

Macro-economic Determinants of UK Treasury Bonds Spread

Soh Wei Chee

Master Student by Economic Department
Faculty of Economics and Management
University Putra Malaysia
43400, Serdang, Selangor, Malaysia
E-mail: swc.soh@gmail.com
Phone: +6018-660-5841

Cheng Fan Fah

Associate Professor
Economic Department
Faculty of Economics and Management
University Putra Malaysia
43400, Serdang, Selangor, Malaysia
E-mail: chengfanfah@yahoo.com
Phone: (60-3)89467746

Abstract

This paper studies the relationship between eight macroeconomic determinants and the UK government bond yields. The paper also enhances the previous researches on relationship between macroeconomic factors and the gilts yields. The results show that only 1) short term interest rates have strong and negative impact on five-year, ten-year and twenty-year UK government bond yields. 2) The exchange rates have significant and positive relationship with five-year UK government bond yield. Whereas, the other macroeconomics variable have no impact on the yields and yield spreads of the UK government bonds.

Key Words: Macro-economic determinants; interest rate; exchange rate; bond yield, bond spreads.

1.0 Introduction

A government bond is a debt instrument that is supported by the credit and taxing power of a country with minimal risk of default; this is because at maturity, the government can redeem the bond by increasing taxes levied, reducing spending, or simply print more money. The term of “risk free” can be defined as the government bonds being free from “credit risk”. Yet, “currency risk” and “inflation risk” cannot be ignored. Currency risk occurs by the change in price of one currency against another, where foreign investors will receive lower return compare to local investors. On the other hand, inflation risk is the possibility of a reduction in the purchasing power of par value when the inflation outturn is higher than expected. However, inflation-indexed bonds issued can effectively protect investors against inflation risk.

Government bonds are useful in modulating the nationwide circulation of cash, compared to other bonds. These bonds are theoretically “risk free” as the government holds the highest credit ranking, therefore, investing in government bonds are relatively conservative than investing in the stock market. In contrast, there are some disadvantages investing in government bonds. These bonds are apt to political upheavals and exposed to political risk, which links to the possibility of default. Currency risk as well as inflation risk both lays in government bonds and cannot be ignored.

U.K. Government bonds are debt-securities that issued by the Bank of England. UK government bonds also known as “gilts”, by reason of the certificates have a gilded edged. The term “gilts” considered the primary characteristic of UK government bond which treated as an investment. There are two types of securities where up to 99% account are gilts in issued, convention gilt and index-linked gilt (Bank of England).

The present of Sterling Treasury bills as important as a significant element in the DMO's Exchequer cash management operations. Besides that, it considered as a substantial element in the UK Government's stock of marketable debt instruments. The DMO (Defense Materiel Organization) is Australia's largest project management organization and involved in many of the demanding large projects in Australia. Treasury bills are zero-coupon regular debt securities and can be held in CREST and Euro clear. Treasury bills will be issued weekly, and it will be held by the DMO on each Fridays to calculate the balance on the next business day. Maturities of treasury bills can be issued by 1 month (approximately 28 days), 3 months (approximately 91 days), 6 months (approximately 182 days) or 12 months (up to 364 days).

Investors, who are resident overseas, have exemption from UK taxation on holding gilts regardless the corporate or the individual. In the prior of April 1988, the UK government has regulated those gilts which appointed as FORTA (Free of Tax to Residents Abroad) will pay gross coupons automatically to the overseas holder. However, after the announcement of the regulation, all gilts have been designated as FORTA and all overseas residents can enjoys this service. Indirectly, the facility has increase the overseas holding of gilt. (The Office of National Statistic, ONS)

There are many macroeconomic factors that are related to the depth and currency composition of government bond markets. Without a distinct picture, investors and the government face difficulty in analyzing the trend of the government bond market. The main purpose of this paper is to fulfill that exact need; to investigate how macroeconomic indicators as the independent variables, influence UK government bond yields, and the yield spread between UK government bond yields and US government bond yields.

There are vast amounts of researchers who have studied gilts markets, but previous studies only specifically seek explanations on certain factors. The highlight of this paper is to gather and enhance previous research on the relationship between macroeconomic factors and the gilts yield. In this paper, studies on the macroeconomic determinants that are significant to gilts provide a broader perspective of reference for future research.

