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# The Relation between the Corporate Bond-Yield Spread and the Real Economy: Stable or Time-Varying?*

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## Abstract

In this paper we assess whether the relation between the corporate bond-yield spread and the real economy has been stable over time. Using quarterly US data from 1953Q1 to 2018Q2, we estimate Bayesian VAR models which allow for drifting parameters and/or stochastic volatility and conduct formal model selection in a Bayesian setting. Our results indicate that the relation between the variables has been stable; we do, however, find strong support for stochastic volatility. We conclude that the corporate bond-yield spread's usefulness for predicting real economic activity has not changed to a relevant extent after the Great Recession.

*JEL Classification:* C11, C32, C52, E44, E47, G17

*Keywords*: Bayesian VAR; Time-varying parameters; Stochastic volatility; Model selection

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# 1. Introduction

Increases in the corporate bond-yield spread have in numerous studies, which span many decades of data, been shown to dampen real economic activity in the United States; see, for example, Stock and Watson (1989), Friedman and Kuttner (1998), Gilchrist *et al.* (2009), Gilchrist and Zakrajsek (2012), Faust *et al.* (2013) and Prieto *et al.* (2016). This finding is obviously a useful result for many economic agents, including policy makers such as the Federal Reserve. However, in order to make full use of the corporate bond-yield spread for economic policy, forecasting or other related purposes, we need to know whether its relation to the real economy is stable over time. This is an issue that has become particularly relevant in light of the unconventional monetary policy which has been conducted since the Great Recession and the fact that policy actions – such as large scale asset purchases – may have changed relations between variables.

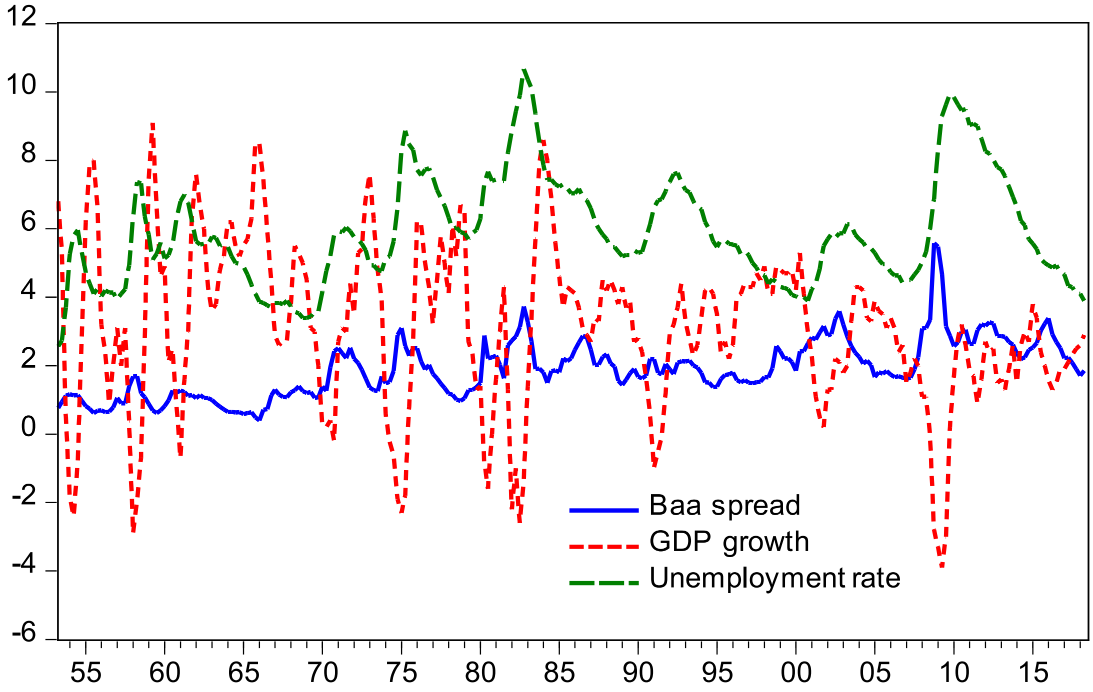
The purpose of this paper is to assess whether there is a stable relation between the corporate bond-yield spread and the real economy in the United States. This is done by estimating bivariate Bayesian VAR (BVAR) models using *i)* real GDP growth and the corporate bond-yield spread and *ii)* the unemployment rate and the corporate bond-yield spread. In line with a growing literature suggesting that there might be time variation in dynamic macroeconomic relationships and/or the volatility of shocks hitting the economy – see, for example, Cogley and Sargent (2005), Primiceri (2005), Stock and Watson (2012), Abbate *et al.* (2015), Prieto *et al.* (2016) and Akram and Mumtaz (2019) – we estimate BVAR models which allow for drifting parameters and/or stochastic volatility. The models are estimated on a sample which ranges from 1953Q2 to 2018Q2. We conduct Bayesian model selection using new methods suggested by Chan and Eisenstat (2018). In doing this, we provide new empirical evidence regarding an important relation in US business cycle analysis.

