CAN GOLD ACT AS A HEDGE AGAINST INFLATION? EVIDENCE FROM IRAQ

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STATEMENT OF NON-PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

CAN GOLD ACT AS A HEDGE AGAINST INFLATION? EVIDENCE FROM IRAQ

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This study investigates the relationship between gold returns and the inflation in Iraq. Monthly data spanning the period from January 2007 to December 2015 were used. Analysis was done by using the Autoregressive Distributed Lag Model (ARDL) (Pesaran et al., 2001). The results show that there is no relationship between gold returns and inflation in the long run, but there is one in the short run. Specifically, the results from the error correction representation of the model indicate that 90.66 percent of the disequilibrium is corrected within one month. Results obtained by using the Toda-Yamamoto approach to causality show evidence of two-way Granger Causality between gold returns to inflation rate.

Key words: Iraq, gold, inflation, hedge, ARDL

ÖZET

ALTIN ENFLASYONDAN KORUNMA ARACI OLABİLİR Mİ? IRAQ ÜZERİNE BİR ÇALIŞMA

Bha Aldan Abdul Sattar Faraj
Finansal Ekonomi Yüksek Lisans Programı
Danışman: Prof. Dr. Ergun DOĞAN

Bu çalışmada Irak'ta altın getiri oranı ve enflasyon oranı arasında bir ilişki olup olmadığı incelenmiştir. Çalışmada Ocak 2007 – Aralık 2015 dönemi aylık verileri kullanılmıştır. Çalışmada yöntem olarak Autoregressive Distributed Lag Modeli (ARDL) (Pesaran et al., 2001) uygulanmıştır. Çalışma sonuçları altın getiri oranı ve enflasyon oranı arasında uzun dönemde bir ilişki olmadığını; kısa dönemde ise olduğunu göstermiştir. Hata düzeltme yöntemi sonuçlarına göre kısa dönemde dengeden sapmaların yüzde 90.66'sı bir ay içinde düzelmektedir. Toda-Yamamoto nedensellik testlerinin sonuçları altın getiri oranı ile enflasyon oranı arasında iki yönlü Granger nedensellik olduğunu göstermektedir,

Anahtar sözcükler: Iraq, enflasyon, altın, hedge, ARDL

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CHAPTER I

INTRODUCTION

1.1 Statement of the Problem and the Importance of Study

Gold has been one of the most important commodities in human history. Gold can be used for investment as well as for ornamental purposes, and in manufacturing, e.g. electrical industries.

The decision to invest does not seem to be easy in light of the complexities of the market. Many investors do not worry enough about the financial and macroeconomics risks, which need to be hedged. Inflation is one of these macroeconomic risk factors that might play a major role in determining the real value of assets. Most investors fear the loss of financial assets in value as inflation continues to climb.

According to Arnold and Auer (2015), a financial asset is said to be a hedge against inflation if there is a positive correlation between inflation rate and the nominal return of that asset, or the inflation rate is independent of the real yield of the asset. Additionally, in a regression of gold returns on the inflation rate, a coefficient of one represents an ideal hedge against inflation, indicating the ability of that asset to compensate for the rise in the level of inflation perfectly.

The Iraqi economy is characterized by a high dependence on oil. Oil export revenues, which are mainly used to finance the state's annual budget, account for 95% of the country's annual revenues. 2005 was the year when the shift of the Iraqi economy to a market economy started after decades of state control. The policy of

transformation to the open economy encountered many obstacles, some of which were legislative. The structure of the Iraqi economy and the absence of solid ground for the private sector were important impediments in economy's transition to a market economy. These obstacles have created a kind of ambiguity about the mechanisms of foreign investment in Iraq and thus prevented foreign investors from investing in Iraq. During this period, inflationary pressure started to rise. The Central Bank adopted a policy of targeting inflation in an effort to curb it.

After the global financial crisis, investors began to think about the mechanisms that prevented their assets from losing their value by diversifying portfolios to counter the effects of the crisis. Gold has been one of the most important assets historically used in financial crises, and one of the most important options to hedge against the expected and unexpected effects of inflation. In this study, we highlight the importance of adopting gold to hedge inflation in Iraq.

1.2 Objectives of the Thesis

There are many studies that examine the relationship between gold prices and inflation in developed and emerging countries. The results of these studies are mixed, perhaps due to the methods and sample periods used. This study will investigate the same issue with data from Iraq by using ARDL bounds testing methodology. Our study is the first attempt to assess the relationship between gold returns and inflation in Iraq. Hence, it will be a contribution to the growing literature on developing country studies, the results of the study should be relevant to policy makers, and especially to investors since inflation is still a growing concern for investors.

1.3 Scope of the Thesis

This study covers the period from January 2007 to December 2015, which is an important period in the Iraqi economy. This period also covers the years of Global Financial Crisis.

1.4 Structure of the Thesis

The second chapter presents a historical perspective on the Iraqi economy. Chapter 3 reviews the literature that is the most relevant to the present one. Chapter 4 presents the methodology adopted in the study, and Chapter 5 presents the empirical results. In the final chapter concluding remarks are presented.

CHAPTER II

A BRIEF OVERVIEW OF THE IRAQI ECONOMY

2.1 1921-1958: The Kingdom of Iraq

The modern Iraqi state was founded in 1921 through British colonialism through the selection of Faisal I as the first king. Iraq gained independence in 1932, but Britain managed to maintain its influence through bilateral treaties in the fields of defense, trade and foreign policy (Özlü, 2006).

The history of oil exploration in Iraq dates back to the end of the nineteenth century, but its commercial discovery was in 1927, when the Iraqi Oil Company awarded concession rights covering the territory of Iraq to several companies (Alnasrawi, 1994). The revenues generated by the Iraqi government were very small when they did not exceed 5% of the actual revenues received by the concessionaires. However, a new era emerged in 1952 by amending the agreement between the Iraqi government and oil concessionaires, and Iraq received 50% of the oil revenues in addition to more than 12% of the Iraqi government's free production at any price level (Özlü, 2006).

The oil boom since 1952 and the prudent decision of the Iraqi government to allocate 70% of the oil revenues to the Reconstruction Council helped to develop a general economic plan in 1950 to reconstruct and modernize Iraq (Al-Haidari, 2115). Oil revenues in 1952 were 22,233,588 dinars. Revenues rose to 34,823,438 dinars in 1953 to 38,752,000 dinars in 1954 and to 42,308,000 dinars in 1955 (Hashim, 1975). The share of the Reconstruction Council from oil revenues in 1952 was 23 million

Iraqi dinars, and in 1954, it was approximately 39 million reaching in 1955 to more than 42 million dinars. The price of the Iraqi dinar was equivalent to more than three Americans dollars (Zinni, 2009) then. The Reconstruction Council had two main objectives: first, the development of the economy and industry in Iraq in order to raise the standard of living by creating jobs. The second objective was to work hard to develop a work plan for planning and conducting comprehensive surveys of exploited and unutilized resources, and to start implementing projects according to their importance, such as flood control, the improvement of irrigation and drainage systems, development of extractive and transformational industries, and the establishment of modern transportation networks.

One of the features of this period was the dominance of feudal groups on agricultural land. The result was a deep gap between people who live in urban areas and those who live in rural areas. This could be considered one of the most important reasons for the military coup in 1958 (Hashim, 1975).

2.2 The Era of Military Rule 1958-1968

Iraq moved from a monarchy to the republican system through a military coup, which marked the beginning of a political and economic stage radically different from those that preceded it. The military coup was the starting point for the beginning of economic and political relations with the Soviet Union.

The state targeted the development of various economic sectors during the reign of Abdul Karim Qasim, who increased allocations for agriculture and industry. The government started serious and practical steps to develop the oil industry in Iraq through legislation, especially by adopting Law No. 80 of 1961, which returned many of the rights stolen by foreign oil companies to Iraq (Enaz, 2014). The differences of opinion among the leaders of the coup had a direct impact on the social and civil life of the country, which led to the coup of comrades against Abdul Karim Qasim in 1963 by General Abdul Salam Aref to start a new era characterized by balanced political relations between the West and East (Issawi, 2013). The comprehensive development

plan, which was developed during the era of General Arif, was characterized by a kind of maturity in planning and implementation, especially in 1965, which was described as the most comprehensive plan since 1952. The plan included specific economic and social objectives while adopting the means to achieve the desired success by taking into account the important role of fiscal and monetary policy to achieve the goals of the development plan. Most of the plan's goals had been achieved, but not at the extent prescribed in the plan. For example, job opportunities rose to 427,000 while the expected number was 262,000 during the five years the plan (Alnasrawi, 1994).

2.3 Iraq During the Baath Era 1968-2003

On July 17, 1968, the Baath party came to power in Iraq as a result of a military coup. Iraq once again moved to an ideological system based on the idea of Arab nationalism. The new system of government was based on the social economic policies inherited from the previous regime. The Baath adopted its own economic plan, abandoning the plans that had been put in place before that period.

From 1968 to 1970, the Government participated in a comprehensive study of the Iraqi economy to begin the development of the first and unique development plan for the 1970-1974 period. This plan was based on the central planning method, and was backed by a strong political will to achieve its objectives. It was specifically designed to take advantage of the relatively high prices of oil during that period. The projected investments for the National Development Plan for the years 1970-1974 were estimated to be 1143.7 million Iraqi dinars distributed by sectors as shown in the following table (Table 2.1).

Table 2.1. Investment allocations for the period 1970-1974

Sector	Investments (in Iraqi dinars)	Percentage
Public sector	536.9	46.9
Public sector (self-financed)	321.8	28.1
Mixed sector	285.0	25.0
Total	1143.7	100

Source: Central Bureau of Statistics

GDP growth rate increased from 4.54% in 1970 to 20.86% in 1979, increasing from $3.2817 million in 1970 to $37.8161 million in 1979. This was associated with the abundance of oil revenues as oil prices rose globally from $3.10 per barrel in 1970 to $26.11 per barrel in 1974 as a result of the outbreak of a general war in 1973 with Israel. Table 2.2 presents a number of indicators of the Iraqi economy for the period from 1970 to 2015.

