

Markets work in war: World War II reflected in the Zurich and Stockholm bond markets

BRUNO S. FREY and DANIEL WALDENSTRÖM¹

University of Zurich and Stockholm School of Economics

In recent years, there has been a growing literature analysing political and institutional change using historical financial market data. Treating financial markets primarily as markets for the dissemination and distribution of information, it is possible to derive measures of the impact of political, economic and institutional changes on the prices of financial assets. A path-breaking analysis is that of Willard et al., who analyse how events during the US civil war affected the market for ‘greenbacks’, a special currency issued by the Union.² Frey and Kucher and Waldenström and Frey analyse the prices of domestic and foreign government bonds traded before and during World War II.³ Oosterlinck looks at the government bond market in France during World War II.⁴ He finds that the spread between bonds issued before the war, and those issued by the collaborationist government reflect market expectations regarding the outcome of the war: traders expected that if the war were to be won by the Allies, the new French government would neither service nor pay back the latter bonds. Mauro et al. show that political events had significant effects on emerging market sovereign debt yields during the early twentieth century.⁵ For example, the Boxer Rebellion in China, or the Russian-Japanese war in 1904, seriously depressed the value of these countries’ government bonds.

¹ We wish to thank Magnus Henrekson for his helpful comments.

² K. L. Willard, T. W. Guinnane and H. S. Rosen, ‘Turning points in the civil war: views from the Greenback market’, *American Economic Review*, 86 (1996).

³ B. S. Frey and M. Kucher, ‘History as reflected in capital markets: the case of World War II’, *Journal of Economic History*, 60 (2000); B. S. Frey and M. Kucher, ‘World War II as reflected on capital markets’, *Economics Letters*, 69 (2000); B. S. Frey and M. Kucher, ‘Wars and markets: how bond values reflect the Second World War’, *Economica*, 68 (2001) and D. Waldenström and B. S. Frey, ‘How government bond prices reflect wartime events: the case of the Stockholm market’, Working Paper Series in Economics and Finance No. 489, Stockholm School of Economics (2002).

⁴ K. Oosterlinck, ‘The bond market and the legitimacy of Vichy France’, *Explorations in Economic History*, 40 (2003).

⁵ P. Mauro, N. Sussman and Y. Yafeh, ‘Emerging market spreads: then versus now’, *Quarterly Journal of Economics*, 117 (2002).

This article analyses for the first time the extent to which trading in two geographically separate market places, the stock exchanges in Zurich and Stockholm, reflected events leading up to and occurring during World War II. To our knowledge, these two stock exchanges are the only ones that functioned continuously during World War II,⁶ where the governments abstained from interfering, and where a substantial number of government bonds were traded. Other stock exchanges do not meet these crucial conditions; in general, governments involved in wars tend to intervene either directly or indirectly in markets under their control. For example, Germany, as the main European (aggressive) actor during World War II, introduced many foreign exchange restrictions and financial trading was strictly controlled. As a consequence, quoted exchange prices in such markets tend not to reflect fully investors' expectations of how historical events will affect the future performance of financial assets.

Our analysis suggests three major insights. First, three crucial events in World War II led to statistically significant and large breaks in the prices of government bonds traded in both Zurich and Stockholm: the 'official' outbreak of the war with the invasion of Poland by German forces in September 1939; the invasion of Benelux and later France in May 1940; and the German defeat at Stalingrad at the beginning of 1943. Traders in Switzerland and Sweden did not differ in their evaluations of the impact of these wartime events on specific government bonds. This supports the notion of a well-functioning financial market even under the influence of a major war. It makes the previous analyses, focusing on one particular financial market, more valuable because they are not likely to reflect the reactions of some isolated traders, but a more general evaluation of future prospects generated by the historical events.

Second, only two European countries had their government bonds listed on both exchanges, Germany and Belgium. We find that the three events mentioned above were all reflected in the prices of these bonds, but on some occasions in opposite directions. While the outbreak of war depressed the value of both bonds, the invasion of Benelux raised the German bonds but depressed the Belgian bonds. In contrast, the defeat at Stalingrad raised the Belgian bonds but depressed the German bonds. Hence, our analysis does not reveal any inconsistencies in that the traders are shown to react in a reasonable, rather than mechanistic or haphazard way. In this sense, financial markets are rational.

Third, some wartime events resulted in statistically significant events in the exchange of *either* Zurich *or* Stockholm. This should not happen in a fully efficient market with shared information. In addition to possible limitations of the econometric techniques used, the explanation may be attributed to differences in the amount of information available (Swiss and Swedish traders might not have received exactly the same information about the war) as well as its subsequent interpretation.

⁶ With the exception of May and June 1940, when the Zurich stock exchange was closed.

