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Flight to quality, consumption volatility, and credit spread

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Abstract

The interdependence of finance and real economic activities has always been at the center of debate among academics, policymakers, and the general public. We study how the risk premium in bond markets, measured by credit spread, is affected by consumption volatility, and how credit market conditions, measured by credit spread level and volatility, affect consumption growth. Aided by a multivariate GARCH-M model, we evaluate these two effects simultaneously. We find that credit spread widens when consumption volatility increases or when consumption growth decreases. In addition, consumption growth tends to decrease when the credit spread increases or becomes more uncertain. We contribute to the consumption-based asset pricing literature by evaluating the effect of consumption volatility on the risk premium, and to the financial accelerator literature by testing credit spread volatility.

1. Introduction

Uncertainty about the economic environment has been regarded as the trigger for investors' preference shifts from risky assets to less risky assets; this is commonly referred to as a "flight-to-quality" episode.

> *"When confronted with uncertainty, especially Knightian uncertainty, human beings invariably attempt to disengage from medium to long-term commitments in favor of safety and liquidity. . . ." Alan Greenspan (2004)*

For example, the recent financial crisis in 2008 was characterized by deteriorating credit market conditions and uncertain economic growth. Amid such uncertainty, investors become increasingly risk-averse, an attitude that is reflected in a surge in the bond credit spread (the yield difference between Baa corporate bonds and treasury benchmarks) of around 400 basis points.

While uncertainty about the economic environment could widen the credit spread, it is also plausible that a deteriorating credit market could lead to further economic contraction. Thus, it is crucial to study these two-way channels simultaneously. The latter circumstance was first brought up by Bernanke and Gertler (1989), who described such a mechanism as the financial accelerator mechanism. Facing high uncertainty in the credit market, investors would reduce their demand for risky bonds, causing a large reduction in the credit supply. With shrinking credit availability, asset prices tend to drop, and economic activities slow down.

In this study, motivated by the two related but distinct phenomena described above, we empirically test whether uncertainty about economic conditions has a negative effect on credit spread. Concurrently, we test whether the volatility of the credit spread would generate downward pressure on the economy. We use consumption growth volatility to measure the uncertainty about the economic condition. We measure the credit spread as the yield difference between Baa-rated bonds and Treasury bonds with matching time to maturity, where ratings are based on Moody's.

The adoption of aggregate consumption volatility as a proxy for economic uncertainty is well-supported by the consumption-based asset pricing literature. Models in line with Epstein and Zin's (1989) type of utility function take into account not only the level of aggregate consumption, but also the volatility of consumption in determining the stochastic discount factor, and hence, asset prices. Since consumption volatility measures the uncertainty surrounding investors' forecasts of macroeconomic growth, it serves as a good proxy for the economic uncertainty in our study.

In addressing the simultaneous nature of these two hypotheses while incorporating a sensible measure of uncertainty, this paper presents an estimation model that effectively combines a reduced-form vector autoregression for consumption growth and credit spread, with a multivariate GARCH-M model. This model fits our purpose for the following compelling reasons: First, GARCH directly models the variance of the stochastic innovation term in a variable. In this way, we are able to test whether movement in the conditional variance of a variable over time is statistically significant. Second, the GARCH-M specification is a traditional candidate for testing the uncertainty impact of one variable on its conditional mean. Third, if the variables of interest exhibit significant conditional heteroscedasticity, then OLS estimation would be inefficient. As shown by Engle (1982), when conditional heteroscedasticity exists, using ARCH instead of OLS could achieve larger gains in efficiency. Fourth, and most important, employing a multivariate GARCH-M framework allows us to test our two hypotheses simultaneously, rather than estimating them one at a time. This provides us with a more comprehensive picture of the channels through which consumption volatility and credit risk influence each other. In addition, simultaneous estimation, as shown by Pagan (1984), achieves efficiency gains compared to a two-step process.

