The Long-Run Effect of Quantitative Easing on Financial Stability in USA: An Econometric Study Based on ARDL Approach

أثر التيسير الكمي على الاستقرار المالي في المدى الطويل في الولايات المتحدة الأمريكية: دراسة قياسية معتمدة على مقاربة ARDL

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Abstract:
This study examines the long-run impact of quantitative easing on financial stability in USA during the period from the third quarter of 2008 and the final quarter of 2018. The unit root tests showed that some variables are stationary at level whereas others are stationary at first difference. Then, the ARDL bounds testing approach was applied.
The results indicate that QE has a weak significant positive long-run effect on FS in the United States. Based on these results, the study recommends that the QE policy should not be overstated.
keyword:Quantitative Easing; Financial Stability; ARDL
JEL classification code : E52, E58

ملخص:
تختبر هذه الدراسة أثر التيسير الكمي على الاستقرار المالي في المدى الطويل في الولايات المتحدة الأمريكية للفترة الممتدة من الربع الثالث من عام 2008 إلى الربع الأخير من عام 2018. ولقد أظهرت اختبارات جذر الوحدة أن بعض المتغيرات مستقرة عند المستوى والبعض الأخر مستقر عند الفرق الأول. وعليه تم استخدام مقاربة ARDL من خلال اختبار الحدود. وتوصلت نتائج الدراسة الى وجود أثر إيجابي ومعنوي ضعيف لسياسة التيسير الكمي على الاستقرار المالي في المدى الطويل في الولايات المتحدة الأمريكية. وبناءً عليه، توصي الدراسة بعدم المبالغة في تطبيق سياسة التيسير الكمي.
الكلمات المفتاحية : التيسير الكمي؛ الاستقرار المالي؛ ARDL
تصنيف JEL : E52،E58

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1. Introduction and literature review :

Quantitative easing (QE) is a monetary policy to increase the money supply by injecting liquidity into the economy by buying government assets back from the market. It increases the capital within the financial sector, and therefore, increases the amount which banks lend to consumers and small businesses, in an effort to promote economic growth. However, it is usually done when interest rates are already extremely low and there are no other measures which can be taken. Through the purchase of long-term government bonds, the central bank decreases yields and, consequently, overall financial costs. QE also impacts the economy by devaluing the home currency hence making export goods more competitive. Therefore it is believed that the increase in government expenditure will lead to increased consumption, which will further increase the demand for goods and services, thus fostering job creation and, ultimately, creating economic vitality.(Magavi, 2012, p. 3)

The most high-profile form of unconventional monetary policy has been Quantitative easing. The phrase was first applied to Japan as it dealt with the bursting of a real estate bubble and the deflationary pressures that followed in the 1990s. The central banks of the US, the Euro area and the UK have all followed Japan in adopting policies that have led to substantial increases in their balance sheets, although there are significant differences both amongst themselves and with Japan in terms of how they have implemented QE and other unconventional policies.(Joyce, Miles, Scott, & Vayanos, 2012, p. 274)

Fed has bought US Treasuries but also large quantities of agency debt and agency-backed mortgage backed securities. The first quantitative easing was announced on November 25, 2008, that the Fed would purchase $500 billion in mortgage-backed securities and up to $100 billion in agency debt of Fannie Mae, Freddie Mac, Ginnie Mae, and Federal Home Loan Banks. Furthermore, in March 2009, the Fed expanded the mortgage buying program with additional purchase of $750 billion more in mortgage-backed securities. Overall, when this first round of LSAP ended on March 31, 2010, it purchased a total of $1.25 trillion in mortgage-back securities and $175 billion in agency debt. The main purpose of this action was to reduce the cost and increase the availability of credit for the purchase of houses, which in turn should support housing markets and foster improved conditions in financial markets more generally. The second quantitative easing was announced on August 10, 2010 Federal Open Market Committee will keep constant the Federal Reserve's holdings of securities at their current level by reinvesting principal payments from agency debt and agency mortgage-backed securities in longer-term Treasury securities. Additionally, the Fed started purchasing $600 billion of longer-term securities. It was intended to promote a stronger pace of economic recovery. The third quantitative easing was announced on September 13, 2012 that the Fed was committing to an open-ended purchase of $40 billion in agency MBS per month until the labor market improves substantially. On December 12, 2012, the Fed decided to continue and magnify the attempt of the third round of quantitative easing by increasing the amount of open-ended purchase from $40 billion to $85 billion per month.(Joanne, 2015, p. 2) The monthly purchase consisted of $45 billion of U.S. Treasury securities and $40 billion of mortgage-backed securities. (Williamson, 2017, p. 10)