This article proceeds in the following way: Section I discusses more fully how capital markets may help in the understanding of historical events, but also points out some of the limitations of that approach. Section II presents the data and the estimation technique used. Section III analyses the results. Twelve events that occurred in the period of time leading up to and during World War II, and that are considered important by historians, are analysed quantitatively and the extent to which they are reflected in movements on the two stock exchanges is considered. Conclusions are offered in Section IV.

I

Most historical events are not valueless ‘facts’, but are the result of an *a priori* decision on the part of the historian. Interpretation is a crucial element in this decision. Great care must be taken not to distort the past. In particular, when the behaviour of people in the past is to be evaluated, the knowledge and information available at that time must be considered. The use of capital market data is advantageous in this respect. Provided the data are correctly noted, they *solely reflect the situation existing at any given point in time*. The future is unknown and does not enter into the data at a later date, which is the case when historians, with the benefit of hindsight, later decide that an event should be considered historically important. What does enter into the data are the subjective *expectations* of the financial actors concerning the future, which is a totally different matter. Capital market data serve to capture the mood existing among traders at a particular point in time. They cannot as such detect important historical events, but rather events that were seen to be important by the players in this market.

Analysing capital markets has one additional advantage for historians. The actors are forced to evaluate carefully the current conditions affecting the prices of financial assets, as well as the likely future developments, because errors directly affect them in monetary terms. This distinguishes capital market data from other types of data, in particular surveys and questionnaires, where errors do not generally affect the persons committing them.

A third advantage of looking at financial markets is that they usually exhibit a high degree of predictive power, due to so-called *marginal traders*.⁷ This type of trader makes decisions with few preconceived ideas or prejudices: they focus on and collect the ‘objective’ prices and information available. In the extreme case, even

⁷ In recent years, the efficiency of capital markets has been under debate. Some scholars have argued that *noise traders* pursue irrational speculations which influence the market (see e.g. B. De Long, A. Shleifer, L. H. Summers and R. J. Waldman, ‘Noise trader risk in financial markets’, *Journal of Political Economy*, 98, 1990). However, bond prices differ from stock prices in that their underlying (fundamental) price is more easily defined, which makes bonds less subject to these inefficiency problems.

one such trader can drive the market price of any individual asset to the underlying equilibrium.⁸

The analysis of break points undertaken here does not identify historical facts, but rather the acquisition and assessment of information relevant to bondholders. Wartime events are evaluated with respect to their likely impact on the probability of having the government bonds correctly serviced and repaid. Thus, bond traders did not attempt to pin down what happened for its own sake, or for some historical reason, but rather so that they could more accurately predict what would happen to the bonds they owned or intended to acquire. Some events were important to bond investors and had significant influence on the prices at which they were traded; while other events did not affect the perceived probability of having the debt serviced and ultimately repaid. They were not, therefore, reflected in the prices at which they were traded on the market.

Financial markets thus are not *per se* related to the *nation* and *population*. A nation may disappear but the related financial assets may survive. Under normal circumstances, there will be a strong correlation between the fate of a population and/or nation and the trading value of its liabilities. In most cases, when a nation ceases to exist, its public debt is no longer serviced nor paid back at maturity, a fact which is reflected in the financial markets by a drop in value to zero (if there is no hope that the debt will ever be repaid). Similarly, if the population of a country is subjected to a significant exogenous shock (say, by natural catastrophes or a war), the respective government may be unable to service its public debt, so that the population's fate is again reflected in the financial market.

Historians deal with past economic and political events in quite a different way. They carefully collect facts and interpret them in the light of the general knowledge of their field and the particular circumstances existing. A major problem is that such interpretation necessarily is *ex post facto*, i.e. after the later developments are known. This knowledge may bias the evaluation of the events, and may lead to 'facts' being overlooked or over-emphasised, as the case may be. This problem is most obvious in the case of wars. Once the outcome is known, resulting, say, in the crushing defeat of the country being considered, it is difficult objectively to analyse the processes by which the decision-makers of the country decided to engage in the war in the first place. To refer simply to a misjudgement is unsatisfactory, because an explanation would have to be offered as to how such an error could possibly have occurred. In order to evaluate the historical situation existing at any given moment in time, historians have to take care not to impute information to the decision-makers at that time, the true nature of which was only revealed by later developments.

Historians are, of course, well aware of this problem. They make significant efforts to capture the information, views, sentiments and feelings existing at a given

⁸ See the literature on the marginal trader and the Hayek Hypothesis (commonly understood as the proposition that competitive markets conform to basic efficiency postulates), e.g. V. L. Smith, 'Markets as economizers of information: experimental examination of the "Hayek Hypothesis"', *Economic Inquiry*, 20 (1982) or R. Forsythe, F. Nelson, G. R. Neumann and J. Wright, 'Anatomy of an experimental stock market', *American Economic Review*, 82 (1992).

point in time. The major avenue is to turn to written documents, but sometimes surveys or oral histories are used. Both approaches may be influenced by the strategic considerations of the writers and orators. In many cases, the sources have been written or spoken in order to support a particular cause and may therefore be subject to considerable partiality. In other cases, the authors of documents or interviews may have been at pains to reveal themselves in a particularly flattering light, or to suggest exaggerated importance or prominence in the course of events.

