

A reflection of history: fluctuations in Greek sovereign risk between 1914 and 1929

OLGA CHRISTODOULAKI*, HAERAN CHO** AND
PIOTR FRYZLEWICZ**

**Department of Economic History, London School of Economics, Houghton Street, London WC2A 2AE, UK, o.christodoulaki@lse.ac.uk, chr_olga@otenet.gr*

***Department of Statistics, Columbia House, London School of Economics, Houghton Street, London WC2A 2AE, UK, h.choi@lse.ac.uk, p.fryzlewicz@lse.ac.uk*

Time series of daily data for Greek sovereign risk have been compiled and analysed statistically to shed light on the way that historical events, including political and institutional changes, determined the creditworthiness of the Greek government on the London stock market from the start of the Great War until the Great Crash. No a priori important dates were specified. The Asia Minor campaign and its aftermath exerted a strongly negative impact on the value of Greek sovereign debt and as a result the risk premium increased rapidly. Statistical analysis shows that investors acted upon news of fiscal performance and public debt developments. Unforeseen political changes also influenced market participants' expectations. In contrast, institutional innovations such as the adoption of the gold exchange standard and the establishment of a central bank *de novo* did not result in any quantitative market response. However, stabilization and the concomitant institutional reforms were gradually factored into the market price of Greek sovereign debt traded in London and as a result the creditworthiness of the Greek government steadily improved.

I. Introduction

The aim of this study was to explore the extent to which historical events, including political and institutional changes, shaped market participants' expectations of the capacity of the Greek government to honour its debt obligations from the outbreak of the First World War until the advent of the great depression. Hence, this work contributes to the literature, which combines historical data with statistical evidence to examine the way that news interacts with capital markets to determine asset prices.

A ground-breaking article of this type by Willard *et al.* (1996) examined the impact of the events of the American Civil War on the market for Greenbacks, a legal tender currency issued by the Union. The literature that followed analysed the influence of war-related events on financial market assets again during the American Civil War or during the period around the Second World War.¹ Authors were particularly interested in whether contemporary market investors were able to anticipate crucial wartime developments and if, in

¹ Waldenstrom and Frey (2008), Frey and Waldenstrom (2004), Oosterlinck (2003), Brown and Burdekin (2002), Weidenmier (2002), Brown and Burdekin (2000), Frey and Kucher (2000a), Frey and Kucher (2000b), and Weidenmier (2000).

fact, they did. Occasionally the results of their statistical analysis were compared with claims in the conventional historiography.²

Mauro et al.'s studies differ from the aforementioned work as regards both the period and geographical region on which they focus. They examine yield spreads for sovereign bonds issued by emerging markets both before the First World War and again in the 1990s.³ Their work shows that turning points in sovereign risk during the first era of globalization are primarily associated with wars, rebellions, and political instability.⁴ No sharp changes in the time series they examined resulted from major institutional reforms. Even the promulgation of a modern constitution or the establishment of a central bank in Meiji Japan failed to elicit an immediate market response.⁵ Changes in monetary regimes, however, produced a statistically significant market reaction and affected the cost of capital even in the short term: the adoption of the gold standard in Japan in 1897 and the return to inconvertibility in Portugal in 1891 are two such examples.⁶

This article extends the analysis of the sovereign debt of emerging market economies during the classic period of the gold standard into an adjacent but quite different historical era. At the same time, it is related to the literature that focuses on wartime developments.

The historical period in question is complex. It includes both the First World War and the 1920s, a decade of widespread monetary upheaval on the Continent. Gold convertibility was restored and central bank independence was strengthened, either as a condition imposed by the League of Nations when assisting countries to *de jure* stabilize their currencies or by money doctors roaming the world.⁷

The paper makes a further contribution through the data it employs. This is the first time that daily time series for Greek sovereign risk have been compiled and presented in such a systematic way. The data is from daily observations and was collected by hand from *The London Times* and the *Stock Exchange Daily Official List*. The three time series of country risk constructed were considered statistically in isolation from their historical context. No dates were specified a priori as significant. Another contribution made by the paper is that it provides the evidence to empirically verify that central banks intervened in the markets to manipulate market prices of government debt, so as to improve the terms of any fresh borrowing. Finally, it introduces to the literature of economic history a new statistical method that can be used to detect breakpoints in the time series.

The statistical analysis here did not produce any breakpoints that would correspond to military news. The time series of sovereign risk demonstrate that it is defeat rather than war that influences market participants' expectations about a country's ability to honour its debt obligations. The analysis confirms that unexpected political changes have a strong impact on investors' behaviour. In addition, it illustrates that fiscal announcements and news related to the flotation of fresh loans can change market actors' behaviour. More importantly, it shows that the introduction of investor-friendly institutions, such as an independent central bank, did not elicit any quantitative market response. Contrary to the conclusions of studies on the first era of globalization, this work demonstrates that monetary regime change in Greece in the late 1920s, namely the introduction of the gold exchange standard, did not

² For example, see Waldenstrom and Frey (2008) and Willard et al. (1996).

³ Mauro et al. (2006), Mauro et al. (2002), Sussman and Yafeh (2000).

⁴ Mauro et al. (2006, pp. 61–73).

⁵ Sussman and Yafeh (2000).

⁶ Mauro et al. (2006, p. 73) and Sussman and Yafeh (2000).

⁷ Christodoulaki (2002) and Eichengreen (1996, pp. 47–49).

produce any breakpoints in sovereign time series. Institutional reforms, however, did lower the cost of capital.

The remainder of the paper is organized as follows. Section 2 describes the data employed. The method followed in the statistical analysis is developed in Section 3 where the results are presented. In Section 4 the breakpoints located in the time series are discussed and correlated to news that influenced investors' expectations. The article closes with some general conclusions. A brief history of the period under consideration is presented in the online Supplementary material, Appendix B.⁸

2. Overview of the data⁹

Three time series have been compiled, each representing a Greek Government loan denominated in gold and traded on the London market, the most important borrowing market for the Greek government in the 1920s. All three loans were issued after the establishment of the International Financial Commission (IFC), a nineteenth-century institution which was responsible for servicing the Greek loans under its aegis. They are the Railways Loan, the Bonds Loan and finally the Refugee Loan floated in 1924. In addition, data has been collected on the British consol as a default-free government loan to construct time series for Greek sovereign risk. Sovereign risk here is defined as the ratio of the yield of a government loan to the British consol. The three Greek government loans concerned are presented in table 1.

The flotation of the Railways Loan was endorsed in 1900 and was aimed at funding the construction and running of a railway. As this was the first attempt by the Greek government to raise capital on the international financial markets since the establishment of the IFC, it was placed under the latter's direct control. The Bonds Loan was authorized by law in 1910 and although it was secured by the surplus of tax revenues assigned to the Commission, it was not placed under their direct control. Both loans were redeemable at par in tranches drawn by lot every 6 months or by purchase on the open market, if the price was below par.

The Refugee Loan was issued under the auspices of the League of Nations late in 1924. This loan was raised to provide funds for the resettlement of refugees who fled to Greece following the Asia Minor debacle. A special body, the Refugee Settlement Commission, was established to administer the proceeds of this loan. The total sum issued was £12,300,000. A substantial part of the loan (£7,500,000) was issued in London while the rest was floated in almost equal parts in Athens and New York. Principal was repayable at par by twice-yearly ballot over a period of forty years commencing in September 1925.

Moody's Manual of Investments which at the time furnished investors with 'a key to the relative security and stability of particular investment bonds', assessed the Refugee Loan as a safer investment than the other two Greek loans examined. Under their system of ratings, the Refugee Loan had a "Baa" rating, while the Railways Loan and the Bonds Loan had a "Ba".¹⁰

⁸ Appendix B can be accessed in the Supplementary Material online.

⁹ For more on the data examined see [Christodoulaki et al. \(2011\)](#), pp. 9–15).

¹⁰ Moody's rating system (from highest to lowest) was: Aaa, Aa, A, Baa, Ba, B, Caa, Ca, C. See [Moody \(1926\)](#), pp. vii–xi and p. 550).

Table 1. *Description of the loans*

	Railways Loan	Bonds Loan	Refugee Loan
Year of issue	1902 and 1904	1910	1924
Amortization (years)	98	50	40
Coupon rate	4%	4%	7%
Sum authorized	£2,250,000	£5,955,000	£12,300,000
Sum issued	£2,183,280	£4,367,000	£12,300,000
Price of issue	83.50% ^a	86.50%	88% ^b
Comments	Purchases of bonds in relation to either the Railways or Bonds loans were possible if quoted below par. All loans were repayable at par by ballot every 6 months		

Sources: Wynne (1951, pp. 347–350), Andreades (1939), Angelopoulos (1937), Stefanides (1930), *Stock Exchange Year-Book* (1928, pp. 146–147), *Stock Exchange Official Intelligence* (1928, pp. 124–125), and *Corporation of Foreign Bondholders* (1926, pp. 199–203).