The implications of all of these programs for the Fed's balance sheet can be observed in Figure 1in Appendices. From December 2007 to October 2014, the Fed's total assets increased from $882 billion to $4.5 trillion— five times its pre-crisis size. By the end of the quantitative easing program, it will gradually decline to about $4.1 trillion in December 2018.

The vast majority of studies on the Fed's QE address its impact on financial markets, long-term interest rates and other macroeconomic variables. Fuster and Willen(Fuster & Willen, 2010) studied the effect of MBS purchase on the mortgage market and found that the purchase of MBS under QE improved the mortgage market via boosting mortgage refinancing activity rather than house purchase as intended by the Fed, and the benefit of QE is disproportionately skewed towards borrowers with high creditworthiness. Krishmamurthy and Vissing-Jorgensen (Krishnamurthy & Vissing-Jorgensen, 2011) using the interaction of different characteristics of assets purchased, showed that QE1 and QE2 lowered the nominal interest rates on Treasuries, Agencies, corporate bonds and MBS through the portfolio balance and signaling channels, but the effect is heterogeneous, as the purchase of US Treasuries has stronger effect on long-term safe assets while lower-rate corporate bonds are more influenced by MBS purchase. Williamson (Williamson S. D., 2014)constructed a model of money, credit and banking, and showed that QE done with US Treasuries lowers inflation through the liquidity channel, which goes against the intention of the Fed. Woodford (Woodford, 2016)compared three alternative dimensions of central bank policy — conventional interest-rate policy, increases in the central bank's supply of safe liabilities, and macroprudential policy — and concluded that quantitative easing policies increase financial stability risk (in the absence of an offsetting tightening of macroprudential policy), but they actually increase such risk less than either of the other two policies, relative to the magnitude of aggregate demand stimulus; and a combination of expansion of the central bank's balance sheet with a suitable tightening of macroprudential policy can have a net expansionary effect on aggregate demand with no increased risk to financial stability. Shogbuyi and Steeley(Shogbuyi & Steeley, 2017)examined the impact on the variance-covariance structure of UK and US equity markets of the QE operations implemented by the Bank of England (BoE) and the Federal Reserve (Fed), and they found that while QE operations in general reduced equity volatility, day to day operations generated spikes in volatility in UK equities and they also found that BoE operations increased the covariance between the UK and US equity markets. Ronkainen and Sorsa(Ronkainen & Sorsa, 2017)suggested that the Fed has legitimated the QE programmes somewhat successfully, Fed has been able to conduct the large-scale purchases, and their legitimation have been imitated by other central banks. But many social institutions influencing Fed's activities have not been aligned with the formal institutions of finance-led growth regimes. Moreover, the asset class limitations of Fed's legal constraints make it difficult to conduct QE consistently. Reisenbichler(Reisenbichler, 2019)showed that QE programmes have supported private housing markets to different degrees as part of these balance sheet expansions. While the Fed has bought close to $2 trillion in mortgage debt, the ECB has purchased housing-related bonds much less extensively. He also showed that growth models, and the role of housing within them, explain these monetary policy differences in the United States and the eurozone. Labonte(Labonte, 2019) provided an overview of how the Fed's monetary policy works and recent developments, and showed that the increase in the Fed's balance sheet has the potential to be inflationary because bank reserves are a component of the portion of the money supply controlled by the Fed (called the monetary base), which grew at an unprecedented pace during QE, but in practice, overall measures of the money supply have not grown as quickly as the monetary base, and inflation has remained below the Fed's goal of 2% for most of the period since 2008. The growth in the monetary base has not translated into higher inflation because bank reserves have mostly remained deposited at the Fed and have not led to increased lending or asset purchases by banks.