The analysis of financial markets is certainly *no substitute* for the traditional inquiries undertaken by historians. But it is a challenging *complementary* method that allows us to evaluate particular sentiments at a given moment in time. Care must be taken, however, to allow for time delays. Thus, an historical 'fact' may have been predicted in advance by those active in financial markets, in which case the resultant impact on prices should be visible before the event or be completely absent, depending on the speed of adjustment. Either way, no break is visible at the time of the event itself. An example is both the outbreak and the end of a war, which in many cases is foreseen well in advance. It should be noted, however, that financial markets tend to overreact to news reaching them.⁹ The overreaction hypothesis implies that even though many investors predicted an event way in advance, and financial markets adjusted accordingly, a break in the price series can still be identified.

Our approach is based on the general premise that 'facts' considered important by historians will be reflected in changing bond prices, provided that the historical occurrence has not been predicted by the market participants and therefore already been integrated into the data. However, there are a number of reasons why historical events may not show up as break points in market price data:

- (i) A 'fact' may be important from the historians' point of view (it relates to the fate of a nation, country or population), but does not affect the servicing and payback of government bonds.
- (ii) The contemporary actors did not evaluate a particular event in the same way as historians have done decades later. This difference between *ex ante* and *ex post* assessments is a natural element of all kinds of human action, but few methods are able to examine it as can our use of historical financial data.
- (iii) The 'fact' does not exist, nor is it as important as the historians believe. Here the quality of historical research is called into question. However, it would be misleading to assume that all historians identify the same 'facts' as important. So the issue is *what* historical school or *which* individual historian has identified what historical 'fact', as well as the actual importance attributed to it.¹⁰
- (iv) The quality of the bond market data is insufficient, e.g. because there are too few transactions.
- (v) Governments have intervened in the bond market either as buyers or sellers, or by imposing controls of some sort. An important case occurs when

⁹ W. De Bondt and R. Thaler, 'Does the stock market overreact?', *Journal of Finance*, 40 (1985).

¹⁰ See e.g. H. Kozicki (ed.), *Developments in Modern Historiography* (Basingstoke, 1993).

governments want to prevent the financial markets reacting to a particular political (or economic) event.

- (vi) The econometric analysis is unable to identify break points relating to historical events, even though they are in the data.

II

This study employs unique price data from the only two neutral states during World War II with functioning financial markets. All countries at war saw their governments intervene directly or indirectly in economic markets, including financial markets. In most cases, any analyses of asset price movements are invalidated because of extensive price regulations.¹¹ However, the stock exchanges in Switzerland and Sweden represent two general exceptions. In both these markets, government bonds were freely traded because the countries retained their neutrality, and hence they are the only relevant markets for our purposes. As pointed out above, only two government bonds were traded simultaneously in Zurich and Stockholm, those of Germany and Belgium. We therefore restrict our analyses to these two types of government bonds. Of course, they were not identical bonds, but this is of little relevance as this article focuses on the effects of war on the general value of the bonds issued by a particular country. First, the raw data are presented and briefly related to wartime events. Then we describe how our empirical estimations are conducted.

(i) *The Zurich market*

The extent of trading in foreign government bonds at the Zurich Stock Exchange fell from about 2.8 billion Swiss francs in the year 1937 to about 0.5 billion in 1943 and rose back up to about one billion in 1946. German government bonds accounted for roughly 40 per cent of the annual turnover. For reasons of neutrality, the Swiss government did not control it. It only stopped trading during May and June 1940, when it was unknown whether the German forces would outflank the Maginot line in the south (i.e. march through Switzerland), or in the north (which they did by invading Belgium and the Netherlands). In order to see World War II in perspective, we use monthly data extending from December 1933 to December 1948.

The data were collected from the *Monatsberichte der Schweizerischen Nationalbank* (Monthly Reports of the Swiss National Bank), January 1934–January 1949, table 14 (1934–8 and 1941–6), table 18 (1939), table 17 (1940) and table 12 (1947–9). Figure 1 shows the monthly index of the 31 German government bonds traded on the Swiss stock exchange.

¹¹ See e.g. K. Oosterlinck, 'Les anticipations des marchés obligataires belges de 1939 à 1944', *Cahiers d'histoire du temps présent*, 6 (2000), for the case of Belgium.



Figure 1. *Index of German government bonds traded in Zurich, 1933–48*
 Source: Monthly Reports of the Swiss National Bank (SNB).