Table 2.2. Indicators of the Iraqi economy for the period 1970-2015

Economic Indicators	1970-1979	1980-1989	1990-1999	2000-2009	2010-2015
GDP	12.9	47.2	6.28	63.5	199.5
GDP Growth Rate (%)	7.8	–2.9	7.6	2.9	7.8
GDP per capita	1.090	3.074	313	2.380	5881
Exchange rate	0.31	0.30	847	1576	1167
Population	11.53	15.36	20.01	26.68	33.92
Inflation	18.20	4.8	122.97	13.12	2.9

Source: International Monetary Fund.
Notes: Figures given in the table are period averages. GDP is at constant 2010 prices in US Dollars, exchange rate is defined as dinars per US dollar.

2.4 Iraqi Economy during the War Years, 1980-1988

The last quarter of the 1980 was the most prominent turning point in the modern history of Iraq, both economically and socially. This was the year when a devastating war broke out between Iraq and Iran, which lasted for eight years.

The effects of war was felt in the second year of the war when the GDP growth rate fell from 20% in 1979 to –0.7% in 1981. Moreover, funding difficulties due to the low oil prices on the one hand and the failure of production and export operations on the other, contributed to the emergence of the inflationary gap and the large deficit in the public budget and the high level of external and internal indebtedness. It, in fact, showed the risks of the oil-based rent economy in Iraq (Mohammed, 2011).

The lowest growth rate, –13.07%, was in 1984 due to a halt in oil exports and several periods as a result of Iraq's entry into the war with Iran. The value of exported crude oil declined from $5.26245 million in 1980 to $3.9900 million in 1984, which then rose to $6.9932 million in 1990 (Mohammed, 2011). On the industrial side, most industrial establishments were unable to function due to the lack of funding and the lack of raw materials. Iraq emerged from the war with a huge debt accompanied by the collapse of world oil prices with the need to finance the repair of the effects of war (Mohammed, 2011).

2.5 Invasion of Kuwait and the Period of Economic Embargo

The war between Iraq and Iran ended in 1988. After the war, several economic problems emerged, including very high inflation rates, high unemployment, declining oil revenues, devaluation, unemployment, and stagnation of industrial production.

Iraq invaded Kuwait on August 8, 1990, before the economy could get a chance to rise from this collapse. The United Nations reacted by imposing a total embargo on Iraq under Resolution 661, which was followed by the US-led campaign to oust Iraq from Kuwait. After the war, the economic situation was desperate again. To alleviate the problems, Iraq and the United Nations signed the oil-for-food memorandum in 1991, which was not implemented until 1995. The first shipments of food arrived in March 1997 (Özlü, 2006).

2.6 Economic Reform Program

The United States launched an offensive against Iraq, which overthrew Baath Party rule. The United Nations Security Council adopted Resolution 1483 on May 22, 2003, lifting trade sanctions against Iraq (excluding arms embargoes) and ending the oil-for-food program.

The United States adopted an ambitious program of economic reform in Iraq in 2004, but faced many challenges, including the gradual transition of the Iraqi economy to a market economy, and structural imbalances in the Iraqi economy.

The task for such an economy required

- Controlling and preventing ethnic and sectarian conflicts
- Restructuring the public sector through privatization
- Developing a competitive market through private sector support
- Developing and supporting service sectors, especially the education, health, water, and energy sectors
- Stimulating the economy by creating jobs and eliminating unemployment

2.7 Reform in the Financial Sector

The reform in the financial sector began through the enactment of Central Bank Law No. 56 of 2004, which defines the functions of the Central Bank. The functions of the Central Bank of Iraq (CBI) include maintaining and managing all foreign reserves, the management of the government's gold reserves, issuing and managing the Iraqi currency, monitoring and enhancing the safety and efficiency of payment systems and issuing licenses to banks, and regulating and controlling banks as specified under the Banking Law No. 56 of 2004.

2.8 Features of Monetary Policy Between 2007-2015

The monetary policy in Iraq under the new law of the Central Bank has been characterized by a completely different monetary path from the former in terms of the tools used in the implementation of monetary policy and in terms of its objectives.

The independence enjoyed by the Central Bank of Iraq after the adoption of Law No. 56 in 2004 allowed it the freedom to take actions that would achieve monetary stability in the Iraqi market and the formulation of a monetary policy aimed at achieving economic stability and social welfare (Al-Mashhadani & Tomeh, 2012). Moreover, the new law allowed the Central Bank of Iraq to draw monetary policy away from the political pressures of the government, which is a real incentive for financial decision makers to move towards real monetary reforms having a key role in stabilizing the value of the Iraqi currency against other foreign currencies and bypassing many of the geopolitical obstacles surrounding the work of the Central Bank of Iraq.

Monetary policy trends can be summarized as follows:

2.8.1 Inflation Targeting

The central bank adopted a policy of targeting inflation, and used sustainable but conservative monetary and financial policies. The new monetary policy has had clear effects, especially in 2008, 2009, 2010 and 2011, where the auction of the Central Bank's currency as part of an open market operation had a major impact on the control of the money supply. In spite of the growth in the money supply compared to previous years, inflation rates fell to reasonable rates, which were the result of monetary stability and stability of the exchange rate of the Iraqi dinar (Dagher, 2014).

2.8.2 Interest Rates

The monetary policy rate of the Central Bank of Iraq is the short term interest rate announced in the cash market. Commercial banks are free to set interest rates in dealing with each other in the market at any agreed interest rate. The rate of the bank is the indicative rate by which rates are determined in the market. By looking at the following table (Table 2.3), we see the difference between the base rate of interest from the Central Bank and the interest rates paid by commercial banks to depositors.

Central Bank's interest rate policy forced the commercial banks to lend to citizens at high rates, which is an obstacle for borrowers to borrow from commercial banks. One of the most important reasons used by commercial banks for this policy is the level of high risk suffered by the financial market of Iraq as a result of political events and security instability in Iraq.

Table 2.3. Policy Rate, Deposit and Loan Rates 2007-2015

Year	Policy rate	Interest Rate on One Year Deposits (of Iraqi dinars)	Interest Rate on One Year Loans (of Iraqi dinars)
2007	20	11.3	18.78
2008	16.75	11.87	19.22
2009	8.83	8.82	16.16
2010	6.25	7.17	14.35
2011	6	6.9	14.13
2012	6	6.7	13.87
2013	6	6.04	13.57
2014	6	6.01	12.60
2015	6	5.75	12.3

Source: Central Bank of Iraq

2.8.3 Money Supply

Table 2.4 shows some statistics on the money supply for the study period between 2007 and 2015 as well as government expenditure and the inflation rate.

Table 2.4. Money Supply 2007-2015

Year	Public expenditure (dinars)	Money supply (dinars)	Currency (%)	Inflation rate (%)
2007	39031232	21721167	55.6	19
2008	59403375	28189934	65.6	13
2009	65658000	37700030	58.4	7.1
2010	83823000	51743489	47.0	2.9
2011	96662767	62473929	45	6.5
2012	105139576	63735871	48	5.6
2013	119127556	73830964	47	2.4
2014	83556226	72692448	50	1.6
2015	70397515	77912398	52	1.39

Source: Central Bank of Iraq

The changes in the money supply are closely related to the nature of the Iraqi economy, which depends mainly on oil revenues, constituting 95% of public revenues, and the huge demand by the government for money to finance the public budget. All of this leads to increasing the quantity of money as a result of increased government demand on the local currency to cover its increasing expenses. By highlighting the monetary policy of the Central Bank of Iraq, we find that the Central Bank of Iraq has succeeded in striking a balance between the money supply on the one hand and maintaining monetary stability by stabilizing the value of the Iraqi dinar against foreign currencies, especially the US dollar. Figure 2.1 shows the upward trend of the money supply and expenditure curve for the 2007-2015 period.

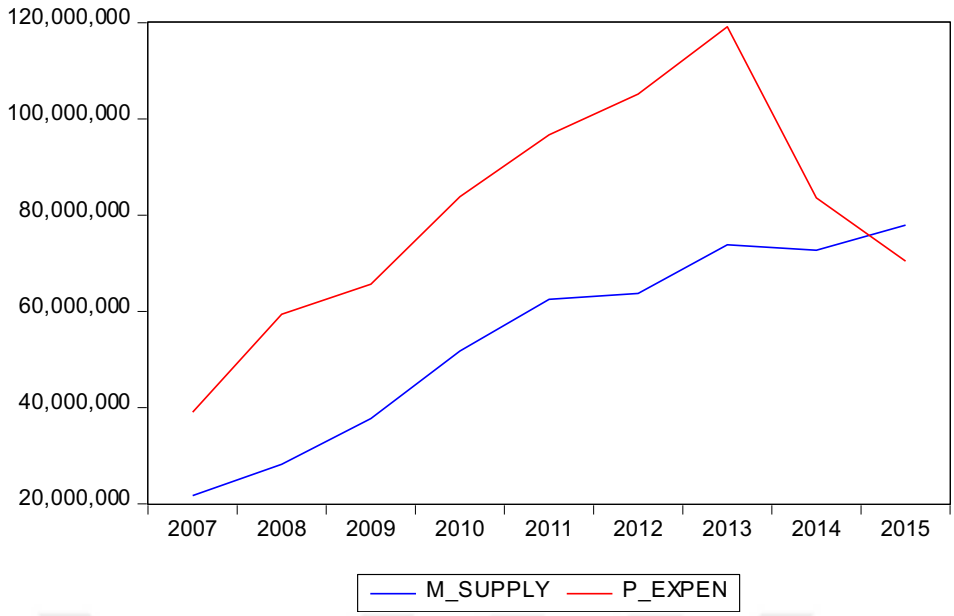


Figure 2.1. The money Supply and Expenditure 2007-2015

2.8.4 Stabilizing the Exchange Rate

The new monetary policy focused on stabilizing the exchange rate of the Iraqi dinar against the US dollar, which was considered as the nominal anchor. For the success of this goal the value of the Iraqi currency against the US dollar was maintained around the level of 1170 (Dagher, 2014).