^aThe March 1902 issue was at 83½ percent, whereas the June 1904 flotation was at 84 percent.

^bPrice of issue in London and New York. The portion floated in Athens was issued at 86 percent.

All the time series compiled for this article are composed of daily observations collected by hand from sources extensively used by contemporaneous market participants to assess the creditworthiness of the Greek government. The Railways and the Bonds Loan data come from *The Times*, whereas the source of the Refugee Loan data is the *Stock Exchange Daily Official List*. They represent each day's final transaction as a percentage of par value.

British consols have been used as default-free bonds to construct time series of Greek sovereign risk. They have been collected by hand from the same sources used for the Greek government loans. For the period between 1914 and April 1925, the data on consols come from *The Times*, whereas for the remaining period the source is the *Stock Exchange Daily Official List*.

The Refugee Loan time series employed starts on 29 April 1925, the first day that this loan was traded on the London Stock Exchange, and finishes on 31 December 1929. In contrast with all other Greek loans traded on the London market, this loan was traded every day that the London Stock Exchange was open during the entire period in question. In fact, if the number of transactions that took place each day is used as a yardstick, then the 7 percent Greek Refugee Loan was one of the most popular loans on the London market.

The Railways Loan attracted investors' interest more than any other Greek loan issued before 1914. However, neither the Railways nor the Bonds loans were traded quite as extensively. See table A1 in Appendix A for the total number of days each year that these two loans were traded on the London market. For the period between 1914 and April 1925 when trading of the Refugee Loan commenced, two Greek loans, the Railways and the Bonds Loan, have been employed to examine how news influenced investors' expectations of the default risk of the Greek government. For the remaining period up to the end of December 1929, the Refugee Loan has been used. The three time series are plotted on figures 1 and 2. Figure 1 also references the most important historical events of the period in question.

Archival material shows that policymakers in Greece observed the market price movements of the 1914 Loan and the Bonds Loan in order to evaluate the country's creditworthiness on the London market.¹¹ It also reveals that the National Bank of Greece, possibly in

¹¹ Emmanuel Tsouderos Archive, Bank of Greece, File 22: Tripartite Loan of 1928, 61: Document undated, signed by Diomides, p. 2.

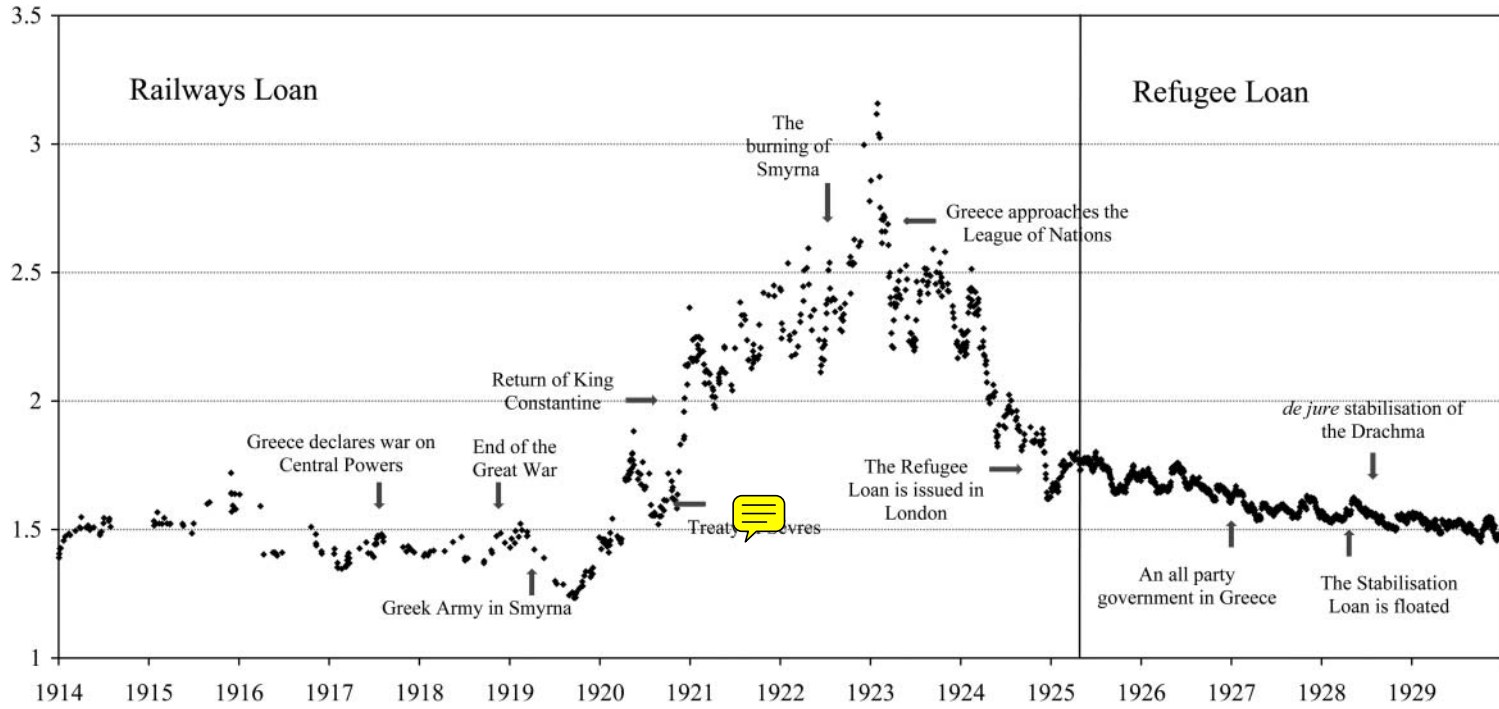


Figure 1. *Railways and Refugee Loans, 1914–1929.* Note: Sovereign risk is defined as the ratio of the yield of the Greek loan indicated above to the British consol. Sources: *The Railways Loan* daily data comes from *The Times* while the source of the *Refugee Loan* data is the *Stock Exchange Daily Official List*. The data on the British consol used to construct the sovereign risk time series comes from the same source as the equivalent Greek government loan in each case.

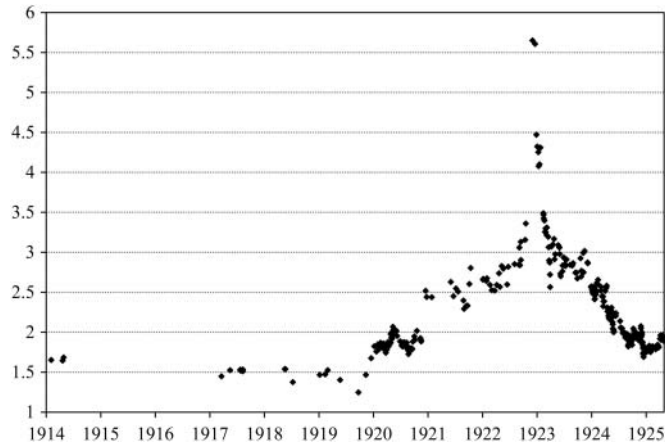


Figure 2. *Bonds Loan Sovereign Risk, 1914–1925*. Note: *Sovereign risk is defined as the ratio of the yield of the Greek loan indicated above to the British consol*. Source: Both the *Bonds Loan* and the *British consol* daily data come from *The Times*.

Table 2. *Support purchases*

	Sum allocated for bond purchases	Loans targeted	Amount quoted of loans targeted in London	Total amount of Greek loans quoted in London ^a
September 1924 – not known ^b	£630,000	1914 loan Bonds loan	£883,900 ^c £3,943,619 ^c	£24,600,909 ^d
Early 1928	£170,000	Not known		£44,887,459 ^e

Sources: See text; *Investor's Monthly Manual* (January 1928, p. 12) and *Investor's Monthly Manual* (September 1924, p. 519).

^aThe 1898 Loan is not included. The amount quoted for the 1898 Loan was £3,751,000 in September 1924 and £3,150,800 in January 1928.

^bMarket interventions must have been terminated early in December 1924 before the flotation of the Refugee Loan. In September 1924.

^dThis sum refers to September 1924 and includes the following loans: the 1881 Loan, the 1884 Loan, the 4% Monopoly Loan, the 4% Rentes Loan, the 1894 Loan, the Funding Loan of 1893, the Railways Loan of 1902, the National Loan of 1907, the Bonds Loan, and the 1914 Loan.

^eThis refers to January 1928 and includes the above loans plus the Refugee Loan of 1924.

co-operation with the government, attempted to manipulate the market prices of Greek bonds twice during the period in question.¹² Certainly an organized intervention by the National Bank began in September 1924, 3 months before the flotation of the London portion of the Refugee Loan. A second intervention seems to have been planned to coincide with the issue of the Stabilization Loan in January 1928.¹³ The information available on these two market adjustments is summarized in table 2.