Figure 1 indicates that, over the entire period, there was a strong downward trend in the bond values. This also holds for the period 1933–6. This is rather surprising, as Hitler's rise to power has often been attributed to the 'capitalists' who considered him to be a bulwark against Communism.¹² The capital market seems to have made a very different evaluation. The bond values made a marked recovery in 1937/8, but fell drastically from the middle of 1938 to September 1939, when war broke out. There was again a rise in the value of German government bonds after the successful *Blitzkrieg* at the beginning of 1940. But it did not last for long: from the second half of 1941 on, there is a permanent drop in German bond values, indicating that the stock market predicted that the Nazis would soon lose the war, the debt would no longer be serviced and the capital would be lost.

Figure 2 shows that the values of Belgian government bonds traded in Switzerland exhibited large fluctuations. A marked rise from 1934 to 1937 is followed by an even stronger fall, dropping to a value of about 30 per cent in 1940. This fall was recorded during a trading halt in Belgian bonds between May and September 1940 which was due to a general moratorium declared by the Belgian exile government right after the German invasion. For the remainder of World War II, the bond values show a steady recovery, ending in 1947.

(ii) *The Stockholm market*

Throughout the entire war, Sweden had an active secondary market for foreign government bonds on the Stockholm Stock Exchange. Except for a short-lived

¹² See e.g. K. D. Bracher, *Die Auflösung der Weimarer Republik. Eine Studie zum Problem des Machtverfalls in der Demokratie* (Villingen, 1964).

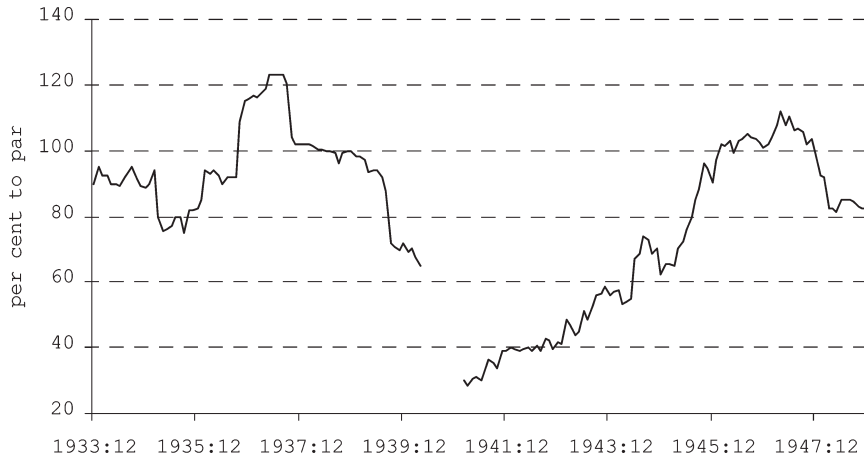


Figure 2. *Index of the Belgian government bonds traded in Zurich, 1933–48*
 Source: Monthly Reports of the Swiss National Bank (SNB).

period of price limits at the beginning of the war, when daily price movements beyond ± 10 percentage units were not allowed, the market functioned normally. German government bonds were the largest foreign securities on the exchange, representing around 25 per cent of the bonds listed and about 6 per cent of the turnover of all government bonds. The Belgian government bonds represented only about 1 per cent in both cases.

Data are end-of-month bond quotes from the Stockholm Stock Exchange, collected from the official stock exchange price lists (*Stockholms Fondbörs kurslista*) and the weekly business chronicle *Affärsvärlden*.¹³ Figure 3 shows the price index for German government bonds traded on the Stockholm Stock Exchange. The prices on German bond loans were constantly below par value and they fell throughout the entire period, which reflected increasing uncertainty about Germany's capacity to win the war and to service and eventually repay its loans.

Figure 4 shows the price index of the Belgian government bonds traded in Stockholm. The outbreak of World War II depressed prices on Belgian bonds by a fourth and the German occupation of Belgium in May 1940 by almost another third. As on the Zurich market, trading in Belgian bonds was stopped during 1940 due to the moratorium and high levels of uncertainty about future debt servicing. After that, the Belgian bonds fluctuated at a low price level until the turning point of the war at Stalingrad in late 1942, when they appreciated considerably.

The raw price data presented for German and Belgian government bonds can only give a preliminary and general impression of how war events affect financial values. In order to isolate statistically significant break points and to isolate them as

¹³ See Waldenström and Frey, 'Government bond prices', for further details about the price indexes.



Figure 3. *Index of German government bonds traded in Stockholm, 1933–47*
 Source: Stockholm Stock Exchange and *Affärsvärlden*.

