International Journal of Finance and Managerial Accounting, Vol.11, No.41, Spring 2026 IJFMA

Examining the Economic Predictive Power of the Sukuk Yield spread: Evidence from the Iranian Financial Market

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Submit: 26/11/2023 Accept: 03/03/2024

ABSTRACT

The yield spread is a tool for predicting economic growth or recession that has garnered considerable attention in both developed and developing countries. The yield spread refers to the difference between the yields of long-term and short-term securities.This research aims to explain the Power of sukuk yield spread to predict Iran's GDP growth. For this purpose, data from 90 trading days of both corporate and government sukuk in the Iran Fara Bourse from the year 2015 (1394 Hijri) to the first half of 2022 (1401 Hijri) were examined and researched. The GDP growth data compared to the same season in the previous year, termed Quarterly growth rate, was compared with various yield spreads of long-term and short-term Sukuk. The yield spread of 4-year and 6-month sukuk (4y-6m) was selected as the appropriate spread to predict real GDP growth.The equation for predicting economic activities for the next 3 quarters based on the 4y-6m spread of the current quarter was designed using a linear regression model and optimized by the ordinary least squares (OLS) method. The results showed that the yield spread of sukuk (4y-6m) with the coefficient of determination (R2=0.10) and the correlation coefficient r=0.317 can predict the next 3 quarters of Iran's GDP.

Keywords: sukuk , Economic Predictive, Yield Spread, Fixed Income securities.

1. Introduction

In today's, sukuk is known as an alternative to conventional bonds, but with a different structure, in the Islamic and even international financial markets.It has been more than a decade that debt instruments in the form of Islamic financial bonds, including types of sukuk and Islamic treasury bills, have entered the financial market of Iran. One of the important goals and functions of debt instruments is providing capital for the public and corporate sectors and implementing monetary and banking policies. With the entry of sukuk and Islamic treasury bills into the securities market, other roles are also defined for them. One of the most important of them is the development of the capital market, the design of new indices and the economic analysis of the indices.The yield curve is considered to be one of the most important indicators and the basis for decision-making in the capital markets of most countries. The macroeconomic factors of the countries are under the effects of the behavioral characteristics of the customers of the same country. It means that the yield curve of each country is fitted and drawn with the economic data and characteristics of fixed income bonds of the same country.

By equating and using the definitions of yield curve of conventional bonds, the yield curve of sukuk bonds is the geometric location of points that show the yield of sukuk in different maturities at a point in time (day). The yield curve and its slope is a very important indicator that shows the preferences and behavior of capital market participants. The slope of the yield curve, which is defined by the yield spread, is the difference between the yields of bonds with long-term and short-term maturities.

Since the 1980s, economic crises have become more frequent and profound. Researchers and stakeholders have endeavored to understand, model, and even predict recessions differently. One of the common predictive tools pursued by economists is the analysis of the yield curve slope or term spread, which is the difference between long-term and short-term interest rates. In this regard, forecasting and preventing economic recessions have become of utmost importance to policymakers, stakeholders, and researchers (Pedro Cadahía Delgado and colleagues, 2022).

Many evidences and studies have been conducted by scientists and researchers on the subject of the relationship between the slope of the yield curve and the yield spread with future GDP activity. The first studies on the predictive power of the yield curve date back to the 1980s, and the pioneers of this research can be mentioned by Estrella and S. Mishkin (1998), then Arturo Estrella and Anthony P. Rodrigue in (2003).In addition, many researchers including Giacomini, R. and B. Rossi(2006), Wright (2006), Kauppi and Saikkon (2008), Chinn, M. and K. Kucko(2010). Rudebusch and Williams (2012), Jana Hvozdenska((2015), Yash Jain and Vani Bhasin(2022) focused their studies on the relationship between economic boom or recession with the concepts of spread and yield curve in the United States of America and other developed countries. But so far, no research has been done on the issue of the existence of a relationship between the real GDP and the yield spread of fixed income bonds in Iran. In this research, we try to use scientific and experimental research to introduce a suitable spread for predicting Iran's economic activities and present a model for this relationship.

In this paper first we examine the previous studies regarding the use of the yield spread as a future economic indicator. Then the theoretical framework of the yield curve is explained and the important topics of this research, such as sukuk, yield curve, yield spread and economic growth rate are explained.In the research methodology section, research model, including econometric methodologies , simple linear regression, least squares optimization method, evaluation techniques, and research data measurement standards, will be introduced.Among the different combinations of sukuk yield spreads with long-term maturities of 2, 3, and 4 years and short-term maturities of 3, 6 months, and one year in the financial market of Iran, the appropriate spread is selected for predicting economic activities.The parameters of the regression equation of the quarterly growth rate of the Iranian economy as a dependent variable in the current quarter and the next 4 quarters and the selected spread in the current season as an independent variable using correlation coefficient, coefficient of determination R2, mean square of the forecast error, absolute value of the average forecast error It is evaluated. In the final part, the estimated coefficients and the regression equation are tested The results of the research and its limitations are stated and practical suggestions are presented.

2. Literature and research background

Estrella and Mishkin wrote a research paper in 1998 on predicting recessions. They used financial variables such as stock prices, interest rates, and spreads as leading indicators. Later, Rodriguez and Estrella conducted an empirical study in 2003 on predicting recessions using the yield curve as an indicator. Again, Kaiopi and Saikounen wrote a research paper in 2008 and chose the interest rate spread as a stimulant index. Once more, in 2012, Rodbush and Williams' research focused on using the yield curve spread as an index, and how the overall model's accuracy could be improved using the yield spread instead of the interest rate spread, which was given much greater significance. Finally, Wright (2006) demonstrated that using both the level of the Federal Reserve funds rate and the term spread predicts U.S. recessions and growth better than models based solely on the term spread. It can be concluded that the predictive performance is limited to model specifications and limited use of related data (Yash Jain and Vini Bahassin, 2022).

In the research carried out by Pedro Cadahia Delgado and etc,(2022), the spread in the 10-year and 3-month yields was identified as the best predictor of a recession in the United States. They categorized yields with maturities of 3 months, 6 months, and 1 year as short-term maturities and the rest as long-term. They found that the 3-month and 6-month spread was the most suitable method for identifying recessions. Therefore, monitoring this spread can be a useful tool for identifying a recession and a reliable indicator of market expectations.