Using monthly consumption and credit yield data in the United States from 1959 to 2013, we find evidence that uncertainty of consumption growth positively affects credit spread. For instance, a one standard deviation increase in consumption growth volatility contributes to an increase in credit spread of around 0.65 percentage points. In addition, consumption growth level is negatively related to credit spread. For example, a one standard deviation decrease in consumption growth level leads to an increase in credit spread of around 0.272 percentage points. We also find that the deteriorating credit market condition reduces consumption growth. When credit spread increases or becomes more volatile, consumption growth tends to decrease. Moreover, our results show that uncertainty in consumption growth and credit spread have negative effects on their levels.

This study directly relates to recent studies on consumption volatility and the bond market risk premium. Although the literature directed at empirically estimating the relationship between consumption and the risk premium is vast, many studies focus on the level of consumption rather than on volatility, and they study the stock market rather than the bond market. Boguth and Kuehn (2013) focus on the cross-sectional implications of consumption volatility on stock returns. Tédongap (2015) compares the differential impacts of consumption level and volatility on stock returns. The study shows that the risk premium attributable to consumption volatility increases over time, while the risk premium attributable to consumption level decreases over time. Bollerslev et al. (2015) find that consumption volatility exhibits greater persistency than economic uncertainty, measured by consumption volatility-of-volatility, and negatively relates to long-run growth shocks. In contrast to these studies, we focus on the risk premium in bond markets.

This study also contributes to the literature on the real effect of the financial market uncertainty. Bernanke and Gertler (1989), Kiyotaki and Moore (1997), Bernanke et al. (1999), Hall (2010), and others emphasize the financial accelerator mechanism, which shows that a reduction in credit availability introduces an unfavorable change in financial conditions, which in turn impose significant adverse consequences on macroeconomic outcomes. With our multivariate GARCH-M model, we are able to directly evaluate the effects of both credit spread level and volatility on consumption growth.

2. Empirical Analysis

We estimate a bivariate GARCH-M system for credit spread and consumption growth to test our hypothesis. This framework allows us to simultaneously estimate equations for the means of the credit spread and consumption growth that include the conditional variance of both series as regressors, along with the time-varying residual covariance matrix.

This multivariate GARCH model can be parameterized in different ways. We choose to use the classic BEKK specification of Enger and Kroner (1995). The BEKK specification reduces the parameter dimension of the original VECH model through certain identification assumptions. Besides, there are other ways to parameterize the bivariate GARCH system, for instance, the DCC model of Engle (2002) and Engel and Sheppard (2001), and the DECO model of Engle and Kelly (2009). Each of these newer models reduce the parameter dimension of the earlier ones. These newer specifications, however, require certain restrictions on parameter space, and these restrictions should be tested ex ante. For example, the DCC model requires testing the dynamic correlation structure. We avoid this issue by using relatively general specifications.

Let y_t represent the credit spread at time t, with $c_t = \log\left(\frac{C_t}{C_{t-1}}\right) \times 100$ being the consumption growth. We model y_t and c_t as a VAR (1) system. We have to rule out the possibility that y_t and c_t contain unit roots before we estimate them as a VAR system. We test our hypothesis within the following bivariate GARCH-M framework:

$$X_t = \mu + \Gamma X_{t-1} + \Psi\sqrt{h_t} + \epsilon_t \tag{1}$$

$$\epsilon_t \sim N(0, H_t)$$

$$H_t = C_0^{*\prime} C_0^* + A_{11}^{*\prime} \epsilon_{t-1}\epsilon_{t-1}^{\prime} A_{11}^* + B^{*\prime}_{11} H_{t-1} B_{11}^* \tag{2}$$

where $X_t = (y_t, c_t)'$, $\epsilon_t = (\epsilon_{y,t}, \epsilon_{c,t})'$, $\sqrt{h_t} = \left(\sqrt{h_{y,t}}, \sqrt{h_{c,t}}\right)'$, $\mu = (\mu_y, \mu_c)'$, $\Gamma = \begin{pmatrix} \Gamma_{11} & \Gamma_{12} \\ \Gamma_{21} & \Gamma_{22} \end{pmatrix}$, $\Psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}$, $H_t = \begin{pmatrix} h_{y,t} & h_{yc,t} \\ h_{yc,t} & h_{c,t} \end{pmatrix}$, $C_0^* = \begin{pmatrix} c_{11}^* & c_{12}^* \\ 0 & c_{22}^* \end{pmatrix}$, $A_{11}^* = \begin{pmatrix} \alpha_{11}^* & \alpha_{12}^* \\ \alpha_{21}^* & \alpha_{22}^* \end{pmatrix}$, $B_{11}^* = \begin{pmatrix} \beta_{11}^* & \beta_{12}^* \\ \beta_{21}^* & \beta_{22}^* \end{pmatrix}$.