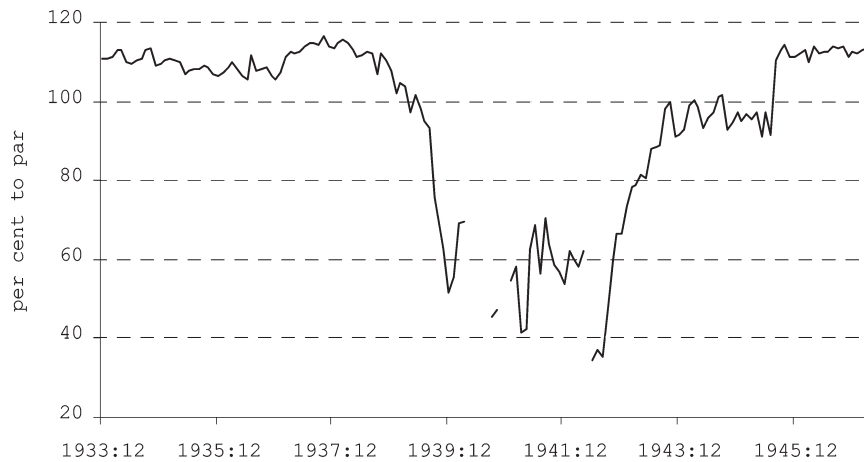


Figure 4. *Index of Belgian government bonds traded in Stockholm, 1933–47*
 Source: Stockholm Stock Exchange and *Affärsvärlden*.

much as possible from other factors also influencing government bond values, econometric estimation techniques are in order.

(iii) Break estimations

In this section, we carry out testing for unknown structural breaks in the bond price series of Germany and Belgium. Hence, we are not examining the price reactions due to well-known events that occurred at some point in time but instead we let the data speak for itself and employ econometric techniques designed to find and

date unknown structural breaks endogenously.¹⁴ Specifically, we use a sequential four-step search technique originally laid out by Banerjee et al. and later modified to an applied framework by Willard et al.¹⁵ This method is essentially to estimate linear regressions within small time windows and then statistically check for differences in the means of the bond prices between them. Although there are other more recent techniques described in the literature for finding and dating structural breaks, the simple structure, straightforward interpretation and well-documented record in previous studies yield support for this method. When deciding the appropriate length of the time window, there is also a trade-off between choosing windows long enough to avoid irrelevant short-term price variations but short enough to capture the persistency of the breaks. The time periods in previous studies have varied between around three months (Willard et al.), 18 months (Mauro et al.) and 36 months (Frey and Kucher). As we need sufficient observations to allow statistical inference to be made, we choose a window length of 36 months as did Frey and Kucher, although we are aware that this length might lead us to overlook some of the shorter breaks.

In the first of the four steps, we place the 36-month window so that it starts from the first observation and estimate

$$\ln P_{jt} = \beta_0 + \sum_{i=1}^k \beta_i \ln P_{jt-i} + \beta_{k+1} \ln P_{Mt} + \varepsilon_{jt}, s = 7, \dots, 42. \quad (1)$$

where $\ln P_{jt}$ is the log of a country j 's government bond price (on either German or Belgian bonds) at period t , $\ln P_{Mt}$ is the log a loan size-weighted market index for the Zurich and Stockholm government bond markets, and ε_{jt} is a white noise error term.^{16,17} By including a market index, our equation differs from the approach of Willard et al., who only included the current and lagged prices of one series. This means that we search for country-specific breaks given the overall market price changes. Another advantage of using a market index is that it corrects for potential exogenous shocks to the data that affect all countries similarly and hence takes care of the potential bias due to omitted variables that occur in the model specifications. Choosing lag length k is done following the backward selection approach suggested by Perron and has resulted in $k = 1$.¹⁸ We insert a Wald test for a structural break

¹⁴ For a recent review of this literature, see B. E. Hansen, 'The new econometrics of structural change: dating breaks in U.S. labor productivity', *Journal of Economic Perspectives*, 15 (2001).

¹⁵ Willard et al., 'Turning points', who only present an applied version of the sequential test of A. Banerjee, R. L. Lumsdaine and J. H. Stock, 'Recursive sequential tests of the unit root and trend break hypotheses: theory and international evidence', *Journal of Business and Economic Statistics*, 10 (1992).

¹⁶ In the Zurich market index, Swiss, German and French government bonds dominate whereas the Stockholm market index is dominated by Swedish and to some extent German bonds.

¹⁷ Equation (1) contains no deterministic time trend because of the short time periods of the windows we have used.

¹⁸ P. Perron, 'The great crash, the oil price shock, and the unit root hypothesis', *Econometrica*, 57 (1989). k was decided such that the t -statistic for β_k was above 1.6 (in absolute number) and the t -statistics for β_l , $l > k$ below 1.6. The same procedure was used by Willard et al., 'Turning points.'