Before each of the past seven U.S. recessions, an inversion of the yield curve, also known as a negative yield curve, occurred. However, not all inverted yield curves lead to recessions. The Federal Reserve found that the near-term spread based on Treasury bills with maturities of less than two years has a "significant predictive power" for recessions, Gross Domestic Product (GDP) growth, and the 12-month future stock market return. Jerome Powell, the chairman of the Federal Reserve, recently stated that the first 18 months of the yield curve has the highest predictive power for economic forecasts. An inversion in that initial part of the yield curve indicates expectations of a reduction in the Federal Reserve's interest rates, and sales usually occur when the economy is weak. (Benjamin Curry, Wayne Duggan, 2022).

A growing literature, including Bernard and Gerlach [1998], Chinn and Kucko [2015],Bordo and Haubrich [2022] and Hasse and Lajaunie [2022], examine whether yield curve predictpower holds across countries. However, these studies restrict themselves to testing.within-country predictability, or the predictive content of the domestic yield curve on domestic economic activity. Bernard and Gerlach [1998] and Mehl [2009] test whether U.S. and European term spreads predict recessions in other countries and find that they do. Christiansen [2013] finds that U.S. and German term spreads predict simultaneously occurring recessions across countries.Rashad Ahmed, Menzie D. Chinn(2022).

3- Theoretical foundations and basic concepts

3-1- Theoretical foundations

There are different theories that try to respond to how the term structure of interest rates is formed and what are the variables on which it depends. Below there is an explanation of four theories based on the information given in Mascareñas (2013).

1) The first one is the Theory of Market Expectations, according to which the yield curve is completely based on what the market expects of future interest rates..According to this theory investors don't have identical expectations but homogeneous ones and, thus, they can certainly predict interest rates. Based on this theory, the yield to maturity of an n-year bond is equal to the average of the yields to maturity of one-year bonds over the next n years. This means that buying a two-year government bond will give the same yield as buying a one-year government bond and reinvest the amount obtained in another one-year government bond.
2) The second theory is the Liquidity Preference Theory, set out by Keynes, that arises because the theory of market expectations does not take into account the risk related to the investment in fixed-income assets. This theory suggests that an investor will demand a higher interest rate when the maturity is longer because they are riskier. If higher interest rates are not paid for assuming more risk, there will not be any incentive to buy these assets as individuals

prefer liquidity or highly liquid assets. For this reason, investors prefer to invest in short-term bonds because they have less sensitivity to variations in the interest rate and have more flexibility when compared to longterm bonds. Thus, the liquidity preference theory explains why the yield curve has a positive slope; the longer the maturity, the higher the risk premium required and therefore the higher the interest rate.

3) The Theory of Market Segmentation is another idea that was presented by Culbertson in order to explain how term structure of interest rates is formed. According to this, there is a segmentation in the market of different instruments, namely, certain instruments are traded in each market and only certain agents have access to them. As this theory assumes that the most important aim for enterprises is to guarantee their survival, they might reduce risk. In order to do it, enterprises perfectly adjust the maturity of their assets with their debt. For instance, we can divide the term structure of interest rates in two segments: short and long-term. Thus, for each segment there will be different buyers and sellers. A commercial bank will invest in short-term bonds because its deposits are short-term products whereas a pension fund will invest in long-term bonds as it has committed to return the money in the long-term.
4) The Preferred Habitat Theory set out by Franco Modigliani and Richard Sutch is based on the idea that investors who match the life of their assets to the life of their debts bear the least possible risk. As investors are risk averse, the match between assets and debts is their preferred habitat. Thus, there will be premiums for maturities where there is insufficient demand as they incentivize investors to move from their preferred habitat. According to this theory, the shape of the term structure of interest rates is determined by expected interest rates and risk premiums because they force agents to leave their preferred habitats.(Sonia Tur Fernández, 2023) .

3-2- Sukuk

"Sukuk" is the plural form of the word "Sekk," which means a document or promissory note. It's an Arabized version of the word "check" in Persian. The Arabs expanded the use of this term to refer to various types of financial instruments, obligations, and financial documents. Sukuk is a financial tool introduced in Islamic countries as an alternative to conventional bonds. In essence, Sukuk are Islamic securities that involve a specific physical asset and are issued in line with Islamic contracts such as Mudarabah, Murabaha, Ijarah, and others. These securities comply with the non-interest-based banking law. Issuing Sukuk is essentially a structure for converting assets into securities. In the asset securitization process, a company or institution in need of financing establishes a special purpose vehicle (SPV) and sells its cash flow-generating assets to this SPV. The SPV, to gather the necessary funds for buying these assets, issues debt securities backed by these assets and offers them to the general investor public. The SPV then pays the originator from the proceeds of the securities sales. Investors who purchase these securities earn returns from the cash flows generated by the SPV's financial assets (Shariat Panahi et al., 2019).

According to the Accounting and Auditing Organization for Islamic Financial Institution (AAOIFI) sukuk are defined as “certificates of equal value representing undivided shares in ownership of tangible asset, usufructs and services, assets of particular projects of special investment activity”. On another side, sukuk (Shariah compliant bonds) are typically considered as Islamic asset-based rather than asset-backed securities, and consequently must be related to a particular asset, service or project for a set of time (Godlewski et al., 2011). Sukuk is one of the fastest growing sectors of the Islamic finance industry and the flagship instrument of the Islamic capital market. Since the 2008 financial crisis, having already played an influential role in propelling sukuk to prominence prompting investors to view it as a viable financing route, the global sukuk market has grown considerably (Jamel Boukhatem,2022)

After the Islamic Revolution in 1979 and the closure of the stock exchange and the jurisprudential discussions related to bond papers, the debt market in Iran remained stagnant for about two decades. For the first time after the Islamic Revolution, the use of participation papers was approved in Note 85 of the

Second Development Plan on December 11, 1994. Ultimately, the law related to the issuance and offering of participation papers titled "Law on the Method of Issuance of Participation Papers" was approved by the Islamic Consultative Assembly on September 21, 1997. After the approval of the Securities Market Law of the Islamic Republic of Iran in 2005, to address non-Shari'a obstacles and the usurious nature of conventional bonds and treasury bills, the jurisprudential committee of the Securities and Exchange Organization was formed. They introduced various Sukuk as Islamic securities to replace conventional bonds and Islamic treasury bills based on debt trading instead of conventional treasury bills. Following the approval of the "Development of New Financial Instruments and Institutions" law in late 2010, Sukuk, in the form of contracts such as leasing, cost-plus sale, mortgage, profit-sharing, debt purchasing, and construction order, were introduced to the Iranian capital market.

