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ABSTRACT

Predicting Winners in Civil Wars*

We develop a method to estimate which side will win a civil war. The key insight we deliver is that, for typical sovereign debt contracts, the probability of debt repayment will equal the probability of victory in a civil war. We test our predictor for standard outcomes in civil wars, including when the incumbent government loses (the Chinese Nationalists), when a new government is installed by a foreign power and decides to repudiate debt (the restoration of Ferdinand VII of Spain), and when there is a secession (the U.S. Confederacy). For China, markets were predicting a Communist victory three years before it happened. For the U.S., markets never gave the South much more than a 40 percent chance of maintaining the Confederacy. For Spain, markets considered the restoration of Ferdinand VII as likely (probabilities above 50%) as soon as France declared its intention to send military forces to the area.

JEL Classification: F3, G1, N2 and O1
Keywords: asset prices, civil wars, conflict and predictions markets

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Predicting Winners in Civil Wars

Civil wars can prove disruptive to growth and development. The circumstances under which civil wars break out and their demographic and economic consequences are well documented (Collier and Hoeffler 1998; Besley and Persson 2008; Guidolin and La Ferrara 2007; Londregan and Poole 1990; Campos and Nugent 2002).[1] The economic costs also come from uncertainty about the resolution of these conflicts.[2] With a typical civil war lasting roughly six years (Fearon and Laitin, 2003), production disruptions and delays in real resource transfers from external states, aid agencies, or non-government organizations can further stall development. Given the costs arising from uncertainty over the outcome of a civil war, it follows that real-time tools developed for predicting who will win a civil war could have large potential payoffs to the policy makers and the development community.

One might rely on expert opinion, but opinions may be ideologically driven (especially during conflicts), experts often disagree, and even when they agree, their predictions are often wrong (Tetlock, 2006). Predictions markets have shown to be a reliable alternative for obtaining real-time insights that are less subjective and have more accuracy for understanding phenomena with uncertain outcomes. For example, they have been used successfully to forecast U.S. presidential, gubernatorial, and congressional races (Wolfers and Zitzewitz 2004: Snowberg, Wolfers, and Zitzewitz 2007; Majumder et al., 2009; Arrow et. al. 2008; Rhode and Strumpf 2004; Wolfers and Zitzewitz 2009). The core of market-based approaches rests on two principles. First, when people put money at risk they tend to pay close attention to events that influence the value of their investments. Second, markets offer a mechanism for aggregating beliefs. Thus, asset prices reflect the beliefs of interested parties about future states of the world.

Most of the academic literature has focused on betting markets where participants wager on political outcomes that have a zero-one payoff structure. Many financial instruments can also be transformed to yield bets with equivalent payoff structures and could be used to complement information from betting markets or in place of it when such markets are illegal or have yet to emerge. Sovereign bonds are one type of asset

[1] For a comprehensive review of the literature, see Blattman and Miguel (2010).
[2] For more on the determinants of the severity of conflicts see Lacina (2006).

with such a payoff structure that has the potential to yield real-time insights into regime changes such as rebellions, coups d'état, secessions, and civil wars. Long-term government bonds have several characteristics that make them particularly attractive to studying civil conflict. First, in cases of conflict, they may become "winner take all contracts" since their issuance is often clearly identified with a party to the conflict. As a result, there is less uncertainty about attributing price movements to the changing nature of a conflict than there would be with some other types of securities. Second, sovereign bonds can (and often do) trade outside the geographical location of conflict. Indeed, they are usually traded in deep and liquid international financial markets, and have done so for centuries.[3]

We stress, however, that the approach we outline in this paper may be applied to other types of assets whose values can be driven to zero, linked to one or another party in a civil war, and are traded in thick markets. The price of properties that are likely to be nationalized by a party may also be used. For example, share prices of companies active in South Vietnam before the fall of Saigon or in Peru before the nationalizations set into place in 1968 would also allow one to make predictions about outcomes in civil wars. Other types of assets, such as fiat currency, land, or corporate stocks or bonds, are likely to be particularly useful for researchers making predictions about civil war outcomes in countries without sovereign debt. Although other types of assets could potentially be used, our article focuses on sovereign bonds since they allow us to illustrate several different "typical" outcomes in civil wars.

Following insights from the predictions literature, in this paper we develop a market-based predictor using sovereign debt obligations to estimate which side will win a civil war. Sovereign bonds represent contingent claims with valuations that depend primarily upon the outcome of the conflict: in the case of defeat, the bonds can become worthless to investors. The debt issued by a dictator facing the threat of ouster from an opposition group, for example, can be used to predict who will win a civil war. The key insight we deliver is that the probability of debt repayment will equal the probability of victory in a civil war.

[3] It is well known, for example, that emerging market borrowers issue currency with foreign-currency clauses, and often do so in New York, London, and other international financial centers (Eichengreen, Hausman, and Panizza, 2004)

We recognize that the nature of victory and the extent of debt repayment may vary across civil wars, so we develop a predictor that can account for outcomes that vary across time and space. For example, some civil wars start as secessions. Others end in a negotiated settlement. In some cases, investors might expect "a haircut" in payment once the conflict ends because the war has reduced the winning side's ability to pay, and in other conflicts, the debtholders might have missed coupon payments during the course of the war they ended up winning.[4] Our cash flow price model allows us to go beyond simply inferring the probability of victory from the ratio of market to par prices, as is commonly done in electoral prediction markets, and permits repayment streams to be modified in order to take these kinds of contingencies into account.

Our predictor has a number of attractive general properties. First, it provides an ex ante judgment about the outcome of a civil war. Second, because it relies on high-frequency, time-series data, it can take into account daily or weekly changes in factors that may influence the outcome (e.g., battlefield victories, technological changes, and shifts in alliances). Third, it mitigates problems of subjectivity: bondholders are not interpreting a question put to them by a researcher; instead, researchers can simply observe bondholder's self-interested behavior.