(change in the constant) in the middle of the window and record the F -statistic. In step 2, we move the window one month ahead and repeat the estimation of (1) and the Wald test. This is repeated until each country's entire price index has been covered by time windows and the tests pursued in the first two steps. In step 3, we take the sequence of F -statistics achieved and, for each country separately, plot it on a time line in order to identify those dates with the highest F -statistics. The peaks in these F -diagrams are selected as potential candidates for windows within which a structural break may have taken place.

Finally, in step 4, all selected break candidates are tested for statistically significant structural breaks within them. For this, we use a new equation that includes a dummy variable allowing us to get explicit estimates for date and sign of the break. Since all dates within the selected 36-month period might be the break candidate driving the high F -statistic, we add six observations before and after the window to allow testing of the first and last dates as well.

$$\ln P_{jt} = \beta_0 + \beta_1 \ln P_{jt-1} + \beta_2 \ln P_{Mt-1} + \gamma_s D_{j,st} + \varepsilon_{jt}, \quad s = 7, \dots, 42, \quad (2)$$

where D_{jst} is a dummy variable taking the value 0 for dates up to the shift-date and value 1 thereafter. The parameter of interest is γ_s , which measures the change in the mean and hence the timing and sign of the structural break. It can be interpreted as the *conditional* price change of the bond index in the sense that it corrects for the effects influencing all government bonds traded in a similar way. An (historical) event that has the same effect on the bond prices of all countries cannot be captured by the econometric method used here. It also means that an event that led to, say, a 10 per cent increase in the German government bond prices and to a 5 per cent increase in the prices of all government bonds, will be shown to increase the conditional mean of the German government prices by only 5 per cent.

Some issues regarding the econometric approach call for special attention. The level-dummy variable in equation (2) is in principal only suitable when the bond price index is $I(0)$ stationary and does not contain a unit root, since otherwise a one-time shock would never die out and hence imply a structural break. In our case, however, unit roots might exist within the relatively short time-windows only because of temporal price shifts, or even a break, although the price series is stationary over longer time horizons. Moreover, as there are well-known problems in testing for unit roots in the possible presence of an unknown number of structural breaks, we consider the level dummy as a sufficient indicator of a structural break.

A potential problem with this mean-shift-oriented break test is that it performs poorly in capturing gradual structural changes. These might arise if market actors gradually anticipate an upcoming event and capitalise it in the prices which might be missed by our algorithm. We hope to mitigate some of these problems by our explicit use of historical literature.

Table 1. Major European historical events and their reflection in German and Belgian government bonds traded in Zurich and Stockholm

Date	Event	German bonds		Belgian bonds	
		Zurich	Stockholm	Zurich	Stockholm
1936.06–07	Berlin Olympics	+8%			
1939.03	Invasion of Czechoslovakia	-17%			
1939.09	Germany invades Poland	-39%	-36%	-10%	-28%
1940.05	Invasion of Benelux	+8%	+21%	-35% ^a	-34% ^a
1941.12	US enters war. German troops stopped at Moscow	-5%			
1942.11– 1943.02	Battle of Stalingrad	-7%	-8%	+10%	+27%
1944.06	Allied troops at Normandy			+6%	
1945.02	Yalta conference	-37%			
1945.05	Germany surrenders		-47%	+7%	
1945.08	Potsdam conference				+16%

Note: All changes in the table represent 5 per cent-significant estimates of γ in equation (1).

^a The trading in Belgian government bonds was stopped between May and September 1940 causing a break in the series which disables the econometric testing. The figure hence represents the price difference between the months just before and after the trading halt.

III

This section discusses how, and to what extent, events considered crucial by historians leading up to, and occurring during, World War II are reflected as statistically significant breaks in the value of the German and Belgian government bonds traded in Zurich and Stockholm. Table 1 lists ten specific events. The first two relate to events which directly or indirectly led to World War II. The Olympic Games taking place in Berlin in June/July 1936 proved to be a great propaganda victory for the Third Reich; many observers started to think that the Nazis were 'domesticated' by their international contacts. With the invasion of Czechoslovakia in March 1939, the Nazis for the first time claimed land that did not belong to the Germans. Notably, some pre-war events considered important by historians to explain the outbreak of war are not significant breaks, for example the German occupation of the Rhineland in March 1936 or the *Anschluss* of Austria to the German Reich in March 1938.¹⁹ This points to the divergence between how historians *ex post* and contemporary actors *ex ante* interpret specific events (see further our discussion in Section II).

¹⁹ See e.g. B. H. Liddell Hart, *History of the Second World War* (New York, 1970).

The wartime events are well known and need no further explanation.²⁰ However, there are some events at which neither market recorded significant price reactions for either of the two bonds. These events are not included since our aim is the explicit comparison of price reactions across the markets. At the Yalta Conference in February 1945, the Allied powers decided only to accept the unconditional surrender of all German forces on all fronts, and that Germany would be divided into four military occupied zones. At the Potsdam Conference in July 1945, the differences in opinion between the Soviets and the Western Allies became apparent. It paved the way for the formation of NATO and made the stationing of American troops in Europe a permanent feature.