¹² Emmanuel Tsouderos Archive, Bank of Greece, File 22: Tripartite Loan of 1928, 61: Document undated, signed by Diomides; Alexandros Diomides Archive, Greek Literary and History Archive, File 11, Document 16: Diomides writes to Kaphandares, 22 December 1927.

¹³ The Stabilization Loan was issued on 31 January 1928 under the aegis of the League of Nations.

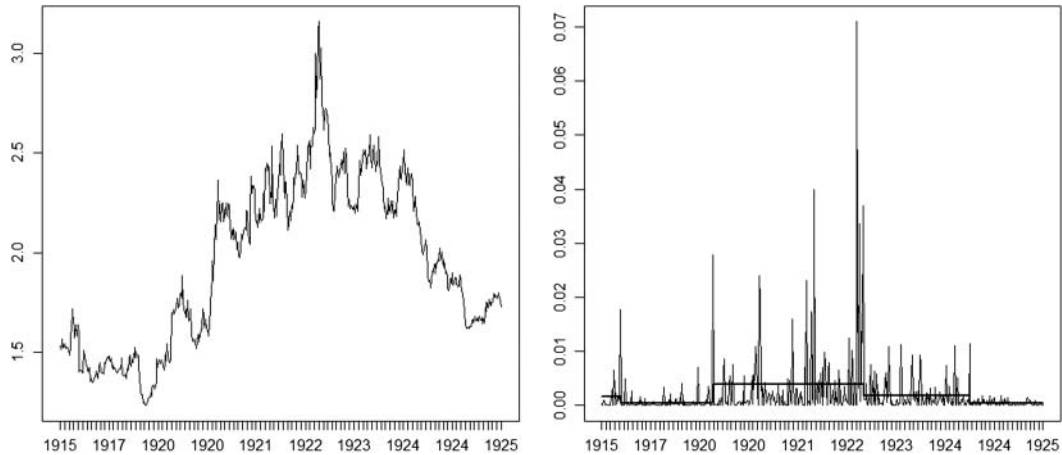


Figure 3. *Railways Loan times series: X_t (left) and Y_t (right). Note: The solid bold line is the estimated local variance of $X_t(\hat{\sigma}_{t,T}^2)$.*

3. Detecting breakpoints

The method applied here to detect breakpoints in the time series of Greek sovereign risk was developed in [Cho and Fryzlewicz \(2012\)](#). Its advantage over the popular [Banerjee et al. \(1992\)](#) four-step technique is that it requires no subjective input on the part of the user. It also offers good practical performance on simulated data as illustrated in [Cho and Fryzlewicz \(2012\)](#).

3.1 Railways Loan time series analysis

The Railways Loan data set used covers the period from January 1915 to April 1925, though trading was uneven during this period with transactions occurring on 571 days out of a possible 3,060. The concatenation of the available data points is treated as the data set in our analysis below.

Denote the time series of length $T = 571$ as $\{X_t\}_{t=1}^T$. Since X_t is a time series with a very high degree of autocorrelation (which makes it challenging to detect breakpoints in its mean or trend), we first difference X_t , which reduces the autocorrelation, and look for changes in its variance by observing the behaviour of the “local” variance estimate $Y_t = (X_{t+1} - X_t)^2/2$. See figure 3, where X_t and Y_t are compared.

Then we have

$$\sigma^2 = \text{var}(X_t) = \frac{E(X_2 - X_1)^2}{2},$$

i.e. the unknown mean of X_t is cancelled out by taking the difference between X_t and σ^2 which can be estimated by $(X_2 - X_1)^2/2$.

In reducing the problem of detecting breakpoints in the variance of X_t to detecting those in the expectation of Y_t , the CUSUM-type breakpoint detection procedure from [Cho and Fryzlewicz \(2012\)](#) is applied to Y_t .¹⁴

¹⁴ See [Cho and Fryzlewicz \(2012\)](#).

The procedure was developed for detecting breakpoints in a multiplicative model of the following form

$$Y_t = \sigma_{t, T}^2 \times \epsilon_t^2, \quad t = 1, \dots, T, \tag{1}$$

where $\sigma_{t, T}^2$ is a piecewise constant sequence (which corresponds to the expectation of Y_t) and $\{\epsilon_t\}_{t=1}^T$ are (possibly correlated) standard normal variables.

The first step of the procedure is to find the most likely location for a breakpoint. We locate such a point among $b \in \{1, \dots, T - 1\}$ as the one which maximizes the following:

$$\begin{aligned} \mathbf{Y}_{1, T}^b &= \left| \sqrt{\frac{T-b}{T \times b}} \sum_{t=1}^b Y_t - \sqrt{\frac{b}{T \times (T-b)}} \sum_{t=b+1}^T Y_t \right| \\ &= \sqrt{\frac{(T-b) \times b}{T}} \left| \frac{1}{b} \sum_{t=1}^b Y_t - \frac{1}{T-b} \sum_{t=b+1}^T Y_t \right|, \end{aligned} \tag{2}$$

where $\mathbf{Y}_{1, T}^b$ is interpreted as the difference between the local means of Y_t over the two segments $\{1, \dots, b\}$ and $\{b + 1, \dots, T\}$, adjusted by a multiplicative factor of the form $\sqrt{(T - b) \times b / T}$. This factor is chosen so that, in the ideal case of Y_t being i.i.d. random variables, the variance of $\mathbf{Y}_{1, T}^b$ remains constant over b . Similar CUSUM statistics have been adopted in the context of breakpoint detection, e.g. in [Brodsky and Darkhovsky \(1993\)](#), [Venkatraman \(1993\)](#), and [Inclán and Tiao \(1994\)](#), to name but three. However, one important difference between the aforementioned and [Cho and Fryzlewicz \(2012\)](#) is that, in the latter $\{\epsilon_t\}_{t=1}^T$ can be autocorrelated.

Once it is found that $\hat{b} \in \{1, \dots, T\}$ as where $\mathbf{Y}_{1, T}^b$ is maximized, i.e.

$$\hat{b} = \operatorname{argmax}_b \mathbf{Y}_{1, T}^b,$$

then $\mathbf{Y}_{1, T}^{\hat{b}}$ can be used to test the null hypothesis of $\sigma_{t, T}^2$ being constant over $t \in \{1, \dots, T\}$. In [Cho and Fryzlewicz \(2012\)](#) the test statistic and its critical value are designed in such a way that, if a breakpoint is present in a given interval, the null hypothesis is rejected with probability converging to 1. If the null hypothesis is rejected, the simultaneous locating and testing of breakpoints is repeated separately on the two segments to the left and right of \hat{b} , i.e. $\{Y_t\}_{t=1}^{\hat{b}}$ and $\{Y_t\}_{t=\hat{b}+1}^T$, in a recursive manner until no further breakpoints are detected. It is shown in [Cho and Fryzlewicz \(2012\)](#) that this procedure, further equipped with a post-processing step whose details we omit here, correctly detects both the total number and the locations of breakpoints under the multiplicative model (1) with probability approaching one.

When the procedure described above was applied to Y_t , it returned $t = 25$ (28 March 1916), $t = 143$ (26 March 1920), $t = 338$ (7 February 1923), and $t = 475$ (19 May 1924) as breakpoints. The right-hand panel of figure 3 shows the local variance of X_t estimated as the local mean over each stationary segment ($\hat{\sigma}_{t, T}^2$).

3.2 Bonds Loan time series analysis

The Bonds Loan time series for the period in question begins in March 1917 (as there was no trading activity between April 1914 and February 1917) and finishes in April 1925. It provides only 361 observations out of approximately 2,540 data points, which again are not equally spaced. We applied the same approach to its analysis as to the Railways Loan time series. Figure 4 compares X_t and Y_t , and the estimated local variance of $X_t = (\hat{\sigma}_{t, T}^2)$ is represented by the bold solid line. The breakpoints obtained are presented in table 5.

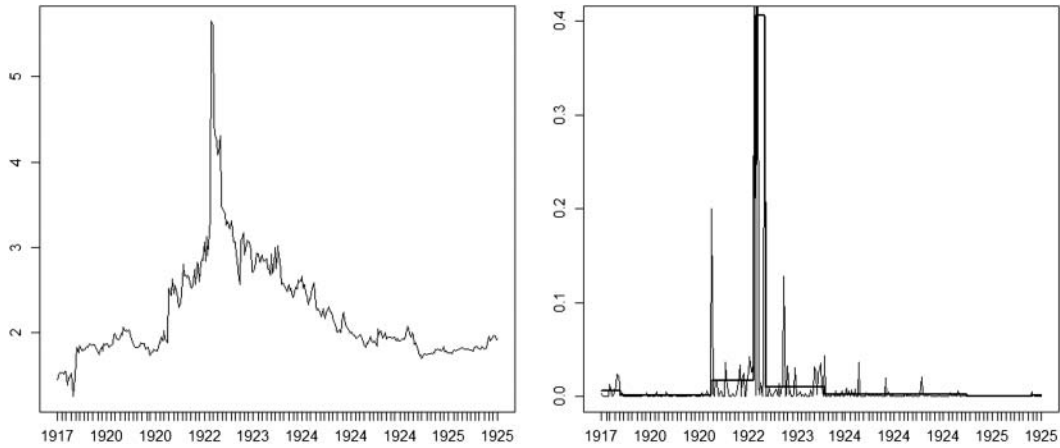


Figure 4. Bonds Loan time series: X_t (left) and Y_t (right). Note: The solid bold line is the estimated local variance of $X_t(\hat{\sigma}_{t,T}^2)$.

