in depth is the relationship between Tier 1 Risk Based Capital and Real GDP that can be found in Appendix F, Table 3. Capital is the buffer against all losses for banks. Tier 1 Risk Based Capital primarily consists of common stock (i.e. retained earnings, surplus, or treasury stock). Leveraging excessively can dilute capital's ability to absorb exogenous shocks. The Granger Causality Test for this pair ended up showing a very curious result. Tier 1 Risk Based Capital on the aggregate level did not end up accurately forecasting the GDP time series, but the opposite relationship existed. Real GDP on the aggregate level accurately forecasted Tier 1 Risk Based Capital time series data. If we think about it intuitively, businesses and consumers indirectly drive a bank's decision to hold more or less capital. Default probability and recovery rates are among an array of other factors that are built into a bank's decision making regarding capital and the Basel Committee's determination of capital requirements. Since businesses and consumers both contribute very strongly to the calculation of overall GDP, when the economy experiences distress banks will hold more capital and vice versa. Hence, there is a statistically significant "causal" relationship between Real GDP and Tier 1 Risk Based Capital.

A second finding that is important to address is the Granger Causality results for Net Interest Income/Real GDP and Total Interest Income/Real GDP. After running the GC statistical test, Total Interest Income accurately forecasted Real GDP whereas Net Interest Income did not. It was difficult to pinpoint a definite reason for this result, but after doing some further research a

simple explanation could be that the size in the underlying observations for the Net Interest Income variable are somehow throwing off the ability to accurately predict the trajectory in Real GDP. Net Interest income takes out the interest paid on deposits on the aggregate level and therefore changes the consistency of the original Total Interest Income. The logic behind Total Interest Income is the fact that it is the payment on outstanding loans and leases that is payed out of the money generated on output produced by businesses and consumers. Thus, it is expected to be closely linked to Real GDP. An additional hypothesis, as net interest income increases in the United States economy, perhaps there is a better probability that the Granger Causality test would actually yield a statistically significant relationship.

In Appendix E, Table 3 Noninterest Income was found to have a direct impact on Real GDP. This result was also expected considering that a good portion of the noninterest income generated by banks is usually made up of fees tied to the depository accounts that individuals, businesses, and governments maintain. To elaborate further, Total Interest Income was "more" statistically (higher p-value) significant than Noninterest income. This is most likely in part due to the weight that Interest Income carries on a bank's consolidated statement of income. A final observation that is worth mentioning is the pairwise GC test for Net Loans & Leases and Real GDP. In this case both caused one another and were statistically significant at the 5 % level. The breakdowns of the cumulative Granger Causality results are provided on the following page.

Regarding the cointegration tests, only Total Interest Income and Total Interest Expense were cointegrated with Real GDP. None of the other pairings of variables yielded similar results. The one noticeable difference was the magnitude by which Noninterest income was NOT cointegrated with Real GDP.

5.1 Cumulative Granger Causality Results

Figure 4: Do Banking Subsector variable Granger Cause Real GDP?

	Net Interest Income (NII)	Net Loans & Leases (NLL)	Total Interest Income (TII)	Total Interest Expense (TIE)	Total Noninterest Income (TNI)	Tier 1 Risk Based Capital (TRBC)
Real GDP	DOES NOT GRANGER CAUSE	DOES GRANGER CAUSE	DOES GRANGER CAUSE	DOES GRANGER CAUSE	DOES GRANGER CAUSE	DOES NOT GRANGER CAUSE

Figure 5: Does Real GDP Granger Cause any Banking Subsector Variable?

	Real GDP
Net Interest Income	Does Granger Cause
Net Loans & Leases	Does Granger Cause
Total Interest Income	Does NOT Granger Cause
Total Interest Expense	Does Granger Cause
Total Noninterest Income	Does NOT Granger Cause
Tier 1 Risk Based Capital	Does Granger Cause

5.0 CONCLUSION

In summary of the content of this research study, there were a considerable number of sources that were consulted prior to acquiring the data and outlining how the statistical data sets

would be run. The main empirical study conducted by Jokipii & Monnin (2013) deployed a different econometric approach that included a panel dataset for multiple countries as well as a VAR method, but overall yielded similar results. Jokipii & Monnin mainly looked at banking sector stability, which this study captured through analyzing the Tier 1 Risk Based Capital variable. The results in this study illustrated that there was a significant pressure that Real GDP exerts on Tier 1 Risk Based Capital. Working with econometric time series data can be challenging, and I would like to thank Dr. Ramesh Mohan and Professor Tebaldi for providing guidance over the course of this semester. The framework of the statistical tests conducted in this study was provided by an empirical paper authored by Dr. Ramesh Mohan on domestic savings & economic growth in 2006.