Table 2.5. Exchange Rates between 2007 and 2015

Year	Exchange Rate (CB)	Exchange Rate (Market)
2007	1255	1267
2008	1193	1203
2009	1170	1182
2010	1170	1182
2011	1170	1196
2012	1166	1233
2013	1166	1232
2014	1188	1214
2015	1167	1247

Source: Central Bank of Iraq

2.8.5 Foreign Currency Reserves

One of the functions of the Central Bank of Iraq is the management of the State's foreign exchange and gold reserves. The reserves of US dollars were $66 billion, $51 billion, and $43 billion in the years of 2014, 2015 and 2016, respectively. Perhaps the most important reason for the decline in foreign exchange reserves was the terrorism related problems that occurred Iraq in 2014 and the Government's need for liquidity to finance government expenditures. One of the most important reasons leading to the stability of the value of the Iraqi dinar against the US dollar were the huge reserves of foreign currencies due to high rates of Iraq's crude oil production on the one hand and the rise in crude oil prices globally on the other (Central Bank of Iraq ,2016).

2.8.6 Gold Reserves

The Iraq imports its gold mostly from neighboring countries (Turkey, the UAE and Iran). Over the last few years, Iraq's imports for industrial use (jewelry) have expanded gradually to reach five-ton high levels per month. According to Saleh (2014), the reasons for the increase in imports of gold may be attributed to the inclusion of the stability of the exchange of local currency against the US dollar, the high purchasing power of the Iraqi individual, and the adoption of commercial banks for gold as collateral for loans to individuals.

As result of the sharp fluctuations in the exchange rates of the US dollar and the possibility of a new global economic crisis as a result of cumulative debt in the dollar currency as well as the high uncertainty in the financial markets, the Central Bank increased its gold reserves to 89.8 tons in 2017 as part of a hedge against exchange rate fluctuations in an attempt to control rising inflation rates as a result of economic crises (World gold council, 2017).

As part of the monetary policy mechanisms, the Central Bank of Iraq (CBI) issued a press release in January 2014 announcing that it had offered for sale gold

bullion weighing between 5 grams and 1,000 grams to diversify the savings of the public through the availability of pure gold from reliable sources to gold dealers for individuals and investors to be sold in Iraqi dinars. The advantage of this mechanism of monetary authority is the possibility of using this gold bullion as reserves by investors. It is one of the mechanisms used to activate the gold market in Iraq. Moreover, it becomes possible for gold to be easily monetized and converted into monetary units in local currency or other foreign currencies, and it is also possible to be limited speculation (Central Bank of Iraq, 2016).

2.9 The Oil Sector

The Iraqi economy is still classified as a rent economy with its continued dependence on oil. Iraq's continued reliance on the oil sector remains a source of concern for experts because of the inability of the Iraqi economy to overcome the problem of relying on only one sector for revenue generation. In mid-2012, Iraq's oil production reached 3 million barrels, of which 2.4 million were exported. In 2011, oil revenues were almost 95% of the Government's revenues and amounted to more than 70% of the gross domestic product (GDP) (Dawood, 2015).

CHAPTER III

LITERATURE REVIEW

In this chapter we present a concise review of a number of relevant papers. As it will be clear from the review, there are many methods that have been used in these papers, together with data ranging from very low frequency (weeks) to very high frequency (annual). The results of these tests studies do not a clear cut indication as to whether gold is a hedge against inflation or not.

Chua and Woodward (1982) conducted an analysis to explore the long-term relationship between gold returns and the consumer price index for six countries, namely, the United States of America, the United Kingdom, Canada, Switzerland, Japan, and Germany by using monthly and semi-monthly data covering the period 1975-1980. The results obtained by using the OLS method indicated that gold was a hedge against inflation only in the United States of America.

Bampinas and Panagiotidis (2015) used annual data covering the period 1791-2010 for both gold and silver prices and the consumer price index in the United States of America and the United Kingdom. Moreover, the researchers adopted the VECM model to assess the relationship between the combined price of gold and the consumer price index with the possibility of adopting gold to hedge against inflation in both countries. The evidence points to the ability of gold to hedge against inflation in the United States, while the results of the UK were insignificant.

Iqbal (2017) aimed to test the gold's hedging capability against the effects of inflation, exchange rates and non-positive movements of stock prices in India, Pakistan and the United States. Both daily and monthly data were used spanning the period of 1990-2013. EGARCH model and the quantile regression approach were adopted in the study. The EGARCH model results show that gold is a hedge against inflation only in the US. Results from quantile regressions show that gold is a hedge against inflation in the United States; the same is true for India only in the quantiles of 10% and 25% gold distribution. For Pakistan, there was no evidence of gold's role as a hedge against inflation.

Batten et al. (2014) conducted a study to investigate the dynamic relationship between gold and the CPI in the United States using monthly data covering the period from January 1985 to June 2012. Three approaches (Johansen, ARDL, and Saikkonnen-Lutkepohl) were adopted. The results showed that there was no co-integration between gold and the consumer price index, which provides evidence that gold cannot be used to hedge against inflation.

Gangopadhyay et al. (2016) used monthly data covering the period 1990-2013 and adopted the VECM model to study the relationships between co-integration among gold prices and a range of variables such as CPI, oil prices, interest rates, exchange rates, and stock price indices. The results showed a simultaneous rise in gold prices with a rise in the consumer price index. As a result, gold could be adopted to hedge against inflation in India.

Wang et al. (2011) investigated the effectiveness of gold as a hedge against inflation in the United States and Japan by using monthly data for gold and CPI from 1971 - 2010. Linear and nonlinear models were adopted in the study (TC-TVECM, TVECM). The study showed that the ability of gold to hedge against inflation depended on the strength of the price momentum of gold. In the case of high momentum, gold provides a hedge against inflation in the US while showing partial effectiveness against inflation in Japan. The rigidity of the gold price in Japan is a major obstacle to gold against inflation in the long-run.

Blose (2010) explored the relationship between gold prices and expected inflation by using monthly data for both the consumer price index (CPI) and gold prices in the USA covering the period 1988-2008. Unexpected changes in the CPI are used as a proxy for changes in inflation. The results show that unexpected changes in the CPI do not affect the spot prices in the gold market. Hence, gold cannot be used as a hedge against inflation in the US.

Khair et al. (2017) examined the potential of gold to hedge against short- and long-term inflation in Malaysia. The study covered the period of 1971-2011. Johansen co-integration test showed a long-term relationship between the CPI and the price of gold. In order to explore the causal relationship in the short-term non-linear TVECM model was adopted. The results indicate that gold can be used to hedge against inflation risk in Malaysia.

Van Hoang et al. (2016) studied gold price-inflation relationship by using local gold prices in India, China, France, Japan, the United Kingdom, and the United States for the period of 1955-2015. The nonlinear ARDL model was used in the study. Results indicate that gold is a hedge against inflation in India, in the UK, and the US in the short run. While in the long run, gold was found to be not a hedge against inflation in all countries.

Beckmann and Czudaj (2013) investigated the ability of gold to hedge against inflation in the economies of the United States, the Euro Area, Japan, and the United Kingdom covering the various periods from December 1969 to December 2011. Results obtained by using the Markov-switching vector error correction model (MS-VECM) show that gold is a partial hedge against inflation in the long-run, more so in the United States and in the UK than in Japan and in the Euro Area.

Dee et al. (2013) analysed the relationship between gold and the consumer price index (CPI) in China. They use daily data for the period from October 31, 2002, to April 6, 2012, and monthly data for the period from December 2002 to December 2012. Binary probit method and quantile regression were employed in the estimations.

The results of the study indicated that gold can be used to hedge against inflation in the long-run, while in the short-run that was not possible.

Shahbaz et al. (2014) assessed the performance of short- and long-term gold as an investment asset in Pakistan by adopting a sample of quarterly data covering the period 1997Q1 to 2011Q4. The study used ARDL bounds testing methodology, and found that gold can be used as a hedge against inflation in both the short-run and the long-run.

Lucey et al. (2016) analysed the co-integration between gold and inflation by using local gold prices in three countries, namely the United States of America, Japan and the United Kingdom. The monthly time series span the period from January 1974 to January 2014. The study adopted a time varying VECM methodology. The results indicated that gold was cointegrated with inflation in certain periods in both the US and the UK. Gold and (CPI) inflation are co-integrated in Japan.

Musah and Ibrahim (2015) examined the relationship between gold prices, inflation, and exchange rates in Ghana. They used annual time series data covering the period of 1990-2012. VECM approach was used in the estimations. The results of the study showed that gold could protect against inflation in the long-run, but not in the short-run.

Ozturk and Acikalin (2008) studied the ability of gold to hedge against inflation in Turkey by using monthly data covering the period from January 1995 to November 2012. Johansen cointegration test results indicate that gold is hedge against inflation.

Worthington and Pahlavani (2007) analysed the long-term relationship between gold price and inflation in the United States for two periods (1945-2006 and 1973-2006) by using monthly gold price data and CPI. The maximum likelihood was used to estimate the long-term relationship between gold and the CPI. The results showed a long-term relationship between gold price and the CPI, implying that gold can be used as a hedge against inflation, especially in the period after 1970.

Le Long et al. (2013) explored the importance of using gold to hedge against inflation in Vietnam by using quarterly data for the period of 2001-2011. The results provided strong evidence of the possibility of gold being able to hedge against inflation**.**

Tufail and Batool (2013) examined the relationship between gold prices and inflation in Pakistan by using annual time series data for the period between 1960 and 2010. They have used Johansen's cointegration test and VECM method in their analysis. The study found a positive and significant relationship between gold prices and inflation.