In this paper we examine the long-run impact of quantitative easing on financial stability in USA during the period from the third quarter of 2008 and the final quarter of 2018.

Researchers have utilized various methods to establish weightings for the variables included in the aggregate financial stability index (AFSI). This paper uses the method of equal weighting across indicators. Furthermore, in order to aggregate the variables into a single index each indicator is normalized to allow for comparability across variables by using the method of empirical normalization. Under this method, the indicators' values will range between 0 and 1, where a value of 0 represents the weakest value of an indicator. More specifically, the formula used for the normalization process is: (Albulescu, 2010, p. 86)

$$I_{it}\,n = \frac{I_{it} - min(I_i)}{max(I_i) - min(I_i)}$$

whereI_{it} represents the value of type $\boldsymbol{i}$ indicator during the t period; $min(I_i)$ and $max(I_i)$ is the minimum respectively the maximum value registered for type i indicator in the analyzed period; $I_{it}n$ is the indicator's normalized value.

The individual indicators, grouped into the composite (or partial) stability indexes which reflect the dimension of the financial stability, are presented in Table 1in Appendices. The formulas used to calculate the composite indexes are:

$$FDI = \frac{1}{3}\sum_{j=1}^{3} I_{dj} \quad ; \quad FVI = \frac{1}{8}\sum_{j=1}^{8} I_{vj} \quad ;$$

$$FSI = \frac{1}{5}\sum_{j=1}^{5} I_{sj} \quad ; \quad WECI = \frac{1}{3}\sum_{j=1}^{3} I_{wj} \; .$$

Finally, the aggregate financial stability index is composed as follows:

$$FDI = \frac{1}{19}(3 \times FDI + 8 \times FVI + 5 \times FSI + 3 \times WECI) \quad ,$$

from which we obtain the following formula:

$$AFSI = 0.16 \times FDI + 0.42 \times FVI + 0.26 \times FSI + 0.16 \times WECI.$$

The evolution of the AFSI and its sub-indexes in the United States over the sample period are presented in Figure 2 in Appendices. A general positive evolution of the AFSI can be observed starting with 2010 after the deterioration that occurred after the financial crisis in 2008, despite the severe deterioration in the World Economic Climate Index (WECI), thanks to the positive development of the Financial Development Index (FDI) and the Financial Soundness Index (FSI).

2. Data and methodology :

The quarterly data used in this study which aims to determine the relationship between QE and FS for the period 2008Q3 to 2018Q4, in USA are obtained from the websites of the Federal Reserve, the Federal Reserve Bank of St. Louis, the Organisation for Economic Co-operation and Development and the Ifo Institute for Economic Research. The models to be used for the analysis are as follows:

$$QE_t = \alpha_0 + \alpha_1 FS_t + \varepsilon_t \qquad (1)$$

$$FS_t = \beta_0 + \beta_1 QE_t + \varepsilon_t \qquad (2)$$

whereQE_t is the ratio of quantitative easing to total assets of the

Federal Reserve; FS_t is the aggregate financial stability index (AFSI); α_i and β_i are parameter estimates and ε_t is the error term.

According to Pesaran et *al.*(Pesaran, Shin, & Smith, 2001, p. 291), if one of the variables' unit root degree is higher than I(1), the critical values obtained by Pesaran et *al.* cannot be used in the Autoregressive Distributed Lag (ARDL) approach. These critical values are based on I(0) and I(1). Therefore, it is necessary to determine whether or not the variables abide by the assumptions of the ARDL bound testing approach by performing the unit root test at the first stage of the analysis. In the first phase of the econometric analysis in this framework, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests are to be performed to determine the degrees of integration of the series. The ADF and PP unit root test results are shown in Table 2 in Appendices.

