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Stocks and bonds during the gold standard

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HIGHLIGHTS

- Inflation obscures the impact of other economic factors on stock-bond correlations.
- In this article, the stock-bond correlations during the Gold Standard are studied.
- The stock-bond correlation is negatively affected by interest rate volatility.
- Financial and political shocks result in a general flight-to-safety effect.

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ABSTRACT

This article assesses the dynamic stock-bond correlations in the absence of inflation by studying the French market during the Gold Standard. We find that the correlation was higher than what is currently observed, and negatively affected by interest rate volatility.

1. Introduction

Parallels can be found between the current low inflation rate environment and the Gold Standard era, when inflation remained close to zero.[1] In this paper, we focus on the period before 1914, during which we have enough long-term data to reliably examine the relationship between stocks and bonds in the absence of inflation.

Since the seminal article of Shiller and Beltratti (1992), stock-bond co-movements have been discussed extensively in financial literature. The research has identified factors that influence the stock-bond correlation, such as inflation, interest rates, rate volatility, GDP growth, economic uncertainty, and financial and political shocks. (Asgharian et al., 2016; Li et al., 2015).

This article makes two key contributions. First, the Gold Standard enables us to assess the stock-bond correlation while controlling for inflation and to study the economic factors influencing that correlation. Second, this article examines not only the correlation between stocks and government bonds, but also the relationship between stocks and corporate bonds, a topic of little research.

The rest of the article is organized as follows: Section 2 describes the data and the econometric model used; Section 3 investigates the results; and Section 4 provides the concluding remarks.

2. Data and methodology

By World War I, Paris was the second biggest stock exchange after London. This study examines data culled from indexes that track the Paris bourse over the 19th century, namely the Arbulu (2007) and Le Bris and Hautcoeur (2010) stock index; the Vaslin

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[1] While the average annual inflation rate for France from 1914 to 2011 was equal to 8.90% with a standard deviation of 12.47% , this average was only 0.58% over the 1838–1913 period with a standard-deviation of 5.09% (data from Lévy-Leboyer and Bourguignon, 1990).

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Table 1
Descriptive statistics (Panel A) and the unconditional correlation of monthly series (Panel B).

	Corp. bonds	Gov. bonds	Stocks
Panel A			
Mean	0.039	−0.018	0.098
Median	0.016	0.038	0.155
Standard deviation	1.512	2.771	3.423
Panel B			
Corp. bonds	1.00		
Gov. bonds	0.81	1.00	
Stocks	0.74	0.82	1.00

(2007) government-bond index; and the corporate-bond index (Rezaee, 2012).

The sample period commences at the creation of the Paris corporate bond market in December 1838 and ends on August 1914 when the Gold Standard is suspended due to World War I (Fig. 1). The sample contains 907 monthly observations for each return series. Table 1 presents the descriptive statistics of the return series.

Given the time varying nature of stock-bond correlations, we use the multivariate AG DCC GARCH model developed by Cappiello et al. (2006), which is a generalization of DCC GARCH.[2]

The model can be presented as:

$$y_t = \mu + \varepsilon_t, \qquad \varepsilon_t|\varphi_{t-1} \sim N\left(0, D_t R_t D_t\right) \tag{1}$$

where y_t is a $\{3 * 1\}$ vector representing the returns on our three indices, ε_t is a $\{3 * 1\}$ vector of innovations conditioned to the information at time $t-1$ and D_t is the diagonal matrix of the conditional standard deviations in which the arrays are $D_t = diag\left\{\sqrt{h_{it}}\right\}$.

Standardizing the residuals $u_{it} = \frac{\varepsilon_{it}}{\sqrt{h_{it}}}$ enables us to develop the following GARCH(1,1) model :

$$h_{it} = c_i + a_i u_{i,t-1}^2 + b_i h_{i,t-1}. \tag{2}$$

Then the conditional correlation matrix, R_t is calculated as:

$$R_t = diag\left(Q_t\right)^{-1/2} Q_t diag\left(Q_t\right)^{-1/2}. \tag{3}$$

With:

$$Q_t = \frac{1}{n}\sum_{t-1}^{T} u_t u_t' \left(1-\alpha-\beta\right) + \alpha u_{t-1}u_{t-1}' + \beta Q_{t-1}. \tag{4}$$

The contribution of Cappiello et al. (2006) consists of the following definition of the model, which allows for an asymmetric generalized DCC process[3] :

$$Q_t = E\left[u_t \acute{u}_t\right] + A\cdot\left(u_{t-1}\acute{u}_{t-1} - E\left[u_t\acute{u}_t\right]\right) + B\cdot\left(Q_{t-1} - E\left[u_t\acute{u}_t\right]\right) + G\cdot\left(\eta_{t-1}\acute{\eta}_{t-1} - E\left[\eta_t\acute{\eta}_t\right]\right) \tag{5}$$

where $\eta_t = \min\left(u_t, 0\right)$.