The rest of the paper is organized as follows. Section 2 describes the literature review base on the aim. Section 3 discusses the empirical strategy to study the macroeconomic factors affecting the yield curve of government bond. Section 4 shows the estimation results. Section 5 discusses the results and concludes.

2.0 Review of Studies

The exchange rate risk occurs when the amount being paid in currency is worth less in real term where bond yield will be influenced. Hence, the existence of exchange rate risk is positive correlation with world market bond portfolio. Also, Purchasing Power Parity theoretically can be used to hedge the exchange rate risk of UK

government in purchasing and selling of government bonds. Investors can gain returns by hedging government bonds and therefore his paper concludes that the exchange rate has an impact in influencing government bond yields (Subrahmanyam 1981).

Research has been made in examined the effect of market value of privately held U.S and Canadian government debt on the real Canadian dollar/U.S dollar exchange rate by Mcmillin and Koray (1990). In the paper, a model allowing small autoregression to find out if there is any relationship between debt and six other variables - exchange rate, output, price level, interest rate, nominal money and government purchases for both U.S and Canadian. They find that debt shock tend to have a negative relationship on both interest rate and exchange rate, which matched with the Ricardian Equivalence framework.

Research that explains the relationship between the yield curve and macroeconomic variables are important for public policy, bond valuation and investment decisions. This significance has recently induced many other papers in studying this issue. To construct a fine yield curve model, Duffie and Kan (2002) have considered models in which quite a number of unobserved factors explain the whole set of yield curves. There are many term structure models using latent factor models in which the factors are giving indirect comparisons to macroeconomic variables. In the other way around, there are other studies trying to clarify the relationships between bond yields and macro variables in direct model by using vector autoregressive (VAR) models. In a study done by Evans and Marshall (1998), they used VAR models in seeing the relationship of yields of various maturities together with macro variables.

This paper is here to explain the relationship of eight macroeconomic factors with bond yield curve, and it is closely related to Ang and Piazzesi (2003) and Diebold et al (2005)'s research in describing the joint dynamics between bond yields curve and macroeconomic variables in a Vector Autoregression (VAR), where absence of arbitrage is the restrictions that have been recognized. However, arbitrage is a vital concept in finance, and models designed based on theory of arbitrage have improved the understanding of option pricing, bond pricing, and the pricing of securities in general (H. Litzenberger and Rolfo 1983).

There are many macro factors that basically explain movements at the period of short end and middle of the yield curve (Ang and Piazzesi 2003). However, unobservable factors are still significant in explaining most of the movement at the long end of the yield curve. Also, they mentioned the pricing kernel, where macro variables are incorporated as factors in a term structure model. The function of price kernel is to price all bonds in the economy, including government bonds. Price kernel is influenced by shocks of both observed macro factors and unobserved factors. However, since macro variables are correlated with yields, therefore incorporating macro variables may lead models to forecast better than models which omit these factors.

Some strong evidences have been found in explaining impacts of macro variables on future movements in the yield curve (Diebold et al. 2005). Also, there have been numerous evidences that there is reverse influence of certain macro variables. They insist that the macroeconomic variables all show significant persistence on the bond yield curve.

Prior studies have investigated the influence of macroeconomic variables news announcements on volatility of government bond yields (Goeij and Marquering 2006). For research purposes, they use daily data of returns on the 1, 3, 5 and 10 year U.S. government bonds. They found that macroeconomic variables news announcements have strong impacts on the bond yield volatility. Results of their study provide empirical evidence in which the bond market reacts more sensitively upon the macroeconomic news announcement compared to other relevant or non-relevant news. Furthermore, they find that news releases based on the situation of employment and price index has the most influence among others at the intermediate and long end of the yield curve. Also, the component of monetary policy, which is interest rate and money supply, seems to affect short-term bond volatility.

Some research, Bar and Campbell (1997) related UK government bond price and real interest rate in order to find out the relationship between them. In their paper, they used the simple asset pricing method to transfer the prices of UK nominal and index-linked government bonds into implied expected real interest rate. As a result, they find that the short run movement in three-month real interest rate and three-month inflation is negatively related.

There are other recent literatures that analyzed the currency composition of debt and highlight the phenomenon of “original sin”, which is defined as the inability of emerging economies to borrow abroad in their domestic currency, no matter in short term or long term; in domestic currency in the local market. Hausmann, Panizza, and Stein (2001) and Hausmann and Panizza (2003) explain that country size does matter in explaining their measures of “international original sin”, that is, the currency composition of government debt is overall issued in foreign markets.