Hoang (2012) examined the hedging potential of gold against inflation in France by using monthly data for the period 1949 to 2011. To examine the short-term relationship, the Pearson and Spearman correlation coefficients were used adopted. Cointegration tests were used to study the long-term relationship between the variables. The article provided evidence that there was no significant correlation between gold and the CPI in France. This gives a clear indication that gold cannot be used as hedge against inflation in France.

Balcilar et al. (2017) discussed the causal relationship between gold and the CPI in seven industrial countries (G7) by adopting nonparametric causality-in-quintiles test, which allows the possibility of testing the causality in both the mean and the variance. The data spanned the period from December 1979 to August 2016. The results indicate gold is not a hedge when the gold returns are very low or very high, in other times it is.

CHAPTER IV

METHODOLGY AND DATA

We start by defining what we mean a hedge, and then explain our main methodology, which is the ARDL model. After we explain the Toda-Yamamoto (1995) approach to causality testing, we present the details on data used in the study.

4.1 Definition of a Hedge

We use the following econometric relationship between nominal rate of return on an asset, say gold, and the actual inflation rate:

$$Y_t = \alpha + \beta\pi_t + \epsilon_t$$

where Y is nominal rate of return on gold, π_t and ε_t are random errors. A significant value of β that equals 1 is defined as a perfect hedge, a significant value of β less than 1 as an imperfect hedge (Arnold and Auer, 2015).

4.2 Autoregressive Distributed Lag (ARDL) Model

As it is clear from the the literature review presented in the previous chapter gold prices or returns and inflation relationship can be analyzed by using many methods. Some of these are based on the simple regression model, while others are based on more sophisticated time series models, such as VECM, GRACH etc. In our

study we will employ the ARDL methodology developed by Pesaran and Shin (1999) and Pesaran et al. (2001). This model is suitable for variables that have different orders of integration. The only requirement is that no variable should be integrated at a higher order than one, that is, a variable should be at most be I(1). Finally, by using the ARDL methodology we can get information on both the long run and the short run relationship between the variables.

ARDL bounds testing procedure starts with the estimation of an ARDL model by using the Ordinary Least Squares (OLS) method. Since an ARDL model requires the use of lags of the dependent and independent variables, the first step in the estimation process is to decide on how many lags to include. To do this, model selection criteria such as, Akaike Information Criterion (AIC) or Schwarz Criterion (SC) are used. Once the *maximum* number of lags to include is specified, the best model is selected by minimizing AIC or SC or some other criteria.

Let's assume that the best model selected is an ARDL (3,3) model, indicating that three lags of both the dependent and the independent variables are used.

$$Y_t = \alpha + \gamma_1 Y_{t-1} + \gamma_2 Y_{t-2} + \gamma_3 Y_{t-3} + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_3 X_{t-3} + \varepsilon_t \quad (1)$$

where ε_t is the usual white noise residuals.

The long-term relationships between the variables are given by

$$Y_t = \alpha^{LR} + \beta^{LR} X_t + \varepsilon_t \quad (2)$$

where coefficients $\alpha^{LR} = \frac{\alpha}{1-\gamma_1-\gamma_2-\gamma_3}$ and $\beta^{LR} = \frac{\beta_0+\beta_1+\beta_2+\beta_3}{1-\gamma_1-\gamma_2-\gamma_3}$ are the long-term coefficients.

The error correction (EC) representation of the model can be obtained by using first differences in equation 1, and then substituting the long run coefficients in the transformed equation:

$$\Delta Y_t = -\gamma_1^* \Delta Y_{t-1} - \gamma_2^* \Delta Y_{t-2} + \beta_0^* \Delta X_t - \beta_1^* \Delta X_{t-1} - \beta_2^* \Delta X_{t-2} - \delta EC_{t-1} + \varepsilon_t \quad (3)$$

where $\gamma^*_1 = \gamma_2 + \gamma_3$, $\gamma^*_2 = \gamma_3$, $\beta^*_0 = \beta_0$, $\beta^*_1 = \beta_2 + \beta_3$, $\beta^*_2 = \beta_3$, $\delta = 1 - \gamma_1 - \gamma_2 - \gamma_3$. EC_t is the error correction term, and is given by

$$EC_t = Y_t - \alpha^{LR} - \beta^{LR} X_t \quad (4)$$

This term indicates the dynamic relationship in the short term. The coefficient of this term determines the amount of disequilibrium corrected in each period.

Substituting error correction term into equation 3 yields the representation for bounds testing:

$$\Delta Y_t = -\gamma_1^* \Delta Y_{t-1} - \gamma_2^* \Delta Y_{t-2} + \beta_0^* \Delta X_t - \beta_1^* \Delta X_{t-1} - \beta_2^* \Delta X_{t-2} - \delta Y_{t-1} + \alpha' + \eta X_{t-1} + \varepsilon_t \quad (5)$$

Equation 4 can be written in a form that can be used in econometric estimation. For any ARDL(p,q) model, with p and q representing the lags of the dependent and the independent variables, this yields the following estimating equation, which is to be used in bounds testing:

$$\Delta Y_t = a + b_1 Y_{t-1} + b_2 X_{t-1} + \sum_{i=1}^{p-1} c_{1i} \Delta Y_{t-i} + \sum_{i=0}^{q-1} c_{2i} \Delta X_{t-i} + \varepsilon_t \quad (6)$$

The bounds test is performed by using the following null hypothesis:

H_0: $b_1 = b_2 = 0$ (There is no cointegration or a long-term relationship)

The critical values for the F test are provided in Pesaran, Shin and Smith (2001).

4.3 Toda-Yamamoto Approach to Causality

Toda and Yamamoto (1995) approach to causality testing methodology is an alternative method to Granger causality testing. We use the Toda-Yamamoto approach because we have mixed order series. While Granger causality testing requires that the variables be of the same order of integration, the Toda and Yamamoto Granger causality test can be used even when series are not of the same order. The details of the method are explained in a section of Chapter 5 where we present the test results.

4.4 Data

The objective of this study is to investigate the relationship between gold returns and inflation. For this we use monthly data for the period from January 2007 to December 2015. Gold returns are calculated from the gold price data available in the Global Economic Data Monitor (GEM) data base compiled by the World Bank. Gold prices provided in this data base are 99.5% fine, London afternoon fixing, average of daily rates. Gold is priced in US dollars based on the London fixed prices for the ounce. Gold prices are converted to Iraqi dinars by using the official exchange rate available in the GEM data base. Seasonally adjusted Consumer Price Index series is also available in the GEM data set. (The base year for the CPI is 2007.) Annual interest rate (AIR) is commercial banks' one year fixed interest rate on bank deposits (end of period), and come from the Central Bank of Iraq. This is converted to monthly rates by using the following formula: $[(1+AIR)^{1/12} -1)\cdot 100]$.The definitions of variables and data sources are shown in Table 4.1, and descriptive statistics are given in Table 4.2.

Table 4.1. Definitions and Sources of Data

Variable	Notation	Data source	Unit
Gold Price in US dollars	GD	GEM	US dollars per troy oz.
Consumer Price Index[i]	CPISA	GEM	Index (2007=100)
Interest rate[i i]	INTM	CBI	percent
Official exchange rate	EXCHR	GEM	Dinars per US dollars
Gold Price in Iraqi dinars	G	GD*EXCHR	Dinars per troy oz.
Gold returns in Iraqi dinars	RG	Log. change in G	percent
Gold returns in dollars	RGD	Log. change in GD	percent
Inflation rate	INFSA	Log. change in CPISA	percent
Dummy variable (for 2008M04-2008M09)	DUM		

Notes: [i] seasonally adjusted, [i i] converted monthly rates.
GEM: Global Economic Monitor data base available from the World Bank web site.
CBI: the Central Bank of Iraq. Gold price is 99.5% fine, London afternoon fixing, average of daily rates.
Interest rate: Commercial banks' one year fixed interest rate on bank deposits (end of period). (Obtained from the CBI web site.)

Table 4.2. Descriptive Statistics

	RG	INFSA	LNINTM
Mean	0.41	0.41	-0.49
Maximum	11.19	3.08	-0.01
Minimum	-11.84	-1.39	-0.78
Std. Dev.	4.05	0.81	0.24
Observations	107	107	108

Plots of the data series are shown in Figures 4.1 - 4.3. It seems that volatility in gold returns and inflation was somewhat higher in the period of 2008M04-2008M09. To account for the high volatility in gold returns and the inflation rate we include a dummy variable in the regressions, which takes the value of one for these months. Interest rate steadily decrease throughout the period, variations in this variable are somewhat smoothed out due to the use of logarithmic transformation.