The conditional mean equation (1) indicates that consumption growth is determined by its previous values, as well as lagged credit spread and lagged "shocks" to credit spread; the same holds true for credit spread. This general specification assumes the interdependence of consumption level and credit spread level.

The conditional variance equation (2) is the standard BEKK specification. The current conditional variance of one variable in the BEKK specification depends not only on its lagged innovation from the conditional mean equation and the previous conditional variance but also on the previous innovation and conditional variance of the other variable as well as the lagged covariations. This specification gives us a richer, more generalizable dynamic of the underlying uncertainty compared to running the specifications separately into two univariate GARCH processes, which is nested in this general setting.

3. Data

Our empirical study is based mainly on two variables: aggregate consumption and the credit spread. The monthly aggregate consumption data is taken from the NIPA tables, which are available from the Bureau of Economic Analysis. Aggregate consumption is measured as the seasonally adjusted real per capita consumption of nondurable goods plus services. We use monthly consumption data from the post-war period between 1959 and 2012, which, given the monthly frequency, provides the longest range of data available. Bond credit spread, as measured by the Baa–10-year treasury yield spread is drawn from Fred Economic Data maintained by the Federal Reserve Bank of St. Louis. Again, we use monthly spread data covering the period from 1959 to 2012.

*** Figure 1 goes around here***

*** Figure 2 goes around here***

Table 1 shows the summary statistics and some preliminary diagnostic tests. The time series mean of the credit spread level is 1.946 percentage points with a variance of 0.693. It is positively skewed and leptokurtic; the null that comes from normal distribution is rejected. Figure 1 shows the time series plot of the credit spread. It reaches its historical high at 6 percentage points around 2010; before that its peak was around 4 percentage points, reached several times during its history. The augmented-Dickey-Fuller test of null that credit spread is unit-root non-stationary is rejected, which justifies our approach to model it within a VAR framework.

On the other hand, the time series mean of consumption growth is around 0.28 percent, with variance of 0.134. Similar to the credit spread series, the consumption growth distribution is positively skewed and leptokurtic, and the normality test of a normal null is rejected. Figure 2 shows the time series plot of consumption growth. Its mean reverting feature is revealed on the graph, and that is further substantiated by the augmented-Dickey-Fuller test.

*** Table 1 goes around here***

4. Results

Figure 3 plots consumption uncertainty estimated by our model (1) and (2) over 1959 to 2013. The mean of consumption volatility is 0.12381 and the standard deviation is 0.027639. Our measure of consumption uncertainty spikes near the Vietnam War in 1965, the 1980 and 1981–1982 NBER defined recessions, the tech bubble of 2000, and reaches its highest level near the 2008 financial crisis. The incidences of high consumption uncertainty near economic recessions confirm our assumption that real consumption is a good measure of overall economic activity.

Figure 4 plots the estimated credit spread volatility over the period 1959 to 2013. Overall, credit spread volatility displays higher time-series variation than real consumption volatility. The mean of credit spread volatility is 0.045437 and the standard deviation is equal to 0.077930. Credit spread volatility is high around the Nixon Shock in 1971, the economic recession of 1975 and 1980–1982, and reaches its peak during the 2008 financial crisis.

*** Figure 3 goes around here***

*** Figure 4 goes around here***

Table 2 reports parameter estimates results from our VAR (1) – MGARCH (1, 1)-M model. First of all, we find that credit spread tends to increase when consumption growth decreases and when uncertainty of consumption growth increases. The first column in Panel A presents estimates from the credit spread equation in our VAR (1) system, equation (1). The uncertainty of consumption growth has a positive significant impact on credit spread. A one standard deviation increase in consumption volatility leads to an increase in credit spread of 0.65 percentage point. The credit spread also negatively correlates with lagged consumption growth. For instance, a one standard deviation decrease in consumption growth multiplied by 100 leads to an increase in the credit spread of around 0.272 percentage points. Taken together, these results provide evidence that the credit spread, a proxy for the risk premium, is determined not only by consumption growth level but also by volatility. This result can be interpreted within the Epstein and Zin (1989) utility framework in that the stochastic discount factor is a function of both consumption growth and volatility.