The ultimate utility of a predictor rests on its performance. We therefore compare the predictions of our model against historical civil wars when the outcome is known ex post and is not bound to change further. We test the predictor's external validity by examining three different types of outcomes – where the incumbent government lost the civil war (the Chinese Nationalists), when, following a civil war, a new government repudiated the debts issued by its predecessor (the restoration of Ferdinand VII of Spain), and a case of failed secession (the U.S. Confederacy). We find that our predictor correctly picked the winner in each of these civil wars years before they ended. In the case of China, our model predicted that the Communists would defeat the Nationalists by March 1946—a full three years before it actually happened. In fact, our model shows that the markets heavily discounted the Nationalist victory in March 1947, in which they drove the Communists from their capital of Yenan. We know, ex post, that this event

[4] For conditions under which civil wars end in negotiated settlements, see Walter (1997) and Mason, Weingarten, and Fett (1999).

made little difference to the ultimate outcome of the war. At the time, however, the fall of Yenan was much heralded in the West as evidence that the communists would be defeated.[5] Importantly, our model got it right: the fall of Yenan did not change the way that markets priced Chinese sovereign debt. In the Spanish case, the Verona Congress, which opened the way for France to invade Spain to restore the throne to Ferdinand VII, led to a change in markets expectations. After October 1822, markets gave less than a 50 percent chance to the constitutional regime. For the U.S. Civil War, our model never gave the South much more than a 40 percent chance of maintaining the Confederacy. With each battlefield setback, our model predicted an even lower likelihood of a Confederate victory.

II. A Baseline Model for Estimating Victory

A standard way of calculating the value of a bond at a point in time is to discount the cash flows using the risk free rate so that risk gets embedded into the risk-neutral probability of repayment (Bierman and Haas, 1975; Yawitz, 1977). The probability of reimbursement of the principal is conditional on no earlier default. Merrick (2001) uses a cash flow model to derive an equation that can be used to extract the probability of repayment of a bond. Following his formulation, the value of a bond at time 0, V_0, depends on: the coupon payment on date t, C_t; the principal repayment at maturity F_T, (where T is the maturity date); the recovery value of the debt obligation, R, in the case of default; the adjusted probability of a timely payment of cash flows on date t, D_t; the adjusted default probability between date t-1 and date t, d_t (where $d_t = d_{t-1}-d_t$); and the risk-free present value factor, f_{rt} (often formulated in practice as the risk-free bond). We can express this as:

$$(1) \quad V_0 = \underbrace{\sum_{t=1}^{T}(D_t \times C_t \times f_{rt})}_{\text{Term 1}} + \underbrace{D_T \times F_T \times f_{rT}}_{\text{Term 2}} + \underbrace{\sum_{t=1}^{T}(d_t \times R \times f_{rt})}_{\text{Term 3}}$$

Equation (1) can be broken down into three simple terms. Term 1 is the risk-free, net present value of the bond's coupons, adjusted for the probability of timely cash flow

[5] See, for example, the way the fall of Yenan is described in *Life*, April 7, 1947, p. 43.

payments (i.e., the fact that the debtor has made coupon payments on time in the past). Term 2 is the net present value of the bond's principal, adjusted for the probability of a timely cash flow payment. Term 3 is the risk-free, net present value of the recovery amount in case of default, adjusted for the probability of default.

From equation (1), we can solve for, d_t, the risk neutral probability of default at a given point in time. One can either extract the default intensity (also called the hazard rate), which represents the probability of default per year, conditional on no earlier default, or one can extract the default density, which represents the unconditional probabilities of default. The model described in equation (1) works particularly well when one wishes to assess a one-time default. During civil wars, however, an issuer may default on its bonds in an early stage of the war, resume payment, and then default again. In some instances defaults are partial or even selective (the default occurs for one series of bonds but not the others). When examining the properties of the predictor in section IV, we therefore assume that bondholders estimate a constant probability of reimbursement; that is, they assess repayment over the entire distribution rather than assessing the probability of repayment for each sub-period. We thus focus on the unconditional probability of default or the default density. The alternative approach of extracting default intensities is more appealing for bonds that are not in default, but it requires one to make assumptions about the underlying process, i.e. how the probability of default is determined in each and every period and can hardly be applied to bonds which may alternate between default and non-default status.[6]

Our approach is to apply this general formulation of bond repayment to sovereign debt instruments whose prices depend on the probability of winning a civil war. Sovereign bonds are contingent claims: bonds can become worthless in the case of defeat. The fact that debt repudiation is regularly the outcome to a civil war allows us to assume that debt repayment is contingent on victory and on the economic ability of the victor to make those payments. Because these are separate considerations, we first estimate our model under a scenario where the sovereign debt obligations of the victor are always honored and the bonds of the defeated party are always repudiated. In this "winner take all scenario," the probability of repayment equals the probability of winning the war.

[6] See, for example, Bhanot (1998), Duffie and Singleton (1999) and Merrick (2001).

To keep the exposition simple, suppose we assume that one party in a civil war, whom we will refer to as the "issuer," has issued the sovereign debt. In the case of victory, the issuer will repay all coupons as well as the principal of the bond. On the other hand, in the case of defeat, the debts of the issuer will be repudiated, and bondholders receive no payments. If the issuer loses, then in equation (1), R is zero and term 3 disappears. We can then rewrite equation (1) as:

$$(2) \quad V_0 = \sum_{t=1}^{T} (D_t \times C_t \times f_{rt}) + D_T \times F_T \times f_{rT}.$$

We then modify equation (2) to take into account the fact that some of the bonds issued may already be in default at the start of the war. We assume that bondholders do not assess a probability of having a timely payment at date t, but instead estimate a constant general probability of victory where D_t equals D_T.[7] In other words, we assume that bondholders believe the incumbent or opposition will repay the coupons (even the ones on which it defaulted), once victorious. Using this assumption, we apply the distributive property of multiplication to find V_0, the market price of the bond:

$$(3) \quad V_0 = D \times (\sum_{t=1}^{T} (C_t \times f_{rt}) + F_T \times f_{rT}).$$

Then, we solve for the probability of debt repayment, D:

$$(4) \quad D = \frac{V_0}{(\sum_{t=1}^{T} (C_t \times f_{rt}) + F_T \times f_{rT}}.$$

Because debt repayment, D, equals the general probability of victory, we have a result that says that the risk-neutral probability of winning a civil war is equal to the market price of the bond, V_0, divided by the sum of the present discounted value of the cash flows and principal repayment. Risk-neutral probabilities of default are known to be higher than real world default probabilities. The size of the bias is generally considered to be small, but can increase as the rating of the bonds declines (Wu, 1991; Wu and Yu, 1996; Hull et al., 2005). In any case, since we assumed risk neutral investors to derive our

[7] For bonds that are not in default, a more reasonable assumption might be to model the payment to take into account the fact that default rate is not likely to be constant (e.g., see Merrick, 2001). Computing probabilities of a timely payment at each date t would lead to a result with probabilities of victory for each time period. Interpreting such results is not straightforward.

predictor, equation (4) must be viewed as providing an upper bound estimate of the probability of winning a civil war.