# 2. Empirical analysis

In order to assess the relation between the corporate bond-yield spread and the real economy, we will estimate bivariate BVAR models. Seeing that we believe that it is highly relevant to both study real GDP growth and the unemployment rate, we will define the 2x1 vector of dependent variables $\boldsymbol{y}_t$ either as $\boldsymbol{y}_t = (g_t \quad s_t)'$ or $\boldsymbol{y}_t = (u_t \quad s_t)'$ where $g_t$ is real GDP growth, $u_t$ the unemployment rate and $s_t$ is the corporate bond-yield spread.

We use quarterly US data which range from 1953Q2 to 2018Q3. Real GDP growth is the year-on-year percentage change in real GDP, that is, it is given as $g_t = 100(Y_t/Y_{t-4} - 1)$ where $Y_t$ is real GDP. The unemployment rate is the seasonally adjusted civilian unemployment rate of individuals 16 years of age and older. Finally, the corporate bond-yield spread is given by the yield on Baa corporate bonds minus the yield on a ten-year Treasury security. Data are shown in Figure 1.

**Figure 1. Data**




Note: GDP growth and the unemployment rate are measured in percent. The corporate bond-yield spread is measured in percentage points.

We consider four different combinations of assumptions for the BVAR models: *i)* constant parameters and covariance matrix, *ii)* drifting parameters and constant covariance matrix, *iii)* constant parameters and stochastic volatility and *iv)* drifting parameters and stochastic volatility. Model *iv)* is the most general specification of the BVAR and we accordingly present the framework using it. The model is given as

$$\boldsymbol{B}_{0t}\boldsymbol{y}_t = \boldsymbol{\gamma}_t + \boldsymbol{B}_{1t}\boldsymbol{y}_{t-1} + \cdots + \boldsymbol{B}_{pt}\boldsymbol{y}_{t-p} + \boldsymbol{\varepsilon}_t \tag{1}$$

$\boldsymbol{B}_{0t}$ is a 2x2 lower triangular matrix with ones on the diagonal. The 2x1 vector $\boldsymbol{\gamma}_t$ contains the intercepts and the 2x2 matrices $\boldsymbol{B}_{1t}, \dots, \boldsymbol{B}_{pt}$ describe the dynamics of the model. Lag length is in all cases set to $p = 2$.[1] The disturbances are multivariate nomal, $\boldsymbol{\varepsilon}_t \sim N(\boldsymbol{0}, \boldsymbol{\Sigma}_t)$, where $\boldsymbol{\Sigma}_t = diag\big(exp(h_{1t}), exp(h_{2t})\big)$. The free parameters of $\boldsymbol{\gamma}_t$ and $\boldsymbol{B}_{it}$ are collected in the vector $\boldsymbol{\theta}_t$ which is assumed to evolve as a random walk, as are the log volatilities:

$$\boldsymbol{\theta}_t = \boldsymbol{\theta}_{t-1} + \boldsymbol{\eta}_t \tag{2}$$
$$\boldsymbol{h}_t = \boldsymbol{h}_{t-1} + \boldsymbol{\zeta}_t \tag{3}$$

where $\boldsymbol{\eta}_t \sim N(\boldsymbol{0}, \boldsymbol{\Sigma}_{\boldsymbol{\theta}})$ and $\boldsymbol{\zeta}_t \sim N(\boldsymbol{0}, \boldsymbol{\Sigma}_{\boldsymbol{h}})$. Models *i)* to *iii)* are all restricted versions of model *iv)*, where $\boldsymbol{\Sigma}_{\boldsymbol{\theta}}$ and/or $\boldsymbol{\Sigma}_{\boldsymbol{h}}$ are set to zero as appropriate. The models' priors are chosen to match the scale and volatility of the data and follow the approach used in Karlsson and Österholm (2019).