*** Table 2 goes around here***

Second, we find favorable evidence to support the financial accelerator hypothesis. The second column in Panel A presents the estimates from the consumption growth equation in our VAR (1) system, equation (1). The lagged credit spread negatively correlates with current consumption growth. For instance, a one standard deviation increase in credit spread leads to a decrease in the rate of consumption growth multiplied by 100 of around 0.47 percentage points. Next, the concurrent uncertainty about the credit spread also has a negative impact on consumption growth, although the coefficient is not significantly different from zero. These results indicate that when the general credit market condition deteriorates (measured by increased credit spread level and uncertainty), consumption growth tends to subsequently decrease. This is consistent with the financial accelerator hypothesis in that tightened credit markets reduce overall credit supply, and hence, subsequent real activities and consumption growth.

Additionally, we find that there are significant conditional heteroscedasticity effects. The elements in matrices $A_{1,1}^{*}$ are coefficients of the ARCH part, and those in $B_{1,1}^{*}$ are the GARCH coefficients. Almost all of them are statistically significant, which provides the foundation of our working assumption, i.e., the volatility is time-varying.

5. Robustness

We use the whole sample (1959.02–2013.08) to look for our main result. We demonstrate that our results remain intact in a more recent subsample for period 1979.02–2013.08. Table 3 presents the result from estimating our multivariate GARCH-M model for this subsample. Overall, the results are consistent with those obtained from using the whole sample.

In this period, the credit spread, both in level and uncertainty, still affects consumption growth negatively. The magnitude of the level effect, measured by the coefficient of the previous credit spread level (-0.094), is greater than the one estimated from the whole sample (-0.063). Most important, the magnitude of the uncertainty effect, measured by the coefficient of the contemporaneous volatility of credit spread (-0.550), is larger than the one estimated from the whole sample (-0.095) and statistically significant at the 1% level.

Further, the effects of consumption growth level and volatility are comparable to those in our main results as well. Consumption growth volatility has a greater impact (0.332) relative to the one found in the whole sample (0.235). The impact of consumption growth level is also greater in magnitude (-0.035) relative to (-0.027).

*** Table 3 goes around here***

6. Conclusion

We study the interdependence between economic condition and the credit spread. Using a multivariate GARCH-M model, we simultaneously evaluate the effects of credit spread level and volatility on consumption growth, and the effects of consumption growth level and volatility on the credit spread. We find that the credit spread tends to increase when previous consumption growth decreases and contemporaneous consumption growth volatility increases. On the other hand, consumption growth tends to decrease when previous credit spread increases and contemporaneous credit spread volatility increases.

These findings on the credit spread shed new light on the vast literature of empirical consumption-based asset pricing. We show that both consumption growth level and volatility determine risk premium. This finding is in line with the Epstein and Zin (1989) preference, which generalizes the level focusing exponential preference by featuring intertemporal substitutions. Investors would require a higher risk premium when intertemporal consumptions, reflected in consumption growth, become more uncertain. We directly test this hypothesis within our volatility in a mean model while accounting for the consumption growth level.

The parallel findings regarding consumption growth can be interpreted by the financial accelerator mechanism (Bernanke et al., 1989). When the credit market condition deteriorates, measured by a widened credit spread and increased uncertainty, the total credit supply decreases, which leads to decreased investment and output (and hence consumption). By employing our general framework, we are able to examine both the level effect and the uncertainty effect regarding credit market conditions.

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Figure 1. Credit Spread Over 1959-2013.

This figure shows the time series plot of credit spread. Bond credit spread as measured by Baa-10 years treasury yield spread is drawn from the Fred Economic Data maintained by the Federal Reserve Bank of St. Louis.