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Appendix A: Net Interest Income/Real GDP (Unit Root, Cointegration, Granger Causality)

1. Table 1: Net Interest Income & Real GDP Unit Root Test: 1st Difference

Null Hypothesis: Unit root (individual unit root process)

Series: Net Interest Income – Real GDP

Method	Statistic	Prob.**
ADF - Fisher Chi-square	82.2207	0.0000
ADF - Choi Z-stat	-7.33224	0.0000

2. **Table 2: Net Interest Income & Real GDP Cointegration Test**

Series: Net Interest Income – Real GDP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 CriticalValue	Prob.**
None *	0.103968	15.77155	15.49471	0.0454
At most 1	0.014303	1.829656	3.841466	0.1762

3. **Table 3: Net Interest Income & Real GDP Granger Causality Test Results**

Pairwise Granger Causality Tests

Lags: 4

Null Hypothesis:	Obs	F-Stat	Prob.
REALGDP does not Granger Cause Net Interest Income	128	3.6630	0.0075
Net Interest Income does not Granger Cause REAL GDP	128	1.4715	0.2151

Appendix B: Net Loan/Leases & Real GDP (Unit Root, Cointegration, Granger Causality)

1. **Table 1: Net Loans and Leases & Real GDP Unit Root Test: 1st Difference**

Null Hypothesis: Unit root (individual unit root process)

Series: Net Loans & Leases – Real GDP

Method	Statistic	Prob.**
ADF - Fisher Chi-square	15.9540	0.0031
ADF - Choi Z-stat	-2.94843	0.0016

2. **Table 2: Net Loans and Leases & Real GDP Cointegration Test**

Series: Net Loans & Leases – Real GDP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.097925	15.37328	15.49471	0.0521
At most 1	0.017831	2.284947	3.841466	0.1306

3. **Table 3: Net Loans and Leases & Real GDP Granger Causality Test Results**

Pairwise Granger Causality Tests

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
Real GDP does not Granger Cause Net Loans and Leases	128	5.82338	0.0003
Net Loans and Leases does not Granger Cause Real GDP	128	4.15455	0.0035

Appendix C: Total Interest Expense/Real GDP (Unit Root, Cointegration, Granger Causality)

1. **Table 1: Total Interest Expense & Real GDP Unit Root Test: 1st Difference**

Null Hypothesis: Unit root (individual unit root process)

Series: Total Interest Expense – Real GDP

Method	Statistic	Prob.**
ADF - Fisher Chi-square	20.0718	0.0005
ADF - Choi Z-stat	-3.47790	0.0003

2. **Table 2: Total Interest Expense & Real GDP Cointegration Test**

Series: Total Interest Expense – Real GDP

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.116656	21.56139	15.49471	0.0054
At most 1 *	0.044704	5.808243	3.841466	0.0159

3. **Table 3: Total Interest Expense & Real GDP Granger Causality Test Results**

Pairwise Granger Causality Tests

Lags: 4

Null Hypothesis:	Obs	F-Stat	Prob.
Real GDP does not Granger Cause Total Interest Expense	128	2.6468	0.0368
Total Interest Expense does not Granger Cause Real GDP	128	3.4351	0.0107

Appendix D: Total Interest Income/Real GDP (Unit Root, Cointegration, Granger Causality)

1. **Table 1: Total Interest Income & Real GDP Unit Root Test: First Difference**

Null Hypothesis: Unit root (individual unit root process)

Series: Total Interest Income – Real GDP

Method	Statistic	Prob.**
ADF - Fisher Chi-square	25.0332	0.0000
ADF - Choi Z-stat	-3.98962	0.0000

2. **Table 2: Total Interest Income & Real GDP Cointegration Test**

Series: Total Interest Income – Real GDP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.124098	22.96471	15.49471	0.0031
At most 1 *	0.047174	6.137025	3.841466	0.0132

3. **Table 3: Total Interest Income & Real GDP Granger Causality Test Results**

Pairwise Granger Causality Tests

Lags: 4

Null Hypothesis:	Obs	F-Stat	Prob.
Real GDP does not Granger Cause Total Interest Income	128	2.2936	0.0633
Total Interest Income does not Granger Cause Real GDP	128	4.0438	0.0041

Appendix E: Total Nonin. Income/Real GDP (Unit Root, Cointegration, Granger Causality)

1. **Table 1: Total Noninterest Income & Real GDP Unit Root Test: First Difference**

Null Hypothesis: Unit root (individual unit root process)
Series: Total Noninterest Income – Real GDP

Method	Statistic	Prob.**
ADF - Fisher Chi-square	90.1123	0.0000
ADF - Choi Z-stat	-7.65711	0.0000

2. **Table 2: Total NonInterest Income & Real GDP Cointegration Test**

Series: Total Noninterest Income – Real GDP

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.089622	12.12497	15.49471	0.1510
At most 1	0.001576	0.200306	3.841466	0.6545

3. **Table 3: Total Noninterest Income & Real GDP Granger Causality Test Results**

Pairwise Granger Causality Tests

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
Real GDP does not Granger Cause Noninterest Income	128	1.34284	0.2581
Noninterest Income does not Granger Cause Real GDP	128	3.33595	0.0126

Appendix F: Tier 1 Capital/Real GDP (Unit Root, Cointegration, Granger Causality)

1. **Table 1: Tier 1 Risk Based Capital & Real GDP Unit Root Test: 1st Difference**

Null Hypothesis: Unit root (individual unit root process)

Series: Tier 1 Risk Based Capital – Real GDP

Method	Statistic	Prob.**
ADF - Fisher Chi-square	66.6268	0.0000
ADF - Choi Z-stat	-6.63203	0.0000

2. Table 2: Total Tier 1 Risk Based Capital Income & Real GDP Cointegration Test

Series: Tier 1 Risk-Based Capital – Real GDP
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.103193	14.18386	15.49471	0.0780
At most 1	0.002765	0.351695	3.841466	0.5532

3. Table 3: Tier 1 Risk Based Capital & Real GDP Granger Causality Test Results

Pairwise Granger Causality Tests

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
Real GDP does not Granger Cause Tier 1 Risk Based Capital	128	2.55981	0.0421
Tier 1 Risk Based Capital does not Granger Cause Rea GDP		0.96166	0.4313