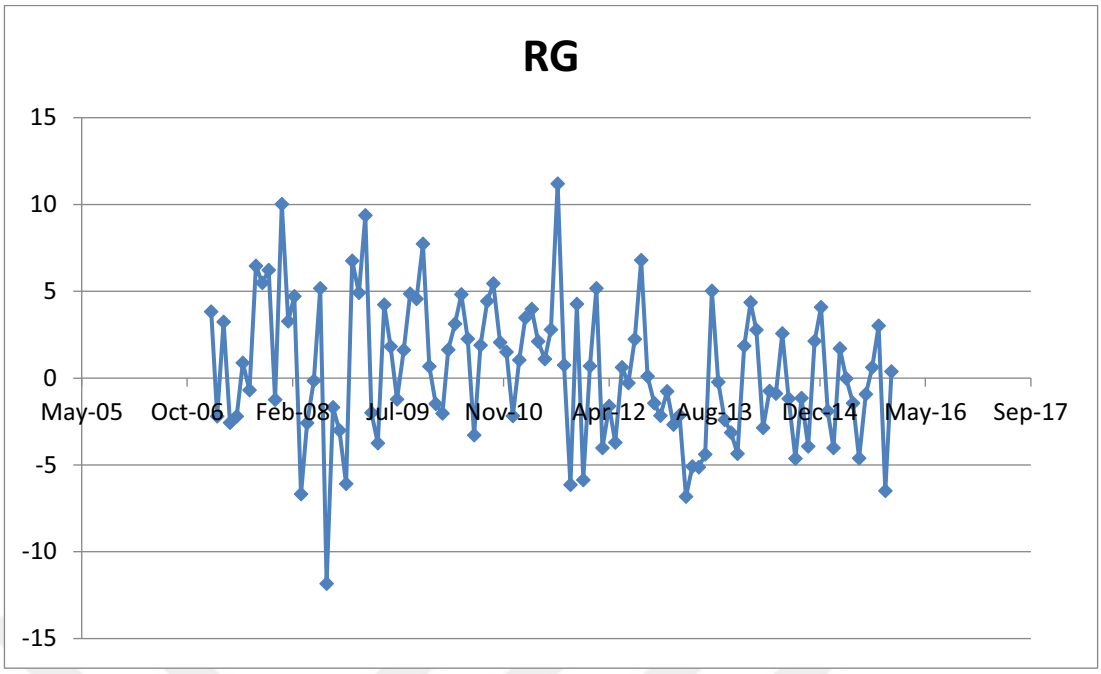


Figure 4.1. Gold returns in dinars (RG) from February 2007 to December 2015.

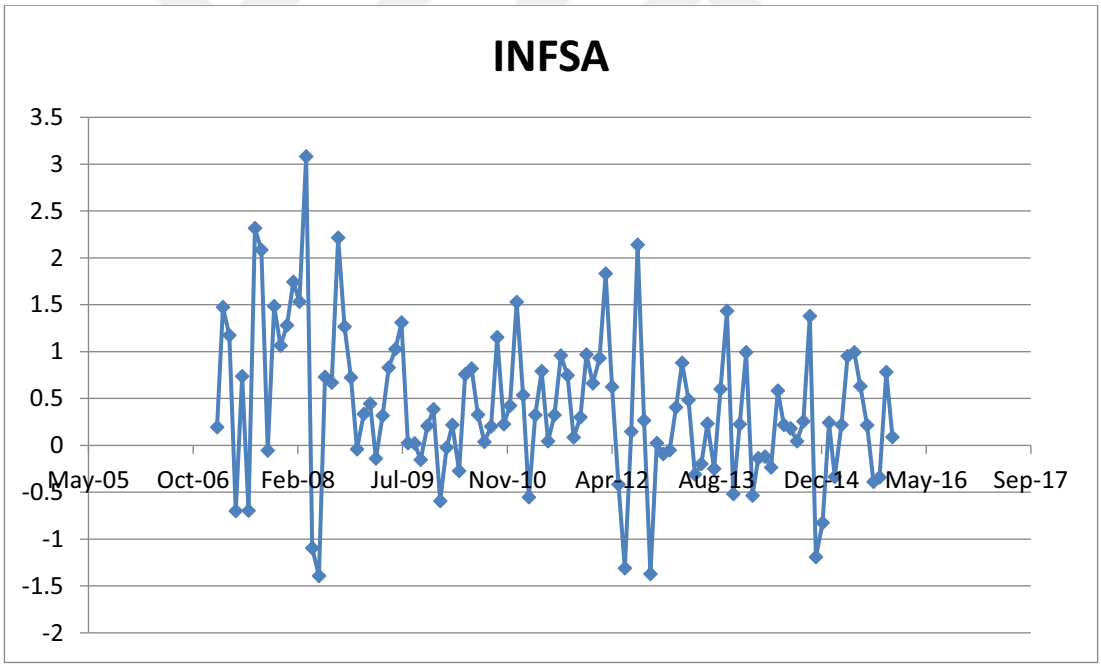
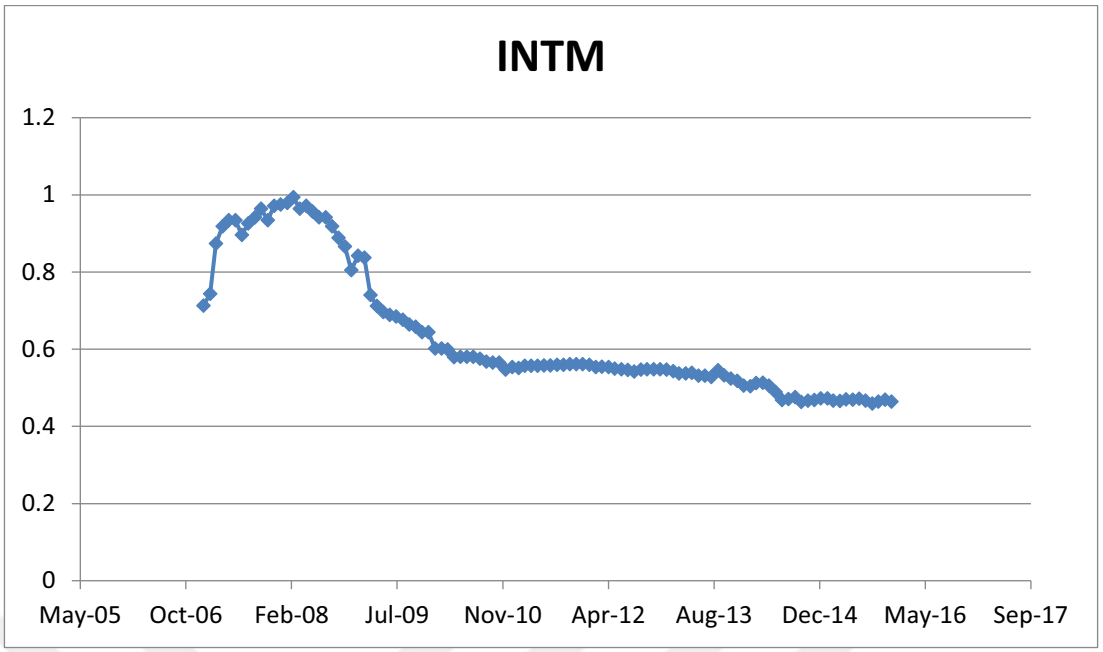


Figure 4.2. The seasonally adjusted inflation rate (INFSA) from February 2007 to December 2015.



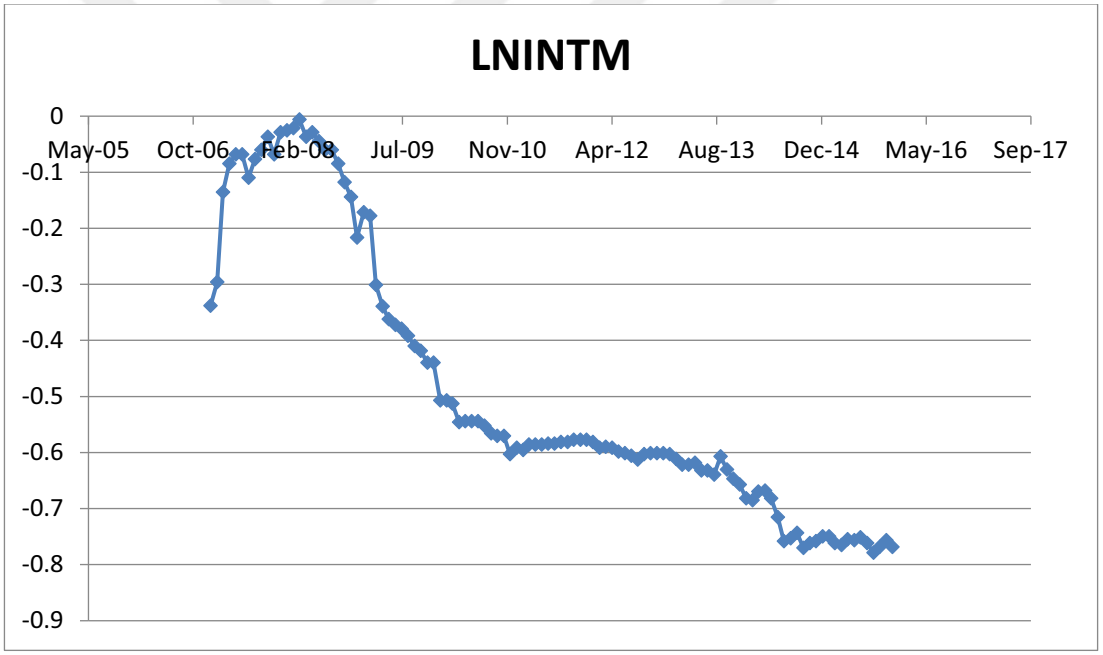


Figure 4.3. Monthly interest rate (INTM) and its logarithmic value (LNINTM) from February 2007 to December 2015.

CHAPTER V

EMPIRICAL RESULTS

5.1 Unit Root Tests

There are many unit root tests that can be used in a study like ours, such as Dickey and Fuller (1979), Phillips and Perron (1988), Kwiatkowski, Phillips, Schmidt, and Shin (1992). In our study, we will employ two methods that are most commonly used for unit root tests, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The null hypothesis assumes that there is a unit root in the time series, in another words it is non-stationary.

These tests are performed by comparing a calculated t-statistic with the critical values at different levels of significance. If the results show that the value of the calculated t-statistic, which is negative, is lower (less negative) than the critical values, this indicates that there is a unit root in this series, which means it is non-stationary at the levels. In this case, we check whether the time series is a stationary in the first differences in the same way. If it is, we say that series is I (1), that is it becomes stationary after first differencing. Table 5.1 displays the results of the unit root tests. The results show that all variables, except for INFSA, are stationary, I (0), while INFSA is non-stationary, I (1).