[1] This is a common choice in the related literature; see, for example, Cogley and Sargent (2005) and Primiceri (2005).

In order to establish whether the relation between the corporate bond-yield spread and the real economy has been constant, we estimate the models and conduct model selection based on marginal likelihoods.[2] Results are given in Table 1.

**Table 1. Log marginal likelihood for the different specifications.**

| Model | $y_t = (g_t \quad s_t)'$ | $y_t = (u_t \quad s_t)'$ |
|---|---|---|
| *i)* | -475.6 | -110.0 |
| *ii)* | -476.5 | -89.2 |
| *iii)* | -411.1 | -53.9 |
| *iv)* | -429.7 | -55.0 |

Note: $g_t$ is real GDP growth, $u_t$ is the unemployment rate and $s_t$ is the corporate bond-yield spread. "i)" is the model with constant parameters and covariance matrix. "ii) is the model with drifting parameters and constant covariance matrix. "iii)" is the model with constant parameters and stochastic volatility. "iv)" is the model with drifting parameters and stochastic volatility.

As can be seen from the table, the model with constant parameters and stochastic volatility – that is, model *iii)* – is preferred both when estimating the models with real GDP growth and the unemployment rate. The evidence in favour of this specification is particularly strong when real GDP growth is included in the BVAR.[3] We accordingly conclude that the relation between the corporate bond-yield spread and the real economy can be described as stable during this period.

Finally, in order to give the reader an idea of what the effect of a shock to the corporate bond-yield spread has on real GDP growth and the unemployment rate respectively, Figures 2 and 3 show the impulse-response functions from the two relevant BVARs (with constant parameters and stochastic volatility).[4] As can be seen, they have the expected effect in both cases, that is, in light of a shock to the corporate bond-yield spread, GDP growth decreases and the unemployment rate increases. The fact that the impulse-response functions vary over time is due to the heteroskedastic nature of the disturbances in the models. This is clearly illustrated in Figures A1 to A3 in the Appendix which shows the effect that a shock to each variable has on itself; the standard deviation of the shock can be read off the zero-horizon in each case. As can be seen, the volatility of the shocks to all three variables seem to have been subject to a fair amount of time variation.[5]

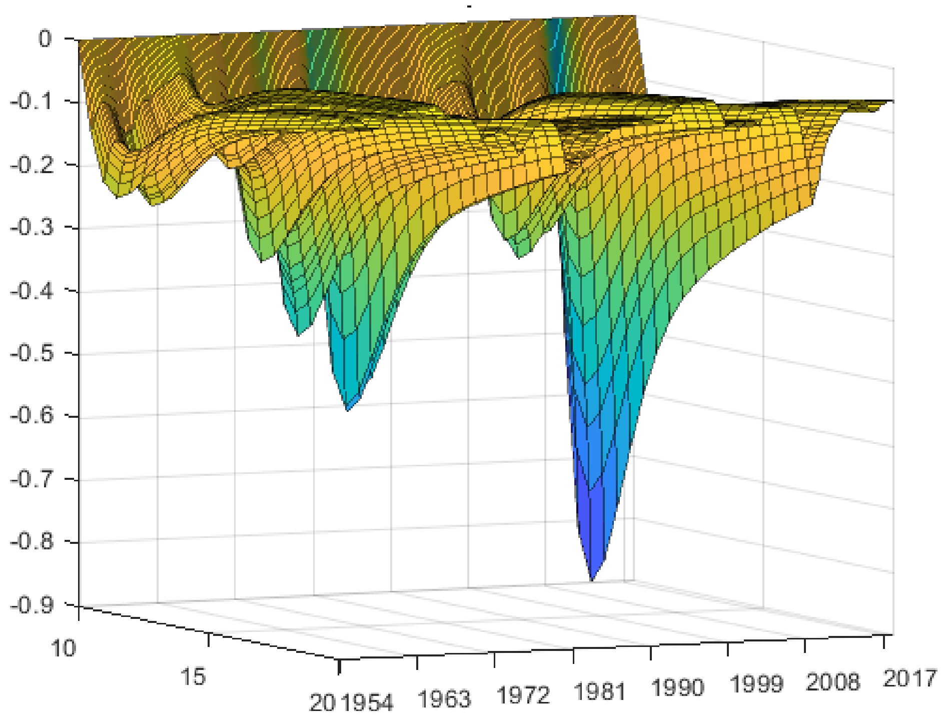
[2] As is well known, the marginal likelihood is the appropriate measure of how well the model and prior agree with the data and the model with the highest marginal likelihood should be selected. However, calculating the marginal likelihood for VAR models with drifting parameters and/or stochastic volatility is non-trivial. We rely on the recently developed methods of Chan and Eisenstat (2018).