In the research paper of Cain et al (2010), they examine the relationship between US dollar denominated government debt and exchange rate movements using unbalanced panel data co-integration techniques on 87 low and middle income countries over the period 1960 to 2007. They find that there are bidirectional causality between exchange rate and external debt. According to their findings, estimated model in the research paper suggests that in the long-run there is a negative relationship between the exchange rate and the government debt, yet, in short-run, positive relationship exist.

The interest rate is an important economic variable in finance, which is controlled by the government as one of a tool in managing financial policies. A study by Checherita and Rother (2010) analyzed the impact of fiscal variables that included government debt, on long-term interest rates as an indirect channel affecting economic growth. The relationship between public debt and economic growth, as explained, tends to appear as a negative relationship.

Jen and Yves (2010) investigated the effects of macroeconomic fundamentals on emerging market sovereign credit spreads, that is, the variation in sovereign yield spreads. Also, they focused on the power of volatility of the fundamentals. To figure out each and every question, they investigated by running linear regressions of yield spreads on explanatory variables. They find that macroeconomic fundamentals have statistically and economically impacted spreads of the sovereign yield curve. Country-specific fundamentals measured by a

country's terms of trade have great explanatory power in influencing market sovereign spreads; even after the global factors has been cancel off.

The influence of macroeconomic announcements have been confirmed by Balduzzi et al. (1997), who did wide study on intraday data of 27 different countries' macroeconomic news release on the bond market. According to them, the sequences of important variable start with Non-farm Payroll, Producer Price Index (PPI), followed by trading volume. Prices of bonds are found to react rapidly on macroeconomic news release although they define volatility on news release day is a non-standard way.

Christiansen (2000) continue the study of Balduzzi et al. (1997). The research investigated the effect of macroeconomic news announcements on the US Treasury bond market. The study mainly concerned on the impact of employment situation and price index report on Treasury bond yield. By applying multivariate model in exercise the test macroeconomic news announcement on Treasury bond yield she found that the announcements of macroeconomic variables' news significantly impact on the volatility of Treasury bond returns.

3.0 Research Methodology

This research is design to identify the impact of eight macroeconomic indicators - exchange rate (EXG), GDP deflator (GD), real GDP (GDP), international reserve (IR), real money supply (M2), short term interest rate (STI), net trade (NT) and stock index (UKI). The impact of the eight macroeconomic indicators on United Kingdom (UK) government bond, named as gilts, which include the direction and magnitude of the yield curve arising from the price change of UK government bond.

In this paper, in order to approach a multiple regression model of several macro factors, the step of estimate each equation separately is needed. This can be done by using ordinary least squares (OLS) where problem of autocorrelation, multicollinearity and heteroscedasticity is assumed to be absent. The aim of the paper is to characterize the impact of the macroeconomic indicators to the government bond yield.

$$\Delta YTM = \beta_0 + \beta_1 \Delta EXG + \beta_2 \Delta GD + \beta_3 \Delta GDP + \beta_4 \Delta IR + \beta_5 \Delta M2 + \beta_6 \Delta STI + \beta_7 \Delta NT + \beta_8 \Delta UKI + u_i \quad (1)$$

Where,

YTM	=	Yield to maturity of government bond
EXG	=	Exchange rate of US dollar per one pound sterling
GD	=	Gross Domestic Product deflator
GDP	=	Real Gross Domestic Product
IR	=	International reserve
M2	=	Money supply, M2
STI	=	Short term interest rate
NT	=	Net trade
UKI	=	UK domestic stock index

3.2 Data Collection

The data sources for this study are obtained from United Kingdom (U.K) central bank website. The data set of UK government bond prices is obtained by accessing the monthly closing prices. For the purpose of research by comparing the result from different bonds with various yields to maturity, therefore, five-year, ten-year and twenty-year UK government bond yields are chosen for data analysis. Yield spreads between UK and US government bonds are also important as a dependent variable for comparison and it is equal to bond yield of each government bonds of UK with different year to maturity minus the government bond yield of US. In this case, short term one-year US government bond yields are used to calculate the yield spreads.