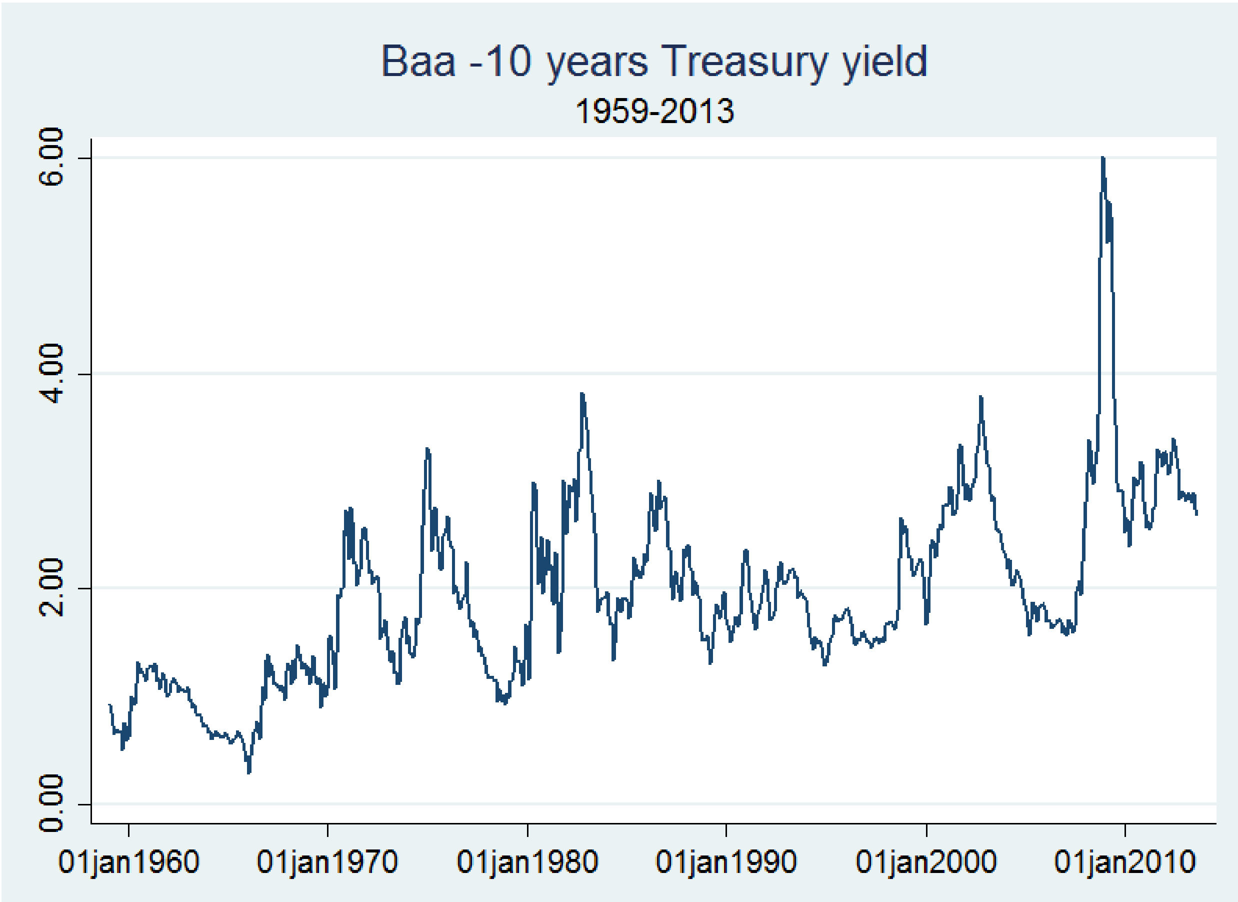

Figure 2. Real Consumption Growth Over 1959–2013.

This figure shows the time series plot of real consumption growth $c_t = \log\left(\frac{c_t}{c_t - 1}\right)$. The monthly aggregate consumption data is taken from the NIPA tables, which are available from the Bureau of Economic Analysis. Aggregate consumption is measured as the seasonally adjusted real per capita consumption of nondurables plus services.