As noted in Table 2, QE variable is stationary in level (I(0)) at significant level of 5%, while FS variable is stationary in the first difference (I(1)) at significant level of 1%.

After the degrees of integration of the series are determined, the ARDL method developed by Pesaran et *al.* (2001) is used. The ARDL bound testing approach has several advantages. The first advantage involves the applicability of the ARDL method, irrespective of whether the series are either I(0) or I(1). Two asymptotic critical bounds are utilized in the ARDL method. If the obtained F-statistic value exceeds the critical upper bound, the null hypothesis which claims a long-run relationship between the variables would be rejected. If the F-statistic value is below the critical lower bound, the null hypothesis cannot be rejected, and the result is that there is no long-run relationship between the variables. If the F-statistic value is between two critical bounds, no comments can be made. Table 3 and 4 in Appendices indicate the ARDL test results for Equations (1) and (2), respectively.

Since the F-test value of Equation (1) is below the lower bound at 10% significance level, no long-run relationship between the variables involved in the analysis is found. Since the F-test value of Equation

(2)is above the upper bound at 1% significance level, a long-run relationship is found between the variables.

Based on the results of the ARDL bound testing, no long-run relationship between the variables for Equation (1) and the long-term coefficients are found by using ARDL model for Equation (2).

The results of the Error Correction Model (ECM) are shown in Table 5. In order to comprehend the short-term adaptation process, the sign and the magnitude of the error correction coefficient ECM(-1) should be considered. Since the ECM(-1) coefficient is between -1 and 0 (ECM(-1)=-0.53 with Prob=0), the adaptation process may be monotonic towards the long-term equilibrium value. According to the magnitude of ECM(-1), any deviation of the equilibrium will be corrected at the speed of 53% quarterly, or the financial stability will take approximately two quarters for full adjustment. To explain further, it is the speed of convergence towards a new long-run equilibrium after a shock due to QE.

The estimated coefficients in ARDL model adequate, only if the model is statistically viable. The Table 6 reports the results of diagnostic tests. The Jurqu-Bera test of the model accepts the null of “residuals are normally distributed”, the Breush-Pagan-Godfrey heteroscedasticity test indicates that the residuals are not serially correlated and the ARCH test shows that the residuals have no heteroskedasticity problem. Further, Cumulative sum (CUSUM) and CUSUM of squares (CUSUMSQ) tests (see Figure 3) show that estimated parameters are stable over the period.

The goodness of fit indicators of the ARDL model shows that estimated long-run coefficients are efficient and adequate. According to the estimation results of the ARDL model in which the financial stability variable is considered as a dependent variable and the quantitative easing variable is considered as an independent variable, there is a long-run relationship between the variables, suggests a 1% increase in the quantitative easing rate reduces the financial stability rate by 0.28%. This result indicates that the quantitative easing policy has a weak significant positive long-run effect on the stability of the financial system in the United States.

3. Conclusion :

This study examines the impact of the quantitative easing policy on the stability of the financial system in the United States in the long term analyzing time series data from the third quarter of 2008 to the final quarter of 2018. First, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were used to examine for unit roots and cointegration. The results show that the variable QE is stationary at level whereas the variable FS is stationary at first difference. Then, the autoregressive distributed lag (ARDL) bounds testing approach was applied to cointegration which is more appropriate for estimation in small sample studies. We found cointegration relations between the independent variable QE and the dependent variable QE in the ARDL model.

The results indicate that QE has a weak significant positive impact on FS the long-run in the United States, although that the quantitative easing eases financial conditions by reducing the spread between the required return on risky investments and the return on safe assets. And this reduces the incentive for private issuance of safe liabilities and favors financing of investment through issuance of non-safe liabilities, which is desirable on monetary and financial stability grounds. But this does not imply the creation of conditions under which it should be more tempting for banks to take on greater risk.

Based on these results, the study recommends that the quantitative easing policy should not be overstated. In addition, taking into account the importance of stock market development, as well as attract more domestic and foreign investment.