Table 5.1. ADF and PP Unit Root Tests

Level			First difference		
Variable	Intercept	Trend and intercept		Intercept	Trend and intercept
RG	-2.768569*				Augmented Dickey Fuller (ADF) test
RGD	-2.726662*	-8.9768***		***-5.9272	***-5.8872
INFSA	-2.851964*				
LNINT	-5.083633***	-2.983722		-7.863218***	-7.810674***
			-4.5207***		
RG	-7.607017***				
RGD	-7.549105***				Philips–Perron (PP) test
INFSA	-7.478203***	-8.9321***		*-45.4440**	-45.8022***
LNINT	-4.729183***				

Notes: *Significant at the 10%; **Significant at the 5%; ***Significant at the 1%; and

5.2 Autoregressive Distributive Lag (ARDL) Model

We begin to explore the issue of cointegration between both gold returns and inflation by estimating an ARDL (p,q) model, with *p* and *q* representing the lags of the dependent and the independent variables. The first step in the analysis is to estimate an ARDL model like the one in equation 4.1, with the optimal lags of the dependent and the independent variables determined by minimizing the Schwarz Criterion (SC). To do this $p \cdot (q + 1)^k$ regressions are estimated, where *p* refers to maximum lag and *k* is the number of independent variables. (In this case $p = q = 4$ and $k = 2$). Table 5.2 shows the results of models achieved through estimation of ARDL (1,0,0), selected from $4 \cdot (4 + 1)^2 = 100$ regressions.

Table 5.2. Autoregressive Distributed Lag Estimates

Variable	Coefficient	t-Stat.	prob
RG(-1)	0.093372	0.954757	0.3420
INFSA	-0.429265	-0.865463	0.3888
LNINTM	4.786655	2.586564	0.0111
DUM	-5.391217	-2.884191	0.0048

5.3 Bounds Testing

As mentioned in Chapter 4, bounds test is conducted by way of an F test. For this, equation 4.6 must be estimated or derived as explained in Chapter 4. This process yields an F statistic that is to be compared with the critical values previously calculated by Pesaran, et-al (2001). If the calculated F statistic is higher than the I(1) bound, the null hypothesis that there is no co-integration between the variables is rejected. If the calculated F statistic is less than the I(0) bound, this will lead to acceptance of the null hypothesis, that is, to the conclusion that there is no co-integration. If the calculated F statistic is between the upper limit and the lower limit, no clear conclusion can be reached.

Table 5.3. Bounds Test Results

Dependent variable	F-stat,	I(0) bound	(1) bound	Result
F(RG/INFSA,LNINTM	29.89926	3.79	4.85	Co-integration
F(INFSA/RG,LNINTM)	26.52719	3.79	4.85	Co-integration
F(LNINT/RG,INFSA)	1.029522	3.97	4.85	No-cointegration

Critical values in the table are for the case of unrestricted intercept and restricted trend, based on Case iii in Table CI(iii) in Pesaran, Shin et al. (2001). Since the calculated F statistic is 29.89926 which exceed the upper critical value, the null hypothesis that there is no co-integration between RG and INFSA, and LNINT can be rejected when RG is the dependent variable. Hence there is co-integration among these variables.

5.4 Long-Run Relationship

Long run coefficients are presented in Table 5.4, and they show that the long-run coefficient between the gold returns and the inflation is negative, but not significant. In other words, there is no long long-run relationship between the two variables. The long-run coefficient between the gold returns and the interest rate is positive and significant. The coefficient is 5.28 approximately, which means that when interest rate increases by one percentage point gold returns increase by approximately 0.0528 percentage points. This result indicates that given the inflation rate an investor would be better off buying gold rather than putting his or her money into a bank account.

Table 5.4. Long-run Coefficients

Variables	Coefficient	T-stat.	Prob.
INFSA	-0.473475	-0.852747	0.3958
LNINTM	5.279622	2.641809	0.0096

Note: ARDL (1, 0, 0) based on Schwarz Criterion

5.5 Short Run Relationship

In order to analyze the dynamic relationship in the short run, we adopt the error correction model (ECM), which is equation 3 in Chapter 4. ECM is obtained by using the long-run coefficients obtained in the previous step. By looking at the results in Table 5.5 we see that error correction term (CointEq(-1)) is negative and significant. To explain this result, it is possible to say that about 90.66 percent of errors (any deviations from equilibrium) are corrected for within a month.

Table 5.5. Error Correction Representation

Variables	Coefficient	T-stat.	Prob.
C	3.158218	6.261196	0.0000
DUM	-5.391217	-3.218367	0.0017
CointEq (–1)	-0.906628	-9.564202	0.0000

5.6 Diagnostic Tests

To ensure the fitness of the model that was adopted as well as to see whether it is stable, we carry out some diagnostic and stability tests. These are Breusch-Pagan-Godfrey Heteroskedasticity Test, Breusch-Godfrey Serial Correlation LM Test, Ramsey RESET. To check the stability we use CUSUM and CUSUMSQ tests (Brown, Durbin, and Evans, 1975). The diagnostic test results shown in Table 5.6 do not indicate any problems with the model.

Table 5.6. Diagnostic Test Results

Test	Type	Test stat.	Prob.	df
A:Heteroscedasticity	$\chi 2$	7.827511	0.0981	4
B:Serial correlation LM test	$\chi 2$	0.399756	0.8188	2
C:Normality	$\chi 2$	0.3268	0.849	2
D:Ramsey test	F	0.016906	0.8968	(1, 100)

In order to verify the structural stability of the model adopted in our study, we conduct two of the most important tests CUSUM, which is based on the cumulative sum of the recursive residuals If this sum goes beyond a critical limit, it is a clear indication of instability. The CUSUM of squares (CUSUMSQ) test is based on the same principle, but uses the squares of recursive residuals. CUSUM and CUSUM of squares are plotted in Figures 5.1 and 5.2 together with the 5 percent critical lines. These results indicate that model parameters are stable since neither series go outside the area between the critical lines.

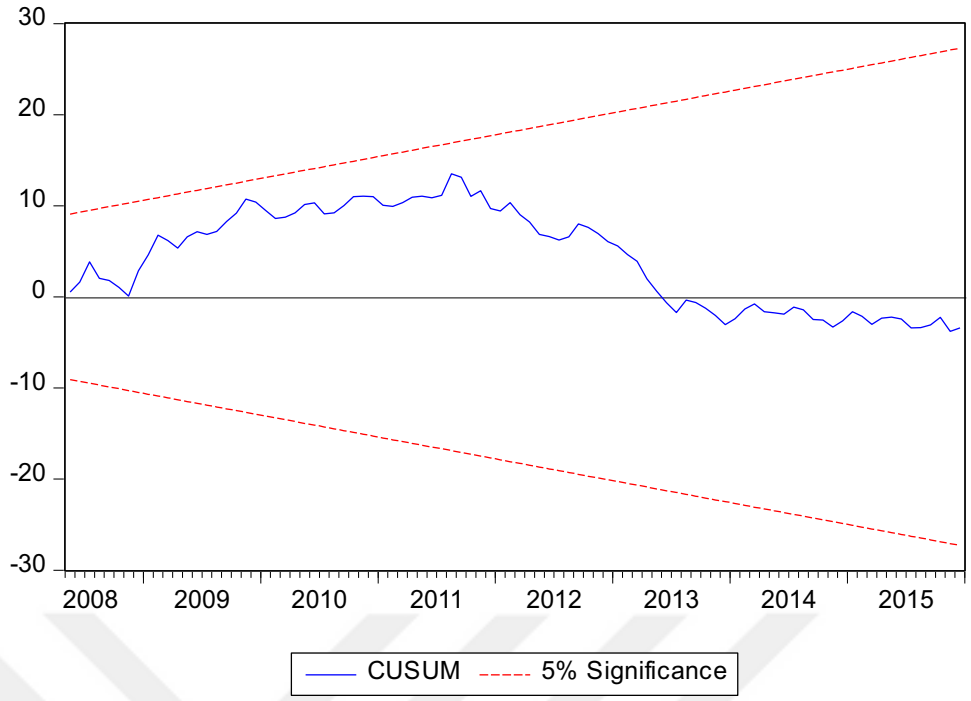


Figure 5.1. Plot of the CUSUM Stability Test

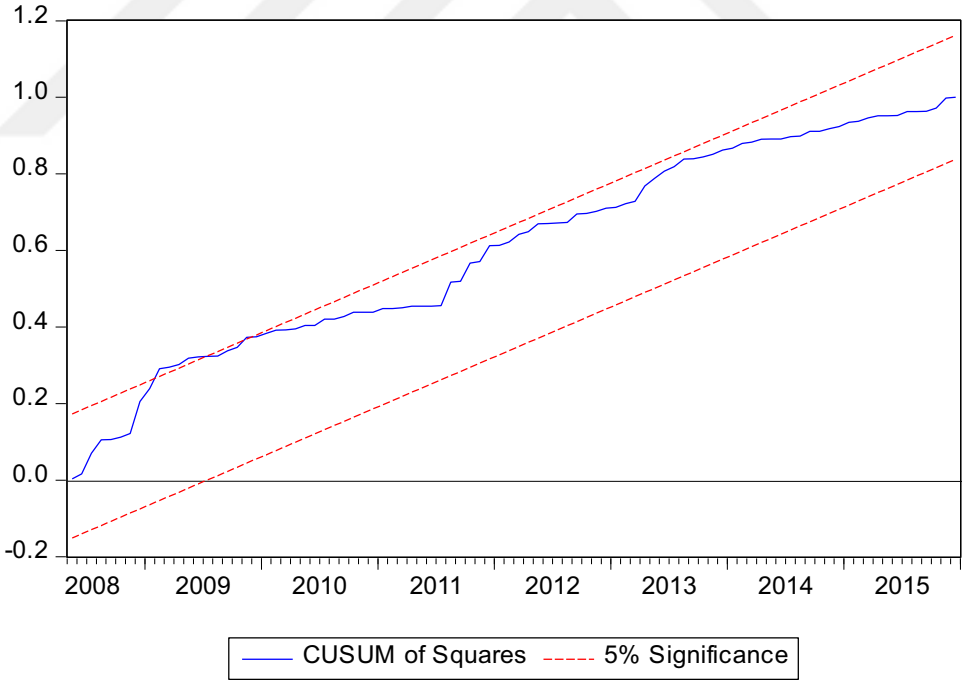


Figure 5.2. Plot of the CUSUMSQ Stability Test

5.7 The Toda and Yamamoto Causality Analysis

Toda and Yamamoto (1995) approach requires determining the maximum order of integration (d_{max}) among the series. Since the highest order of integration is one in this study d_{max}=1.

