Do Momentum, Value, and Size Premia Predict Economic Growth?

Mohammed M. Elgammal* and Mohamed Abdelaziz Eissa **

This paper explores whether market anomalies can predict economic growth and other macroeconomic factors using the time-varying volatility methodology. The findings indicate that risk premia have different and significant relationships with different macroeconomic factors in the U.S. market. The findings of using different univariate and multivariate specification of Ordinary Least Squares and TARCH models suggest that momentum can predict economic growth while there is no evidence that value premium, size premium or momentum can do. However, there is strong evidence that the liquidity crisis can predict the economic growth.

Key words: Value Premium; Size Premium; Momentum; Default Risk; Term Premium; Financial Crises; Economic Growth.

JEL Codes: G01, G12, G14

1. Introduction

Fama and French (1992, 1993, 1995, 1996, and 1998) argue that value and size premia are state variables that describe changes in the investment opportunity set. Consequently, it could be expected that value and size premium should be related to the fundamental risks in the economy. Vassalou (2003) examines the links between risk premia and economic growth. Other authors such as Levis and Liodakis (1999) link the value premium to variables such as inflation. They also link the size premium with changes in the interest rate, equity risk premium, term premium, and inflation rate. Moreover, Lettau and Ludvigson (2001) argue that returns on value stocks are related to consumption growth when the risk aversion is high. The current paper explores further the nature of the relationship between variables that are constructed from financial market rates of return and fundamental measures of output associated with the real economy using time-varying methodology and U.S data over the period 1954-2007.

This piece of work is motivated by the findings in the literature which indicate for a mix of relationships between stock market variables and macroeconomic factors. This provides the motivation to expand our knowledge by examining the relationship between the value premium, size premium as well as momentum and macroeconomic conditions. The macroeconomic factors include the change in industrial production as a proxy for economic growth, default premium as a proxy for aggregate leverage, Federal Interest

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Rate as a proxy for liquidity crisis, and inflation as a proxy for economic state. Market and term premia are used as stock market risk factors. Furthermore, this paper aims to examine whether the value premium, the size premium, and momentum can predict the economic growth.

The importance of this study is inspired from the argument that linking market anomalies to economic conditions may add to our knowledge by explain the source of these anomalies. Furthermore, if the value premium, size premium and momentum contain a risk factor, which predicts or precedes economic condition, these factors could work as economic signals for recession and inflation.

The findings indicate that the risk premium factors are forward looking factors and could incorporate expectations about future macroeconomic conditions. There is evidence that the market premium, momentum, and term premium can predict future economic growth as proxied by the change in industrial production. These results are consistent with the findings of Fama (1981) and Aylward and Glen (2000) who report a positive relationship between market factor and future economic growth in the U.S and international data respectively.

The remainder of this paper is organized as follows. Section 2 discusses the literature review. Section 3 introduces a brief description for the data set used in the paper. Section 4 explains different methodologies used in the current paper, while Section 6 discusses the empirical analysis while Section 7 summaries the main conclusions of the paper.

2. Literature Review

A growing part of literature examines the relationship between market premia (anomalies) and macroeconomic risk factors (see for example, Chan and Chui (1996), Cochran (1999), Liew and Vassalou (2000), Vassalou (2003) Vassalou and Xing, (2004), Chordia and Shavikumar (2002), Black and McMillan(2006), Avramov and Chordia (2006), Li et al. (2009), Lui and Zhang (2008), and Bali and Engle (2010)). The motivation for their work is often to investigate whether risk premia can work as a proxy for macroeconomic risk and whether these anomalies can predict or be predicted by macroeconomic risk factors. The answers to these questions are helpful for a number of reasons. First, it can enhance our understanding for the source of the return premia. Second, this may be useful for advising policy makers since it may help in forecasting economic growth or different economic conditions. Third, if risk premia can be predicted by the economic growth then this may imply that profitable portfolio strategies can be predicted using macroeconomic factors.

The premise that macroeconomic factors associated with the business cycle can predict stock market returns has made a profound impact on the development of the asset pricing literature [see for example Campbell (1991), Ghysels et al. (2005), Bali et al. (2005), Guo and Whitelaw (2006) and Bali and Engle (2010)]. Fama and French (1992, 1993, and 1998) argue that value and size premia should be related to the fundamental risks in the economy. Other authors such as Levis and Liodakis (1999) and Lettau and Ludvigson (2001) argue that returns on value stocks are related to macroeconomic factors.
Anderson (1997) reports a positive relationship between the size premium and the inflation, while Levies and Liodakis (1999), conversely, argue that the size and value premiums respond negatively to inflation rates and the size premium responds positively to changes in interest rate and the equity risk premium and term spread. Jensen et al. (1997, 1998), and Kim and Burnie (2002) document a positive size and value premium in expansion periods (expansive monetary policy) and a negative or insignificant size and value premiums in the contraction periods (restrictive monetary policy).

Additionally, Brennan et al. (2001) imply that value and size premia are priced because they can predict changes in the investment opportunity set. Building on this, Vassalou (2003) argues that changes in the investment opportunity set can be described by information related to future economic growth. Vassalou (2003), among others, links the cross-sectional variation of value and size premia to the news related to cross-sectional variation of future economic growth. Furthermore, Black and McMillan (2002) suggest that examining the relationship between the value premium and macroeconomic conditions may be helpful in explaining the source of the value premium. They illustrate that economic conditions may affect the value premium through expected future cash flows. If the economy expands and the expected cash flows increase, the present value of projects will be positive and the prices of growth stocks will increase more rapidly than those of value stocks. Thus, the value premium index will fall in good times and increase in bad times.

Moreover, Levis and Liodakis (1999) and Black and McMillan (2002), among others, suggest that the relationship between inflation and the value premium price index could be a positive relationship. The story is that, the increase in inflation results in a corresponding increase in the nominal risk-free rate as well as discount rate, which may slow the economy, and, consequently corporate earnings and stock prices. The decrease in growth stocks prices will be greater than the decrease in value stocks prices as growth stocks are more sensitive than value stocks to future earnings.

Gregory et al. (2003) and Kelly (2003) report positive correlation between the size and value premiums and future GDP growth. However, Gregory et al. (2003) cannot confirm correlation between value premium and future GDP growth when the size and market factors are included. Although they find correlation between the size premium and the investment and consumption components of GDP growth, they cannot find such correlation between value premium and GDP components. Additionally, Bagella et al. (2000) suggest that the value and size portfolios are less exposed to risk related to the economic growth (as measured with the covariance with GDP) than growth and large portfolios in UK data. These results are consistent with those of Avramov and Chordia (2006) who argue that the size premium has contra-cycle behaviour.