There are eight macroeconomic independent variables, which are exchange rates, GDP deflators, real GDP, international reserves, money supplies, short term interest rates, net trades and stock index. The exchange rates are measured in the fluctuating exchange rates of U.S dollar / pound sterling. GDP deflators are measured by the change in price of goods newly produces within a country over a certain period of time and it is used as a measurement of inflation. GDP is a figure equal to total consumer, investment and government spending plus net import, which is the value of export minus the value of import. However, real GDP can be further explained as the inflation-adjusted measure of total market value of all final goods and services produces in a country for a given year. International reserves are an acceptable form of reserve fund or payment which passed around central bank of different countries. There are many ways to measure money supply, in this research M2 is chosen as measurement of money supply. M2 includes M1, plus savings and small time deposits, overnight repos at commercial banks, and non-institution money market accounts. Short-term interest rates are the rates at which short-term borrowings are affected between financial institutions or the rate at which short-term treasury bill is issued or traded in the market. Net trades are considered as the difference in value between a nation's imports and exports of goods and services over a period of time. Lastly, stock index which is also called as share index is a statistical indicator used in order to measure and reporting changes of the market value in a group of stocks. Other sources of data are obtained from the DataStream Navigator on a monthly basis. Research period for each and every data resource is from November 2006 to December 2010 which in total has 50 observations.

3.3 Hypothesis

The major hypothesis in this study is that a strong relation exists between government boon yield curve and eights macroeconomic indicators as variables. The null strategic hypothesis is:

$$H_0 : \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$$

$$H_1 : \beta_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$$

The null hypothesis shows that changes in government bond price is not explained or determined as shown by the sign and the magnitude of the macro factors. The null hypothesis will be accepted if there is no significant relation between government bond price changes and macro variables changes.

4.0 Results

In the result part, table 4.1 shows the data descriptive of all dependent and independent variables which exhibits summary information of data on mean, standard deviation, minimum and maximum. Table 4.2, 4.3, and 4.4 list the output of the data analysis in which independent variable does have impact on the government bond yield. Regression result of five-year, ten-year and twenty-year to maturity bond yield spread have been taken out as

the macroeconomic determinants show no impact on the bond yield spread between UK and US in the test period from November 2006 to December 2010.

4.1 Descriptive Analysis

Table 4.1 Data analysis

	Mean	Standard deviation	Minimum	Maximum
YTM5	0.04	0.008	0.03	0.054
YTM10	0.04	0.008	0.028	0.054
YTM20	0.044	0.003	0.037	0.051
YS5	0.024	0.013	-0.004	0.039
YS10	0.024	0.013	-0.006	0.042
YS20	0.028	0.018	-0.01	0.048

Table 4.1 shows data description of each and every independent variable on the four main criteria, which are mean, standard deviation, minimum and maximum. By comparing the mean and standard deviation of YS5, YS10 and YS20; YS20 has the highest figure of mean and standard deviation. However, YTM20 has the lowest value of standard deviation compared to the standard deviation of YTM5 and YTM10. It is difficult to compare the mean and standard deviation of the eight macroeconomic indicators as the unique and units of measurement for each macroeconomic indicator vary.

4.2 Significance of Macroeconomic Indicators Determinant for Five-Year, Ten-Year, and Twenty-Year Government Bond Yield

Table 4.2: Regression results for five-year to maturity UK government bond

Independent Variable	Model 1	Model 6	Model 9
Exchange rate, β_1	0.429 -2.331 (0.024*)		0.088 -0.362 -0.719
Short term interest rate, β_6		-0.299 (-4.419) (0.000***)	-0.319 (-3.947) (0.000***)

Note: Number in each bracket is t-statistic and p-value, significant at (*) 0.05 level, (**) 0.01 level, (***) 0.001 level

Table 4.3: Regression results for ten-year to maturity UK government bond

Independent Variable	Model 6	Model 9
Short term interest rate, β_6	-0.108 (-3.4192) (0.001**)	-0.112 (-2.620) (0.012*)

Note: Number in each bracket is t-statistic and p-value, significant at (*) 0.05 level, (**) 0.01 level, (***) 0.001 level.

Table 4.4: Regression results for twenty-year to maturity UK government bond

Independent Variable	Model 6	Model 9
Short term interest rate, β_6	-0.096 (-3.889) (0.000***)	-0.11 (-2.951) (0.005**)

Note: Number in each bracket is t-statistic and p-value, significant at (*) 0.05 level, (**) 0.01 level, (***) 0.001 level.