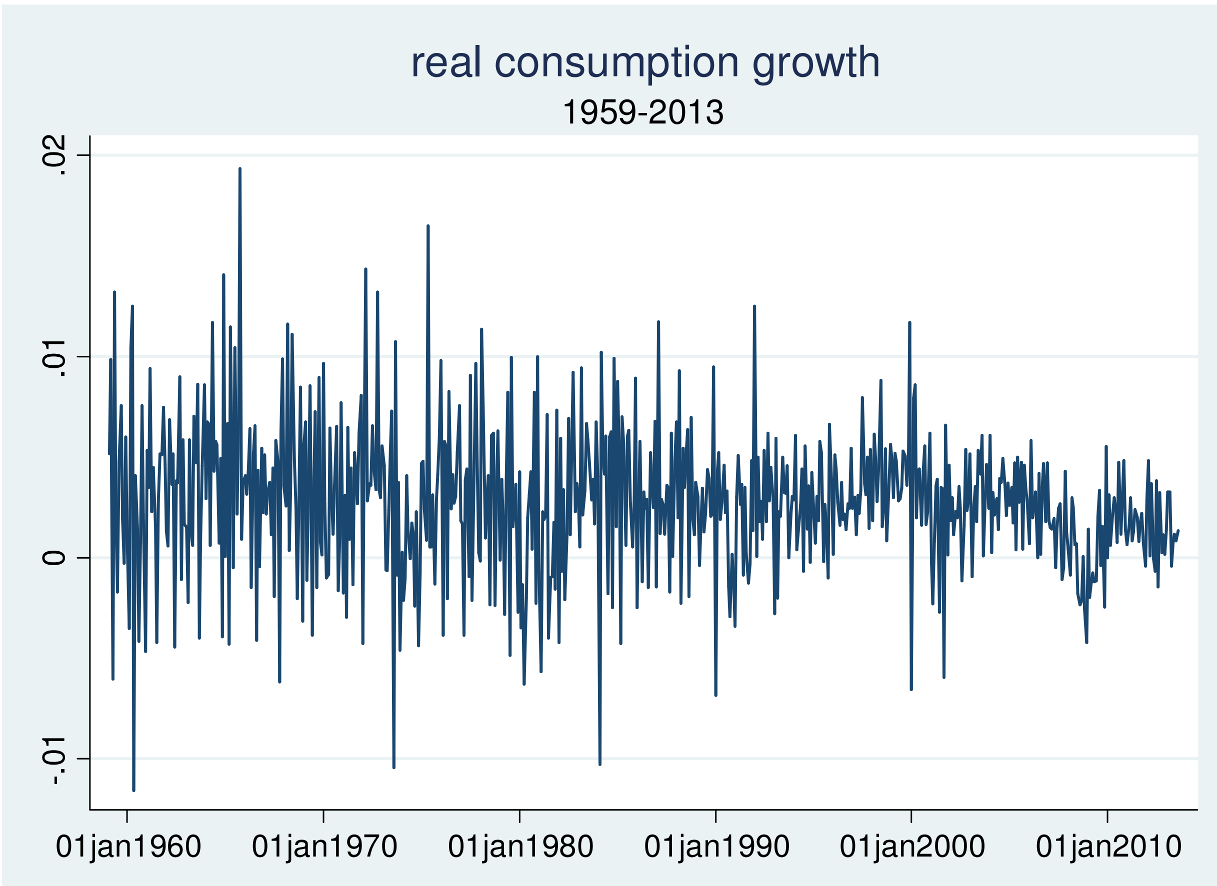

Figure 3. Real Consumption Volatility Over 1959–2013.

This figure shows the time-series plot of real consumption growth volatility. The consumption volatility is estimated by model (1) and (2). The monthly aggregate consumption data is taken from the NIPA tables, which are available from the Bureau of Economic Analysis. Aggregate consumption is measured as the seasonally adjusted real per capita consumption of nondurables plus services.