From these ten historical events and the two types of government bonds (German and Belgian), we have 20 separate tests of whether the financial markets in Zurich and Stockholm reflected World War II in a symmetrical way. Drawing on the figures in Table 1, the most important results are as follows:

First, in six of the 20 cases, there was a *statistically significant* reaction to wartime events in the same direction in *both* Switzerland *and* Sweden:

- a) The invasion of the *Wehrmacht* in Poland on 1 September 1939 depressed the German government bonds in Zurich by 39 per cent and in Stockholm by 36 per cent (always compared to the general government bond market). This dramatic reduction in value suggests that investors in both Switzerland and Sweden were very pessimistic about the consequences of this invasion with regard to Germany's ability or willingness to service and repay its debts. They sensed that the Polish invasion marked an important step in European history. Historical research concurs by attributing the start of World War II to this event.
- b) The German invasion of Benelux, and later on France, in May 1940 was an unprecedented and unexpected success for the *Wehrmacht*. It was greeted by a rise in the value of German government bonds in Zurich by 8 per cent and in Stockholm by 21 per cent. Investors became more optimistic about the probability that Germany would service and repay its debt.
- c) The Soviet counteroffensive at Stalingrad, beginning in November 1942 and leading to the capitulation of the 6th German Army in February 1943, decreased the value of German public bonds by 7 per cent in Zurich, and by 8 per cent in Stockholm. Investors in both countries saw the significance of this event, which many observers see as marking the final turning point of the war.
- d) The outbreak of war in September 1939 strongly depressed Belgian government bonds by 10 per cent in Zurich and by 28 per cent in Stockholm.
- e) Not surprisingly, the German invasion of Benelux in May 1940 dramatically reduced the value of the Belgian government bonds: by 35 per cent in Zurich and by 31 per cent in Stockholm.

²⁰ See e.g. G. L. Weinberg, *The World at Arms: a Global History of World War II* (Cambridge, 1994).

- f) The German defeat at Stalingrad was seen to raise the prospects of the Belgian government bonds; they rose by 10 per cent in Zurich and by 27 per cent in Stockholm.

These results support the hypothesis that financial markets work even during major wars, as long as they are relatively free from interference. The three events captured by econometrically isolating break points in the value of government bonds are generally considered to be major turning points of the war in Europe: the start of the war in the East (invasion of Poland) and in the West (invasion of Benelux), and the decisive defeat of the German forces in Russia (Stalingrad). The approach used here coincides with the findings of historical research. It also suggests that capital markets in the two neutral countries, Switzerland and Sweden, were well connected in terms of information, so that in each case the reaction on the two markets was consistent.²¹

The notion of a well-functioning capital market even during major wars is further supported by the fact that while the direction of the reactions was the same in Zurich and Stockholm, it differed between the two types of government bonds. The value of the government bonds of the military winner increased, and that of the loser decreased. The attack in the West in May 1940, which was a victory for the *Wehrmacht*, raised the German, and lowered the Belgian, government bonds. The German capitulation at Stalingrad in February 1943 lowered the German, and raised the Belgian, government bonds. But we observe one movement common to both types of bonds: the outbreak of war was seen by investors in Switzerland and in Sweden to be a losing proposition, harming *all* countries involved in the war. This is also reflected by the fact that the *overall* government bond index, comprising all countries at the outbreak of war, strongly decreased in both Zurich (where it fell by 26 per cent) and in Stockholm (where it fell by 8.5 per cent).²²

The second set of results suggests that several pre-war and wartime events considered important by historians are not reflected on either the Zurich or the Stockholm stock exchange. For German government bonds these are the Allied invasion of Normandy and the Potsdam Conference; for Belgian government bonds these are the Berlin Olympics, the invasion of Czechoslovakia, the US entry into the war, coupled with the German defeat at Moscow, and the Yalta Conference. As we discuss in section II, there are several potential explanations for this observation, among which we cannot discriminate fully. Investors might not have seen how these events would significantly influence the future stream of debt service on their bonds. It is also natural to think that actors of that time did not fully comprehend the impact of some incidents on the subsequent war development. However, the opposite

²¹ It is not surprising that the size of the reactions differ. It should be remembered that the reactions identified are conditional on the behaviour of all other government bonds traded in the two stock exchanges. Just as the comparison differs, so does the size of the reaction.

²² Frey and Kucher, 'History as reflected in capital markets' p. 476; Waldenström and Frey 'Government bond prices', p. 12.

could also be true, namely that investors had already anticipated these events and capitalised them in the prices.