The latest classifications and definitions provided in the executive regulations approved on June 7, 2023, by the Council of Ministers in Iran regarding Islamic financial instruments and their components are as follows:

Islamic Financial Papers: Islamic securities with names like participation papers, various Islamic Sukuk (including lease, agency, general cost-plus sale, and profit-sharing), and Islamic treasury bills that are issued within the framework of Islamic contracts and by relevant laws and regulations at a specific nominal price for a specified period in either the national currency or foreign currencies. These papers are subject to zero percent taxation.

Participation Papers: Islamic financial papers governed by the "Method of Issuance of Participation Papers" law - approved in 1997 - and its executive bylaw approved under resolution number 132865/56484 dated October 8, 2019, or the Securities Market Law of the Islamic Republic of Iran - approved in 2005.

Islamic Sukuk: A type of Islamic financial paper issued by relevant laws and regulations, such as lease Sukuk, profit-sharing Sukuk, general cost-plus sale Sukuk, and agency.

Islamic Treasury Bills: Islamic financial papers issued in line with credit notifications and allocations made by the Planning Organization within the framework of these regulations to settle definitive claims and contractual prepayments as per the contracts signed by the executive agencies.

In many countries, to predict economic growth or recession, they prioritize the use of yield curve of treasury bills, government bonds, and corporate bonds, among others. Given the limitations of Iran's capital market in the fixed-income sector and its emerging nature, we utilized sukuk (corporate-government) securities, which have a longer history in the Iranian market compared to treasury bills.

3-3- Yield Curve

The calibration of yield curves with matured data traces back at least to the pioneering efforts of David Durand in 1942, who for the first time, using data dispersion, fit an appropriate curve (Nelson & Siegel, 1987). Indeed, the emergence of the yield curve by investors for long-term securities began in mid-1942, and the Treasury and the Federal Reserve (the Central Bank of the US) demonstrated their efforts in managing and controlling the yield curve across all maturities by setting the interest rate on short-term treasury bills and limiting the rates on long-term treasury bonds. This control approach persisted until 1951 (Jonathan Rose, 2021).

The government bond yield curve plots yield against the maturity of government bonds with equal credit quality. Investors pay strong attention to the yield curve since it has predictive powers for inflation and the levels of economic activity. The US treasury yield curve, which compares the yields of short-term Treasury Bills (with a maturity of less than a year) with long-term Treasury Notes (two, three, five, and ten years) and bonds (twenty and thirty years), is the most commonly referenced government yield curve. Due to its power to predict potential economic output, the yield curve has broader application and is also used as a benchmark rate for consumer lending or mortgages. (Collin, 2022).

- **Normal**

A normal yield curve has an upward sloping shape, which indicates that the yields of bonds with a longer duration could continue to increase as a response to periods of elevated economic activity. A normal yield curve implies investors are confident that the economy will grow more quickly, and mortgage and loan rates would follow the yield curve. In practice, longer-term loans require a higher interest rate than shorter-term ones.

- **Flat**
  A flat yield curve indicates that investors expect slower growth, and as a result, yields are low across the board. It typically sends mixed signals about the potential economic output. A flat yield curve would also mean that the difference between long and shorter-term rates is insignificant.
- **Inverted**
  An inverted yield curve is downward sloping and signals an economic recession. Investors would typically have low confidence in the economy, and the yields on bonds with a shorter duration are higher than those with a longer duration.
- **Humped**
  A humped yield curve, also known as a bell-shaped yield curve, is a rare type of yield curve that occurs when interest rates on medium-term fixed income securities are higher than the rates of both long and short-term instruments.

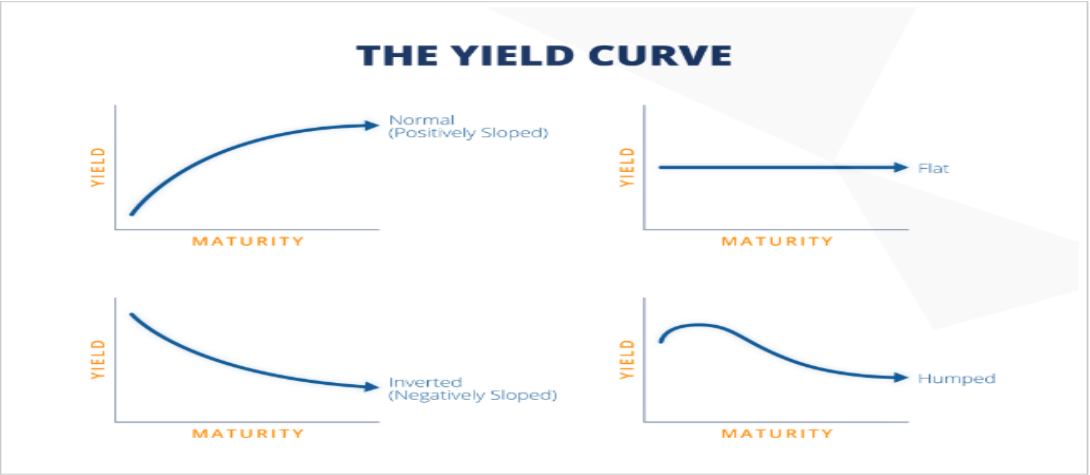

Figure 1: Different shapes of the yield curve.
Source: https://www.fe.training/free-resources financial-markets/government-bond-yield-curve/ (2022)

There is no single yield curve that describes the rate of return for all types of debt securities. The economic position of governments and the credit rating of companies is the main factor in determining the yield curve. There is a general classification of the yield curve in the financial market, which is related to the credit rating of bonds and their issuers.

1) Government yield curve: The yield curve related to bonds issued by governments in their own currency is called the government bond yield curve.
2) Bank yield curve (LIBOR): yield curve related to bonds issued between banks
3) Corporate yield curve: These curves are made from the yield of bonds issued by companies. Because the companies have less credit than most governments and most major banks, these yields are usually higher.

This classification in Iran is currently known under the titles of Islamic treasury bond curve, government sukuk curve, corporate sukuk curve and total sukuk curve.