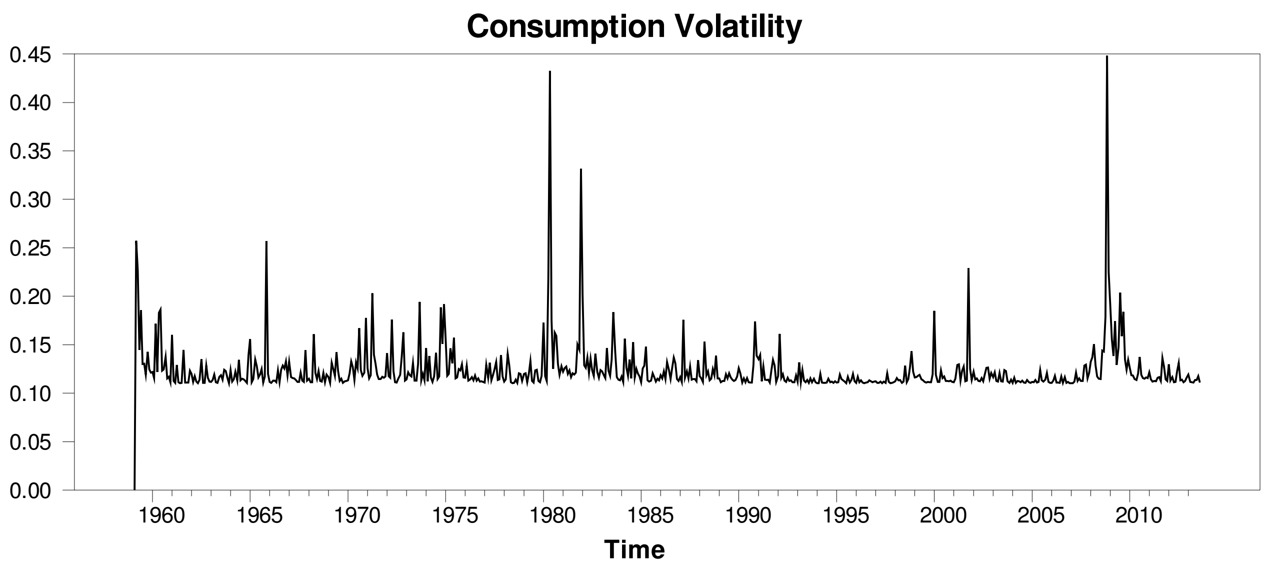

Figure 4. Credit Spread Volatility Over 1959–2013

This figure shows the time-series plot of credit spread volatility. The credit spread volatility is estimated by model (1) and (2). Bond credit spread as measured by Baa-10 years treasury yield spread is drawn from the Fred Economic Data maintained by the Federal Reserve Bank of St. Louis.