Third, six events influenced the value of government bonds in Zurich, but not in Stockholm in a statistically significant way. For German government bonds, the Berlin Olympics raised the value by 8 per cent; and the Czech invasion, the US entry into the war, coupled with the defeat at Moscow, and the Yalta Conference, reduced it by 17.5 and 37 per cent, respectively. The value of Belgian government bonds increased by 6 per cent and 7 per cent for the Normandy invasion and the German surrender, respectively.

Fourth, two events influenced the value of government bonds in Stockholm, but not in Zurich, in a statistically significant way. The value of German public bonds was reduced 36 per cent due to the German surrender. The value of Belgian government bonds rose by 17 per cent due to the Potsdam Conference.

The asymmetric break points, where a historic event is picked up only at one of the two stock exchanges in a statistically significant way, may at first appear to speak against well-functioning financial markets in times of war. However, we could list at least four reasons, two of a formal nature and two regarding the specific content, for such diversity: first, the data used may not be of sufficient quantity and quality. Second, as already discussed to some extent above, the econometric technique may not be able to identify the relevant break points for several reasons. Third, the investors had different information on the historical issues in question. During wartime, information certainly does not flow as freely as during peacetime. Indeed, all nations engaged in war make huge efforts to try to control information and to reveal only what is in their own interests. Persons living in politically neutral countries, such as Switzerland and Sweden, had an advantage over nations at war, but they still had great trouble seeing through the maze of deliberate misinformation, half-truths, errors, speculations and facts coming from many different sources. It is safe to say that investors in Switzerland and Sweden did not receive the same information, especially as there were fewer providers of international information than we are used to nowadays. As not all information important to investors was public knowledge, it is not surprising that some events systematically affected government bond values only in Zurich, and others only in Stockholm. It is worth noting that the three events which *ex post* proved to be crucial for World War II were picked up sharply by public bond values in both countries.

Finally, investors in Zurich and Stockholm may have interpreted the available information differently. The same wartime event may have been seen as strengthening the value of a government bond or weakening it. The German invasion of Czechoslovakia in March 1939, for example, may be interpreted as being the final territorial claim of Germany and thus improving the chance of averting a war, but it can also be interpreted as contributing to further acts of war, ending in disaster for Germany. Our analysis suggests that investors in Switzerland favoured the latter interpretation, as the value of German public bonds fell by 17 per cent compared to other government bonds. Among investors in Stockholm, according to

our analysis, there was no consensus, and the value of German government bonds was not systematically affected.

IV

This article examines whether prices on similar financial assets traded in different markets respond in the same way to specific large-scale political shocks. We use a unique data set of German and Belgian sovereign debt traded simultaneously on the stock exchanges in Zurich and Stockholm during World War II. We find several symmetries in the price reactions to wartime events across the two exchanges, which suggests that financial markets, given that they are not subject to significant public intervention, may function well even during a major war. The markets do not seem to reflect the reactions of some geographically isolated traders, but rather a more generally shared evaluation of future prospects generated by historical events, a finding that also emphasises the value of studying single financial markets.

From our empirical analysis, the following insights are important: first, three crucial events in World War II led to statistically significant and large breaks in the prices of government bonds traded in both Zurich and Stockholm: the 'official' outbreak of war coinciding with the German invasion of Poland in September 1939; the invasion of Benelux, and later on France, in May 1940; and the German defeat at Stalingrad at the beginning of 1943. Traders in both Switzerland and Sweden did not differ in their evaluations of these wartime events on specific government bonds.

Second, the two government bonds for Germany and Belgium traded in both Zurich and Stockholm reflect the *same* three events mentioned above. However, the reactions differ as follows: the outbreak of the war depressed both bonds; the invasion of Benelux raised the value of the German, and depressed the value of the Belgian government bonds; and the defeat at Stalingrad did the opposite. The traders can thus be shown to react in a reasonable, rather than mechanical or haphazard manner. In this sense, these financial markets were rational.

Third, the analysis does not reveal any inconsistencies. When a wartime event took place, the value of a German or Belgian bond was affected in the same way, or was not affected in a statistically significant way. Fourth, various wartime events were reflected in a statistically significant way in the stock exchange of *either* Zurich *or* Stockholm. This would not happen in an efficient market with the same information available to all. In addition to possible limitations of the econometric techniques used, the reason may be due to differences in information received as well as actual interpretation. Both were likely under the specific circumstances generated by World War II.

Altogether, the use of a quantitative methodology to analyse historical financial market data represents a powerful complement to traditional historical analysis. The material offers large-scale evidence of individuals acting in their own pecuniary interest, without producing lasting systematic biases. The rapid growth of long-term economic and financial data bases opens a very worthwhile field of study.

Authors' addresses:

*Institut für Empirische Wirtschaftsforschung
Blumlisalpstrasse 10
8006 Zurich
Switzerland*

*Department of Economics
Section for Historical Economics and Entrepreneurship
Stockholm School of Economics
PO Box 6501
SE – 113 83 Stockholm
Sweden*

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