[3] In addition, we calculated the deviance information critierion which also can be used for model selection. This generated the exact same ranking of all four models in both cases. Results are not reported but are available from the authors upon request.

[4] We have used a recursive identification of orthogonal shocks, as is common in the literature; see, for example, Primiceri (2005) and Prieto (2016).

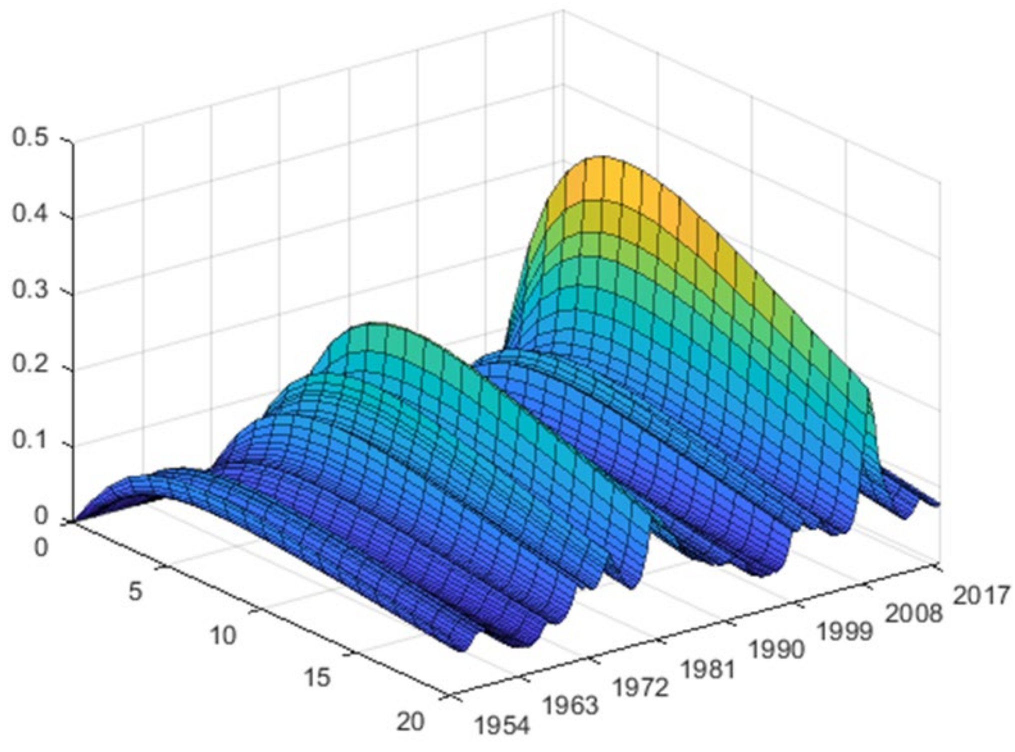
[5] Due to space constraints, we only present the the effect of shocks to the corporate bond-yield spread on itself from the moddel with GDP growth (in Figure A2). This impulse-reasponse function looks very similar though to the one from the model with the unemployment rate.