A significant part of the literature supports the view that there is a significant relationship between return premiums and economic future growth. For example, Fama (1981) reports a significant positive relationship between the market factor and the future economic growth in the U.S market. This association is also confirmed in international data analysed by Aylward and Glen (2000). Also, there are considerable attempts to link Fama-French factors with macroeconomic factors as well as economic growth (for example see, Liew and Vassalou (2000), Lettau and Ludvigson (2001), Kelly (2003), Petkova (2006), and Hahn and Lee (2006)). However, the relationships between these three premia and the business cycle factors would benefit from more investigation. This paper investigates these potential relationships between the return premia and
macroeconomic risk factors further to examine if these premia reflect risk factors can predict the economic growth in the U.S market over the period of July 1954 to July 2007.

Elgammal and Al-Najjar (2015) and Elgammal and McMillan (2014) focus on the extent to which leverage and default risk play a role in characterising the value premium. The motivation for considering leverage and default risk arose from the economic explanation of Fama and French (1996) and others; that suggest financial distress may be an important driver in the existence of market anomalies. Elgammal and McMillan (2014) argue that the default premium has positive explanatory power for the value premium. This gives strength to the view that the default premium captures systematic risk in the macro-economy and that the value premium is associated with rational decision making on the part of investors. This positive association between default and value premia accompanied by evidence for the leverage effect on the value premium, as discussed in Elgammal and Al-Najjar (2015), is relevant for the risk-based explanation for the source of value premium.

Altogether, this provides the motivation to expand our knowledge by examining the relationship between the value premium, size premium as well as momentum and macroeconomic conditions. This paper extends the previous work by considering other risk factors including size premium, momentum, default premium, and term premium. There are also deeper question at its heart, is a desire to explore further the nature of the relationship between variables that are constructed from financial market rates of return and fundamental measures of output associated with the real economy and to examine whether this financial market returns can predict the economic growth.

This paper can be differentiated from the literature in many aspects. First of all, monthly data are used instead of quarterly data and the data covers a longer time period from July 1954 to July 2007. The default premium is added to the Liew and Vassalou (2000) model to proxy for financial distress risk. The Fed interest rate as a proxy for the liquidity crisis is also added. Moreover, the change in industrial production is used as a proxy for economic growth, since the GDP information is not available in monthly data format. Also, we provide more comprehensive analysis using GARCH, Bootstrap and OLS techniques.

3. Data Description

The empirical analysis examines monthly data variables include; value premium; market premium; size premium; default premium, term premium, inflation, the change in industrial production, and a Federal interest rate (Fed) for the period of July 1954 to July 2007. Monthly U.S. total returns indices in local currency are collected from the Morgan Stanley (MSCI) database. The value premium (HML) is the difference between returns in the top 30 per cent of portfolios sorted on book-to-market and the bottom 30 per cent. The default premium index is the difference between returns on long-term corporate bonds and long-term government bonds. Total returns on the S&P 500 Index and the 30-day US Treasury Bill are used to derive the market risk premium index. The term premium index is defined as the difference between the total return on long-term (30-years) government yield minus short-term Treasury bills (TB 30 days).

The monthly Federal fund effective rate and monthly Industrial Manufacturing production rate are obtained from the Federal Reserve Board database- Statistics release-
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download program. The value, size and momentum premium indices are obtained from Kenneth French's website. The momentum factor constructed from six value-weight portfolios formed using independent sorts on size and prior return of NYSE, AMEX, and NASDAQ stocks. Momentum is the average of the returns on two (big and small) high prior return portfolios minus the average of the returns on two low prior return portfolios. Big means a firm is above the median market capitalization on the NYSE at the end of the previous month; small firms are below the median NYSE market capitalization. Prior return is measured from month -12 to -2. Firms in the low prior return portfolio are below the 30th NYSE percentile. Those in the high portfolio are above the 70th NYSE percentile. All data are transformed to the first difference logged data to avoid non-stationarity in the raw data.

4. Methodology

Ordinary Least Squares models (OLS), threshold Autoregressive Conditionally Heteroscedastic models (TARCH), and Bootstrap methods are used to examine the predictability power of the risk premia for the future economic growth. All methods are used in the context of time series analysis. The standard GARCH (1, 1) model is defined as follows:

\[ V = \lambda_i + \phi_i X + \epsilon_i, \quad \epsilon_i \sim N(0, h_i^2) \]

\[ h_i^2 = w + \alpha \epsilon_{i-1}^2 + \beta h_{i-1}^2 + \psi_i VolX \]  

(1)

Where \( V \) is a vector for dependent variables of interest, \( X \) is a vector of explanatory variables and \( VolX \) is a vector of the conditional volatility of selected explanatory variables. Moreover, \( \alpha, \beta \) and \( w \) are non-negative parameters. It is a necessary and sufficient condition that \( \rho = \alpha + \beta < 1 \) in order for a finite unconditional variance to exist (Black and McMillan, 2006). Where \( \alpha \) measures the effect of volatility shock in period \( (t-1) \) on volatility on period \( (t) \) and \( (\alpha + \beta) \) measures the speed at which this effect dies away.

The threshold ARCH, or TARCH, model is used to measure the leverage effect on value premium and to allow for asymmetric shocks to volatile motivated by the reasoning that good news and bad news have different predictability for future volatility (see Bollerslev et al., 1992; and Glosten et al., 1993). The specification for this model is:

\[ V = \lambda_i + \phi_i X + \epsilon_i, \quad \epsilon_i \sim N(0, h_i^2) \]

\[ h_i^2 = w + \alpha \epsilon_{i-1}^2 + \gamma \epsilon_{i-1}^2 d_i + \beta h_{i-1}^2 + \psi_i VolX \]  

(2)

Where \( d_i = 1 \) if \( \epsilon_{i-1} < 0 \) otherwise \( d_i = 0 \). Therefore, there are differential effects on the conditional variance where \( \epsilon_{i-1} < 0 \) (an unexpected decrease in price) denotes bad news and \( \epsilon_{i-1} > 0 \) (an unexpected increase in price) denotes good news. The impact of good news is given by \( \alpha \), the impact of bad news by \( \alpha + \gamma \), and the leverage effect by \( \gamma \). The leverage effect reflects how the decrease in stock prices leads to an increase in financial leverage (since the value of equity falls relative to corporate debt); therefore both the required return of equity and the risk increase (see Christie, 1982; and Black, 1986).
The (ARCH) effect in the data is investigated before and after the model estimated using ARCH LM test. The ARCH test is a Lagrange multiplier (LM) test for autoregressive conditional heteroskedasticity (ARCH) in the residuals (Engle 1982). ARCH in itself does not invalidate standard least squares (LS) inference. However, ignoring ARCH effects may result in loss of efficiency. If residuals are not conditionally normally distributed, the quasi-maximum likelihood (QML) co-variances and standard errors are calculated by the method described by Bollerslev and Wooldridge (1992) for heteroscedasticity consistent covariance. Their method only affects the covariance matrix, but does not affect the parameter estimates. Brooks (2008) illustrate that the usual t- and F-tests are valid in the context of non-linear models, however, there are not flexible enough. Thus, in addition to t- and F- tests the Maximised Log Likelihood Function (MLLF) is used to test whether the coefficients are equal to zero and whether there any coefficients need to omitted from the regression models.