Equation (4) is quite flexible and can be easily altered to consider a wide variety of possible political outcomes or repayment scenarios. For example, what if the victor decides to honor the debts of the loser after the conclusion of the civil war? In this case, the recovery value of the asset, R, can be set to a positive number to see how it impacts the probability of winning the civil war.[8] If the victor suspended payment during the war, investors might expect it to pay unpaid past coupons under the assumption that the government plans to fully honor its debt obligations in the postwar period. In that case, the value of the past coupons may be added to the right hand side of Equation (4). What if the issuer of the debt wins the war, but then has difficulty repaying its debt obligations in the postwar period, perhaps due to the cost of war? Investors may then expect the sovereign to renegotiate the terms of the debt contract by reducing the size of the principal or placing a moratorium on interest payments. We can incorporate these types of investors' expectations into our predictor.

One other factor worth considering in the context of our model is negotiated peace settlements. Civil wars reach a stable equilibrium when they provide a definitive political outcome, such as independence or secession or a complete surrender of the opposition. Hence, our measure indeed calculates the probability of victory in a civil war. Small events likely will not disturb such outcomes. By contrast, peace settlements are unstable equilibria. They represent points at which fighting has stopped, but there exists a greater than epsilon probability of resuming in the future. A large literature in political science shows that peace is more durable following a decisive military outcome (Maoz, 1984; Kozhemiakin, 1994; Licklider, 1995; Stinnett and Diehl, 2001; Dubey, 2002; Toft, 2003; Fortna, 2004).

III. Applying the Model

Thus far, we have provided a model that can be used to examine how markets believe civil wars will end. What are the features of the data that are desirable for

estimating our predictor and how frequently do we observe these criteria across time and space?

We highlight five features of the data. First, in order to control for inflation, it is optimal if the asset under consideration is issued in a stable currency, such as the pound sterling or the US dollar, or is backed by a precious metal. An asset issued in a stable currency is desirable so that the risk-free rate of interest can easily be extracted for the empirical analysis. Second, it is desirable if the asset trades primarily on an international financial market or outside the country of conflict, where it is more difficult for a warring government (or insurgents) to directly affect its price.[9] Third, it is desirable if the asset has a long duration (perhaps of at least 10 years), since this would imply that most of the coupon payments are made after resolution of the civil war. If the bond has a very short maturity then investors will probably focus more on the government's ability to service the debt in the short term and not on its prospects of winning the war. Fourth, financial markets need to expect that the civil war is not going to drag on interminably, a requirement that is usually met in practice because the median duration of a civil war is approximately 6 years (Fearon, 2004). If conditions three or four are not met, then additional assumptions are needed since, in both cases, the war will last longer than the bond's life. Two potential scenarios can emerge: (1) the bond is reimbursed and a new series is needed to assess the outcome of the war and (2) the country defaults on the bond and one needs to make an assumption regarding the duration of the civil war and how long it will take to reach a settlement regarding the bond.

Fifth, it is desirable to have an *ex ante* proclamation or announcement by the (winning) party that it intends to repudiate the opposition's debt obligations in the event of victory. In this case, there is no uncertainty regarding the future of the value of the asset in the case of victory: market participants know it will be repudiated. This justifies the suppression of Term 3 in equation (1). These statements often exist in the contemporary press or legal documents. For example, during the American Civil War, the United States government stated that they would not honor the debts of the Southern Confederacy (Weidenmier, 2000). During the Russian Revolution, to cite another

[9] See Oosterlinck (2010) for the French and German interventions on the Paris stock exchange in occupied France during WW2.

example, the revolutionaries had already made it clear by 1906 that they intended to repudiate the czarist debts as early as 1906 (Collet and Oosterlinck, 2012). The repudiation of the czarist debts in 1918 set a clear precedent for subsequent successful communist insurgencies to follow the path of debt repudiation (as in Vietnam, Romania, China, Czechoslovakia, Bulgaria, and Serbia).

Repudiation based on the concept of "odious debt" emerged at the end of the 19th century. Market participants frequently priced repudiation into sovereign bonds issued by regimes that were viewed as odious. For example, in addition to the Russian case, where bonds traded at a discount after political parties declared the 1906 bond issue as illegitimate, holders of Cuban bonds during the Spanish-American war required a premium as the debts were viewed as odious (Collet, 2013). Repudiation of "odious debts" has occurred with enough regularity in the 20th century to generate attention by scholars (Khalfan, King, and Thomas, 2003; Jayachandran and Kremer, 2006). Countries, such as Angola, Burma, Cuba, Haiti, Iraq, Sudan, Syria, and Zimbabwe, where dictators have contracted debts under the state's name but for their own profit, have been singled out as examples where legal scholars have suggested that new regimes would have a legitimate position to repudiate debt (Ochoa, 2008). Bonds issued in non-authoritarian regimes have also been declared odious. For example, Rafael Correa, the president of Ecuador, has refused to pay part of the national debt declaring it odious because he considers it to have been tainted "by graft and bribes to international courts" (Faiola, 2008). Indeed, since the issuance of sovereign debt at the national level is almost never subject to a direct popular vote, it invites the possibility that even democratically elected leaders can declare debts of their predecessors as illegitimate and repudiate them.

How frequent are the five ideal features we outline above encountered empirically? Historically, in addition to the cases we describe in detail below, there are many other cases that fit these criteria. To name just a few spanning other times and places, the debts issued in Paris by Dom Miguel in the framework of the Portuguese civil war (1828-1834), the debts issued in London and Paris by Maximilian I of Mexico (1864-1867), the Austrian debts issued in Switzerland and repudiated following the Anschluss (1938) all fit the criteria outlined above.

Sovereign borrowing in international capital markets was the primary way that developing countries financed debt prior to World War II; however, the nature of interstate lending changed after World War II. From 1945 to the 1970s, the bulk of sovereign borrowing took the form of official interstate lending (usually bilateral in nature). Although some debt repudiations occurred during this period (North Korea and Ghana, for example), prices of assets with the features outlined above are not available. In the 1970s, banks started lending over the counter to governments. In the 1980s, however, many commercial banks ended up in trouble following a string of government defaults.