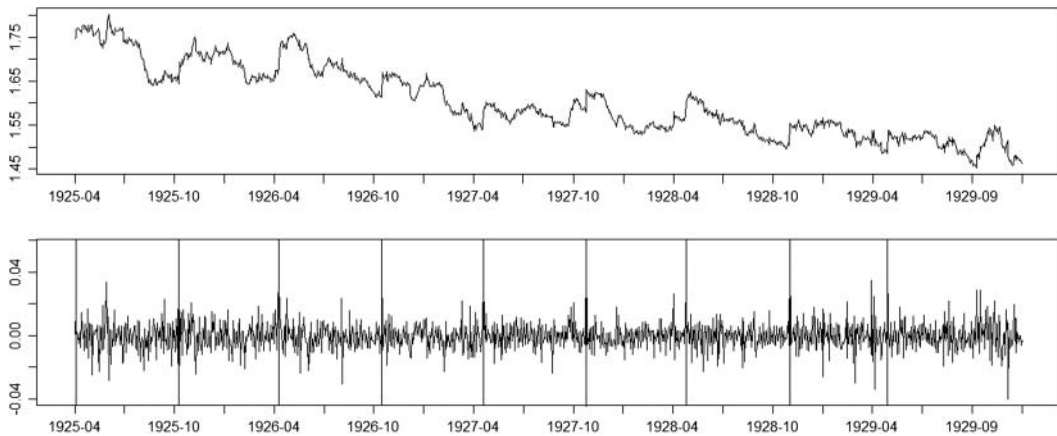


Figure 5. Refugee Loan time series. Notes: The first figure above represents the time series of the Refugee Loan sovereign risk. The second figure is the plot of the difference of the sovereign risk of the Refugee Loan represented by $\{X_{t+1} - X_t\}_{t=1}^{T-1}$. The vertical lines denote the spikes.

3.3 Refugee Loan time series analysis

The Refugee Loan time series offers a complete data set with 1,180 observations covering the period from 29 April 1925 until 31 December 1929. Owing to its particular statistical features described below, the Refugee Loan data set was analysed differently from the previous two time series.

3.3.1 Removing the regular spikes A key feature of the Refugee Loan daily time series is its biannual spikes. Figure 5 which is a plot of the difference in the time series represented by $\{X_{t+1} - X_t\}_{t=1}^{T-1}$, captures graphically these biannual spikes, which occur on the last day of each April and October that the London Stock Exchange was open. See also table 3 where the spikes identified are presented.

Table 3. Regularly spaced biannual spikes in the Refugee Loan time series

Dates of spikes	Events
30 April (Thursday) 1925	Coupons and bonds drawn by lot were honoured at par following 1 May and 1 November each year
30 October (Friday) 1925	
30 April (Friday) 1926	
29 October (Friday) 1926	
29 April (Friday) 1927	
31 October (Monday) 1927	
30 April (Monday) 1928	
31 October (Wednesday) 1928	
30 April (Tuesday) 1929	

Note: $T = 1141$, which coincides with 31 October 1929, is not included as a spike since, unlike in previous years, no sharp upward movement is observed. The difference is explained by the turmoil that the Great Crash on the New York Stock Exchange created on the international financial markets. Nevertheless, it is important to note that, even if $t = 1141$ is included in the statistical analysis as a spike, the outcome remains identical.

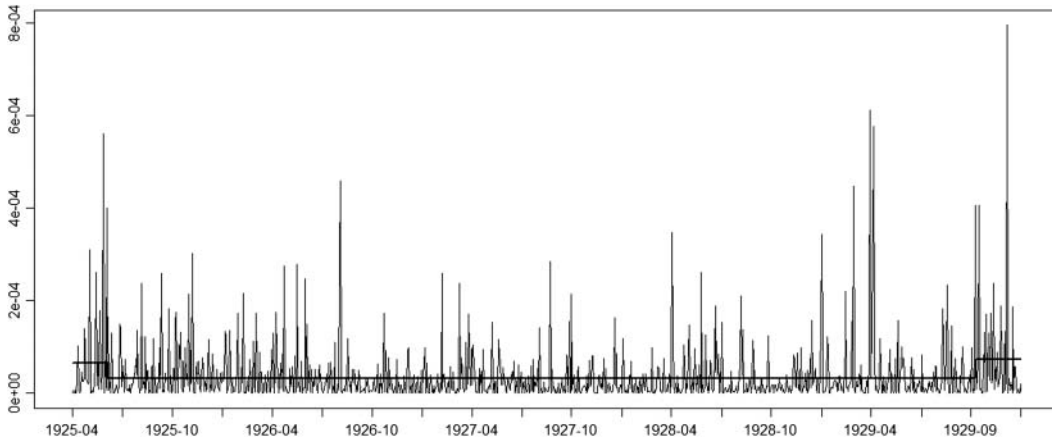


Figure 6. Refugee Loan time series: $Y_t = (X_{t+1} - X_t)^2/2$. Note: The solid bold line is the estimated local variance of $X_t(\hat{\sigma}_{t,T}^2)$.

These biannual spikes in the Refugee Loan time series coincide with coupon payments and redemption of bonds drawn by lot. From 1 May and again from 1 November each year, coupons were paid off at Hambros Bank in London, while at the same time bonds drawn by lot for redemption could be redeemed.¹⁵ Consequently, these biannual, regularly spaced spikes were removed from the data set before any further analysis was carried out.

3.3.2 Detecting breakpoints in the variance After the spikes have been removed from the data set of the Refugee Loan, the breakpoints in the variance of X_t are detected by applying the CUSUM-type testing procedure to $Y_t = (X_{t+1} - X_t)^2/2$. As a result, two breakpoints are

¹⁵ Draws of bonds of the Refugee Loan took place in Athens twice a year in March and September, commencing in September 1925. The numbers drawn were announced in the press, including British newspapers, so that repayment could be made at par after 1 May and 1 November, respectively, each year.

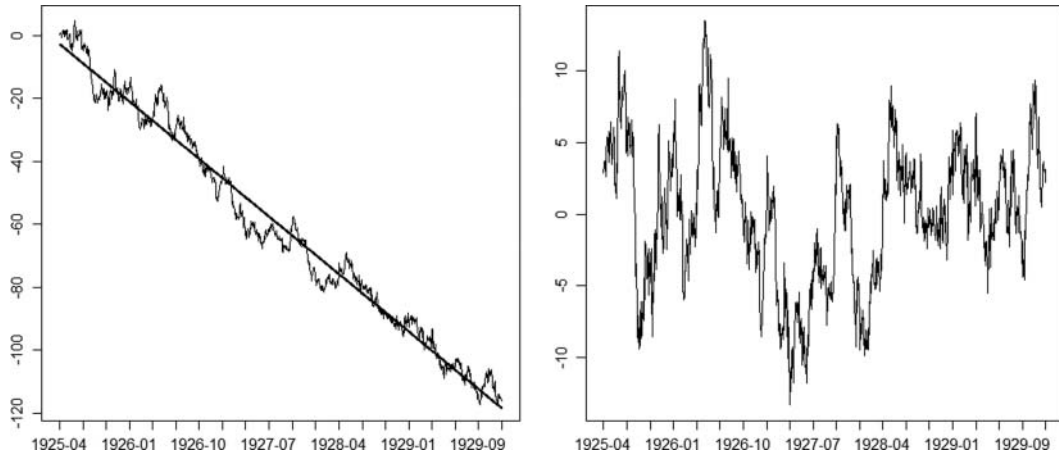


Figure 7. *Refugee Loan time series: Z_t obtained as in equation (3) (left) and z_t obtained after removing the linear trend from Z_t (right). Note: The linear trend is in the solid line.*

Table 4. *Refugee Loan: simple linear regression fit of Z_t over time*

Coefficients	Estimate	Std. error	<i>t</i> -value	$P(> t)$
Intercept	-2.8874441	0.2796638	-10.32	$<2 \times 10^{-16}$
Time	-0.0971146	0.0004137	-234.72	$<2 \times 10^{-16}$
Residual standard error: 4.78 on 1168 degrees of freedom				
Multiple R^2 : 0.9792			Adjusted R^2 : 0.9792	
F -statistic: 5.509×10^4 on 1 and 1168 DF			p -value: $<2.2 \times 10^{-16}$	

returned at $t = 47$ (6 July 1925) and $t = 1123$ (7 October 1929). See figure 6 and table 5 below where these two breakpoints are presented.