If the null hypothesis of no-serial correlation is rejected for the residual of the Least Squares models, then the approach of Liew and Vassalou (2000) is followed using the Newey-West (1987) statistic. While in the case of GARCH models the methodology of Bollerslev and Wooldridge (1992) is used to correct for the serial correlation. In the case of finding any serial correlation in the squared residuals after applying Bollerslev and Wooldridge (1992) methodology, we use two different methods to overcome the autocorrelation problem. The first method is to include the first lag of the dependent variable in the analysis as an additional explanatory variable. The second method is to apply Bootstrap methods to generate statistical inferences.

5. Empirical Results

5.1 Macro Economic Factors and Different Premia

Investigate the relationship between these risk premia and the macroeconomic factors may help in explaining the source of these premia from one side and for testing whether these premia could predict the economic crises from the other side. The TARCH model is used to investigate whether the return on different trading strategies (value premium, size premium, and momentum) and the market factors (market premium and term premium as control factors) can explain four macroeconomic factors. These macroeconomic factors include: default premium as a proxy for financial distress risk; the change of industrial production as a proxy for the economic growth; inflation rate as a proxy for the economic state; and, finally, the Fed interest rate as proxy for the liquidity crisis. This could be explained in the following model:

\[
V_t = \mu + \delta V_{t-1} + \phi_1 \text{Vol}_t + \phi_2 \text{Market}_t + \phi_3 \text{Term}_t + \phi_4 \text{Size}_t + \phi_5 \text{Momentum}_t \\
+ \eta_i \text{Season} + \lambda h + \pi_i D + \varepsilon_i \\
\varepsilon_i \sim N(0, h^2_t) \\
h^2_t = w + \alpha \varepsilon^2_{t-1} + \gamma \varepsilon^2_{t-1} d + \beta h^2_{t-1} + \psi_1 \text{Vol}_t p + \psi_2 \text{VolMarket}_t + \psi_3 \text{VolTerm}_t \\
+ \psi_4 \text{VolSize}_t + \psi_5 \text{VolMomentum}_t
\]

(3)
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$V_t$ are the variables of interest, including default premium, the change in industrial production, the Fed interest rate, and inflation rate. $V_{t-1}$ is the first lag of these variables. $VP$ is the benchmark value premium. Market is the market risk premium. Term is the risk term premium, while Season is a vector for the seasonal effect for eleven months. D is a dummy variable = 1 if the observation in the period from November 2001 to July 2007 and =0 otherwise.

Table 1: Macro Economic Factors and Different Premia (With Leverage Effect)

$$
V_t = \mu + \delta_1 V_{t-1} + \phi_1 VP + \phi_2 Market + \phi_3 Term + \phi_4 Size + \phi_5 Momentum + \eta_i Season + \lambda h^i + \pi_i D + \epsilon_i \\
\epsilon_i \sim N(0, h^i) \\
h^i_i = w + \alpha \epsilon_{t-i} + \gamma \epsilon_{t-i}^2 d + \beta h^{t-i} + \psi_i (VolMarket) + \psi_i VolTerm + \psi_i VolSize + \psi_i VolMomentum
$$

The table presents the results from regressing four macroeconomic variables (default spread (Default), the change in industrial production ($\Delta$IP), the inflation rate (INF), and the effective federal interest rate (FED)) on different return premia over the period of 1954:07 to 2007:07. The explanatory variables include the first lag the dependent variable ($V_{t-1}$), the value premium ($VP$), the market premium ($Market$), term spread ($Term$), the size premium ($Size$), and the momentum. $A_i$ denotes an $i$th order ARCH LM test, $A_i \sim X^2_i$; $Q_i$ denotes an $i$th order Ljung-Box test for residual serial dependency; $Q_i \sim X^2_i$. The sample period is. $V_i$ denotes variables of interest. (*, **, ***) denote a coefficient that is significant at 1%, 5% and 10% levels respectively. VOLDEF, VOLInf, and VOLTerm denote the volatility of default, the inflation, and the term premium as estimated from GARCH model mean equation. D is a dummy variable = 1 if the observation in the period from November 2001 to July 2007 and =0 otherwise.

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>$\delta_1$</th>
<th>$\phi_1$</th>
<th>$\phi_2$</th>
<th>$\phi_3$</th>
<th>$\phi_4$</th>
<th>$\phi_5$</th>
<th>$\eta_1$</th>
<th>$\lambda$</th>
<th>$\pi_1$</th>
<th>$\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>-0.044</td>
<td>0.023**</td>
<td>0.042*</td>
<td>-0.221*</td>
<td>0.007</td>
<td>0.018*</td>
<td>0.218***</td>
<td>0.119***</td>
<td>0.021</td>
<td>0.013</td>
</tr>
<tr>
<td>$\Delta$IP</td>
<td>0.240*</td>
<td>-0.004</td>
<td>-0.002</td>
<td>-0.019</td>
<td>0.002</td>
<td>-0.004</td>
<td>-0.339**</td>
<td>-0.105</td>
<td>0.175***</td>
<td>-0.003</td>
</tr>
<tr>
<td>INF</td>
<td>0.362*</td>
<td>-0.005</td>
<td>-0.003</td>
<td>-0.008**</td>
<td>-0.006**</td>
<td>0.001</td>
<td>0.290*</td>
<td>1.388*</td>
<td>-0.203**</td>
<td>0.111*</td>
</tr>
<tr>
<td>FED</td>
<td>0.247*</td>
<td>-0.019</td>
<td>-0.105</td>
<td>-0.365</td>
<td>-0.086</td>
<td>0.199</td>
<td>0.585</td>
<td>0.049</td>
<td>2.375</td>
<td>0.154</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$\psi_1$</th>
<th>$\psi_2$</th>
<th>$\psi_3$</th>
<th>$\psi_4$</th>
<th>$\psi_5$</th>
<th>$Q^4$</th>
<th>$A^4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>0.267*</td>
<td>0.844*</td>
<td>-0.001*</td>
<td>0.001</td>
<td>0.001***</td>
<td>0.001***</td>
<td>0.001*</td>
<td>4.301</td>
<td>-0.018</td>
</tr>
<tr>
<td>$\Delta$IP</td>
<td>0.426*</td>
<td>0.658*</td>
<td>0.001</td>
<td>-0.001</td>
<td>-0.003***</td>
<td>-0.001</td>
<td>-0.001</td>
<td>35.509**</td>
<td>0.036</td>
</tr>
<tr>
<td>INF</td>
<td>-0.133*</td>
<td>0.923</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>4.198</td>
<td>-0.031</td>
</tr>
<tr>
<td>FED</td>
<td>0.113</td>
<td>0.536*</td>
<td>-0.079</td>
<td>-0.638***</td>
<td>-0.408</td>
<td>-0.592*</td>
<td>-0.040*</td>
<td>18.76</td>
<td>-0.013</td>
</tr>
</tbody>
</table>