If the matrices A, B and G are assumed to be diagonal, they can be written as:

$$A = a_M \acute{a}_M, \qquad B = b_M \acute{b}_M, \qquad G = g_M \acute{g}_M \tag{6}$$

where a_M, b_M and g_M are $3*1$ vectors. Finally following Cappiello et al. (2006), a two-step maximum likelihood method estimates the parameters.

Table 2
DCC GARCH model.

	Corporate bonds	Gov. Bonds	Stocks
Panel A. Estimation results			
μ	0.191***	0.255***	0.313***
	(*0.027*)	(*0.082*)	(*0.076*)
c	0.184***	1.838***	0.339***
	(*0.036*)	(*0.280*)	(*0.042*)
a	0.724***	0.215***	0.092***
	(*0.111*)	(*0.057*)	(*0.011*)
b	0.666***	0.660***	0.897***
	(*0.035*)	(*0.052*)	(*0.009*)
α	0.032***		
	(*0.009*)		
β	0.625***		
	(*0.134*)		
Note: Standard errors are given in brackets. *** Indicate significance of coefficients at 1%.			
Panel B. Robustness tests results on model standardized residuals			
Mean	−0.16***	−0.03	−0.04
Std-Deviation	1	0.99	0.99
Skewness	−8.29***	−16.79***	−2.38***
Skewness (Returns)	*−13.96* ***	*−14.02* ***	*−8.20* ***
Kurtosis	168***	417***	29.73***
Kurtosis (Returns)	*330.11* ***	*334.60* ***	*168.14* ***
Tests statistics			
JB	1 080 938***	6 634 456***	34 269***
Q(12)	31.70***	31.62***	49.02***
Q(12) (Returns)	*73.80* ***	*52.36* ***	*36.76* ***
ARCH (12)	0.68	0.61	1.27

Note: The test for kurtosis coefficient is normalized to zero. JB is the Jarque–Bera test for normality. Q(12) is the Ljung–Box test for autocorrelation of order 12. ARCH (12) is the Engle test for conditional heteroscedasticity of order 12.
*** Indicate rejection of the hypotheses of student t-test, no autocorrelations, normality and homoscedasticity at 1%.

Table 3
Estimation results of AG DCC GARCH.

	a^2	b^2	g^2
Corporate bonds	0.0087**	0.2453***	0.0402***
	(*0.0371*)	(*0.1429*)	(*0.0428*)
Gov. bonds	0.0104***	0.9683***	0.0001
	(*0.0046*)	(*0.0013*)	(*0.0095*)
Stocks	0.0039***	0.9950***	0.0029***
	(*0.0082*)	(*0.0008*)	(*0.0092*)
Log-likelihood	(*−4835.261*)		
BIC	(*9833.965*)		

Note: Standard errors are given in brackets.
** Indicate significance of coefficients at 5%.
*** Indicate significance of coefficients at 1%.

3. Results

Table 2 summarizes DCC-GARCH model estimations. The model captures the behavior of the historical return series accurately (coefficients are significant at a 1% level). The variables of the GARCH(1,1) model (c, a and b), and the DCC (1,1) fit the return series, proving the relevance of the model.

Table 3 depicts the parameter estimates of the AG DCC GARCH model, all of which are statically significant. In all cases, there is evidence of asymmetries in the conditional correlation, which suggests that the AG DCC model fits the series dynamics.

Fig. 2 depicts the evolution of the conditional correlations obtained by the model. The results are worth some remarks:

The average conditional correlations between stocks and corporate bonds (54%), and stocks and government bonds (60%), are very

[2] The Augmented Dickey–Fuller (ADF) tests, which we have conducted, confirm that the index series contains a unit root (non-stationary), and that their first difference series (return series) are stationary.

[3] Here we assume the conditional volatility to follow a univariate asymmetric GARCH(1,1) process (GJR GARCH).