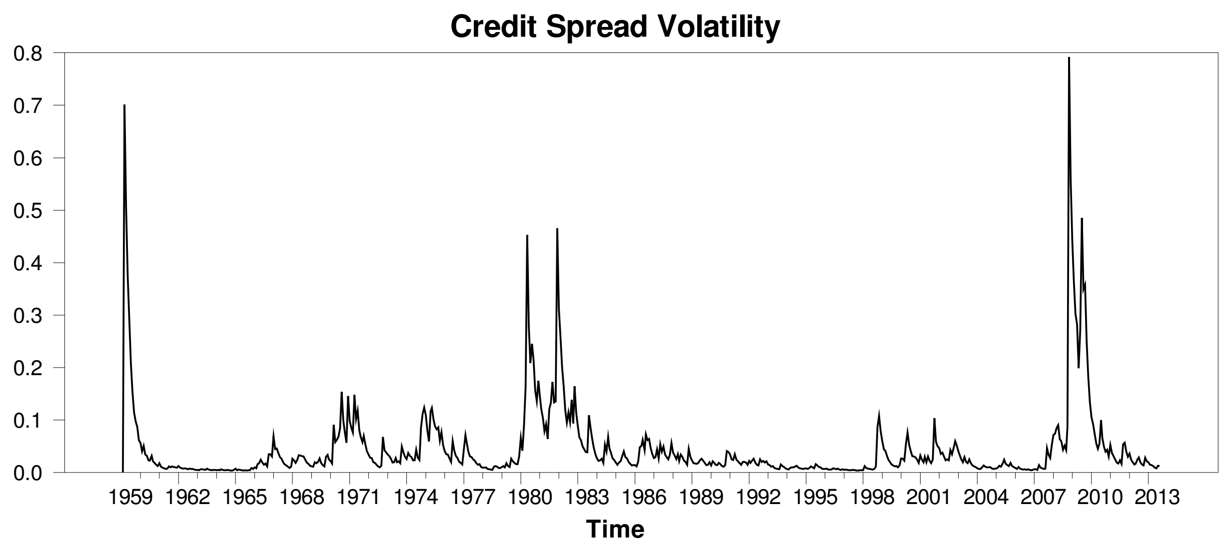

Table 1: Summary Statistics

	Credit spread	ConsumptionGrowth100
Mean	1.946	0.278
Median	1.850	0.283
Variance	0.693	0.134
Skewness	0.961	0.142
Excess Kurtosis	2.454	1.603
Bera-Jarque Test	265.214 (p<0.01)	72.382 (p<0.01)
Augmented-Dicky-Fuller test	-4.483 (p<0.01)	72.382 (p<0.01)
N	655	655

Table 2: The Multivariate GARCH-M Model

This table shows estimates of the multivariate GARCH-M Model, equation (1) and (2). The sample consists of monthly consumption growth and the credit spread, and the yield difference between BAA rated bonds and the T Bond with same maturity for the period of 1959.02 to 2013.08. P-values are in parentheses.

Panel A: Conditional Mean Equation Estimates		
	Y_t	C_t
$Const$	0.005	0.578
	(0.274)	(0.000)
C_{t-1}	-0.027	-0.269
	(0.002)	(0.000)
Y_{t-1}	0.976	-0.063
	(0.000)	(0.000)
$h_{c,t}$	0.235	-0.710
	(0.000)	(0.000)
$h_{y,t}$	0.160	-0.095
	(0.364)	(0.562)

Panel B: Conditional Variance Equation Estimates				
	$c_{1,1}$	$C_{1,2}$	$C_{2,2}$	
Mean	0.330	0.001	-0.000	
P-Value	<0.001	0.790	0.999	
	$\alpha_{1,1}$	$\alpha_{1,2}$	$\alpha_{2,1}$	$\alpha_{2,2}$
Mean	0.220	-0.030	-0.351	0.578
P-Value	<0.001	<0.001	<0.001	<0.001
	$\beta_{1,1}$	$\beta_{1,2}$	$\beta_{2,1}$	$\beta_{2,2}$
Mean	-0.082	0.090	0.259	0.827
P-Value	0.189	<0.001	<0.001	<0.001

Table 3: The Multivariate GARCH-M Model – A Subsample Analysis

This table shows estimates of the multivariate GARCH-M Model, equation (1) and (2). The sample consists of monthly consumption growth and the credit spread, and the yield difference between BAA rated bonds and the T Bond with same maturity for the period of 1974.02 to 2013.08. P-values are in parentheses.

Panel A: Conditional Mean Equation Estimates		
	Y_t	C_t
$Const$	0.078	0.402
	(0.274)	(0.000)
C_{t-1}	-0.035	-0.256
	(0.040)	(0.000)
Y_{t-1}	0.948	-0.094
	(0.000)	(0.000)
$h_{c,t}$	0.332	-2.358
	(0.002)	(0.000)
$h_{y,t}$	0.252	-0.550
	(0.292)	(0.001)

Panel B: Conditional Variance Equation Estimates				
	$c_{1,1}$	$C_{1,2}$	$C_{2,2}$	
Mean	0.015	0.052	-0.000	
P-Value	<0.001	<0.001	0.999	
	$\alpha_{1,1}$	$\alpha_{1,2}$	$\alpha_{2,1}$	$\alpha_{2,2}$
Mean	-0.124	-0.115	-0.280	0.674
P-Value	<0.001	<0.001	<0.001	<0.001
	$\beta_{1,1}$	$\beta_{1,2}$	$\beta_{2,1}$	$\beta_{2,2}$
Mean	0.986	-0.034	0.259	0.676
P-Value	0.189	<0.001	<0.001	<0.001