The $VP$ estimates in Table (1) indicate to a positive association between value premium and default premium at 5% level of significance. Conversely, the results also indicate that the conditional volatility of value premium is negatively associated with the conditional variance of default premium at 1% level of significance. Although the default
premium increase as value premium do, the decrease in the risk related with value premium result in an increase in the risk related with default premium.

Moving to the market premium, the results confirmed a positive association with the default premium, which is consistent with the intuition that the increase in the market risks my increase the probability of default (for more detail, review Liu et al, 2007). Additionally, the conditional volatility of market premium has a negative association with the conditional variance of the change in the Federal interest rate. Furthermore, the term premium has a significant negative relationship with both the default risk premium and the change in the inflation. The predictability power for term premium for both the default and economic growth are supported by investigating the relationship between the conditional volatility of these variables. The \( \psi_3 \) estimates in Table (1) suggest that the conditional volatility of term premium has explanatory power for the conditional variance for both the default premium and the economic growth at 10% level.

Conversely, the size premium only shows a predictive power (negatively) for the inflation rate. The conditional volatility of the size premium is associated negatively with conditional variance of the Fed interest rate and positively with default risk premium at 1% and 10% respectively. Finally, the momentum premium and its conditional volatility are positively associated with the default risk premium and its conditional variance respectively. However, the conditional variance of momentum has a negative explanatory power for the Federal interest rate. Overall, the results indicate that risk premia have different and significant relationship with different macroeconomic risk factors. These results may lead us to support the risk explanations for return premia and invite us to wonder about the ability for this premia to predict macroeconomic growth.

### 5.2 Economic Growth and Risk Premia

Liew and Vassalou (2000) investigate whether book-to-market ratio, size, and momentum could be risk factors that forecast economic growth. Liew and Vassalou (2000) first run a univariate regression as follows:

\[
GDP_{growth_{(t+4)}} = a + b^* \text{Factor}_{tn_{(-4:t)}} + e_{(t+4)}
\]

Where GDP growth is growth rate for a country's GDP and \( \text{Factor}_{tn} \) is market, value, size, and momentum premia. Liew and Vassalou (2000) findings confirm a positive relationship between future economic growth and both value and size premia. However, the returns on the momentum strategy appear to contain little, if any, information about future economic growth. Furthermore, Liew and Vassalou (2000) run another regression model that includes business cycle variables and the market factor in addition to different premia:

\[
GDP_{growth_{(t+4)}} = a + b^* \text{MKT}_{tn_{(-4:t)}} + c^* \text{Factor}_{tn_{(-4:t)}} + d^* TB_{t} +
\]

\[
f^* DY_{t} + e_{(t+4)} + g^* \text{TERM}_{t} + h^* IDP_{growth_{(t-4:t)}} + q_{(t+4)}
\]

Where \( TB_{t} \) is the Treasury Bill yield or Call Money Rate; \( DY_{t} \) is dividend yield on country market capitalization index; \( \text{TERM}_{t} \) is ten-year government yield minus one month treasury bill yield; \( IDP_{growth_{(t-4:t)}} \) is past one-year growth in country industrial production;
and \(q_{t,t+12}\) are the residuals of the regression. Again, the previous results are confirmed; both the value premium and size premium have positive relationships with future economic growth.

We expand Liew and Vassalou (2000) work by using monthly data instead of quarterly data and covering a longer time period from July 1954 to July 2007. The default premium is added to the Liew and Vassalou (2000) model to proxy for financial distress risk. The Fed interest rate as a proxy for the liquidity crisis is also added. Moreover, the change in industrial production is used as a proxy for economic growth, since the GDP information is not available in monthly data format. Also, both GARCH methods and OLS are used in running the regression. The regressions take the following form:

\[
\Delta IP_{t+12} = a + b \cdot MKT_{t-12} + c \cdot FactorRet_{t-12} + d \cdot TB_t +
\]

\[
f \cdot DY_t + g \cdot TERM_t + h \cdot FED_t + j \cdot Default_t + q_{t,t+12}
\]

(6)

Where \(\Delta IP\) is the economic growth as proxied by the change in industrial production; \(MKT\) is the monthly market premium as the difference between market portfolio rate of return and the risk-free rate; \(FactorRet\) stands for the rate of return on value, size, and momentum strategies; \(TB\) is the Treasury bill yield; \(DY\) is dividend yield on market capitalization index; \(TERM\) is the difference between the rate of return of 30 years-government bonds and \(TB\); \(Fed\) is the Federal interest rate; \(Default\) is the default premium as the difference between the yield on long term corporate bonds and the rate of return of long term governmental bond; and \(q\) are the residuals of the regression. The variables are rebalanced annually. Since, variables are observed at monthly frequencies, thus consecutive annual rates have eleven overlapping months. This induces serial correlation in the residuals of our regressions. To correct for this, we follow Liew and Vassalou (2000) approach using the Newly - West (1987) estimators and set the parameter equal to three.

### 5.2.1 Univariate Analysis

The Ordinary Least Squares (OLS) methodology is applied to estimate the model illustrated in equation (6) in different univariate regressions. The results reported in Table (2) indicate that the value premia, term premium or size premium cannot explain the future economic growth as proxied by the annual growth of industrial production. However, the market premium estimates in Table (2) confirms the results of Fama (1981), Aylward and Glen (2000), and Liew and Vassalou (2000) who report a positive and statistically significant relationship between the market factor and future economic growth in both the U.S and international context.