Subsequently, these breakpoints are used to estimate the local variance of $X_t(\sigma_{t,T}^2)$ as the local mean over each stationary segment ($\hat{\sigma}_{t,T}^2$). Finally, this estimate is used to compute the “variance-stabilized” version of X_t ,

$$Z_t = \sum_{s=1}^t \frac{X_{s+1} - X_s}{\hat{\sigma}_{s,T}}. \quad (3)$$

3.3.3 Removing the linear trend from the data As can be seen in the left-hand panel of figure 7, there is a strong downward linear trend in Z_t as obtained in equation (3). The trend is removed from Z_t via a linear fit (see table 4) and the residuals after de-trending are denoted by z_t . See the right-hand panel of figure 7.

3.3.4 Fitting an AR(2) model to the residuals To study the behaviour of z_t , its autocorrelation (acf) and partial autocorrelation (pacf) functions are plotted in figure 8. The acf on the left-hand panel shows that z_t is strongly autocorrelated and the pacf on the right-hand panel shows that z_t may be well explained by an autoregressive (AR) process of order 2.

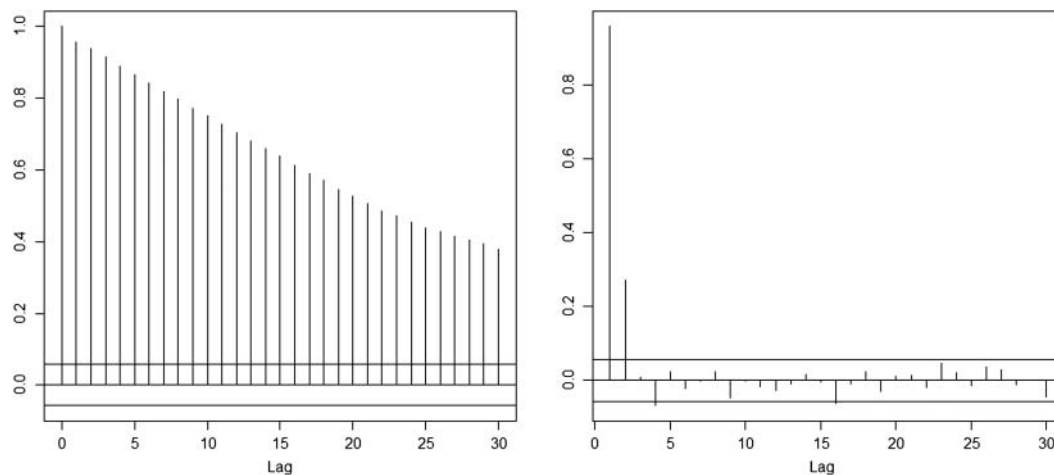


Figure 8. *Refugee Loan time series: autocorrelation (left) and partial autocorrelation (right) functions of z_t .*

To confirm this observation, an AR(2) process was fitted to z_t ; the residuals comfortably passed the Ljung-Box test for the lack of serial correlation. Therefore, we concluded that no further systematic pattern was present in the data.

4. Breakpoints and historical events

Table 5 presents the breakpoints detected by the statistical analysis of the three Greek sovereign risk time series employed here. The second column of this table refers to the historical events that correlate in time with the breakpoints identified.

The two time series of sovereign risk analysed here, those relating to the Railways and Bonds loans respectively, which cover the period between 1914 and April 1925 as shown by figures 1 and 2, present a consistent picture of the period in question in spite of some differences. The statistical analysis confirms this discrepancy in the behaviour of the two loans. This difference could offer a “guide to the labyrinth”¹⁶ of Greek public debt, while at the same time demonstrating the complexity of the markets. It could be explained by the different attributes of the two loans, some of which are not always readily apparent. For example, the seniority sequence in the service of these two loans was dissimilar: the Railways Loan was under the direct control of the IFC but the Bonds Loan, despite being secured by public revenues assigned to the Commission, was not placed under their direct control. Knowing the identity of the ultimate buyers and sellers of Greek government bonds on the London Stock Exchange could also help to shed light on why there is a discrepancy in the behaviour of the two time series. However, this is evidence that it may not be possible to find for the period in question.

Both time series demonstrate that during the First World War Greek sovereign risk remained low. Uncertainty began a month after Greek troops disembarked in Smyrna and consequently country risk increased as the creditworthiness of the Greek government

¹⁶ *The Economist*, 27 January 1923.

Table 5. *Correlation of breakpoints to historical events, 1914–1929*

Breakpoints	Historical events
Railways Loan	
28 March (Tuesday)/10 April (Monday) 1916	See text
26 March (Friday)/29 March (Monday) 1920	Asia Minor campaign
7 February (Wednesday)/9 February (Friday) 1923	See text
19 May (Monday)/22 May (Thursday) 1924	Public debt developments
Bonds Loan	
16 December (Tuesday), 1919/6 January (Tuesday), 1920	Asia Minor campaign/Fiscal news
15 November (Monday)/16 November (Tuesday) 1920	The general election of 14 November 1920 (Gregorian calendar)
13 October (Friday)/17 October (Tuesday) 1922	Immediate (political) aftermath of the Asia Minor debacle
23 January (Tuesday)/12 February (Monday) 1923	See text
6 December (Thursday)/27 December (Thursday) 1923	Events surrounding the general election of 16 December 1923
15 December (Monday)/16 December (Tuesday) 1924	Flotation of the Refugee Loan in London
25 March (Wednesday)/26 March (Thursday) 1925	See text
Refugee Loan	
6 (Monday)/7 July (Tuesday) 1925	Events following the coup d'état of 25 June 1925
7 (Monday)/8 October (Tuesday) 1929	See text

deteriorated. The Asia Minor campaign, acting perhaps as a proxy of fiscal performance, prompted a continuous increase in the risk premium of Greek government debt. By the end of the Asia Minor campaign, Greek sovereign risk had rocketed, reflecting the debacle and its aftermath in a striking fashion. It is noteworthy, however, that the statistical analysis here did not locate any breakpoints that would coincide with military news.

In early 1923, as both loans' data sets show, risk premium started falling and the statistical analysis of the Refugee Loan country risk time series reveals a strong linear downward trend in this data set. By the end of the period in question, Greek country risk had decreased considerably, but still remained higher than it had been at the beginning of 1914.

It is a real challenge, using advanced statistical analysis, to attempt to understand market investors' behaviour during such a complex historical period. The challenge becomes even greater when irrational noise trading occurs, leading to a divergence between market prices and fundamental values.¹⁷ In such cases, breakpoints detected by statistical analysis do not correspond to historical events. The underlying fundamentals of bond prices, however, are more easily defined than those of stock prices, a fact that makes the analysis of time series of bond prices less subject to problems of market inefficiency.¹⁸

The statistical analysis of the three daily time series examined here shows that investors acted upon news of fiscal performance and public debt developments. Political events and in particular unanticipated political changes also influenced bondholders' behaviour. In contrast, institutional innovations, such as the adoption of the gold exchange standard and the establishment of a central bank *de novo*, did not produce any quantitative market response. A

¹⁷ De Long et al. (1990).

¹⁸ Frey and Waldenstrom (2004, p. 53).

comprehensive review of the London press of the period establishes that market participants were able to keep themselves very well informed about developments in Greece.¹⁹ Market actors observed and evaluated every step taken towards reconstruction. As a result, stabilization and the concomitant institutional reforms were gradually factored into the market price of Greek government debt traded on the London Stock Exchange and therefore the risk premium demanded by investors fell steadily.

The results of statistical analysis here echo findings in the literature related to this article in that the importance of fiscal announcements and political changes that are not anticipated by markets is highlighted. Our research further complements that literature by demonstrating that news related to public debt developments, and more specifically to the flotation of fresh loans, elicit a quantitative market response. Our findings, however, depart from those of studies on the first era of globalization in that the statistical analysis did not produce any breakpoint that would correspond to the adoption of the gold exchange standard in Greece in the late 1920s.

Statistical analysis indicates that the two organized interventions of the National Bank to manipulate market prices of Greek government bonds in London, as described in table 2, did not produce any statistically significant market reaction that would indicate a change in the behaviour of market participants. As table 5 shows, no breakpoints were detected during the period in which the National Bank was attempting to improve the market price of Greek sovereign debt and thus to influence the terms for further borrowing by the Greek government on the London market. One of the two loans targeted by the market interventions of the National Bank in the autumn of 1924 was the Bonds Loan analysed here. It is, however, unlikely that the breakpoint detected in mid-December 1924 by statistical analysis of the Bonds Loan sovereign risk time series was triggered by market interventions. By then not only had the terms of the Refugee Loan been determined, but the loan itself had already been issued.²⁰

In the text that follows, the breakpoints detected by statistical analysis are correlated with historical events that appear to have shaped investors' behaviour on the London Stock Exchange.