To prevent a systemic collapse of lending to developing countries, the U.S. devised a system in 1989, the Brady bonds that led to a revival in publicly-traded sovereign debt. As trade in these assets has deepened, more countries (of even quite modest levels of development) began to issue bonds in publicly-traded international markets in the 1990s. In 2006, the Seychelles was the first Sub-Saharan country (other than South Africa) to issue sovereign bonds on global markets. In spite of the Great Recession, the number of countries issuing sovereign bonds on global markets has continued to grow, and now includes Rwanda, Ghana, Nigeria, Senegal, and Papua New Guinea. Moodys' expects several countries (Angola, Cameroon, Kenya, Tanzania, Uganda and Mozambique) to join the group in 2014 (Blas, 2013). As the concept of odious debt has gained traction and international financial markets have once again begun to issue sovereign debt to more than just a handful of developed countries, it seems highly likely that the predictor we develop in this paper will have applicability in the near future.

IV. Testing the Predictor

Having described the predictor, extensions, and data requirements, we now test its utility across time, space and types of conflicts, drawing on bond price data from three civil wars. We consider a failed secession (the U.S. Civil War), the defeat of an incumbent (the Chinese Civil War), and the case when a new government is installed by a foreign power (the restoration of Ferdinand VII of Spain). All cases presented below

fulfill the necessary assumptions. The Confederacy, Nationalist China and the Spanish Cortes government issued long term debts denominated in stable currencies which were then traded in international markets (Amsterdam, gold bonds for the Confederacy, London, sterling bonds for Nationalist China and the Spanish Cortes). In all instances, one of the parties pledged to repudiate the debts issued by its enemy. In fact, in all cases, bonds were eventually repudiated.

A. The U.S. Civil War

The U.S. Civil War began in April 1861 and concluded in May 1865 with the defeat of the breakaway southern states. By the end of 1862, the Confederacy was beginning to feel the pinch of financing a war with a weak revenue stream. Hence, it began to sell bonds on European capital markets. After negotiations with several second tier investment banking firms, the Confederacy managed to float two bond issues in Europe: (1) cotton bonds that traded primarily in England and (2) domestic gold bonds sent to the Amsterdam Stock Exchange.

In our analysis, we use the domestic gold bonds that were traded in Amsterdam since they fit the criteria outlined in the previous section.[10] Issued under the Acts of August 19, 1861, the gold bonds paid an 8 percent coupon in specie with maturities ranging from 10 to 20 years. Coupon payments were paid semi-annually on January 1st and July 1st (Davis and Pecquet 1990; Todd 1954; Dinger 1868).[11] The Confederate government initially turned down offers to sell the gold bonds directly to European investors at 60 percent of par value in December 1862 and mid-January 1863. The offer

[10] By contrast, the cotton bonds are problematic. Issued in March 1863 by Erlanger and Company, the cotton bonds were a sterling denominated debt instrument that paid investors 7 percent interest semi-annually. The pricing of the cotton bonds is complicated, however, by the existence of an option clause that allowed investors to convert the security into cotton on demand within 60 days. Moreover, the cotton bonds are not a representative debt series for the Confederacy because it met all the payments on that debt issue for the duration of the conflict while defaulting on all of their other debt obligations – those accounting for more than 92 percent of borrowing.

[11] It can easily be shown that the Confederate bonds sold in Amsterdam were gold denominated. Letters between rebel agents in Amsterdam and the Confederate Treasury Secretary discuss the funds raised from the sale of domestic war bonds in terms of the amount of foreign exchange the bond sale raised for war finance. The Confederate bonds in Amsterdam generally traded for more than twice the price of the domestic paper version of the bond. Moreover, there was not an active market for Confederate paper money in Europe during the Civil War since European governments did not recognize the South.

price was actually set by British citizens who had privately purchased Confederate bonds directly from the Southern government and were reselling those bonds on the secondary market (Fenner 1969). The offer price of 60 percent of par would be consistent with financial markets giving the Southern Confederacy a 42 percent chance of winning the Civil War. The exact number of Confederate bonds sold in Amsterdam is unclear (Fenner 1969; Ball, 1991:75; Sexton (2006, p. 158, n. 74).[12]

The *Amsterdamsch Effectenblad*, a leading Dutch financial newspaper, first began quoting Confederate bond prices August 1, 1863. To carry out our analysis, we hand collected a new data set of Confederate gold bonds using this source. The bonds initially sold at 47 percent of par (par = 100 gold dollars) in sizes of 50, 100, 500, and 1,000 gold dollars. Over the next several weeks, trading in these bonds appears to have significantly increased and Dutch newspapers began quoting prices almost every day by October 1863. The *Amsterdamsch Effectenblad* reported almost 500 price quotations for Confederate bonds between August 1863 and the end of the war in May 1865. Dinger, a contemporary observer, wrote that Confederate bonds traded almost every day on the Dutch market (Dinger, 1868, p. 374; 1873, p. 600).[13] As is common for the 19th century, the British consol is used to extract the risk free rate.

Using our predictor, Figure 1 displays the computed probability of victory (interpreted for this civil war as a successful secession by the Confederacy from the union) from the summer of 1863 until May 1865. The vertical lines in the figure and the accompanying text denote important military events. Confederate defeats are denoted by a solid vertical line while Confederate victories are shown by a dashed line. Confederate debt prices in Amsterdam continued to fall in August and early September 1863. As measured, the Confederacy's prospect for victory (approximately 34 percent) was greatest at the beginning of the sample period, in early August 1863. By the end of November 1863, participants in European sovereign bond markets assessed the

[12] Correspondence between Confederate agents in Europe and the rebel Treasury Secretary Memminger also indicate that about $3,000 of the gold bonds sold in Amsterdam were five-year securities with an option to convert to 5-30 year bonds. The *Amsterdamsch Effectenblad* quoted prices for the convertible debt instrument in 1864 (Veenendael, 1996). Given the small number of convertible bonds sold in 1864, we focus the analysis on the larger and more liquid bond issue purchased by Dutch investors in the summer and fall of 1863.