Moreover, the Momentum premium estimates in Table (2) are negatively associated with the economic growth. This may indicates that the winners convert to be losers when the economy slowdowns. Similarly, business cycle variables including Fed interest rate, Treasury- bills yield, and dividend yield have negative relationships with the economic growth. This suggests that the decrease in these variables enhance the economic growth. These could explain the race between different central banks in decreasing the interest rates to face the recessions and financial crises. In the same context, the
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reported positive relationship between economic growth and default premium implies that the increase in default risk may predict future economic growth. In the rebalancing periods, the decrease in the government bonds interest rate, especially short term interest rates, with relatively high corporate bonds interest rate may enhance the prosperity of this corporate sector and help the economics to recover.

Table 2: Economic Growth and Different Anomalies, Univariate Regressions Using the OLS

\[
\Delta IP_{(t,t+12)} = a + b \times MKT_{(t-12,t)} + c \times FactorRe_{t(t-12,t)} + d \times TB_{t} + f \times DY_{t} + g \times TERM_{t} + k \times FED_{(t-12,t)} + j \times Default_{(t-12,t)} + q_{(t,t+12)}
\]

Where \( \Delta IP \) is the economic growth as proxied by the change in industrial production; \( MKT \) is monthly market premium as the difference between market portfolio rate of return and the risk-free rate; \( FactorRe \) stands for the rate of return on value, size and momentum strategies; \( TB \) is the Treasury bill yield; \( DY \) is dividend yield on market capitalization index; \( Term \) is the difference between the rate of return of 30 years-government bonds and \( TB; Fed \) is the federal interest rate; \( Default \) is the default premium as the difference between the yield on long term corporate bonds and the rate of return of long term corporate bond; and \( q \) are the residuals of the regression.

<table>
<thead>
<tr>
<th>Market</th>
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<th>LVP</th>
<th>SVP</th>
<th>Size</th>
<th>Momentum</th>
<th>TB</th>
<th>DY</th>
<th>Term</th>
<th>Fed</th>
<th>Default</th>
<th>( R^2 ) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.138*</td>
<td>-0.026</td>
<td>-0.023</td>
<td>-0.01</td>
<td>-0.002</td>
<td>-0.088**</td>
<td>-0.14</td>
<td>-0.072</td>
<td>0.09</td>
<td>-0.048*</td>
<td>0.353**</td>
<td>15.11 0.2 0.1 -1 3.59 13.57 5.38 0.06 14.39 3.14</td>
</tr>
</tbody>
</table>

5.2.2 Multivariate analysis

5.2.2.1 Estimates of ordinary least squares method

To run multivariate versions of the equation (6), the dividend yield is excluding from the model because the dividend yield data is not available before 1965 and the results of the multivariate model for the period of March 1965 to July 2007 shows that the dividend yield cannot explain the change in industrial production. This invites us to believe that omitting the dividend yield from the model will not affect the goodness fit of our model.15 The new model is as follows:

\[
\Delta IP_{(t,t+12)} = a + b \times MKT_{(t-12,t)} + c \times FactorRe_{t(t-12,t)} + d \times TB_{t} + f \times TERM_{t} + k \times FED_{(t-12,t)} + j \times Default_{(t-12,t)} + q_{(t,t+12)}
\]
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Table (3) shows a negative coefficient for the moment premium. This momentum premium effect is absorbed by including the business cycle variables in the model. As expected, the business cycle factors show a predictability power for economic growth. In detail, both the treasury-bills interest rate and Federal Reserve interest rate are negatively associated with the economic growth. This indicates that the economic growth positively responds to the reduction in the interest rates during the liquidity crisis periods. This evidence increases our trust in the effectiveness of using the reductions in the federal interest rate to overcome the liquidity crisis and to enhance the economic growth. Finally, the market premium, the term premium and default spread have positive associations with the economic growth. However, including the momentum in the model absorb the explanatory power of default spread. This finding invites us to wonder about the relationship between the momentum strategy and default spread. Investigation this relationship is out of this paper interest, however, it could be a possible further research opportunity.  

Table 3: Economic Growth and Different Anomalies (Multivariate OLS Regressions)

\[
\Delta IP_{t+12} = a + b \times MKT_{t-12} + c \times FactorRet_{t-12} + d \times TB_t + g \times TERM + k \times FED_{t-12} + j \times Default_{t-12} + q_t
\]

Where \( \Delta IP \) is the economic growth as proxied by the change in industrial production; \( MKT \) is monthly market premium as the difference between market portfolio rate of return and the risk-free rate; \( FactorRet \) stands for the rate of return on value, size and momentum strategies; \( TB \) is the Treasury bill yield; \( Term \) is the difference between the rate of return of 30 years government bonds and \( TB \); \( Fed \) id the Federal interest rate; \( Default \) is the default premium as the difference between the yield on long term corporate bonds and the rate of return of long term corporate bond; and \( q \) are the residuals of the regression.

<table>
<thead>
<tr>
<th>Market</th>
<th>VP</th>
<th>Size</th>
<th>Momentum</th>
<th>TB</th>
<th>Term</th>
<th>Fed</th>
<th>Default</th>
<th>Adjusted ( R^2 ) (%)</th>
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</thead>
<tbody>
<tr>
<td>0.146*</td>
<td>0.03</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.3</td>
</tr>
<tr>
<td>0.138*</td>
<td>0.002</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.82</td>
</tr>
<tr>
<td>0.131*</td>
<td>-0.074**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.43</td>
</tr>
<tr>
<td>0.134*</td>
<td>0.01</td>
<td>0.002</td>
<td>-0.070**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.23</td>
</tr>
<tr>
<td>0.142*</td>
<td>0.01</td>
<td></td>
<td>-0.074</td>
<td>0.131***</td>
<td>-0.032*</td>
<td>0.249**</td>
<td></td>
<td>33.59</td>
</tr>
<tr>
<td>0.139*</td>
<td>-0.005</td>
<td></td>
<td>-0.075*</td>
<td>0.135**</td>
<td>-0.031*</td>
<td>0.262**</td>
<td></td>
<td>35.55</td>
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<tr>
<td>0.136*</td>
<td>-0.045</td>
<td></td>
<td>-0.076*</td>
<td>0.133**</td>
<td>-0.030*</td>
<td>0.195</td>
<td></td>
<td>34.4</td>
</tr>
<tr>
<td>0.136*</td>
<td>0</td>
<td>-0.003</td>
<td>-0.045</td>
<td>-0.076*</td>
<td>0.132***</td>
<td>-0.030*</td>
<td>0.196</td>
<td>34.19</td>
</tr>
</tbody>
</table>