**Figure 2. Effect of shocks to the corporate bond-yield spread on real GDP growth.**




Note: Bivariate BVAR with $\boldsymbol{y}_t = (g_t \quad s_t)'$. Model has constant parameters and stochastic volatility. Size of impulse is one standard deviation. Effect in percentage points on vertical axis. Horizon in quarters and dates on horizontal axes.

**Figure 3. Effect of shocks to the corporate bond-yield spread on the unemployment rate.**




Note: Bivariate BVAR with $\boldsymbol{y}_t = (u_t \quad s_t)'$. Model has constant parameters and stochastic volatility. Size of impulse is one standard deviation. Effect in percentage points on vertical axis. Horizon in quarters and dates on horizontal axes.

# 3. Conclusions

When estimating macroeconomic relations, it is often a concern that the relations in question may have changed over time. In this paper, we have assessed this issue when it comes to the relation between the corporate bond-yield spread and the US real economy. In an empirically appealing manner, this assessment was done using formalized model selection, unlike most of the previous literature where it often simply has been assumed that drifting parameters and/or stochastic volatility are relevant features.[6] We conclude that while heteroskedastic disturbances is supported by the data, the same cannot be said for parameter drift. Since the parameters of the models which describe the dynamics are judged to be constant, the corporate bond-yield spread's usefulness for predicting real economic activity should accordingly not have changed to a relevant extent over time.

[6] See, for example, Cogley and Sargent (2005) or Akram and Mumtaz (2019).

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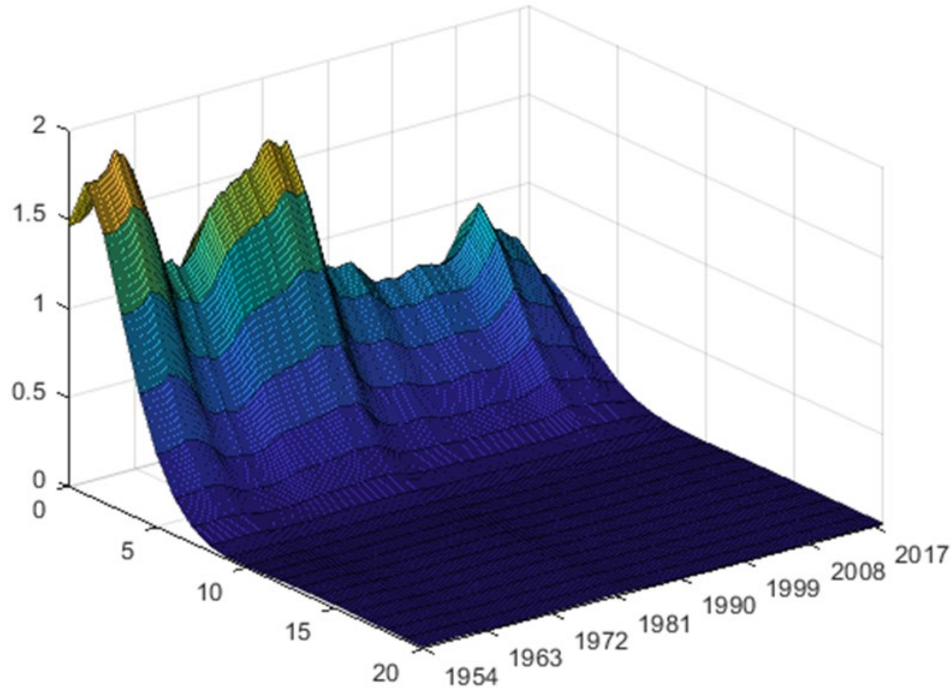
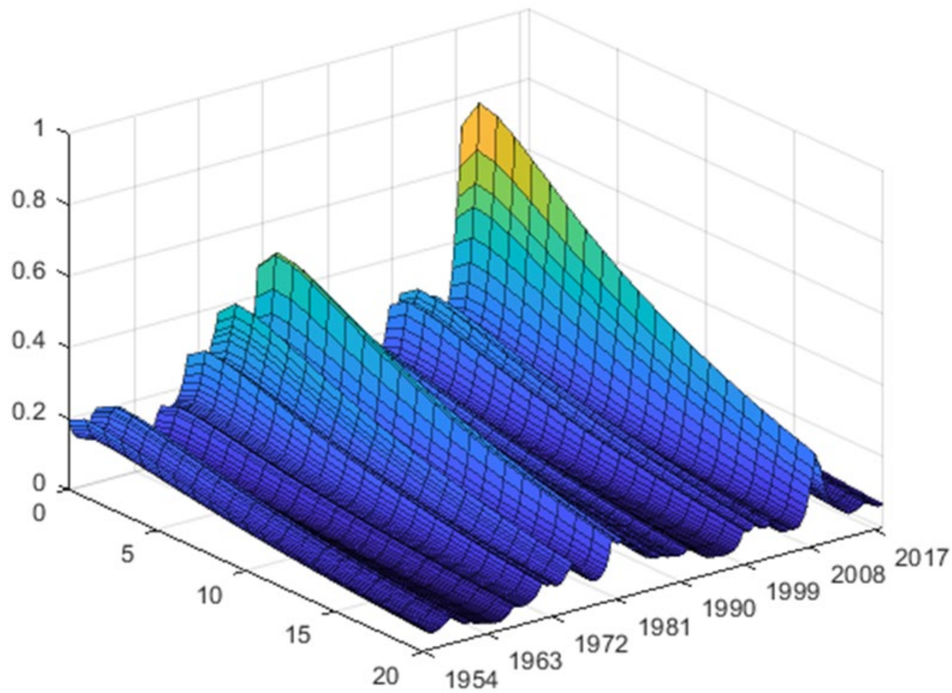
# Appendix