4.1 *Asia Minor: increasing uncertainty*

In 1916 deals in Greek government bonds on the London market were "rare"²¹ and did not "reflect the unsettled condition of politics"²² in Greece. Prices of Greek government bonds were supported by purchases for the sinking fund and by wealthy Greeks, in particular by those connected with the shipping industry.²³ The statistical analysis locates a breakpoint in the Railways Loan sovereign risk time series between late March and early April 1916. However, dealings on this loan were so sporadic throughout 1916, as table A1 in Appendix A shows, and at the same time both the political and financial conditions in Greece were so complex, that it is difficult to isolate the events that may have produced this breakpoint.

¹⁹ See Christodoulaki and Penzer (2004).

²⁰ The terms of the Refugee Loan were published on 4 December 1924, which suggests that market interventions must have been terminated by that date. See *The Times*, "Terms of Greek Loan", 4 December 1924. See also *The Times*, "Greek Government 7% Refugee Loan", 8 December 1924.

²¹ Greek Extracts, *Financier*, 21 February 1916; see table A1 in Appendix A.

²² Greek Extracts, *Morning Post*, 4 October 1916.

²³ Greek Extracts, *Morning Post*, 4 October 1916.

The two time series under scrutiny here show that sovereign risk began to increase at the end of 1919 when there had “been [a] considerable reduction in the quotations of Greek loans” on the London market.²⁴ The statistical analysis of the Bonds Loan risk premium data set displays a breakpoint early in January 1920 when an uncomfortable “discrepancy between revenue and expenditure”²⁵ was disclosed, demonstrating a change in investors’ perceptions of the fiscal health of the country in that month. The analysis of the country risk based on the daily data set of the Railways Loan locates a breakpoint approximately 3 months later than in the Bonds Loan, in late March 1920. Both these breakpoints indicate that investors considered it a possibility as early as spring of 1920 that the Greek government would not be able to service its debt and at the same time pursue its territorial aspirations in Asia Minor.

The Bonds Loan time series of sovereign yield spreads then displays a second breakpoint in the middle of November 1920, which supports the conventional historiography. The timing of this breakpoint coincides with the overwhelming defeat of Venizelos in the general election of that month which brought the Populist Party to power.²⁶ Political historiography views this change of government in Athens as crucial to the course of history on the Asia Minor front and economic history literature sees it as central in explaining the slide of the drachma.

4.2 *The debacle*

After 1919 Greek government bonds sustained their downward trend and consequently the risk premium on Greek government debt rocketed, reflecting the decreased credibility of the Greek government as a borrower on the London market. *The Economist* repeatedly reassured holders of Greek government bonds that, although the situation in Athens was critical both financially and politically, there was no reason to suppose that this would affect the servicing of public debt.²⁷ Market signals were also encouraging to investors. In 1920 the IFC paid bondholders of Greek loans issued before the 1893 default which were under its supervision their full contractual interest rate for the first time since the introduction of the Law of Control.²⁸

The Asia Minor campaign ended disastrously for Greece in the late summer of 1922. The effect of this outcome, along with the political changes in the country that followed the military defeat, is illustrated dramatically in the sovereign yield spreads as expressed by the two time series employed here. The statistical analysis of the Bonds Loan time series detects a breakpoint in October 1922 during a period when “Greek bonds remained out of favour” on the London Stock Exchange.²⁹ This breakpoint reflects the precarious financial situation in Athens. A military convention signed at Mudania on 11 October 1922 provided for the evacuation of the Greek population from Eastern Thrace. Approximately 200,000 people

²⁴ Greek Extracts, *Daily Telegraph*, 1 January 1920.

²⁵ Greek Extracts, *Daily Telegraph*, 1 January 1920.

²⁶ The general election was held on 1 November by the Julian calendar which was used in Greece at that time. That is 14 November by the Gregorian calendar.

²⁷ *The Economist*, 22 October 1921, 4 March 1922, and 5 August 1922.

²⁸ The interest rate paid each year on the “Old Loans”, as these loans are known, fluctuated between the minimum rate defined by the Law of Control and the original nominal interest rate of the loan. For more information on these loans see [Christodoulaki and Penzer \(2004\)](#), pp. 15–16 and p. 60).

²⁹ *The Times*, “Stock Exchange”, 15 November 1922; the Bonds Loan was traded twice in October 1922, whereas in November of that year no dealings took place on this Greek Loan.

had to leave the area for Greece “in a short space of time”.³⁰ “Sheltering and feeding” over a million refugees while sustaining the “financial needs of the Treasury” were the most pressing problems that the Revolutionary Committee faced at the time.³¹

Clearly developments on the Asia Minor front had a decisive influence on the value of the country’s sovereign bonds traded in London. Political developments in the country and the uncompromising stance of the Revolutionary Committee in handling domestic issues had a strong impact on investors’ confidence in the creditworthiness of the Greek government on the London market. The value on the London market of the Bonds Loan, for example, fell to as low as 16 percent of face value on 1 December 1922, demonstrating a dramatic decrease in public confidence in the Greek government.³²

4.3 Improved credibility and reform

Figures 1 and 2 clearly show that late in 1922 market actors believed that the Greek government was approaching default. In contrast, none of the Greek governments of the period, despite the difficulties they encountered in financing public expenditure, considered default an option. The humiliation of the military defeat in 1922, combined with the transaction costs, and the embarrassment of the 1893 default which still loomed large in politicians’ minds in Athens, as well as the belief that foreign aid would be forthcoming, led governments to opt for other, often controversial measures to cover expenditure rather than ceasing to honour their interest-bearing obligations.

Both time series of sovereign risk examined here present a breakpoint in early February 1923. These breakpoints and in particular that of the Railways Loan time series, since it is the first breakpoint of this data set located after March 1920, denote the end of a long period marked by the events that led to the Asia Minor debacle. It is possible that these breakpoints in early February 1923 reflect developments on the diplomatic front. On 30 January 1923, a convention was signed in Lausanne between Greece and Turkey for the compulsory exchange of populations between the two countries. In addition, the Greek government tried to improve its credibility by making positive statements in the London press about the fiscal position of the country at a time when it was searching for capital to finance the settlement of the refugees.³³

Analysis of the Bonds Loan distinguishes it again from the Railways Loan and presents a breakpoint in late December 1923 which reflects the political developments in Greece that led to the return, albeit temporarily, of Venizelos to the political arena.

After unsuccessful attempts to raise capital on the international markets for the rehabilitation of refugees, the Greek government turned to the League of Nations for assistance. The news that an external loan on behalf of the refugees was to be granted to Greece under the auspices of the League was first announced to the public early in May 1923.³⁴ It took a whole

³⁰ *The Times*, “A Million Refugees”, 19 October 1922.

³¹ *The Economist*, 21 October 1922.

³² For the dramatic events that had occurred in Athens 3 days before see Yanoulopoulos (1999, pp. 297–303), History of the Greek Nation (1978, pp. 255–259), Daphnes (1955, pp. 10–20), and Morgenthau (1929, pp. 105–106).

³³ *The Times*, “Refugees and the League”, 3 February 1923, Pepelasis Minoglou (1993, p. 70), Minoglou Pepelasi (1989, p. 339 and footnote 13 on p. 360).

³⁴ *The Economist*, “Greece”, 16 June 1923.

year, however, before in May 1924 it was finally confirmed that the Greek Refugee Loan would be floated in the following October or November. At the same time the Bank of England consented to despatch a second advance for the continuation of the settlement of the refugees until the flotation of the loan. The breakpoint that the analysis of the Railways Loan time series detects in May 1924, the last breakpoint that this series presents, coincides with these developments as they related to the flotation of the Refugee Loan. It also signifies the return of the country to the financial markets, for all that this return was under the supervision of the League of Nations.

In the end, the terms and conditions of this loan were finalized and announced early in December 1924. On 8 December subscription lists were opened in London at 9:45 a.m. but had to be “closed at about one minute past ten” that same morning and “hundreds of belated applications were excluded”.³⁵ “The actual result far outstripped the most optimistic expectations”,³⁶ as the Greek Refugee Loan was 21 times oversubscribed.³⁷ The breakpoint located in the Bonds Loan sovereign risk time series in the middle of December 1924 correlates with the success of the flotation of the Refugee Loan on the London market as this encouraged “buying of some of the older Greek loans”.³⁸

The euphoria created by the success of the Refugee Loan soon faded away. By March 1925, it was apparent that the proceeds of this loan would not be sufficient to complete the resettlement of the refugees.³⁹ In March 1925, the Bonds Loan time series presents the last breakpoint detected by statistical analysis. There is no obvious reason that would explain this change in the Bonds Loan time series other than that it was by then evident that the settlement of the refugees would be a more costly operation than had been anticipated.