[13] Bosch (1948), a Dutch historian, also noted that Confederate bonds traded daily on the Dutch market.

probability at less than 20 percent. News of the Confederate victory at Chickamauga in October briefly reversed the downward trend in Confederate secession prospects.

For the remainder of the war, Confederate bond prices generally declined, suggesting that investors were losing confidence in the prospect of a successful secession by the South. By the end of November 1864, the probability of victory by the Southern Confederacy was less than three percent. Confederate secession prospects continued to fall for the remainder of the war and were approximately one percent by the first week of May 1865, a few weeks before the last Confederate field army surrendered to Union forces in Texas.

Although the baseline model provides some insight into the evolution of Southern victory prospects during the Civil War, one could argue that several of the assumptions employed in the cash flow model are unrealistic. The Confederate government could have partially defaulted on its bonds or placed a moratorium on interest payments in the post-war period (assuming a military victory). Robustness checks show that incorporating a 10 or 20 percent hair cut in the baseline model or allowing for a five-year moratorium on interest payments has little effect on the estimated probability of a Confederate victory. The long dated nature of the Confederate war bonds means that the debt security derived most of its value from the post-war period and is generally not very sensitive to changes in the contract terms of the debt obligation.

One might also argue that the risk preferences of Confederate bond investors may have changed during the war. Purchasers of Confederate bonds in the secondary market might have been less risk-averse (i.e., be more risk tolerant) as the price of Confederate bonds fell to very low levels with news of Southern battle defeats. The skewness of the probability distribution suggests that this might have been the case. The distribution of Confederate bond returns became more negative toward the end of the war. For the purposes of our analysis, however, the presence of less risk-averse investors reduces the estimated probability of a Southern victory and does not qualitatively affect the upper bound probability estimated from the baseline model.

B. The Chinese Civil War

The collapse of the Qian dynasty in 1911 led to a period in China where the country was governed by warlords. Two major political movements emerged: the Kuomintang Party (KMT-Nationalist Party), led by Sun Yat-Sen, and the Communist Party of China (CPC) led by Mao Tse-Tung.

The rivalry between the KMT and the CPC led to the outbreak of civil war in early 1927. From 1936 to 1945 the KMT and CPC cooperated in the war against Japan, although their forces skirmished occasionally. After World War II, the KMT and CPC immediately sought to gain control of regions formerly controlled by the Japanese and build up their military forces while the two parties discussed the possibility of a peace agreement (Fenby, 2004; Snow, 1938; Moran, 2001; Salisbury, 1985). The first post-war peace meeting between the KMT and CPC took place from August 28 to October 10, 1945. The two sides agreed to establish the Political Consultative Council that would contain representatives from both the CPC and KMT, and the Council was supposed to draft a constitution and develop plans for a new Chinese government. This effort was stillborn, however, as the Communists and Nationalists could not agree on the form and organization of a new Chinese government. US Secretary of State George Marshall was immediately dispatched to China in December 1945 to help jumpstart peace talks. The two parties agreed to a military ceasefire January 1946.

When those peace talks broke down and full-scale civil war broke out in June 1946, the United States provided financial assistance to the KMT. The KMT gained control of many northern Chinese cities and parts of Manchuria in the last half of 1946 in spite of runaway inflation, widespread corruption, and social unrest (Burdekin and Wang, 1999; Chang, 1958; Chou, 1963). They also convened a Nationalist Assembly and approved a constitution. The communists, on the other hand, were gaining the upper hand, in part, because they promised land reform. By early 1947, the United States believed that the KMT could not win the civil war without significant military assistance from the United States. US Secretary of State George Marshall left China, signaling an end to major US involvement in the conflict (Melby, 1968; Hammond, 2004). Although the Nationalist took control of Yenan in March, the People's Liberation Army of the CPC

took several key cities in Manchuria and moved towards the Yangtze River. By the end of 1947, the Nationalists were on the defensive. Throughout 1948 they continued to give ground to the People's Liberation Army (PLA) the military arm of the CPC. By 1949, the Nationalists were offering to partition China into two countries—a CPC-led North and a KMT-led South—an offer that was rejected by the Communists. The PLA continued their push through China, forcing the KMT from Nanjing to Guangzhou and from Chongqing to Chengdu. While the campaign to remove the Kuomintang from China would continue until the end of 1949, Mao declared the People's Republic of China October 1, 1949. Shortly thereafter, the communists defeated the Nationalists at Chengdu, effectively ending the military conflict. Chiang Kai-shek and his supporters fled to the island of Taiwan in December, establishing the Republic of China (ROC). (Hammond, 2004; Westad, 2003).

To assess the impact of the political events on the estimated probability of a Chinese Nationalist victory, we analyze weekly data on the five percent bond issue of 1913. The data were hand collected from *The Times* of London for a period ranging from July 1945 to July 1954. The bond was denominated in pound sterling. Interest was paid semi-annually, on January 1 and July 1, with the bond maturing in 1960. The initial bond issue was 25 million pounds and sold in London, Belgium, France, Germany, and Russia. The bonds appear to have actively traded on the London market. The Nationalists faithfully repaid the debt issue until 1938 despite the outbreak of civil war and an invasion by Japan.

Figure 2 shows the estimated probabilities of a Nationalist victory along with important political and military events. Solid lines denote communist victories while dashed lines denote a military victory for the Nationalists. It is striking that when World War II ended, the markets were already predicting that the Communists would win the civil war: our model yields only a 45 percent probability of Nationalist victory in July 1945. That probability increased to 60 percent when the Nationalists and Communists engaged in peace talks in September, but then fell back to 50 percent once the peace talks failed. From this point onwards, the market increasingly came to discount the probability of a Nationalist Victory. By the end of 1946, our model indicates that the market priced the probability of a KMT victory at only 35 percent. With each battlefield victory for the

communists, the market adjusted downwards, so that by the by the end of 1948, the probability of a Nationalist victory had fallen to less than 10 percent.

The preferences of Chinese bond investors might have changed during the Civil War. The distribution of bond returns (skewness) suggests that this may have taken place as Chinese Nationalist defeats began to mount. The skewness of bond returns for the two Chinese Nationalist debt obligations increased over the course of the sample period as bond returns became more negative (at least up until the time Mao Zedong proclaimed the establishment of the People's Republic of China (PRC) in the fall of 1949). Again, the presence of less risk-averse inverse (as in the Confederate case) simply means that the baseline results provide an upper bound estimate of the probability of victory by the Chinese Nationalists. Overall, the empirical results suggest that the prospects of a Nationalist victory hinged on political solution. Bond market predicted that the KMT had little chance of victory once the United States was unable to broker a peace deal between the Nationalists and CPC.