5.2.2.2 Estimates from using a TARCH model

Using the TARCH models give many advantages. The first advantage is that the TARCH models can deal with non-normal distributed variables and can capture nonlinearity. Second, the TARCH model measures the leverage effect. Finally, the TARCH models
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help to determine whether the dependent variable is time-varying or not. The TARCH model version of equation (7) is illustrated as follows:

$$\Delta IP_{t,t+12} = a + b * MKT_{t-1|t} + c * FactorRet_{t-1|t} + d * TB_t$$
$$+ g * TERM_{t,k} + k * FED_{t-1|t} + j * Default_{t-1|t} + q_{t,t+12}$$

$$\epsilon_t : N(0,h_t^2)$$

$$h_t^2 = w + \alpha e_{t-1}^2 + \beta h_{t-1}^2 + \gamma e_{t-1}^2 d$$

Where ($\alpha$) measures the effect of volatility shock in period (t-1) on volatility on period (t), and ($\alpha + \beta$) measures the speed at which this effect dies away. Moreover, $d_t = 1$ if $\epsilon_{t-1} < 0$ otherwise $d_t = 0$. The parameter ($\gamma$) measures the leverage effect on value premium. The impact of good news is given by $\alpha$ and the impact of bad news by ($\alpha + \gamma$).
Table 4: Economic Growth and Different Anomalies Using TARCH Model

\[ \Delta IP_{(t+12)} = a + b * MKT_{(t+12)} + c * FactorRet_{(t+12)} + d * TB_t + g * TERM_t + k * FED_{(t+12)} + j * Default_{t-1} + q_{(t+12)} \]

\[ \epsilon_t^2 : N(0, h_t^2) \]

\[ h_t^2 = w + \alpha \epsilon_{t-1}^2 + \beta h_{t-1}^2 + \gamma \epsilon_{t-1}^2 d \]

Where \( \Delta IP \) is the economic growth as proxied by the change in industrial production; \( MKT \) is monthly market premium as the difference between market portfolio rate of return and the risk-free rate; \( FactorRet \) stands for the rate of return on value, size and momentum strategies; \( TB \) is the Treasury bill yield; \( Term \) is the difference between the rate of return of 30 years government bonds and \( TB \); \( Fed \) id the Federal interest rate; \( Default \) is the default premium as the difference between the yield on long term corporate bonds and the rate of return of long term corporate bond; and \( q \) are the residuals of the regression.


<table>
<thead>
<tr>
<th>Market</th>
<th>VP</th>
<th>Size</th>
<th>Momentum</th>
<th>TB</th>
<th>Term</th>
<th>Fed</th>
<th>Default</th>
<th>( \gamma )</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.078*</td>
<td>0.032*</td>
<td>-0</td>
<td>-0.019*</td>
<td>-0.020*</td>
<td>-0.004</td>
<td>-0.018*</td>
<td>0.052**</td>
<td>0.191</td>
<td>20.26</td>
</tr>
</tbody>
</table>

### Panel B: Including the first lag of the dependent variable

\[ \Delta IP_{(t+12)} = a + bL \Delta IP_{(t+12)} + bMKT_{(t+12)} + c * FactorRet_{(t+12)} + d * TB_t + g * TERM_t + k * FED_{(t+12)} + j * Default_{t-1} + q_{(t+12)} \]

\[ \epsilon_t^2 : N(0, h_t^2) \]

\[ h_t^2 = w + \alpha \epsilon_{t-1}^2 + \beta h_{t-1}^2 + \gamma \epsilon_{t-1}^2 d \]

<table>
<thead>
<tr>
<th>Market</th>
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<th>Size</th>
<th>Momentum</th>
<th>TB</th>
<th>Term</th>
<th>Fed</th>
<th>Default</th>
<th>( \gamma )</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.005</td>
<td>0.962*</td>
<td>0.004</td>
<td>-0.003</td>
<td>-0.009*</td>
<td>0.013**</td>
<td>0.018</td>
<td>-0.001</td>
<td>0.059*</td>
<td>0.081</td>
<td></td>
</tr>
</tbody>
</table>

### Panel C: Using Bootstrap methodology

<table>
<thead>
<tr>
<th>Market</th>
<th>VP</th>
<th>Size</th>
<th>Momentum</th>
<th>TB</th>
<th>Term</th>
<th>Fed</th>
<th>Default</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.122*</td>
<td>0.009</td>
<td>-0</td>
<td>-0.027</td>
<td>-0.086*</td>
<td>0.05</td>
<td>0.016**</td>
<td>0.123</td>
<td>0.061</td>
</tr>
</tbody>
</table>

In contrast with the ordinary least squares regressions results, the TARCH results reported in Table (4, Panel A) indicate that both value premium and momentum have a negative explanatory power for the economic growth. Additionally, the results reported in Table (4, Panel A) support the OLS results reported in Table (3) with respect to the explanatory power of market premium, and treasury–bill yields and federal interest rate for the future economic growth. However, the term premium loses its predictability power. The findings also indicate a negative relationship between default spread and future economic growth. These results are consistent with the findings of Liew and Vassalou (2000) who report that both the value and size premium contain significant information about the future economic growth (for the period of July 1978 to July 1996), and that information is similar in nature to the information contained in popular business cycle variables. Altogether the results appear to support the hypothesis of Fama and French (1992, 1993, 2006, 2007) that both value and size premium are working as state variables in the context of inter-temporal capital assets pricing model, as these variables can predict the changes in the investment opportunity set.
The contradiction between the OLS results and the TARCH findings could be explained by the auto-correlation structures of GARCH models (for more detail, see Francq and Zakoian (2000)). To test for the serial correlation we use the Ljung-Box Q-statistics and their p-values. The Q-statistics capture serial correlation in the residuals. Even after applying Bollerslev and Wooldridge (1992) methodology, the squared residuals have some auto-correlations. One way of further examining the distribution of the residuals is to plot the quantiles. Theoretical quantile-quantile plot (QQ-plot) is used to assess whether the data in a single series follow a specified theoretical distribution; e.g. whether the data are normally distributed (Cleveland, 1994). If the errors have a normal distribution, the QQ-plot should lie on a straight line. If the QQ-plot does not lie on a straight line, the two distributions (errors distribution and theoretical/normal distribution) differ along some dimensions. The pattern of deviation from linearity provides an indication of the nature of the mismatch. Plot (1) indicates that it is primarily large negative and positive shocks that are driving the departure from normality.