3-4- Yield spread

Despite the difference in the nature of sukuk from conventional bonds, the method of issuance and functions of sukuk in the secondary market are similar to fixed income securities. Currently, sukuk are issued in Iran with a maximum maturity of 5 years. These bonds have a periodic interest rate (coupon) that the publisher pays the periodic interest and the bond amount is deposited into the bond holder's account at the end of maturity. The yield to maturity of sukuk is the average annual rate of return that the investor receives if he holds the bond. The yield to maturity (YTM) rate is calculated annually, discounted and with compound interest and with the following relationship.

$$p = \sum_{t=1}^{n \cdot m} \frac{C_t}{(1 + ytm)^{\frac{t}{m}}} + \frac{FV}{(1 + ytm)^{n}}$$

P: net payment of the investor to buy bonds (for bonds that are traded at a discount, this amount is less than the nominal price)
n: distance to maturity (annual)
m: the number of interest payment dates per year
ytm: yield to maturity
C: Coupon amount
FV: face value (or maturity value, which is usually assumed to be 1,000,000 riyals).

The difference between the yield rate of bonds with long-term maturity and the yield rate of bonds with short-term maturity is called yield spread. As usual and in a growing economy, bonds with long – term maturity have higher returns than bonds with short-term maturity due to accepting more risk.Therefore, the slope of the normal return curve is always upward. So, according to the usual procedure, the difference between the yield of bonds with long-term maturity and the yield of bonds with short-term maturity is positive. When the yield spread is negative, it means that the yield curve has a negative slope and the yield of short-term bonds is greater than the yield of long-term bonds. In many countries, negative spreads are used to predict future real activity.

5-3- Economic Quarterly Growth Rrate (EQGR)

Business cycles involve periodic fluctuations in economic activities. In macroeconomic literature, fluctuations of the Gross Domestic Product (GDP) around its long-term growth path are generally recognized as business cycles. In periods when the GDP is above its long-term growth path, it signifies economic prosperity, and in times when it's below, it signifies an economic recession (Ranj Pour and colleagues, 2021). According to another definition by the U.S. National Bureau of Economic Research (NBER), whenever there are at least two consecutive quarters of negative GDP growth, a recession has occurred.

GDP is a standard measure of overall economic activity. In this research, the quarterly growth numbers of the current season's gross domestic product compared to the same season's gross domestic product from the previous year have been used. The economic growth rate measures the economic health of a country in a comparative manner, over a period of time. In most cases, economic growth rate reflects the changes in GDP. In general, the economic growth rate is obtained according to the following formula.

$$EG = \frac{GDP_2 - GDP_1}{GDP_1}$$

In the above formula, GDP2 is the gross domestic product of the current period (season) and GDP1 is the gross domestic product of the previous period (season). In this research, the Economic Quartlyl Growth Rate is called EQGR for short.

Economic growth data is not available on a monthly basis. Therefore, in this research, the quarterly growth numbers of the current season's gross domestic product compared to the previous season's gross domestic product (in terms of economic activities at constant prices of 2016) were used. These data were extracted from the database of Central Bank of Iran under the title of time series of quarterly accounts. Figure (2)

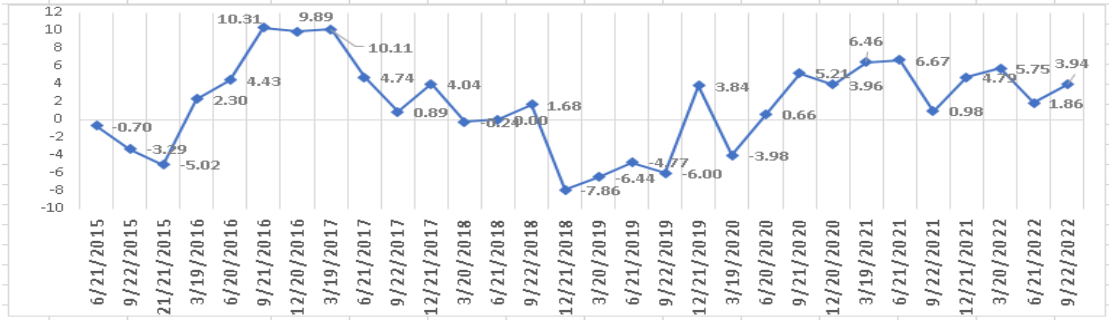

Figure 2- Time series of the quarterly growth rate of the economy in the research period

4-Research Methodology

This research is an applied research in terms of its objective, because the results can be used in investment decisions. Also, in terms of inference , it is in the group of descriptive correlational research, because to discover the relationships between research variables, regression and correlation techniques will be used. The statistical population of this research includes Iran's gross domestic product and sukuk issued in Iran from 2015 to 2022.The research sample includes daily trading data of sukuk trading symbols (government and corporate) with coupons, which were collected from the databases of the Tehran Stock Exchange Technology Company, Iran Fara Bourse (OTC) website.In addition to sukuk, the statistics of Iran's GDP table (in terms of economic activities at constant ppowerrices of 2015) were used in the time domain of the research. These data were extracted from the database of Central Bank of Iran under the title of time series of quarterly accounts.

4-1- Research model

One of the most important applications of bond yield spread mentioned in the research literature is forecasting economic growth or recession. One of the common models for measuring the relationship between yield spread and forecasting economic activity is the regression and propit model. In this research, we use econometric modeling, linear regression and the ordinary least squares (OLS) method to predict the changes in the economic growth rate due to the independent variable (yield spread) and to check its economic predict power.if $spread_{2t}$ is the yield spread variable in the current quarter and Let's name the economy quarterly growth Rate in k next quarter as EQGR(t+K), In this case, the simple linear regression equation of the model is defined by equation 3.

$$EQGR_{(t+K)} = \beta_1 + \beta_2 spread_{2t}$$

4-2 Research Questions

1) Which of the sukuk yield spreads predicts future economic activities?
2) Can the selected spread predict several future seasons of Iran's economic activities?
3) Is it possible to provide a prediction model with the selected spread?

4-3- Measurement and test criteria

To measure and evaluate the relationship between different sukuk yield spreads and economic growth rates, and to evaluate how well each model estimates the observed data parameters,we employ four of the most frequently used criteria for gauging the success and accuracy of parameter estimation for each model.