The Refugee Loan sovereign risk time series employed to provide insight into the way that investors reacted to news from May 1925 until the end of 1929 shows that two statistically significant market responses resulted. A breakpoint is detected at the beginning of this period, early in July 1925, and a second one occurs close to the end of the period under scrutiny here, early in October 1929. See also table 5. The breakpoint located early in July 1925 must surely have been produced by the coup d'état of General Pangalos and the political events that followed,⁴⁰ since the news of the political turmoil in Athens triggered “a sharp decline” in the value of the Greek Refugee Loan on the London market.⁴¹ By the time of the breakpoint a new government had been formed and the Minister of Finance had already announced both the economic policy and the aims of the new government.⁴² The policy adopted by officials was to convince the financial markets that what had happened in Athens was “a mere change of government”.⁴³

The final breakpoint located in the time series occurs early in October 1929 when uncertainty had already begun to loom over the world's stock exchanges. This breakpoint might

³⁵ Greek Extracts, *Morning Post*, 9 December 1924. *The Times*, “Greek Loan Success” 9 December 1924.

³⁶ *The Times*, “Heavy Rush for Greek Loan”, 9 December 1924.

³⁷ [Pepelelasis Minoglou \(1993, p. 89\)](#). The press at the time reported fifteen times and compared the Greek Refugee Loan with the German Dawes Loan which was covered thirteen times over.

³⁸ *The Times*, “Stock Exchange”, 10 December 1924.

³⁹ Greek Extracts: *Financial News*, 19 March 1925; *Financial News*, 24 March 1925.

⁴⁰ See [Daphnes \(1955, pp. 276–295\)](#).

⁴¹ *The Times*, “Fall in Greek Bonds”, 26 June 1925.

⁴² See Greek Extracts: *Financial News*, 1 July 1925; *Financial News*, 6 July 1925. *The Times*, “Greek Government Crisis Ended” and “New Greek Government”, 2 July 1925.

⁴³ Greek Extracts, *Financial News*, 8 July 1925.

reflect developments related to new borrowing by the Greek government, as described briefly in the last paragraph of this section.

The statistical analysis of the Refugee Loan time series does not reveal any breakpoints between July 1925 and the implementation of a League of Nations stabilization plan in 1928. However, it is apparent from figure 1 that eventual stabilization and the concomitant institutional reforms had already been factored into the market value of the bonds and consequently the creditworthiness of the Greek government improved on the London market. There are no breakpoints corresponding to events that the literature regards as playing a significant role in achieving monetary stability: that is to say the elections of November 1926, settlement of war debts with Great Britain, resorting to the League of Nations in 1927, and finally the flotation of the Stabilization Loan in 1928. Crucially, there is no statistically significant change that coincides with the establishment of the central bank and *de jure* stabilization of the drachma.

The central banking reforms and the adoption of the gold exchange standard in Greece in 1928 would hardly have taken investors by surprise. Both events had been publicized in the press. In addition, there was generally a lengthy time span between the initial, possibly informal, announcement and the promulgation of the reforms. Statements about the Greek government's intention to stabilize the drachma appeared in the British press as early as July 1925⁴⁴ and the matter was frequently in the news up to the *de jure* stabilization.⁴⁵ The formal announcement and the timing of *de jure* stabilization of the drachma close to its market value were therefore anticipated by market participants. The drachma had been *de facto* stabilized for a whole year before May 1928 and the monetary authorities as well as government officials involved advocated at every opportunity legal stabilization without "revalorization".⁴⁶

News about possible central banking reforms in Greece appeared in the British press on the same day that the Greek representatives in Geneva officially asked the Council to authorize a stabilization loan for Greece. The *Financial News* of 15 June reported that, under the League's scheme, the National Bank of Greece "would be transformed into an issue bank and would engage a foreign advisor".⁴⁷ Some of these central banking reforms would in any event have been anticipated by the markets, as they were an integral part of all the League-sponsored reconstruction schemes that had preceded the Greek stabilization plan. Three weeks later, *The Economist* published a long article on the negotiations between Greek officials and the Financial Committee of the League. It was reported that a prerequisite for the flotation of a League-sponsored loan was that the Greek parliament authorize "the gradual conversion of the National Bank of Greece into a central bank of issue of modern type".⁴⁸ By that time, however, not only had the manner of central banking reform in Greece been agreed upon, but the statutes of the new bank of issue had been drafted.⁴⁹

⁴⁴ Greek Extracts, *Financial News*, 6 July 1925. See also *The Economist*, 10 January 1925.

⁴⁵ See Christodoulaki and Penzer (2004, table 4, pp. 23–26).

⁴⁶ Greek Extracts: *Financial Times*, 31 January 1927; *Financial News*, 9 May 1927; *Financial Times*, 27 June 1927; *Morning Post*, 5 October 1927; *Financial News*, 23 January 1928; *Financial Times*, 14 May 1928. *The Economist*, 14 May 1927.

⁴⁷ Greek Extracts, *Financial News*, 15 June 1927.

⁴⁸ *The Economist*, 9 July, 1927.

⁴⁹ See Bank of England Archive: OV9/190, 1: J.A.C. Osborne to Otto Niemeyer, 12 July 1927; OV9/190, 93: Osborne to Strakosch, 14 July, 1927.

The London press reported developments in Athens as they unfolded.⁵⁰ A statistically significant market reaction might be expected, reflecting the announcement of the imminent establishment of the Bank of Greece. In fact, statistical analysis of the daily observations of the Refugee Loan shows that financial market actors' behaviour was not dramatically influenced by the news. Market prices of Greek government bonds, however, did respond to the information available. Bond prices drifted gradually upwards as news of institutional changes in Athens reached the market and consequently, as figure 1 illustrates, the spread between the yield of the Refugee Loan and the British consol steadily declined.

The political authorities expected that institutional developments resulting in the establishment of a central bank and the adoption of the gold exchange standard would facilitate an influx of foreign capital essential for economic growth. However, by May 1928 the Greek government had over-borrowed and the international economy was about to enter the most severe depression ever experienced. A few months after Greece adopted the gold exchange standard, in December 1928, a loan for public works with a nominal value of four million pounds was issued on the London market, on similar terms to those of the Stabilization Loan. Only one-third of this loan was covered. A month later, in January 1929, the Greek government signed an agreement with Seligman & Co for a loan with a nominal value of up to 54 million dollars.⁵¹ The agreement provided for the flotation of a loan on terms similar to the Stabilization Loan on the condition that the IFC would assume responsibility for its service. Seligman would take responsibility for any part of the loan that remained uncovered. On 30 October 1929 the *Evening Standard* announced the cancellation of this loan.⁵² The official reason for the termination of this agreement was that the IFC had refused to assume responsibility for the service of this loan.⁵³ The timing of the termination of the agreement, however, is more revealing than the official announcement.

5. Conclusion

In this article three daily time series of sovereign risk have been compiled using Greek government loans denominated in gold and the British consol as a default-free government loan. The objective has been to analyse them statistically so as to shed light on the way that historical events, including institutional changes, interact with capital markets to determine asset prices.

The daily time series of Greek sovereign risk analysed here demonstrate that during the Great War, country risk remained low. However, the value of Greek bonds traded on the London Stock Exchange decreased dramatically in response to developments in Asia

⁵⁰ Greek Extracts: *Financial News*, 18 July 1927; *Financial News*, 22 July 1927; *Financial Times*, 4 August 1927; *Financial Times*, 13 August 1927; *Financial Times*, 3 September 1927; *The Times* 14 September 1927; *Financial News*, 17 September 1927; *The Times*, 28 September 1927; *Financial News*, 3 October 1927; *Morning Post*, 5 October 1927; *The Times*, 28 October 1927; and *The Times*, 26 November 1927. *The Economist*, 8 October 1927, 31 March 1928, and 26 May 1928.

⁵¹ The nominal value of this loan in sterling was approximately eleven million, close to that of the Refugee Loan of 1924. This means that the Seligman Loan was potentially a bigger lending operation than the Stabilization Loan.

⁵² Greek Extracts, 30 October 1929.

⁵³ Greek Extracts: *Morning Post*, 2 November 1929; *Financial News*, 25 November 1929. On the refusal of the IFC see Greek Extracts: *The Times*, 30 August 1929; *The Economist*, 19 October 1929. See also Stefanides (1930, pp. 257–258).

Minor and consequently the risk premium soared. News relating to the military campaign in Asia Minor became a proxy for fiscal performance.

The statistical analysis clearly shows that investors acted upon news of fiscal performance and public debt developments. Political events and, in particular, political changes that had not been anticipated also influenced the behaviour of investors in Greek government debt.

Institutional innovations such as *de jure* adoption of the gold exchange standard and the establishment of a central bank *de novo* did not produce any quantitative market reaction. Formal announcements on institutional changes such as the adoption of the gold exchange standard and the establishment of a central bank were unlikely to contain new information. Such reforms are promulgated over a period of time and need to be ratified by parliament. Market actors were able to observe and carefully evaluate every step taken towards stabilization. As a result, stabilization and the concomitant institutional reforms were gradually factored into the market price of Greek sovereign debt traded in London. The credibility of the Greek government on the London market improved and consequently the cost of capital was lowered.

Supplementary material

Supplementary material is available at *EREH* online.