We implement the Toda and Yamamoto approach to causality by going through the following steps:

1- The lag selection: The SC criterion is used as to select the lag length (k) of the model.

2- Once the optimal lag length is determined as per step1, we check for unit roots, autocorrelation, etc. In case there are any such problems, lag length must be increased until the problem is solved.

3- The correct model specified in the previous step is run with an extra lag for all the variables in the model. The lag length is determined by maximum order of integration in the model (d_{max}). Since d_{max}=1, we estimate (k + d_{max})th order VAR. In Eviews10, this can be done by adding an extra lag on all the variables in the *exogenous* variables box.

4- In the final step, the Granger causality test is done by using the VAR Granger causality/Block Exogeneity Wald Test, with the null hypothesis that X does NOT cause Y.

Test results are reported in Table 5.7. Since the chi-square value for RG (LNINTM) is significant when the dependent variable is LNINTM (RG) we can say that there is a two-way causality between these two variables. There is also and one-way causality from LNINTM to INFSA.

Table 5.7. Toda-Yamamoto Results

Excluded	Chi-square	d.f.	Prob.
Dependent variable: RG			
INFSA	1.039267	3	0.7918
LNINTM	10.42657	3	0.0153
All	12.01254	6	0.0617
Dependent variable: INFSA			
RG	2.923835	3	0.4035
LNINTM	9.697199	3	0.0213
All	14.07292	6	0.0288
Dependent variable: LNINTM			
RG	7.561447	3	0.0560
INFSA	1.534854	3	0.6742
All	8.198916	6	0.2239

5.8 Robustness Checks

There are several robustness checks we have done. First, we repeat the calculations whose results given above (Model 1) with maximum lag lengths eight and ten. Results do not change.

Second, we estimate Model 1 without the interest rate to see how our main results would change (we refer to this model as Model 2). We report the bounds test results, the long-run coefficients, error correction representation for the selected model, and causality test results in Appendix B.

The results for this model are quite sımilar to the ones obtained from model 1 for RG and INFSA. There is no long run relationship between gold returns and inflation, short run adjustment coefficient (-0.852579) is six percentage points higher the one obtained for Model 1. As for Toda-Yamamoto test, the test results from model 2 indicate that there is only one-way causality from INFSA to RG.

CHAPTER VI

CONCLUSIONS

This study examines the relationship between gold returns and the inflation in Iraq by using monthly data for the period from January 2007 to December 2015, which also includes the period of the Global Economic Crisis.

We use ARDL bounds testing methodology to check for cointegration, and Toda-Yamomoto (1995) approach to causality to test for Granger causality. Our main model includes the monthly interest rate on deposits (calculated from annual interest rates offered each month by the banking system). For robustness we also estimate a model without the interest rate.

The results indicate that there is only a short run relationship between gold returns and inflation. Toda-Yamamoto causality test results show that there is a two-way Granger causality between gold returns and inflation.

This result indicates that given the inflation rate an investor would be better off buying gold rather than putting his or her money into a bank account. This might be a reflection of the some concerns on the part of the investor about the reliability of the banking system, or uneasiness about the policies of the Central Bank, or the general prospects of the Iraqi economy.

Another interesting result of the study is the finding that gold returns and the deposit interest rate are positively related. This result indicates that given the inflation rate investors would be better off buying gold rather than putting their

money into a bank account. This might be a reflection of some concerns on the part of the investors about the reliability of the banking system, or uneasiness about the policies of the Central Bank, or the general prospects of the Iraqi economy.

We expect the results of the analysis shown in the paper to be of particular interest to investors in the Iraqi market, and also for emerging markets with similar conditions to those of the Iraqi market. In these markets volatility in inflation might be high in the short run, and the need for hedging against short term inflation risks might arise. Hence, diversification of asset portfolios by adding gold as an investment asset to reduce the risks resulting from volatility in the returns of those portfolios as well as an optimal hedge against inflation.

In the direction of future research, researchers can address the shortcomings we encountered in this research. Using data for longer periods, the adoption of new methodologies for econometrics, and expanding this study to include other emerging markets are some avenues that can be considered in future research.

The study recommends the importance of expanding the Iraqi financial market through the establishment of a special market for gold as part of the Baghdad Stock Exchange. The paper also recommends that the central bank adopt a flexible inflation targeting policy not only by controlling the amount of interest rate exposure, but by adding other assets such as gold as an effective means against inflation in the short term.

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APPENDIX

APPENDIX A

RESULTS FOR MODEL 2 (RG/INFSA)

Dependent Variable: RG
Method: ARDL
Date: 04/06/18 Time: 14:14
Sample (adjusted): 2007M03 2015M12
Included observations: 106 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Schwarz criterion (SIC)
Dynamic regressors (4 lags, automatic): INFSA
Fixed regressors: DUM1 C
Number of models evalulated: 20
Selected Model: ARDL(1, 0)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RG(-1)	0.147421	0.098166	1.501746	0.1363
INFSA	-0.084393	0.490883	-0.171921	0.8638
DUM1	-3.151938	1.702244	-1.851637	0.0670
C	0.527624	0.441702	1.194523	0.2350

R-squared	0.061895	Mean dependent var	0.374558
Adjusted R-squared	0.034304	S.D. dependent var	4.054158
S.E. of regression	3.984014	Akaike info criterion	5.639462
Sum squared resid	1618.982	Schwarz criterion	5.739969
Log likelihood	-294.8915	Hannan-Quinn criter.	5.680198
F-statistic	2.243287	Durbin-Watson stat	1.980757
Prob(F-statistic)	0.087758		

*Note: p-values and any subsequent tests do not account for model selection.

LONG-RUN COEFFICIENTS AND BOUNDS TEST

ARDL Long Run Form and Bounds Test
Dependent Variable: D(RG)
Selected Model: ARDL(1, 0)
Case 3: Unrestricted Constant and No Trend
Date: 04/06/18 Time: 14:16
Sample: 2007M01 2015M12
Included observations: 106

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.527624	0.441702	1.194523	0.2350
RG(-1)*	-0.852579	0.098166	-8.685041	0.0000
INFSA**	-0.084393	0.490883	-0.171921	0.8638
DUM1	-3.151938	1.702244	-1.851637	0.0670

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFSA	-0.098985	0.577951	-0.171270	0.8644

EC = RG - (-0.0990*INFSA)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	39.31069	10%	4.04	4.78
k	1	5%	4.94	5.73
		2.5%	5.77	6.68
		1%	6.84	7.84
Actual Sample Size	106	Finite Sample: n=80		
		10%	4.135	4.895
		5%	5.06	5.93
		1%	7.095	8.26

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-8.685041	10%	-2.57	-2.91
		5%	-2.86	-3.22
		2.5%	-3.13	-3.5
		1%	-3.43	-3.82

ECM

ARDL Error Correction Regression
Dependent Variable: D(RG)
Selected Model: ARDL(1, 0)
Case 3: Unrestricted Constant and No Trend
Date: 04/06/18 Time: 14:16
Sample: 2007M01 2015M12
Included observations: 106

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.527624	0.400385	1.317791	0.1905
DUM1	-3.151938	1.682306	-1.873582	0.0639
CointEq(-1)*	-0.852579	0.095685	-8.910229	0.0000

R-squared	0.436618	Mean dependent var	-0.032523
Adjusted R-squared	0.425679	S.D. dependent var	5.231483
S.E. of regression	3.964627	Akaike info criterion	5.620594
Sum squared resid	1618.982	Schwarz criterion	5.695975
Log likelihood	-294.8915	Hannan-Quinn criter.	5.651146
F-statistic	39.91223	Durbin-Watson stat	1.980757
Prob(F-statistic)	0.000000		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	39.31069	10%	4.04	4.78
k	1	5%	4.94	5.73
		2.5%	5.77	6.68
		1%	6.84	7.84

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-8.910229	10%	-2.57	-2.91
		5%	-2.86	-3.22
		2.5%	-3.13	-3.5
		1%	-3.43	-3.82

HETEROSKEDASTICITY TEST

Heteroskedasticity Test: Breusch-Pagan-Godfrey

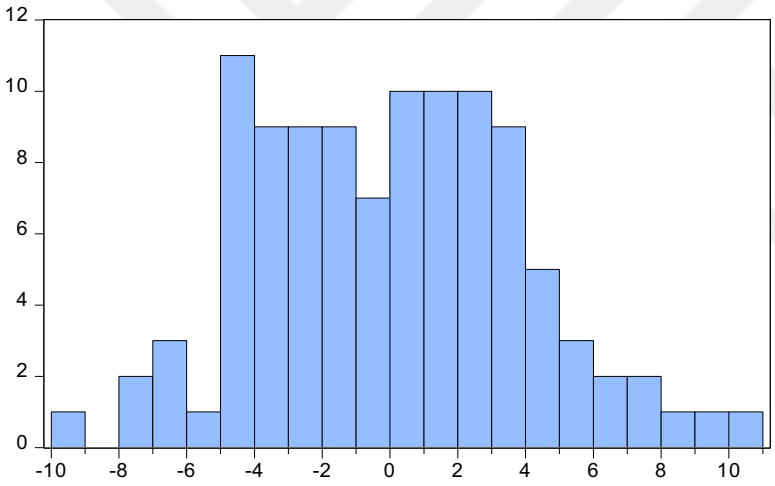
F-statistic	2.742342	Prob. F(3,102)	0.0470
Obs*R-squared	7.911533	Prob. Chi-Square(3)	0.0479
Scaled explained SS	6.557850	Prob. Chi-Square(3)	0.0874