1- **Pearson Correlation Coefficient:** Pearson Correlation Coefficient: This can be used to measure the strength and correlation between two economic variables. A positive coefficient indicates a direct linear relationship between the two variables, while a negative one signifies an inverse relationship. The closer the correlation coefficient is to 1 or -1, the stronger the linear relationship between the two variables. Notably, if the correlation coefficient is close to 1, the direction of changes for both variables is the same. Pearson's correlation coefficient, is as follows.

$$r = \frac{\sum_{i=1}^{n}(X_i-\bar{X})(Y_i-\bar{Y})}{\sqrt{[\sum_{i=1}^{n}(X_i-\bar{X})^2][\sum_{i=1}^{n}(Y_i-\bar{Y})^2]}}$$

where (X1,Y1),...(Xn,Yn) represents n pairs of observations. For Iran's economic data, if the correlation value is 0.3 at a 5% error level, the two variables are correlated.

2- **Coefficient of Determination (R^2):** This represents the ratio of the sum of squares of the variations of the explanatory variables (xi) to the total variations. R^2 indicates what percentage of the dependent variable's changes are explained or accounted for by the independent variables. R^2 values range between 0 and 1. The closer this value is to 1, the better the estimation provided.(5)

$$R^2 = 1 - \frac{S_e^2}{S_y^2}$$
$$0 \le R^2 \le 1$$

3- **Mean Absolute Error:** The Mean Absolute Error (MAE) is a criterion used to evaluate the accuracy of an estimate. This metric consists of the weighted average of the absolute differences between the observed market values (yi) and the estimated values (ŷi), i.e., the errors given by. i.e. the errors calculated by expression (6). where n is the number of securities (sample size).

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|y_i - \hat{y}_i|$$

4- **Root Mean Square Error:** Another metric used in this study is the Root Mean Square Error (RMSE). The errors are calculated using Equation (7). The closer metrics 3 and 4 are to zero, the more accurate the model is.

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

Research findings

5-1- Formation of yield spreads table

Currently, sukuk are issued in Iran with a maximum maturity of 5 years. Reviews shows that less than 10 days out of the 90 day research sample have trading symbols with maturities greater than 4 years. This limitation caused that sukuk bonds with maturities of more than 4 years were not included in the research. Therefore, in this research, long-term bonds are sukuk with 2-year, 3-year, and 4-year maturities, and short-term sukuk are 3-month, 6-month, and 1-year maturities. The next limitation is the basis for calculating the time period of economic growth data. which is reported quarterly and at the end of the quarter. The next limitation is the basis for calculating the time period of economic growth data. which is reported quarterly and at the end of the quarter. If it is possible to trade sukuk bonds with all maturities in the days leading to the end of each season, it is almost impossible or rarely happens. In order to solve this limitation and access the spread of the final returns in each quarter, the average sukuk returns are calculated in different maturities.The time interval for calculating the average in each maturity, It starts from the first day of time to maturity And until the last day, time to maturity of the same period is calculated. . for example. The meaning of the phrase "average yield of 6 months at the end of the first quarter(Q1) of 2022". It consists of calculating the average yield of bonds with maturity less than 185 days and greater than 93 days on 2022/05/30(.(the selected date of the research sample in June). On some days of the research sample, the average of all the above periods may not exist due to the lack of symbols with the desired maturities. In this case, estimated data is used. The average yield of sukuk in short-term and long-term maturities is shown in Table 1. For abbreviation, the Latin letters M (for month) and Y (for year) and their combinations are used in naming spreads.

As stated in the literature ،Sukuk yield spread is obtained from the difference between long-term and short-term yield of bonds. 9 different spreads are obtained from the difference between two sets of bonds with long-term maturity A={2Y,3Y,4Y} and bonds with short-term maturity B={3M,6M,1Y} .For example, we show the yield spread of bonds with a maturity of 4 years and the yield of bonds with a maturity of 3 months as 4y-3m. The data of 9 spreads and the quarterly economic growth rate (EQGR) of Iran in 30 seasons of the research period can be seen in Table (2).

The central indicators of the data from table (2) and the Pearson correlation coefficient between spreads and seasonal growth are displayed in table (3). The correlation coefficient between the economic quarterly growth rate and the 5 spreads in the aforementioned table is negative, implying that the mentioned 5 spreads don't align with the quarterly growth rate. Thus, they don't meet the conditions for forecasting the quarterly growth rate. However, the correlation coefficients of the spreads 3y-1y,3y-6m, 4y-1y and 4y-6m with the quarterly growth rate are positive. But the correlation of 3y-1y and 4y-1y with EQGR is close to zero and not significant. Considering the purpose of the research, which is to examine the spread of long-term and short-term returns and its relationship with economic growth rate forecasting. Therefore, two spreads 4y-6m, 3y-6m are selected for subsequent research stages and two spreads 4y-6m and 3y-6m with a correlation coefficient of more than 0.2 are chosen as suitable spreads for the next stages of the research.

Table 1- The average yield of sukuk in short-term and long-term maturities in 2015- to September 2022

QUARTER	AVR3M	AVR6M	AVR1Y	AVR2Y	AVR3Y	AVR4Y
2015-Q2	21.5803	21.5366	21.2020	21.3470	21.5586	23.7287
2015-Q3	22.7767	21.6561	21.5742	20.1664	22.3955	22.7275
2015-Q4	26.7400	22.7900	21.6021	20.8426	22.3380	22.9946
2016-Q1	21.7190	21.6110	21.4546	21.5764	21.9492	22.8888
2016-Q2	21.5874	21.3691	20.6991	20.2940	20.4747	20.6744
2016-Q3	22.8679	20.9507	20.0531	19.9392	19.5701	19.5183
2016-Q4	21.9576	21.2308	21.5894	19.9789	21.4635	21.2352
2017-Q1	22.0279	21.3704	22.1004	21.9672	22.9755	21.8751
2017-Q2	17.8183	21.6374	22.6626	21.5828	22.2566	21.9238
2017-Q3	17.9464	18.7580	18.7380	20.5428	19.5901	19.6766
2017-Q4	20.8822	17.6273	17.9092	19.0265	18.1943	19.8200
2018-Q1	18.9087	21.5892	20.9007	23.0406	21.1783	19.4339
2018-Q2	26.4371	28.5501	21.9533	23.1364	23.7623	21.4529
2018-Q3	32.9962	24.2516	22.7530	26.9931	26.8370	28.1721
2018-Q4	23.0962	30.3072	24.8157	27.7248	22.6715	21.0045
2019-Q1	16.4177	24.0028	26.4370	22.5671	22.7975	20.6197
2019-Q2	19.5122	22.7780	22.5740	25.6700	23.8489	22.3669
2019-Q3	21.9958	21.8107	20.5907	23.7191	24.3662	24.8090
2019-Q4	23.3936	22.4263	21.5675	22.0395	22.1611	22.0312
2020-Q1	22.8102	23.0844	22.3541	25.7433	22.5427	20.2706
2020-Q2	22.9943	21.2849	20.2418	19.4005	20.9745	23.8732
2020-Q3	14.7835	19.1862	20.8231	20.7942	19.9745	17.1350
2020-Q4	21.6905	19.5523	22.3767	22.1653	23.1517	19.3485
2021-Q1	14.3205	17.3276	18.3528	18.9457	19.2567	19.1044
2021-Q2	22.3468	20.3177	22.1281	16.6750	19.6935	18.8166
2021-Q3	17.4118	22.9614	24.9338	25.3883	19.3039	19.3261
2021-Q4	24.1085	21.9664	19.8284	20.1215	19.8814	18.8465
2022-Q1	26.3115	22.2651	20.1954	17.7051	18.9995	19.1209
2022-Q2	35.1329	25.1839	20.6004	18.9653	19.4135	19.8337
2022-Q3	21.1017	16.5541	15.4121	21.5077	21.3594	19.6348