C. Spain: The Liberal Triennium (1820-1823) and the Ominous Decade (1823-1833)

The abdication of the throne by Charles IV of Spain in 1808 started a fight for his succession. Charles' oldest son, Ferdinand VII, considered himself to be the legitimate heir to the throne. Napoleon also laid claim to the throne as Charles IV had relinquished his rights to him. Following several military defeats, Napoleon agreed to recognize Ferdinand VII as king of Spain. During Napoleon's rule, the Spanish government changed the constitution and established a constitutional monarchy. The new constitution reduced the power of the monarch and established an independent chamber called the Cortes. Shortly after his return as king, Ferdinand VII began to question the validity of the newly-drafted constitution. In May 1814, he abolished the constitution, arrested supporters of the new government, and returned the country y to absolutist rule.

The restored king soon realized that the country was on the verge of bankruptcy. To increase the resources of post-war Spain, Ferdinand VII envisioned recovering the American Empire (Carr, 1966, p. 122). In 1818, he began to concentrate troops in Andalusia to be sent to Latin America as an expeditionary force. The prospects of

fighting in Latin America coupled with promises from liberal officers led the troops stationed in Cadiz to mutiny in January 1820. Their leaders were mid-ranking officers who wanted to stop the absolutist rule imposed by Ferdinand VII. With the support of other military factions, the revolutionaries captured Ferdinand VII and forced him to restore the constitutional monarchy. A new constitution was drafted and served as the basis for law between 1820 and 1823. This constitution was in fact very close to the one existing at the time in Great Britain (de Waresquiel, 2006, p. 551). As a result, Great Britain viewed the new regime very positively, prompting it to support the Cortes. However, at the same time, Ultra royalists at the Seu d'Urgell created a counter-government that aimed to restore absolutist rule (Capefigue, 1858).

Pro-monarchy forces gained credibility when the major European nations convened at the Verona Congress in October 1822. During that Congress, France proposed to intervene in Spain to restore the throne to Ferdinand VII. Russia, Prussia and Austria supported France while the United Kingdom favored non-intervention. On April 17, 1823, France invaded Spain and stormed the citadel in Trocadero on August 31, 1823. A few months later, Cadiz fell and Ferdinand VII was restored to the throne in September, 1823. Ferdinand VII murdered and incarcerated his enemies and the administration was purged. The absence of coordination regarding the purges led to very different outcomes, and in some regions, employees from the finance minister were the only target of the purges. The purges did not end until 1827 (Luis, 1994).

During its short existence, the Cortes government managed to float several bonds abroad. Table 1 lists the six loans that traded on the Paris and London markets. The debt issues had a total value of 2,080,000,000 reals (547,368,421 FF). Following the reestablishment of the absolutist regime, Ferdinand VII refused to recognize the debts issued by the Cortes. He argued that the debts were a "revolutionary misappropriation" (Fontaine, 1861, p. 37). Later, Ferdinand declared the loans null and void in a decree signed in Port-Sainte-Marie (Cadiz) in 1823. Some investors continued to believe that the Spanish government would repay loans because they believed that repudiation would tarnish the country's bond market reputation. This proved to be true but only after many years. Indeed, some form of compensation was given in 1831.

We use the 5% Spanish loan floated in Paris and London and issued in 1821 as well as the British consol to compute the probabilities of winning. For comparability with the consol, we use the prices from London as the British part of the loan was issued in sterling. Interest on the bond was paid twice per year (on May and November 1st), and bonds were, in all likelihood, perpetuities.[14] Capefigue (1858, p.120) states that contemporaries believed the bond to be highly liquid during the years 1821-1823. Figure 3 shows the reimbursement probabilities for the Spanish debt from January 1822 to December 1827.

Figure 3 suggests that even when the Cortes government was in power markets never gave the political regime a high probability of survival. This is consistent with historical accounts. The Cortes government constantly faced opposition from Ferdinand VII. The constitutional monarchy gave the king enough power to actually block many of the reforms the Cortes wanted to enact. The Congress of Verona dramatically reduced the perceived likelihood that the Cortes government would remain in power. Indeed, France garnered support for a military intervention from Austria, Prussia and Russia; the United Kingdom was the only major power that supported non-intervention in the conflict. As a result, the government proved to be extremely unstable. In February 1823, once it became certain that the French were likely to intervene, the relationship between the king and his ministers deteriorated even further (Carr, 1966, p. 140). By that time, the probability of repayment had fallen to close to 25 percent. It remained at this relatively high level even after the fall of Trocadero and the repudiation decree. As the purges intensified, the probabilities fell much further but not all the way to zero. There are several reasons that might explain the high reimbursement probabilities. First, our predictor delivers upper bound probabilities. Second, investors may have expected a reversal in the Cortes fortunes in the ongoing war. Third, even though the Cortes episode was definitively over by the end of 1823, Spain was far from stable. Several extreme royalists revolted before 1830 and rumors of revolution were frequent. And finally, investors may have anticipated

[14] The *Morning Chronicle* defines these as rentes – the term used for French perpetuities and there is no mention of maturity (*Morning Chronicle* January 4th, 1822 and January 21st). Reimbursement was meant to be done exclusively through a sinking fund. We thank Marc Flandreau for providing price data on the Spanish bond. See Flandreau and Flores (2009) for the details of the loan and the market for sovereign bonds in London during the 1820s.

that Spain would have to come back to the negotiation table to borrow again. By the end of 1827, however, probabilities had fallen below 8 percent.

V. Conclusion

We develop a method for estimating the real-time probability of a victory during a civil war or revolution. To illustrate the utility of the predictor and assess its external validity, we analyzed data from three civil wars with well-known outcomes, the U.S. Civil War, the Spanish Civil War, and the Chinese Communist revolution, which differ in type (victories by the opposition and a failed secession), location, and era.