4. References:

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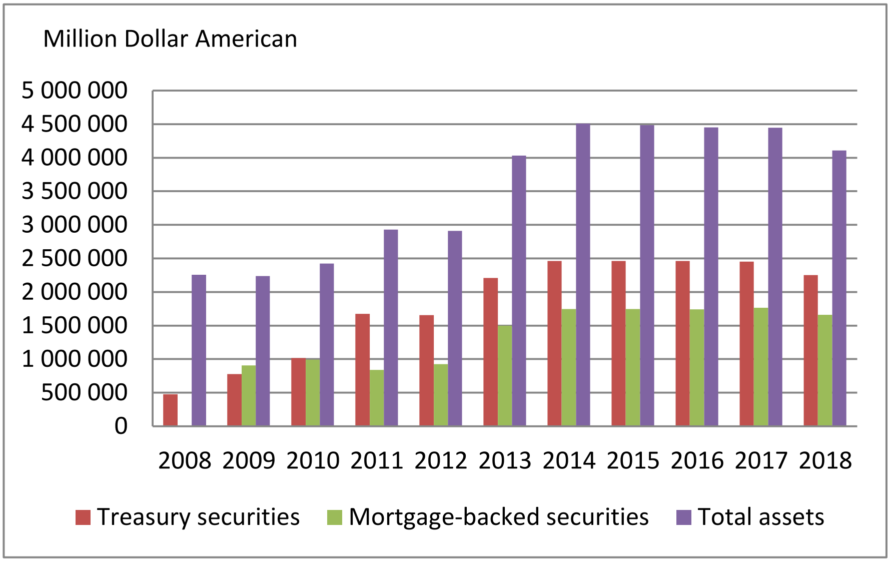
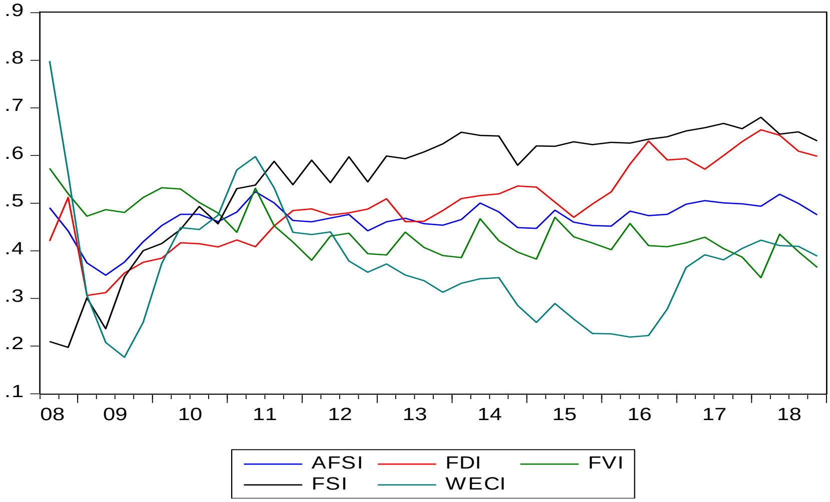
15. Appendices :

Fig.1:*Federal Reserve assets during the period 2008-2018*



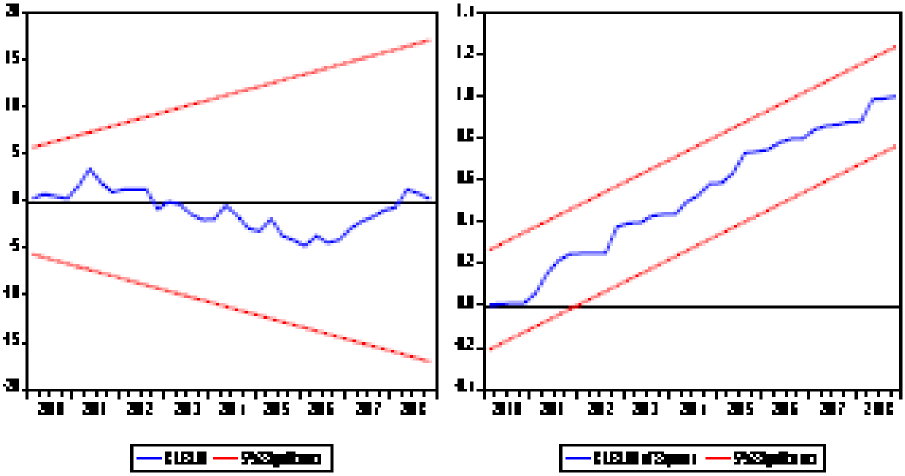
Source: *Prepared by researchers, based on Fed reports.*