Tabel 2. Quarterly growth rate data and sukuk yield spreads in 30 Quarter of Iran's economy

Row	QUARTER	EQGR	2y-3m	2y-6m	2y-1y	3y-3m	3y-6m	3y-1y	4y-3m	4y-6m	4y-1y
1	2015-Q2	-0.7036	-0.2333	-0.1896	0.1450	-0.0218	0.0220	0.3566	2.1483	2.1921	2.5267
2	2015-Q3	-3.2859	-2.6103	-1.4897	-1.4078	-0.3812	0.7394	0.8213	-0.0492	1.0714	1.1533
3	2015-Q4	-5.0249	-5.8974	-1.9474	-0.7594	-4.4021	-0.4520	0.7359	-3.7454	0.2046	1.3926
4	2016-Q1	2.2988	-0.1426	-0.0346	0.1218	0.2302	0.3382	0.4946	1.1698	1.2779	1.4342
5	2016-Q2	4.4348	-1.2935	-1.0751	-0.4051	-1.1127	-0.8943	-0.2243	-0.9130	-0.6946	-0.0247
6	2016-Q3	10.3093	-2.9288	-1.0115	-0.1140	-3.2978	-1.3805	-0.4830	-3.3496	-1.4324	-0.5348
7	2016-Q4	9.8855	-1.9787	-1.2519	-1.6105	-0.4941	0.2327	-0.1259	-0.7224	0.0043	-0.3543
8	2017-Q1	10.1063	-0.0607	0.5969	-0.1332	0.9475	1.6051	0.8750	-0.1529	0.5047	-0.2254
9	2017-Q2	4.7405	3.7645	-0.0546	-1.0798	4.4383	0.6192	-0.4060	4.1056	0.2865	-0.7387
10	2017-Q3	0.8860	2.5963	1.7848	1.8048	1.6437	0.8321	0.8521	1.7302	0.9186	0.9386
11	2017-Q4	4.0376	-1.8557	1.3992	1.1173	-2.6879	0.5670	0.2851	-1.0622	2.1927	1.9108
12	2018-Q1	-0.2354	4.1318	1.4513	2.1399	2.2695	-0.4110	0.2776	0.5252	-2.1553	-1.4668
13	2018-Q2	-0.0022	-3.3007	-5.4137	1.1830	-2.6748	-4.7878	1.8090	-4.9842	-7.0972	-0.5004
14	2018-Q3	1.6844	-6.0031	2.7415	4.2401	-6.1592	2.5854	4.0841	-4.8241	3.9204	5.4191
15	2018-Q4	-7.8619	4.6286	-2.5823	2.9091	-0.4247	-7.6357	-2.1443	-2.0917	-9.3027	-3.8112
16	2019-Q1	-6.4356	6.1495	-1.4357	-3.8698	6.3799	-1.2053	-3.6394	4.2020	-3.3832	-5.8173
17	2019-Q2	-4.7725	6.1578	2.8920	3.0960	4.3368	1.0710	1.2750	2.8548	-0.4110	-0.2070
18	2019-Q3	-6.0011	1.7233	1.9084	3.1285	2.3704	2.5555	3.7756	2.8132	2.9983	4.2183
19	2019-Q4	3.8359	-1.3541	-0.3867	0.4720	-1.2326	-0.2652	0.5936	-1.3624	-0.3950	0.4637
20	2020-Q1	-3.9762	2.9331	2.6589	3.3893	-0.2676	-0.5417	0.1886	-2.5397	-2.8139	-2.0835
21	2020-Q2	0.6581	-3.5938	-1.8845	-0.8413	-2.0198	-0.3104	0.7327	0.8789	2.5883	3.6314
22	2020-Q3	5.2134	6.0107	1.6080	-0.0289	5.1910	0.7883	-0.8486	2.3515	-2.0511	-3.6881
23	2020-Q4	3.9604	0.4749	2.6131	-0.2114	1.4612	3.5994	0.7750	-2.3420	-0.2038	-3.0282
24	2021-Q1	6.4642	4.6252	1.6181	0.5929	4.9362	1.9291	0.9039	4.7839	1.7768	0.7516
25	2021-Q2	6.6717	-5.6718	-3.6427	-5.4531	-2.6533	-0.6241	-2.4345	-3.5302	-1.5010	-3.3115
26	2021-Q3	0.9753	7.9764	2.4268	0.4544	1.8921	-3.6576	-5.6300	1.9143	-3.6353	-5.6078
27	2021-Q4	4.7869	-3.9871	-1.8450	0.2930	-4.2271	-2.0850	0.0530	-5.2620	-3.1199	-0.9819
28	2022-Q1	5.7496	-8.6064	-4.5600	-2.4903	-7.3121	-3.2657	-1.1959	-7.1907	-3.1442	-1.0745
29	2022-Q2	1.8553	-16.1675	-6.2186	-1.6351	-15.7194	-5.7704	-1.1869	-15.2991	-5.3502	-0.7667
30	2022-Q3	3.9443	0.4060	4.9536	6.0956	0.2577	4.8053	5.9473	-1.4669	3.0807	4.2227

Table3. Central indices and correlation coefficient of E.Q.G.R with sukuk yield spreads