We find that European investors gave the South about a 42 percent chance of winning the war in early 1863 prior to the battle of Gettysburg. The chances of a Confederate victory may have been even higher given that we do not have data on gold bonds prior to the battle of Antietam. The analysis suggests that contemporary financial markets believed that the South had a reasonable chance of achieving its political objective. News of the severity of Confederate defeats at Gettysburg/Vicksburg, followed by a military defeat at Chattanooga, led to a sell-off in Confederate bonds and the probability of a Southern victory fell to about 15 percent by the end of 1863. Confederate victory prospects generally declined for the remainder of the war, suggesting the financial markets placed little hope in the belief that the United States was growing tired of the war in 1864 and might elect George McClellan President on a peace party platform.

The analysis of the Chinese Civil War suggests that the Nationalist had about a 60 percent chance of winning the conflict after the end of World War II. The Nationalist best chances of victory rested on the possibility of a peaceful agreement with the communist party. Victory prospects for the Nationalists generally declined over the next couple of years. By September 1950, financial markets basically considered the conflict a communist victory. Nationalist bond prices briefly recovered in the mid-1950s, however, as there was a belief that American forces might invade China during the Korean War. Such a move by the US military might have helped Chiang Kai-Shek regain control over mainland China and led to the Nationalists repaying their debts.

As for Spain, markets believed the constitutional monarch would probably survive during the first few months of the new regime. France's invasion of Spain changed the markets assessment of the survival probability for the Cortes regime and simultaneously increased the probability that Ferdinand would be restored to the throne as an absolute monarch. This was especially true after the French victory at Trocadero which dramatically reduced the probability that the Cortes would win the war. Financial markets continued to believe that there was a significant, but unlikely chance, that Cortes would survive the war with France or that a more investor friendly government would emerge.

We have argued that market-based measures, such as those based on predictions markets or sovereign bonds, likely provide a more reliable estimate of the outcomes than expert opinion. Using assets with zero-one payoff structures to understand civil conflicts may have additional advantages over the types of prediction markets that are now widely used for forecasting election outcomes. First, if predictions markets are thinly traded, then the noise to signal ratio rises. High noise-to-signal ratios are less likely to occur in deep and liquid sovereign bond markets than current online platforms. Second, sovereign bonds trade internationally and have been for centuries; prediction markets, however, can be decreed illegal or rendered inoperable (i.e., get closed in a civil war, if run domestically). Third, since the start of civil wars are not entirely predictable events, sovereign bonds potentially offer en earlier window into outcomes with uncertain probabilities than betting markets established after the conflict has escalated. Relatedly, aid agencies and others may even want to monitor countries that have not entered into civil wars and can do by using our predictor.

Although we tested our predictor using historical evidence to ensure finality of the outcomes, it will likely have considerable utility to current and future policymakers and the development community since developing countries have once again turned to international capital markets for long-term borrowing and regime changes since the beginning of the 19th century have begun to justify repudiation on the basis of odious debt. Sovereign debt issues have a number of features that make them particularly well suited to this kind of analysis; however other types of assets that trade in thick markets

whose values can be driven to zero by regime change can also be employed, especially when sovereigns don't trade or meet the necessary criteria we describe.

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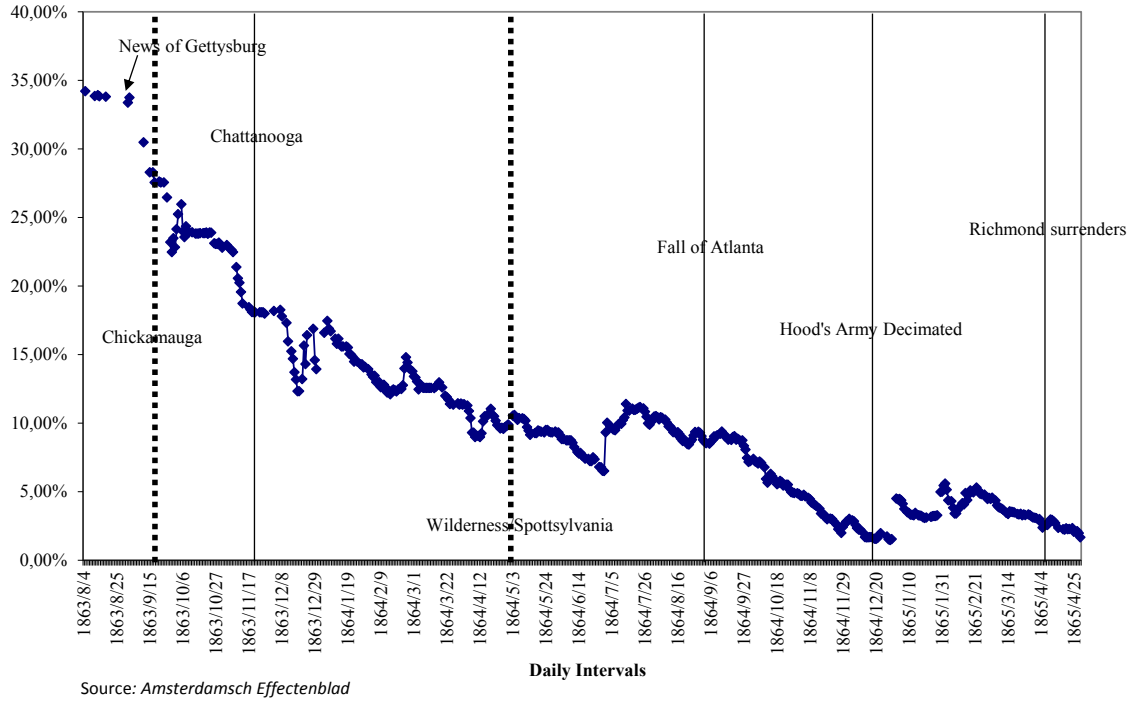
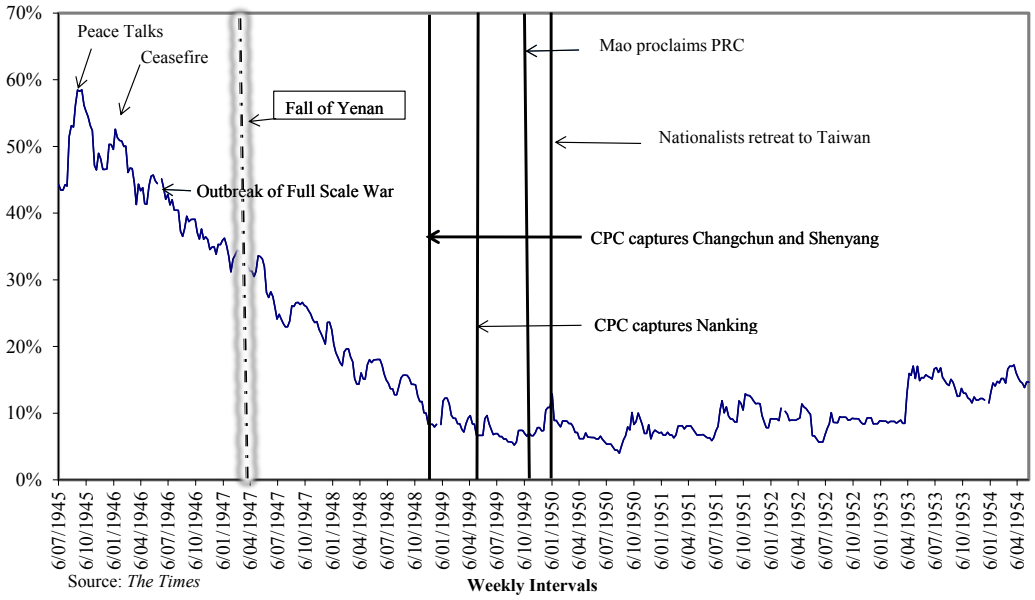
Figure 1
Probability of a Confederate Victory
August 1863-April 1865