Fig.2:*The trend of the aggregate financial stability index and its composites indices in USA during the period 2008-2018*



Source: *Prepared by researchers, based on EViews 9 software.*

Fig.3:*CUSUM and CUSUMSQ tests for parameter stability*



Source: *Prepared by researchers, based on EViews 9 software.*

Table 1:*Individual indicators for financial stability analysis*

Indicators	Symbole	Impact	Subgroup
Market Capitalization/GDP	I_{d1}	+	Financial Development Index (FDI)
Total Credit/GDP	I_{d2}	+	
Interest Spread	I_{d3}	-	
Inflation Rate	I_{v1}	-	Financial Vulnerability Index (FVI)
General Budget Deficit/Surplus (%GDP)	I_{v2}	+	
Current Account Deficit/Surplus (%GDP)	I_{v3}	+	
Real Effective Exchange Rate (REER)	I_{v4}	-	
Non Governmental Credit/Total Credit	I_{v5}	+	
Loans (%deposits)	I_{v6}	-	
Deposits/M2	I_{v7}	+	
(Reserves/Deposits) / (Note & Coins/M2)	I_{v8}	+	
Non Performing Loans/Total Loans	I_{s1}	-	Financial Soundness Index (FSI)
Regulatory Capital / Risk Weighted Assets	I_{s2}	+	
Own Capital / Total Assets	I_{s3}	+	
Liquidity Ratio	I_{s4}	+	
General risk ratio	I_{s5}	-	
World Economic Growth	I_{w1}	+	World Economic Climate Index (WECI)
World Inflation Rate	I_{w2}	-	
Economic Climate Index	I_{w3}	+	

Source: *Prepared by researchers, based on (Albulescu, 2010, p. 81) and (Verlis, 2010, p. 7).*

Table 2:The ADF and PP unit root test results for QE and FS series

Unit Root Test		ADF		PP	
At Level					
Variable		FS	QE	FS	QE
With Constant	t-Stat	-4.6495	-3.2065	-2.7033	-4.2542
	Prob.	0.0006	0.0267	0.0821	0.0017
	Stationarity	***	**	*	***
With Constant & Trend	t-Stat	-3.917	-2.3981	-3.498	-2.7097
	Prob.	0.0215	0.3751	0.0529	0.2383
	Stationarity	**	n0	*	n0
None	t-Stat	0.5903	1.0174	-0.2517	0.658
	Prob.	0.8396	0.9155	0.5894	0.8542
	Stationarity	n0	n0	n0	n0
At First Difference					
Variable		d(FS)	d(QE)	d(FS)	d(QE)
With Constant	t-Stat	-4.6901	-10.4248	-7.106	-5.487
	Prob.	0.0007	0	0	0
	Stationarity	***	***	***	***
With Constant & Trend	t-Stat	-4.5902	-4.8388	-7.4364	-6.3317
	Prob.	0.0048	0.0026	0	0
	Stationarity	***	***	***	***
None	t-Stat	-6.6906	-4.8134	-6.5143	-5.1687
	Prob.	0	0	0	0
	Stationarity	***	***	***	***
Notes: a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant b: Lag Length based on AIC c: Probability based on MacKinnon (1996) one-sided p-values.					