Central Tendency	EQGR	2y-3m	2y-6m	2y-1y	3y-3m	3y-6m	3y-1y	4y-3m	4y-6m	4y-1y
standard deviation	4.9488	5.05339	2.6011	2.32779	4.2994	2.6058	2.12022	4.007928	3.00212	2.69561
MAX	10.3093	7.97644	4.9536	6.09556	6.3799	4.80529	5.94728	4.783928	3.92045	5.41912
MIN	-7.8619	-16.168	-6.2186	-5.4531	-15.719	-7.6357	-5.63	-15.29912	-9.3027	-5.8173
Average	1.80664	-0.4703	-0.2124	0.37143	-0.6244	-0.3666	0.21723	-1.047004	-0.7891	-0.2053
Pearson correlation		-0.2573	-0.0338	-0.2733	-0.1512	0.21581	0.00667	-0.147046	0.20756	0.02779

5-2- Determining the forecast period

The period or quarter of forecasting economic activities by yield spread is different according to the economic conditions prevailing in the countries. To investigate whether the selected spreads, labeled "4y-6m" and "3y-6m" can predict the economic growth of several upcoming quarters, The correlation of the mentioned spreads with the growth rate of the current season and the following seasons are calculated. In other words, we calculate the correlation of the selected spreads in quarter t with the quarterly growth rate of period t+k. The value of k varies from 0 to 4 (that is, the current quarter to the next 4 quarters). The results of the estimation of the correlation coefficient of the selected spreads with the quarterly growth rate of the economy for k=0...4 of the next quarter are displayed in Table No4.

Based on the data in Table 4 for k=3, there is the highest correlation between the selected spreads and the quarterly growth rate. In other words, the spread data of the current season has the highest correlation with the data of the next three quarter. And the 4y-6m spread with the growth rate of the next 3 quarter with a correlation of R=0.31767 is chosen as the most appropriate spread. The time series of the 4-year average yield curve and the 6-month average yield curve of sukuk, as well as The time series of the 4y-6m spread curve of the current quarter and the economic growth rate of the next 3 quarter are shown in Figure 3.

Table 4 Correlation coefficient of quarterly growth rate with selected spreads

The number of the next quarters	3y-6m	4y-6m
current quarters=0	0.216	0.208
1	0.076	0.066
2	0.158	0.111
3	0.217	0.318
4	0.055	0.150

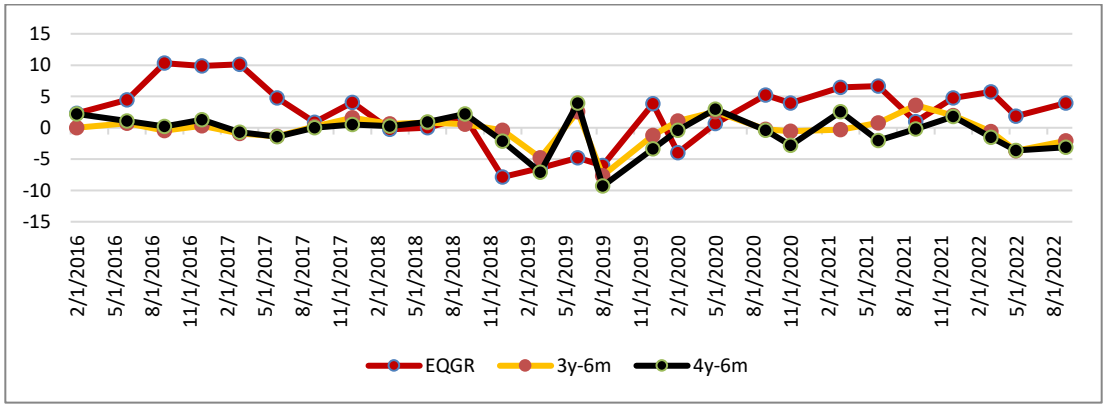

Figure 3- Time series of 3y-6m and 4y-6m spreads curve with quarterly growth rate curve (next 3 quarters)

5-3- Presentation of economic growth prediction model

To model and determine the relationship between spread as independent variables and quarterly growth rate as a dependent variable, we use a two-variable linear regression model. In other words, we consider 4y-6m spread as explanatory or independent variables and quarterly growth rate (EQGR) as a dependent variable. As stated in the research literature, the spreads of season t will be able to predict the growth rate of quarter (t+k) (Equation 3).

Although in determining the forecast period for k=3, the correlation coefficient of the selected spread with the EQGR variable was higher than other k values, but the compound correlation coefficient between the spreads and EQGR(t+K) is re-examined for k=0...4. The estimated values of the parameters of the quarterly growth regression relationship and their error rate have been optimized using the ordinary least squares method, which can be seen in table (5).

The data in table (5) shows that the values of MAE, RMSE, MSE error criteria of the estimated coefficients of the proposed model for k = 3 are smaller than other k values and the determination coefficient R2 is larger than other rows. This means that the chosen model has both the least error and the best fit among the proposed models, and it expresses a more appropriate prediction of the growth rate of the next three quarters of the economy. By determining the partial regression coefficients (Bi), the linear regression equation of the seasonal growth rate of the research period is in the form of equation (8). The output of statistical tests of the following regression relationship with the value of R^2=0.1009 is shown in Appendix A.

$$Y_{(t+3)} = 2.6959 + 0.5245\,X_{1t}$$
$$\text{s.e.} \quad (0.9356) \quad (0.3131)$$
$$\text{t:} \quad (2.8813) \quad (1.6751)$$

The significance of the whole regression is tested with 90% confidence with the assumption of zero R^2 =0 using Equation (9).

$$H0: \quad R^2=0$$
$$H1: \quad R^2\neq 0$$

Because the calculated statistic value of F=2.726 is greater than the critical value of F=1.665, therefore the hypothesis H0 is rejected. And the proposed model has the power of economic forecasting.

For the practical test of the model, we evaluate the output of the proposed model with real data. The end period of the sample period of this research is 22 - 9 - 2022, so with the spread of the sukuk yields of the current quarter and ending on this, it is possible to predict the economic growth of the three seasons after this date, that is, until 21 - 6 - 2023. The spread values of the Q1 of 2022 and the forecast values of the Q4 of 2022 (the next three quarters) and actual values can be seen in table (7).