(To save space, table 4.2, 4.3 and 4.4 display the result of OLS test where the variables are significant to UK government bond yield. The full results can be provided upon request)

In table 4.2, the model 1, 6 and 9 exhibit the coefficient of macroeconomic indicator exchange rate and short term interest rate are significant to five-year UK government bond yield at the level of 0.05. The coefficient for exchange rate is a positive t-statistic value shows that exchange rate of US dollar / UK pound is positively related to the five-year UK government bond yield. However, in model 6, the negative coefficient of short term interest rates shows that short term interest rate has negative relationship with five-year to maturity UK government bond yield. Based on model 9, short term interest rate is negatively significant to five-year UK government bond yield compared to the other seven macroeconomic indicators.

In table 4.3, the models of 6 and 9 exhibits that coefficient of macroeconomic indicator short term interest rate is significant to ten-year UK government bond yield at the level of 0.05. Result of model 6 and 9 show that macroeconomic indicator of short term interest rate has negative relationship with ten-year to maturity UK government bond yield.

In table 4.4, the models of 6 and 9 exhibits that coefficient of macroeconomic indicator short term interest rate is significant to twenty-year UK government bond yield at the level of 0.05. The coefficient of short term interest rate show that macroeconomic indicator of short term interest rate has negative relationship with twenty-year to maturity UK government bond yield. There are no economic problems in this study.

Given that this parameter is expected to be no multicollinearity, autocorrelation and heteroskedasticity, one can suggest that the regression output provides powerful parameter estimation.

4.5 Significance of Macroeconomic Indicators Determinant for Five-Year, Ten-Year, and Twenty-Year Government Bond Yield Spread between UK and US

The model 1, 2, 3, 4, 5, 6, 7, and 8 are insignificant to the three dependent variables, five-year, ten-year, and twenty-year government bond yield spread between UK and US. These also show that the eight macroeconomic variables have no impact on government bond yield spread between UK and US. There are no economic problems in this study.

5.0 Conclusion

There are many macroeconomic factors that are related to the depth and currency composition of government bond markets. The main aim of this paper is to investigate how macroeconomic indicators as independent variables influence UK government bond yield and yield spread between UK government bond yield and US government bond yield. There are eight macroeconomic indicators chosen as independent variables - exchange rate, GDP deflator, GDP, international reserve, money supply, short term interest rate, net trade and UK stock index.

From the overall findings of regression results, there are six macroeconomic indicators that show insignificant variables in influencing UK government bond yield. Based on the result, coefficient of exchange rate indicator and short term interest rate indicator are significant in influencing five-year UK government bond yield. Also, the findings show that short term interest rate is a significant indicator in influencing five-year, ten-year and twenty-year UK government bond yield. Yet, regression results show that short term interest rate tend to be highly significant in twenty-year UK government bond yield compared to ten-year UK government bond yield. This finding tallies with the study of Sudipto and Ariff (2002), in which they mentioned that there is a common theory that shows short term interest rate volatility should negatively relate to government bond yield. Most importantly, the negative relationship tends to be stronger in the case of long term maturity bonds, as shown in their findings, where the significance for twenty-year government bond yield is greater than ten-year government bond yield.

This study has included eight macroeconomic indicators - exchange rate, GDP deflator, GDP, international reserve, money supply, short term interest rate, UK stock index and net trade - as the independent variables in the regression test. However, only short term interest rate is significant to the UK government bond yield among the others macroeconomic indicators. From the result of the regression, it shows short term interest rate has a strong and inverse relationship with UK government bond yield for five-year, ten-year and twenty-year government bond. Besides that, the exchange rate for five-year UK government bond concludes a significant and positive relationship with five-year UK government bond yield. This finding benefits investors, portfolio managers, policy makers and other parties that are related to bond movements and bond investments. Thus, when there is a public announcement of changes in interest rate, the parties mentioned above should be aware and pay close attention to the changes. The changes should be put under their consideration when they set up their investment portfolios.

In conclusion, short term interest rate is significant and negatively related to UK government bond yields. Therefore, further tests can be conducted by using other types of interest rate, such as commercial paper rate, to

compare and analyze the result with current regression output. In addition, to increase the reliability level of the research, sample size can be increased by using daily data.

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