Source: *Prepared by researchers, based on EViews 9 software.*

Table 3:*The ARDL bound test results for Equation (1)*

ARDL Bounds Test
Date: 12/06/19 Time: 14:04
Sample: 2009Q3 2018Q4
Included observations: 38
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	3.295813	1

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
1%	6.84	7.84

Test Equation:
Dependent Variable: D(QER)
Method: Least Squares
Date: 12/06/19 Time: 14:04
Sample: 2009Q3 2018Q4
Included observations: 38

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(QER(-1))	0.113667	0.109771	1.035492	0.3090
D(QER(-2))	0.178520	0.085943	2.077183	0.0467
D(QER(-3))	-0.071261	0.046316	-1.538602	0.1347
D(AFSI)	0.053348	0.082280	0.648377	0.5218
D(AFSI(-1))	0.029090	0.084117	0.345822	0.7320
D(AFSI(-2))	-0.130462	0.082747	-1.576632	0.1257
C	0.167646	0.067889	2.469413	0.0197
AFSI(-1)	-0.044363	0.094302	-0.470432	0.6416
QER(-1)	-0.155350	0.065654	-2.366196	0.0249

R-squared	0.939212	Mean dependent var	0.009256
Adjusted R-squared	0.922443	S.D. dependent var	0.027220
S.E. of regression	0.007581	Akaike info criterion	-6.723070
Sum squared resid	0.001666	Schwarz criterion	-6.335221
Log likelihood	136.7383	Hannan-Quinn criter.	-6.585076
F-statistic	56.00832	Durbin-Watson stat	2.234489
Prob(F-statistic)	0.000000		

Source: *Prepared by researchers, based on EViews 9 software.*

Table 4:*The ARDL bound test results for Equation (2)*

ARDL Bounds Test
Date: 12/06/19 Time: 14:01
Sample: 2009Q1 2018Q4
Included observations: 40
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	20.69581	1

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84

Test Equation:
Dependent Variable: D(AFSI)
Method: Least Squares
Date: 12/06/19 Time: 14:01
Sample: 2009Q1 2018Q4
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AFSI(-1))	0.250413	0.119541	2.094792	0.0433
C	0.176463	0.037191	4.744703	0.0000
QER(-1)	0.113919	0.023965	4.753576	0.0000
AFSI(-1)	-0.592942	0.095081	-6.236156	0.0000

R-squared	0.568853	Mean dependent var	0.000847
Adjusted R-squared	0.532924	S.D. dependent var	0.024679
S.E. of regression	0.016866	Akaike info criterion	-5.232343
Sum squared resid	0.010241	Schwarz criterion	-5.063455
Log likelihood	108.6469	Hannan-Quinn criter.	-5.171278
F-statistic	15.83274	Durbin-Watson stat	1.892122
Prob(F-statistic)	0.000001		

Source: *Prepared by researchers, based on EViews 9 software.*

***Table 5:** The ARDL cointegrating and long run form for Equation (2)*

ARDL Cointegrating And Long Run Form
Dependent Variable: AFSI
Selected Model: ARDL(2, 0)
Date: 12/08/19 Time: 05:35
Sample: 2008Q3 2018Q4
Included observations: 40

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AFSI(-1))	0.247239	0.120524	2.051373	0.0476
D(QER)	0.147948	0.031565	4.687091	0.0000
CointEq(-1)	-0.533020	0.089404	-5.961931	0.0000

Cointeq = AFSI - (0.2776*QER + 0.2174)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
QER	0.277566	0.056469	4.915331	0.0000
C	0.217351	0.050955	4.265520	0.0001

***Source:** Prepared by researchers, based on EViews 9 software.*

***Table 6:** The diagnostic tests for ARDL approach for Equation (2)*

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.093451	Prob. F(2,34)	0.3466
Obs*R-squared	2.417342	Prob. Chi-Square(2)	0.2986
Heteroskedasticity Test: ARCH			
F-statistic	0.212924	Prob. F(1,37)	0.6472
Obs*R-squared	0.223149	Prob. Chi-Square(1)	0.6367
Histogram– Normality Test			
Jarque-Bera	0.564269	Prob.	0.7542

***Source:** Prepared by researchers, based on EViews 9 software.*