**Figure A1. Effect of shocks to real GDP growth on itself.**



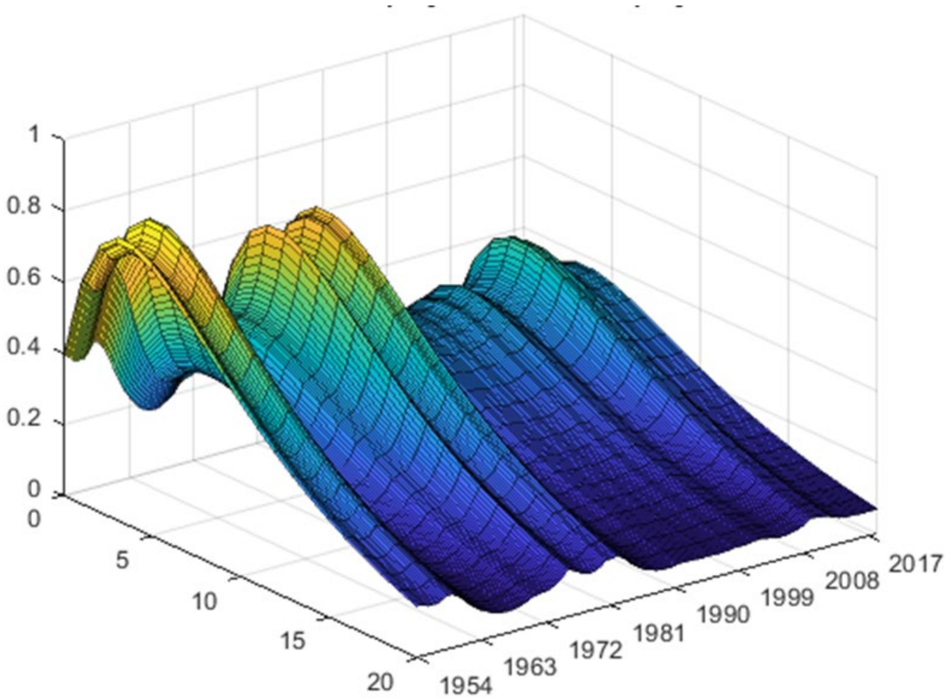

Note: See Figure 2.

**Figure A2. Effect of shocks to the corporate bond-yield spread on itself from BVAR with real GDP growth.**




Note: See Figure 2.

**Figure A3. Effect of shocks to the unemployment rate on itself.**




Note: See Figure 3.