Two different methods are applied to deal with the auto-correlation problem. The first method is to include the first lag of the dependent variable in the analysis as an additional explanatory variable. The second method is applying the Bootstrap methods to generate statistical inferences. Using the first lag of the economic growth as an explanatory variable in the equation (8) yield the following equation:

$$
\begin{align*}
\Delta IP_{t+12} &= a + bL\Delta IP_{t+12} + b*MKT_{t-12,t} + c*Factort_{t-12,t} + d*TB_t \\
&+ g*TERM_{t} + k*FED_{t} + j*Default_{t} + q_{t}(t+12) \\
\varepsilon_t : N(0,h_t^2) \\
h_t^2 &= w + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \gamma \varepsilon_{t-1}^2 d
\end{align*}
$$

Where $L\Delta IP_{t+12}$ is the first lag of the annual growth in the industrial production where $L\Delta IP_{t+12} = \Delta IP_{t-12,t+11}$. The results illustrated in Table (4, panel B) show that including the first lag of the dependent variable absorbs the explanatory power of the market premium, value premium, and federal interest rate. In addition, there is evidence for a leverage effect in the model. All other results are similar to those of the original model in Panel A.
Following Davison and Flachaire (2008) and Ioannidis and Peel (2005), we apply the wild bootstrap method with reference to equation (8). Firstly, equation (8) is estimated by the TARCH method. Then, the residuals estimated of this regression ($\hat{q}_{(i,t+12)}$) is used to generate a new series of residuals as follows:

$$u^*_t = f(\hat{q}_{(i,t+12)}) \varepsilon_t,$$

(9)

Where $f(\hat{q}_{(i,t+12)}) \varepsilon_t$, is a transformation of the TARCH residual ($\hat{q}_{(i,t+12)}$) and the ($\varepsilon_t$) are mutually independent drawings, completely independent of the original data, from an auxiliary two-point distribution has the following properties:
Thus, for each bootstrap sample, the exogenous explanatory variables are reused unchangeably, as are the TARCH residuals \( \hat{q}_{(t+12)} \) from the estimation using the original observed data. Consequently, any non-normality and heteroskedasticity in the estimated residuals \( \hat{q}_{(t+12)} \) is preserved in the created residuals \( u_{t+}^* \). We create 10,000 sets of residuals. The results displayed at Panel (c) of Table (4) are similar to the findings of the Least Squares model reported in Table (3). There is no evidence that value premium, size premium or momentum can predict the economic growth. However there is strong evidence that the liquidity crisis can predict the economic growth.

### 5.2.2.3 Estimates of GARCH in mean model

The variance for economic growth is added to the main equation (8). The new equation is:

\[
\begin{align*}
\Delta P_{(t+12)} &= a + b \cdot MKT_{(t-12,t)} + c \cdot FactorRe t_{(t-12,t)} + d \cdot TB_t \\
+ g \cdot TERM_{t} + k \cdot FED_{(t-12,t)} + j \cdot Default_{(t-12,t)} + \lambda h_t^2 + q_{(t+12)}^* \\
\epsilon_t &\sim N(0, h_{t+1}^2) \\

h_t^2 &= w + \alpha \epsilon_{t-1}^2 + \beta h_{t-1}^2 + \gamma \epsilon_{t-1}^2 d
\end{align*}
\]

Where \( h_t^2 \) is the conditional variance for the period \( t \). We replicate our previous analysis for equation (8) on equation (12). The findings reported in Table (5) Panels A, B, and C supported our previous findings. There is no evidence that value premium, size premium or momentum can predict the economic growth. However there is strong evidence that the liquidity crisis can predict the economic growth. The single difference that the findings show a strong leverage effects on all panels. Furthermore, the variance estimates Table (5) suggest that the economic growth is time-varying variable.
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Table Error! No text of specified style in document.: Economic Growth and Different Anomalies Using TARCH-In Main Model

\[
\Delta \text{IP}_{(t,.12)} = a + b \times \text{MKT}_{(t,-12)} + c \times \text{FactorRet}_{t(12,t)} + d \times \text{TB}_t \\
+ g \times \text{TERM}_t + k \times \text{FED}_{(t-12.t)} + j \times \text{Default}_{t-1} + \lambda h_t^2 + q_j(t_{(t+12)}) \\
\varepsilon_t : N(0, h_t^2) \\
h_t^2 = w + \alpha \varepsilon^2_{t-1} + \beta h_{t-1}^2 + \gamma \varepsilon^2_{t-1} d
\]

Where \( \Delta \text{IP} \) is the economic growth as proxied by the change in market portfolio rate of return and the risk-free rate; \( \text{FactorRet} \) stands for the rate of return on value, size and momentum strategies; \( \text{TB} \) is the Treasury bill yield; \( \text{Term} \) is the difference between the rate of return of 30 years- government bonds and \( \text{TB} \); \( \text{Fed} \) is the Federal interest rate; \( \text{Default} \) is the default premium as the difference between the yield on long term corporate bonds and the rate of return of long term corporate bond; and \( q \) are the residuals of the regression.

<table>
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<td>Momentum</td>
<td>TB</td>
<td>Term</td>
<td>Fed</td>
<td>Default</td>
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<tr>
<td>---------------------</td>
<td>---------------</td>
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<td>--------------</td>
<td>-------------</td>
<td>--------------</td>
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</tr>
<tr>
<td></td>
<td>0.036*</td>
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<td>0.038*</td>
<td>0.029*</td>
<td>-0.034</td>
<td>0.01</td>
<td>-0.033*</td>
<td>0.046**</td>
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<tr>
<td>Panel B: Including the first lag of the dependent variable</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>
| \( \Delta \text{IP}_{(t,.12)} = a + \beta L \Delta \text{IP}_{(t,.12)} + b \times \text{MKT}_{(t-12,t)} + c \times \text{FactorRet}_{t(12,t)} + d \times \text{TB}_t \\
+ g \times \text{TERM}_t + k \times \text{FED}_{(t-12,t)} + j \times \text{Default}_{t-1} + \lambda h_t^2 + q_j(t_{(t+12)}) \\
\varepsilon_t : N(0, h_t^2) \\
h_t^2 = w + \alpha \varepsilon^2_{t-1} + \beta h_{t-1}^2 + \gamma \varepsilon^2_{t-1} d
\]