SERIAL CORRELATION TEST

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.118817	Prob. F(2,100)	0.8881
Obs*R-squared	0.251295	Prob. Chi-Square(2)	0.8819

NORMALITY TEST



Series: Residuals
Sample 2007M03 2015M12
Observations 106

Mean	-7.06e-16
Median	0.226451
Maximum	10.33330
Minimum	-9.924421
Std. Dev.	3.926687
Skewness	0.184036
Kurtosis	2.790367
Jarque-Bera	0.792450
Probability	0.672855

TODA-YAMAMOTO CAUSALITY TEST RESULTS

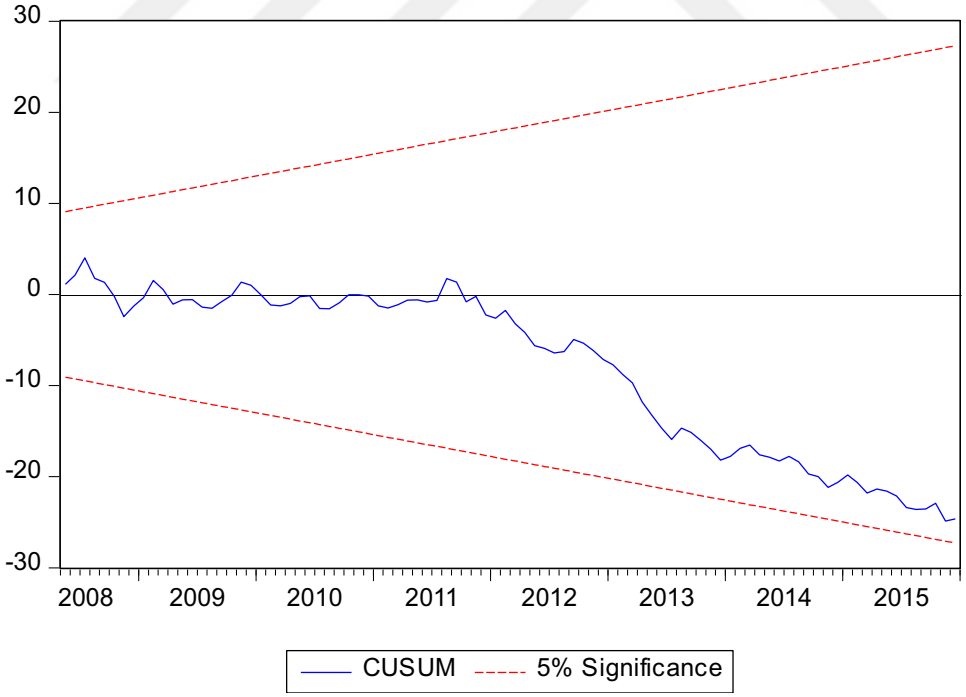
VAR Granger Causality/Block Exogeneity Wald Tests
Date: 04/06/18 Time: 14:44
Sample: 2007M01 2015M12
Included observations: 103

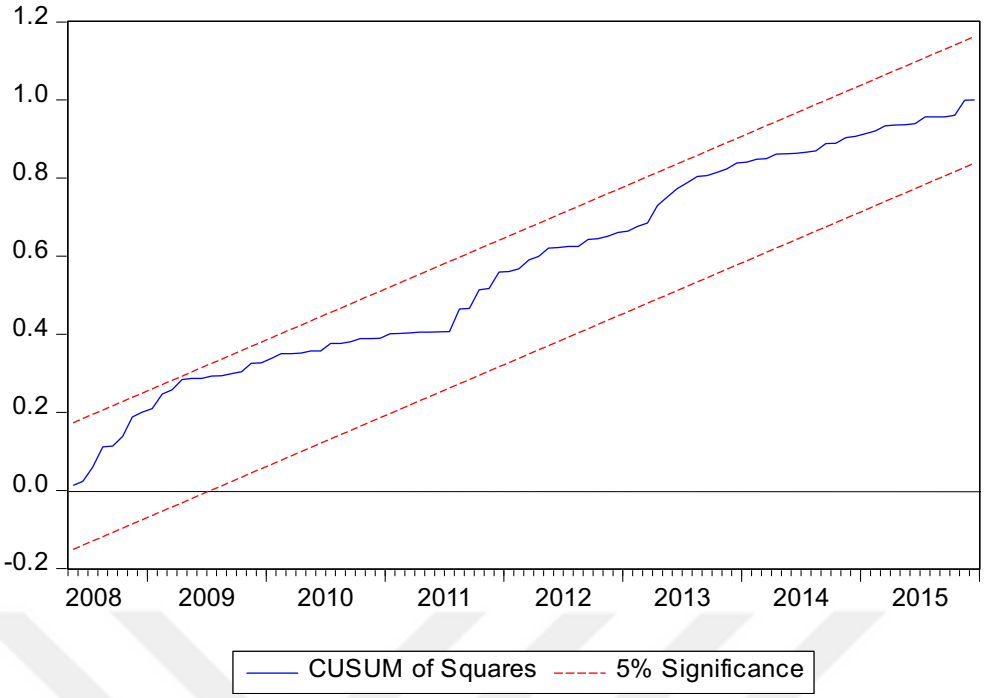
Dependent variable: RG

Excluded	Chi-sq	df	Prob.
INFSA	2.152524	3	0.5414
All	2.152524	3	0.5414

Dependent variable: INFSA

Excluded	Chi-sq	df	Prob.
RG	6.632732	3	0.0846
All	6.632732	3	0.0846




1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
2008
2009
2010
2011
2012
2013
2014
2015
CUSUM of Squares
5% Significance

APPENDIX B

Table B1. Summary of relevant studies

Authors	Variables	Period	Frequency	Method	Conclusion
Balcilar et al. (2017)	CPI	1979 -2016	Monthly	Nonparametric causality in quintiles	Gold is not a hedge when the gold returns are very low or very high, in other times it is.
Georgios Bampinas (2015)	CPI	1791-2010	Mnnual	TI-VECM methodology	The results showed a hedging capability for gold in the e-long-term more so in the USA than in the UK
Batten, Ciner et al. (2014)	CPI	1985-2012	Monthly	Johansen, ARDL, and Saikkonnen–Lutkepohl	No cointegration between gold and inflation.
Beckmann and Czudaj (2013)	CPI,PPI	1969-2011	Monthly	Markov switching VECM	Gold is a partial hedge against inflation in the long-run, more so in the United States and in the UK than in Japan and in the Euro Area
Blose (2010)	CPI	1988-2008	Monthly	Non-linear OLS	Gold is not a hedge against inflation in the USA.
Chua and Woodward (1982	CPI	1975-1980	Monthly	OLS	Gold is a hedge against inflation only in the USA.
Dee, Li et al. (2013)	CPI	2002-2012	Daily, monthly	Binary probit method and quantile regression	Gold can be used to hedge against inflation in the long-run, while in the short-run that is not possible.
Hoang (2012)	CPI	1949-2011	Monthly	Cointegration tests	Gold is not a hedge against inflation in France
Iqbal (2017)	CPI	1990-2013	Daily, monthly	EGARCH, Quantile regression	The EGARCH model results show that gold is a hedge against inflation only in the US. Results from quantile regressions show that gold is a hedge against inflation in the United States; the same is true for India only in the quantiles of 10% and 25% gold distribution. For Pakistan, there was no evidence of gold's role as a hedge against inflation.
Khair-Afham, Law et al. (2017)	CPI	1971-2011	Monthly	Johansen co-integration test, Nonlinear TVECM	Gold can be used to hedge against inflation risk in Malaysia.

Le Long, De Ceuster et al. (2013	CPI	2001-2011	Quarterly	OLS	Gold is a hedge against inflation in Vietnam.
Lucey, Sharma et al. (2016)	CPI and PPI	1974-2014	Monthly	Time varying VECM	The results indicate that gold is cointegrated with inflation in certain periods in both the US and the UK. Gold and (CPI) inflation are co integrated in Japan.
Musah and Ibrahim (2015)	CPI	1990-2012	Annual	VECM	Gold can be a hedge against inflation in the long-run, but not in the short-run.
Ozturk and Acikalin (2008)	CPI	1995-2006	Monthly	Johansen cointegration test, VECM	Johansen cointegration test results indicate that gold is hedge against inflation.
Shahbaz, Tahir et al. (2014)	CPI	1997-2011	Quarterly	ARDL bounds testing methodology	Gold can be used as a hedge against inflation in both the short-run and the long-run in Pakistan.
Tufail and Batool (2013)	CPI	1960 -2010	Annual	Johansen cointegration test, VECM	The study finds a positive and significant relationship between gold prices and inflation.
Van Hoang, Lahiani et al. (2016)	CPI	1955-2015	Monthly	Nonlinear ARDL.	Results indicate that gold is a hedge against inflation in India, in the UK, and the US in the short run. While in the long run, gold is found to be not a hedge against inflation in all countries.
Wang, Lee et al. (2011)	CPI	1971-2010	Monthly	TC-TVECM, TVECM	The study shows that the ability of gold to hedge against inflation depended on the strength of the price momentum of gold. In the case of high momentum, gold provides a hedge against inflation in the US while showing partial effectiveness against inflation in Japan. The rigidity of the gold price in Japan is a major obstacle to gold against inflation in the long-run.
Worthington and Pahlavani (2007	CPI	1945-2006 and 1973-2006	Monthly	Maximum likelihood	Gold can be used as a hedge against inflation, especially in the period after 1970.

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