Acknowledgements

This article has benefited from the suggestions and comments on earlier versions of Nicholas F. R. Crafts, William P. Kennedy, Michalis Psalidopoulos, two anonymous referees and the editors of this *Review*. Thanks are also due to the participants at the Sixth SEEMHN Conference in Bucharest in March 2011. The usual disclaimer applies. A previous version of this work has been published as working paper no. 50 of the Hellenic Observatory of the London School of Economics (GreeSE).

Conflict of interest statement. None declared.

Archival Sources

Alexandros Diomides Archive, Greek Literary and History Archive, File 11, Athens.

Emmanuel Tsouderos Archive, Bank of Greece, File 22, Athens.

Historical Archives of the National Bank of Greece, XIX: Foreign Exchange, File 35, Document 15, Athens.

Bank of England Archive, OV9/190, London.

Council of the Corporation of Foreign Bondholders. *Greek Extracts*. Vol. 6, 27 October 1904–25 September 1916, Guildhall Library, City of London, London.

Council of the Corporation of Foreign Bondholders. *Greek Extracts*. Vol. 7, 25 September 1916–31 October 1931, Guildhall Library, City of London, London.

The Economist, 1914–1929.

The London Times, 1914–1929.

The Stock Exchange Daily Official List, 1925–1929. Guildhall Library, London.

References

- ANDREADES, A. (1939). *Wórks*. Athens: Faculty of Law, University of Athens (in Greek).
- ANGELOPOULOS, A. (1937). *The Public Debt of Greece*. Athens: Zacharopoulos (in Greek).
- BANERJEE, A., LUMSDAINE, R.L. and STOCK, J.H. (1992). Recursive and sequential tests of the unit root and trend break hypothesis: theory and international evidence. *Journal of Business and Economic Statistics* **10**, pp. 271–87.
- BRODSKY, B.E. and DARKHOVSKY, B.S. (1993). *Nonparametric Methods in Change-point Problems*. Dordrecht: Kluwer.
- BROWN, W.O., Jr and BURDEKIN, R.C.K. (2000). Turning points in the US civil war: a British perspective. *Journal of Economic History* **60**, pp. 216–31.
- BROWN, W.O., Jr and BURDEKIN, R. (2002). German debt traded in London during the Second World War: a British perspective on Hitler. *Economica* **69**, pp. 655–69.
- CHO, H. and FRYZLEWICZ, P. (2012). Multiscale and multilevel technique for consistent segmentation of nonstationary time series. *Statistica Sinica* **22**, pp. 207–29.
- CHRISTODOULAKI, O. (2002). Banking reform and the establishment of the bank of Greece. In C. HATZIOSSIF (ed), *History of Greece in the Twentieth Century: The Interwar Period, 1922–1940*, Vol. **B1**. Athens: Bibliorama, pp. 250–67 (in Greek).
- CHRISTODOULAKI, O. and PENZER, J. (2004). News from London: Greek Government Bonds on the London Stock Exchange, 1914–1929. Department of Economic History, LSE, Working Paper No. 86/04. Available online at <http://www2.lse.ac.uk/economicHistory/pdf/WP8604.pdf>.
- CHRISTODOULAKI, O., CHO, H. and FRYZLEWICZ, P. (2011). A Reflection of History: Fluctuations in Greek Sovereign Risk between 1914 and 1929. Hellenic Observatory of the LSE, GreeSE Working Paper No. 50. Available online at: <http://www2.lse.ac.uk/europeanInstitute/research/hellenicObservatory/pdf/GreeSE/GreeSE50.pdf>.
- Corporation of foreign bondholders. (1926). *Fifty-Third Annual Report of the Council of the Corporation of Foreign Bondholders for the Year 1926*. London: Council House.
- DAPHNES, G. (1955). *Greece Between the Two Wars, 1923–1940*. Athens: Ikaros (in Greek).
- DE LONG, J.B., SHLEIFER, A., SUMMERS, L.H. and WALDMANN, R.J. (1990). Noise trader risk in financial markets. *Journal of Political Economy* **98**, pp. 703–38.
- EICHENGREEN, B.J. (1996). *Globalizing Capital: A History of the International Monetary System*. Princeton, NJ: Princeton University Press.
- FREY, B.S. and KUCHER, M. (2000a). History as reflected in capital markets: the case of World War II. *Journal of Economic History* **60**, pp. 468–96.
- FREY, B.S. and KUCHER, M. (2000b). World War II as reflected on capital markets. *Economic Letters* **69**, pp. 187–91.
- FREY, B.S. and WALDENSTROM, D. (2004). Markets work in war: World War II reflected in the Zurich and Stockholm bond markets. *Financial History Review* **11**, pp. 51–67.
- History of the Greek Nation: Modern Greece, 1913–1941*. (1978). Athens: Ekdotiki Athinon (in Greek).
- INCLÁN, C. and TIAO, G.C. (1994). Use of cumulative sums of squares for retrospective detection of changes of variance. *Journal of the American Statistical Association* **89**, pp. 913–923.
- Investor's Monthly Manual*. (September 1924). London: Investor's Monthly Manual Office.
- Investor's Monthly Manual*. (January 1928). London: Investor's Monthly Manual Office.
- MAURO, P., SUSSMAN, N. and YAFEH, Y. (2002). Emerging market spreads: then versus now. *Quarterly Journal of Economics* **117**, pp. 695–733.
- MAURO, P., SUSSMAN, N. and YAFEH, Y. (2006). *Emerging Markets and Financial Globalization: Sovereign Bond Spreads in 1870–1913 and Today*. New York: Oxford University Press.
- MINOGLOU PEPELASI, I. (1989). The negotiations of the refugee loan of 1924. In T. VEREMIS and G. GOULIMI (eds), *Eleftherios Venizelos: Society, Economy, and Politics in his Era*. Athens: Gnosi, pp. 331–6 (in Greek).
- MOODY, J. (1926). *Moody's Manual of Investments and Security Rating Service; Foreign and American Government Securities*. New York: Moody's Investors Service.

- MORGENTHAU, H. (1929). *I was Sent to Athens*. Garden City, NY: Doubleday, Doran & Company, Inc.
- OOSTERLINCK, K. (2003). The bond market and the legitimacy of Vichy France. *Explorations in Economic History* **40**, pp. 326–44.
- PEPELASSIS MINOGLU, I. (1993). The Greek State and the International Financial Community, 1922–1932: Demystifying the Foreign Factor. Unpublished Ph.D. thesis. London: Department of Economic History, London School of Economics.
- STEFANIDES, D. (1930). *The Inflow of Foreign Capital and its Political and Economic Consequences*. Thessaloniki: M. Triantafillou & Sias (in Greek).
- Stock Exchange Official Intelligence*. (1928). London: Spottiswoode, Ballantyne & Co Ltd.
- Stock Exchange Year-book*. (1928). London: Thomas Skinner & Co.
- SUSSMAN, N. and YAFEH, Y. (2000). Institutions, Reforms and Country Risk: Lessons from Japanese Government Debt in the Meiji Era. *Journal of Economic History* **60**, pp. 442–67.
- VENKATRAMAN, E.S. (1993). Consistency Results in Multiple Change-point Problems. Unpublished Ph.D. thesis. Stanford University: <http://statistics.stanford.edu/~ckirby/techreports/NSA>.
- WALDENSTROM, D. and FREY, B.S. (2008). Did Nordic countries recognize the gathering storm of World War II? Evidence from the bond markets. *Explorations in Economic History* **45**, pp. 107–26.
- WEIDENMIER, M. (2000). The market for confederate cotton bonds. *Explorations in Economic History* **37**, pp. 76–97.
- WEIDENMIER, M. (2002). Turning points in the U.S. Civil War: views from the grayback market. *Southern Economic Journal* **68**, pp. 875–90.
- WILLARD, K.L., GUINNANE, T.W. and ROSEN, H.S. (1996). Turning points in the Civil War: views from the greenback market. *AER* **86**, pp. 1001–18.
- WYNNE, W.H. (1951). *State Insolvency and Foreign Bondholders*. New Haven: Yale University Press.
- YANOULOPOULOS, Y. (1999). *Foreign Policy and 'National Issues' from the Defeat of 1897 until the Asia Minor Debacle*. Athens: Bibliorama.

Appendix A

Table A1. Total number of trading days per loan on the London Stock Exchange, 1914–1925

	Railways Loan	Bonds Loan
1914 ^a	25	3
1915	23	0
1916	14	0
1917	36	6
1918	19	3
1919	34	7
1920	79	77
1921	65	11
1922	62	25
1923	92	56
1924	108	122
1925 ^b	39	54
Total	596	364

Source: Our own calculations using the daily data of the Railways and the Bonds loans collected from *The Times*.

^aNumber of observations from 1 January 1914 until 30 July 1914. Between 30 July and 31 December 1914 the London Stock Exchange remained closed.

^bNumber of observations from 1 January 1925 until 28 April 1925.