<table>
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<th>Market</th>
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<th>TB</th>
<th>Term</th>
<th>Fed</th>
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<th>( \gamma )</th>
<th>( R^2 ) (%)</th>
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<td>0.004</td>
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<td>-0.013*</td>
<td>0.02</td>
<td>-0.001</td>
<td>-0.062*</td>
<td>0.074***</td>
<td>0.072***</td>
<td>93.23</td>
</tr>
<tr>
<td>Panel C: using Bootstrap methodology</td>
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<th>TB</th>
<th>Term</th>
<th>Fed</th>
<th>Default</th>
<th>( \lambda )</th>
<th>( \gamma )</th>
<th>( R^2 ) (%)</th>
</tr>
</thead>
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<td></td>
<td>0.122*</td>
<td>0.009</td>
<td>-0.027</td>
<td>-0.086*</td>
<td>0.05</td>
<td>-0.016**</td>
<td>0.123</td>
<td>-1.578*</td>
<td>0.0433*</td>
<td>16.81</td>
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</tbody>
</table>

6. Conclusion

This paper provides an analysis of the relationship between market risk premia and non-diversible macroeconomic risk factors using GARCH models in order to inform us about variations in the conditional volatility of the additional variables. This allows for an investigation of the associations between both the mean value of variables and the volatility of these variables. An examination of the predictability associated with risk premia for future economic growth also took place. The findings suggest that return premia explain macroeconomic risk factors in different patterns. This may suggest that these premia are proxy for fundamental risk factors and also support the rational explanation for these premia. In detail, the findings suggest that the value premium can positively explain the default premium; however the conditional volatility of value
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premium is negatively associated with the conditional variance of default. This means that; however, the default premium increase as value premium do, the decrease in the risk related with value premium result in an increase in the risk related with default premium.

Furthermore, the results confirm a positive association between the market premium and the default premium in consistent with the intuition that the increase in the market risks my increase the probability of default (for more detail, review Liu et al, 2007). Additionally, the conditional volatility of market premium has a negative association with the conditional variance of the change in the Federal interest rate. Furthermore, the term premium has significantly negative relationship with both the default risk premium and the change in the inflation. The predictability power of the term premium for both the default and economic growth are supported by investigating the relationship between the conditional volatility of these variables. Conversely, the size premium only shows a predictive power (negatively) for the inflation rate, while its conditional volatility is associated negatively with conditional variance of the Fed interest rate and positively with default risk premium.

Finally, the momentum premium and its conditional volatility are positively associated with the default risk premium and its conditional variance respectively. However, the conditional variance of momentum has a negative explanatory power for the Federal interest rate. Overall, the results indicate that the risk premia have different and significant relationship with different macroeconomic risk factors. All the previous findings, which highlight an association between different premia and macroeconomic factors, motivate us to investigate the predictability power of the risk premium for the future economic growth. We find evidence that the momentum can predict the economic growth. However, we cannot find any similar evidence for both value and size premium. These results are consistent with Liew and Vassalou (2000) who report a predictability power for value and size premia in international data but they do not find this predictability power in the U.S data with except for the period of July 1978 to July 1996. This may mean that the failure of risk premia to predict the economic growth is specified to the U.S market. This creates needs to do more investigation to our model in international context and also in different time periods which will be one our further research interest. The empirical work in this paper contributes to our knowledge by providing additional evidence for the positive association between Macroeconomic conditions (as proxied by default, inflation, and the change in industrial production) and different risk premia (momentum, size and value premia). This appears to support the rational explanation for the return premia which may act as a proxy for fundamental risk.

Endnotes

1 The size premium is defined by Fama and French (1992, 1993) as a rate of return on a zero- investment portfolio, which is long on small market equity stocks and short on big market equity stocks. The value premium is a rate of return on a zero- investment portfolio, which is long on with stocks which have large book-to-market ratio( value stocks) and short on low book-to-market stocks ( growth stocks).

2 Although the GDP is widely used in the literature as a proxy for the economic growth, it is also common in the literature to use the change in the industrial production as a proxy for the economic growth in the monthly data because of the unavailability of GDP in monthly data [for example, see Black and McMillan (2004) and Mouselli (2008)]. Furthermore, Andreou et al. (2000) argue that the Industrial production accounts for 26.6% of the UK GDP in 1995 and 25.9% for the US in 1996.
3 The period of July 1954 to July 2007 is the longest available set of data for all of variables of interest before the last financial crisis.
4 According to Fama and French (1993), the treasury-bill rate is supposed to proxy for the general level of expected returns on bonds so that term premium proxies for the deviation of long-term bond returns from expected returns due to shifts in interest rates. While the default premium is a proxy for the change in the economic conditions that modify the default likelihood.
5 I thank Kenneth French for making the data available on his website: http://mba.tuk.dartmouth.edu/pages/ken.french/.
6 The Augmented Dickey-Fuller (ADF) is used to test the unit root in the data. The results indicate that all variables contain a single unit root in the level, thus we differentiate all the variables. The results of the Augmented Dickey-Fuller (ADF) indicate that the first differences of all variables are stationary. All results are available upon request.
7 The variance equation in GARCH model has non-linear structure.
8 Residuals are found to be non-conditionally normally distributed, thus the Quasi-Maximum Likelihood (QML) are calculated by the method described by Bollerslev and Wooldridge (1992) for heteroscedasticity consistent variance. The only change in the default regression is that the term premium conditional variance loses some explanatory power as its significance level turns from 5% to be 10%. Wherever, the term premium loses its explanatory power for the DIP.
9 The seasonal effects for months from March and April are significant at 10% level.
10 Following Engel (2001) we test for autocorrelations of squared standardized residuals indicates. There is no evidence for serial correlation in the model.
11 The dividends data are only available for the period of March 1965 to July 2007. Thus, for the multivariate models, we run two different versions for every regression. The first version covers the period of March 1965 to July 2007including the dividends. The dividends is excluding from the second version, which executed for the period of July 1954 to July 2007.
12 Resetting the parameter q in the Newly-West estimator at alternative values of 4, 5 or 6 produce qualitatively the same results.
13 Liew and Vassalou (2000) report insignificant negative association between momentum and economic growth. This may be due to the short time period used by them.
14 The dividend data are only available from the period of March 1965 to July 2007.
15 The dividend data are only available from the period of March 1965 to July 2007. Thus, we remove the dividend from the multivariate regression. We run a multivariate regression for the period of March 1965 to July 2007 including the dividend, however the log likelihood ratio for redundant variables was 0.769 with probability 0.3845 indicate that the dividend cannot explain the economic growth and can be omitted from the model. All results are available up on request.
16 There is a negative correlation between the annual momentum rate of return and the annual default spread. The correlation coefficient is -0.335.

References