Table 5 Estimated parameters of the linear regression model for predicting economic growth in the next quarters

k	n	B1	B2	B3	$\sum e_i^2$	RMSE	MAE	R^2	r
0	30	2.010208	0.270388	0.132375	675.9941	4.746908	3.859673	0.048203	0.219552
1	29	1.976019	0.15193	0.000039	699.6452	4.911791	4.001134	0.005777	0.076009
2	28	2.142282	0.499755	-0.15035	657.671	4.846468	3.924233	0.174667	0.417932
3	27	2.779775	-0.42024	0.804162	554.0112	4.529783	3.785302	0.282002	0.531039
4	26	2.603213	-0.55498	0.618679	598.0073	4.795861	3.724327	0.219639	0.468657

Table 6 - Total regression test results, economic growth rate prediction model

F-Test Two-Sample for Variances		
	E.S.G.R	*4y-6m*
Mean	2.341238871	-0.676288163
Variance	23.98493003	8.79662772
Observations	27	27
df	26	26
F	2.726605103	
P(F<=f) one-tail	0.006513182	
F Critical one-tail	1.665660957	

Table 7- Comparison of actual and predicted values in the next three quarters

Quarter(t)	4y-6m	Quarter(t+3)	Predicted values(Y')	REAL GDP(Y)
2022-Q1	-3.1442	2022-Q4	1.04674849	4.9
2022-Q2	-5.3502	2023-Q1	-0.1102606	5.3
2022-Q3	3.0807	2023-Q2	4.31173073	6.2

The comparative graph of the predicted values (Y') of the economic growth rate with the dotted orange curve and the actual values of the economic growth rate with the blue curve in the research period are shown in Figure 4. Out-of-sample values can be seen at the end of the curve with different colors.

The degree of alignment of the predictor curve ẏ with the real season growth rate curve (y) can be seen in Figure 4.

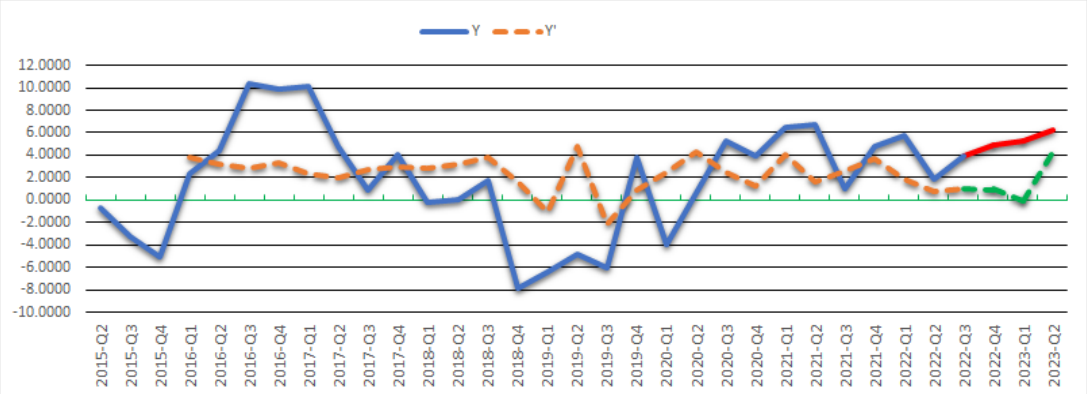

Figure 4 - Comparison curve - predicted and actual values of the economy

6-Discussion and Conclusion

The yield spread is measured by the difference between the long-term and short-term yields of fixed income bonds. The results of researches in different countries show that the yield of fixed income bonds is affected by important factors such as bank interest rate, inflation rate, exchange rate, stock market volatility. Determining the type of spread and the power of economic forecasting, especially economic recession, depends on monetary policies, bank interest expectations, the size of the fixed income bond market from all securities, and the state of macroeconomic indicators of countries and international economic shocks.Therefore, the choice of the type of spread and the power to predict the next several quarters are different according to the economic capacities of the countries.For example, in the research conducted by Jana Huzdenska (2015), the spread of 10-year and 3-month bond yields in the United States and a number of European countries has the ability to predict real GDP activities from 2 quarters to 6 quarters ahead.

Findings from this study suggest that among various combinations of yield differences between long-term maturities(2, 3, and 4 years) and short-term maturities (3, 6 months, and 1 year) sukuk (Islamic bonds) , the 4y-6m spread is one ofthe most suitable for forecasting economic activities of iran. And the spread of 4y-6m has the highest correlation of r=0.3176 with the growth rate data of the next 3 quarters of Iran's GDP. The prediction equation of economic activities was optimized by the aforementioned spread using simple linear regression model and ordinary least squares (OLS) method and introduced with the relation Y(t+3)=2.6959 + 0.5245X1t. The ability to predict the spread and the presented model was measured and evaluated with the determination coefficient R2 with 90% confidence and the F test. The results showed that the spread of the current season describes and explains

more than 10% of the changes in Iran's GDP in the next 3 seasons. According to similar financial researches, this result is not far from expected. In addition, in economics and finance, due to the unsteadiness of conditions and time in different markets and the different behavior of investors, obtaining small coefficients of determination is considered a natural thing.The alignment of the prediction curve for the real data was presented in Figure 4.One of the most important applications of this research is that its results can be used to prevent economic recession through the adoption of appropriate and timely monetary and financial policies.

This research is done for the first time with the data of the financial market of Iran, and in this respect, with limitations such as the small number of symbols and the low acceptance of investors in the early years of publication, the lack of regular publication of bonds with different maturities for weekly or monthly coverage, the lack of Securities faced with long-term maturity and more than 5 years. The aforementioned limitations did not prevent the research, and in the research data section, it was replaced as much as possible through estimated values. This research was done using the yield spread of Sukuk. In the next research and using the yield spread of Islamic treasury bills, similar research can be done and its results can be compared and analyzed with the results obtained in this research.

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Appendix A

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.317673619							
R Square	0.100916528							
Adjusted R Square	0.064953189							
Standard Error	4.735718776							
Observations	27							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	62.93237257	62.93237257	2.806094522	0.106372158			
Residual	25	560.6758082	22.42703233					
Total	26	623.6081808						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 90.0%*	*Upper 90.0%*
Intercept	2.695990223	0.935670407	2.881346042	0.008014799	0.768940947	4.623039498	1.097733462	4.294246983
4y-6m	0.524556499	0.313141858	1.67514015	0.106372158	-0.12037123	1.169484228	-0.01033387	1.059446871