Source: *Amsterdamsch Effectenblad*

Figure 2
Probability of a Chinese Nationalist Victory, July 1945-May 1954



Source: *The Times*

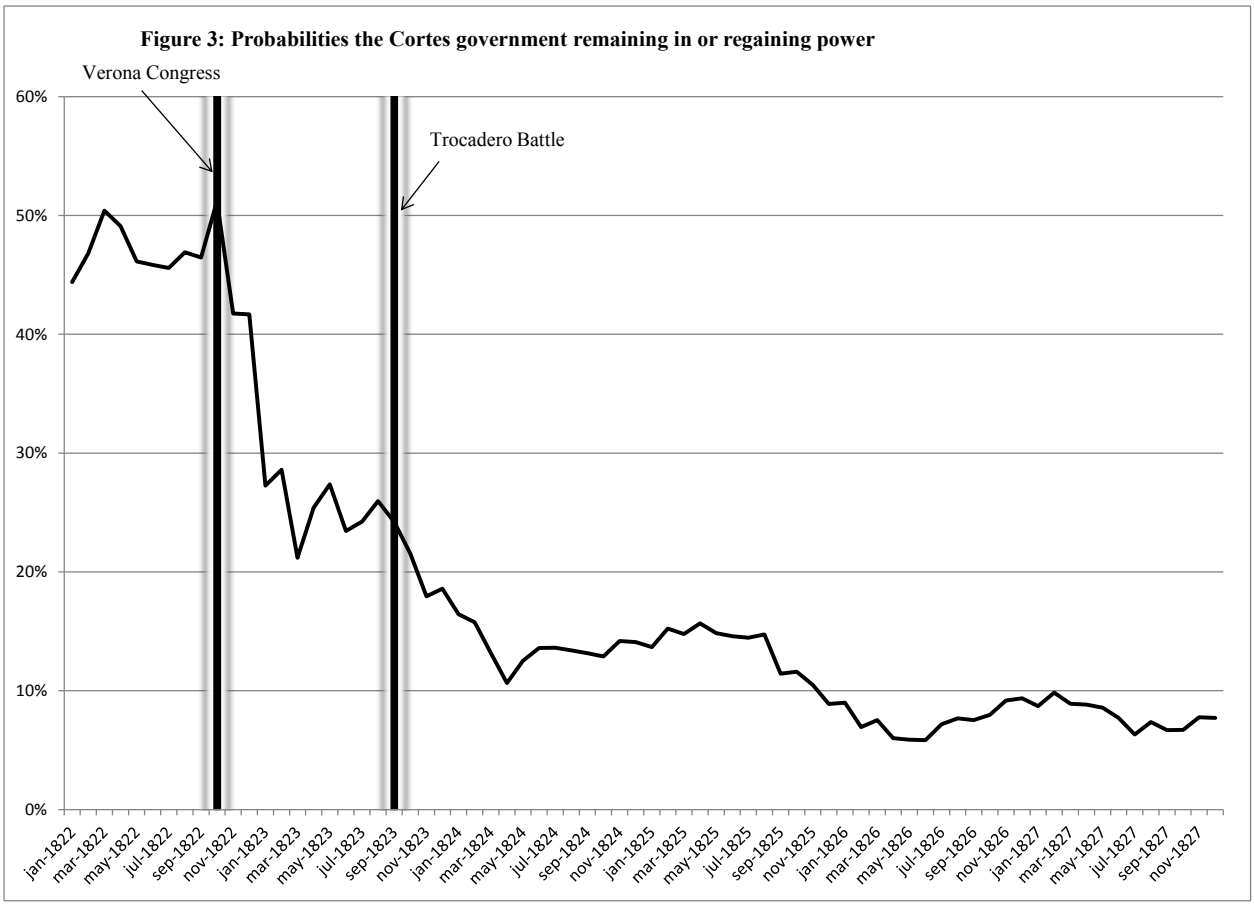


Figure 3: Probabilities the Cortes government remaining in or regaining power
Verona Congress
Trocadero Battle
60%
50%
40%
30%
20%
10%
0%
jan-1822
mar-1822
may-1822
jul-1822
sep-1822
nov-1822
jan-1823
mar-1823
may-1823
jul-1823
sep-1823
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nov-1825
jan-1826
mar-1826
may-1826
jul-1826
sep-1826
nov-1826
jan-1827
mar-1827
may-1827
jul-1827
sep-1827
nov-1827

Table 1: Loans issued by the Cortes government (source: Fontaine, 1861)

Loan	**Real**	**FF**
Lafitte bonds	84,000,000	22,105,265
Bareta	27,000,000	7,105,265
Issued in London by Ardouin an Hubbard with a guarantee from Lafitte	1,228,000,000	323,157,895
Issued in Paris with the same guarantees	279,000,000	73,421,053
To convert Spanish bonds held in Holland and Lafitte bonds	171,000,000	45,000,000
Total	2,080,000,000	547,368;421