WAR NEWS AND EXCHANGE RATES DURING WORLD WAR I: THE EASTERN VERSUS THE WESTERN FRONT[*]

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This version: December 22, 2015

Abstract

Using a newly compiled dataset on prisoners of war and on soldiers killed and wounded on the Eastern and Western Fronts of World War I, this paper shows that changes in the exchange rate among the currencies of the belligerent countries were associated with good or bad news from the battlefield. Prospects of losing the war depreciated a country's currency because a defeat would increase the likelihood of inflationary policies to pay off war debts. The paper further provides evidence that exchange rate fluctuations were less associated with news from the Eastern Front than with news from the Western Front, suggesting that foreign exchange traders followed the military news from the Western Front more closely to forecast the outcome of the war.

Keywords: Exchange Rates, News, World War I.

JEL: F31, N14, N44.

1 Introduction

With the outbreak of World War I in 1914, all belligerent countries announced they would temporarily abandon the gold standard. They inflated national debt with the promise of restoring gold convertibility and paying back war bonds at the old parities after the war was over. Analyzing exchange rate developments during the war, Hall (2004) shows that the general depreciation-trend of combating nations' currencies against neutral countries' currencies was associated with rapid increases in money supply to finance the war. Hall (2004) provides empirical evidence that information about casualties on the Western Front affected exchange rates *between* the currencies of the countries of the Entente and Central Powers, implying that traders believed the winning side was more likely to adopt deflationary policies after the war and restore gold convertibility.

In this paper we extend Hall's study by testing if exchange rates during World War I were also influenced by military news from its second major battlefield – the Eastern Front. The answer is not obvious. Today, the victories of the Entente and its allies (most importantly the US) on the Western Front are usually assumed to have decided the outcome of World War I. From this perspective, casualties on the Eastern Front might not have been of importance to foreign exchange traders (e.g. Ferguson 1998, Hall 2004). But the fact that the Western Front is now considered more important in the outcome of the war does not imply that this was also the perception of traders a hundred years ago.[1]

Although the trench war on the Western Front and the famous battles of Verdun and the Somme are more prominently featured in historical accounts (e.g. Jankowski 2013, p. 12), in documentaries and in the collective postwar memories, historians have continued to emphasize the importance of the two-front war and the long "Forgotten"[2] Eastern Front in understanding the complex evolution of the First World

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[1]Adams (2015) documents that structural breaks in French bond prices during World War I reflect war news about events, which are not necessarily considered of extraordinary importance today.

[2]See Groß (2009).

War. In a two-front war, the results on one front affect the results on the other. For instance, in October 1914 the Central Powers transferred troops from the Western to the Eastern Front to fight against Russian forces in East Prussia (e.g. Mommsen 2004, pp. 40-55, Stone 1998, p. 48).

To examine whether the news from the Eastern Front affected exchange rates, we present new data on prisoners of war as well as soldiers killed and wounded in action for the main belligerents on the Eastern Front: Germany, Austria-Hungary and Russia. We compiled this data by going through the German Imperial Archive's (1926-1944) multi-volume documentation "Der Weltkrieg 1914 bis 1918 - Die militärischen Operationen zu Lande" and the Austrian War Office's anthology "Österreich-Ungarns letzter Krieg 1914 - 1918." Merging our data with Hall's (2004) data for the Western Front, we constructed a rich new dataset of casualties on both fronts.

Using our new dataset we find that news from the "Forgotten" Front, seems to help in explaining the fluctuations in exchange rates between the currencies of the Entente and Central Powers. We find that the higher number of soldiers taken prisoner, suggesting the side was losing the war, led to a depreciation of that country's currency. War news from the Eastern Front, however, seems to have been less strongly associated with exchange rate fluctuations than was the war news from the Western Front. This is consistent with historical accounts that emphasize that contemporary media and propaganda were more concerned with the progress of the fighting on the Western Front. Therefore, traders may have known less about what was happening on the Eastern Front[3] and relied more heavily on military news from the Western Front to predict the outcome of the war.

Furthermore, Hall (2004) reports that the higher numbers of killed and wounded soldiers on the Western Front were considered good news for the country's currency on foreign exchange markets; in a trench war the winning side sustains higher losses on offensives. Indeed, taking into account data for the Eastern Front, where warfare was rather diverse, we do not find the same association between soldiers killed and

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[3]Churchill (1931) wrote of an "unknown war" on the Eastern Front.

wounded and exchange rates, supporting Hall's interpretation.

The remainder of the paper is organized as follows. Section 2 explains why it is likely that war news affected exchange rates. Section 3 describes our dataset. Section 4 empirically shows that casualties on both fronts were associated with exchange rate fluctuations. Section 5 summarizes the results and concludes.

2 War news and exchange rates during World War I

The link between war news and exchange rates has attracted the interest of researchers since at least the time of the American Civil War. As early as 1866, Edward Pollard suggested that the value of the "grayback", the currency of the Confederacy, depended on news from the battlefield (Pollard 1886, p. 415). Similarly, in 1903 Wesley Mitchell argued that the volatility of the greenback's value reflected military news rather than changes in the money supply. Every military victory was found to have led to an increase in the value of the currency and every defeat was found to have led to its depreciation (Mitchell 1903, p. 203).[4]

There are good reasons to believe that war news also affected exchange rates among the currencies of the countries fighting in World War I. The world was on a gold standard until the war started in 1914. To finance World War I, however, all countries announced a temporary abandonment of the gold standard. They increased national debt with the promise of paying back war bonds and restoring gold convertibility at the old parities after the war. The value of a country's currency with respect to other currencies, therefore, hinged on the ability of the country to return to the prewar gold parities.

Returning to the prewar parities included the promise to service the debts in terms of gold and to be able to enact deflationary policies following an inflationary expansion of the money supply – in other words adherence to the rules of the game (Bordo and Kydland 1996). Therefore, the more notes a country issued to finance its war debt, the lower the likelihood of actually implementing the deflationary policies that would allow a return to the old parity. In particular, if the debt burden was

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[4]Mitchell (1903, p. 188) further wrote that fluctuations "were so much more rapid and violent than the changes in the volume of circulating medium that not even academic economists could regard the quantity theory as an adequate explanation of the phenomena". Further Mitchell (1908, p. 15) suggested that monthly gold premium fluctuations coincided with war events. In a similar vein, Schwab (1901, p. 169) found that the "value of the 'greenback' was much more a barometer of popular feeling as to the eventual outcome of the war than a gauge of their amount in circulation, (...)." However, Lerner (1955, p. 24) maintained that an increase in money supply remained to be the main driver of the Greenback's devaluation during the American Civil War. See Hall (2004, p. 1715) for further references on the Civil War. More recently Mauro et. al. (2007, pp. 86-107) demonstrated that war or violence news affected bond yields in emerging markets during the first era of globalization from 1870 to 1913.

high, sufficient budget surpluses to service the debt in gold were less likely. Based on the quantity theory of money and purchasing power parity, the value of a country's currency depended on the amounts issued and on fundamentals such as economic growth (see Cassel 1925, p. 140).

It was, however, more likely that the winning party would be able to honor its wartime debt and return to gold parity as the losing side was about to face high reparation claims and to struggle generating the necessary primary surpluses. Therefore, news from the battlefield may have affected exchange rates if that news was used to predict which side was winning. According to Stephens (2014), during World War I "both sides used all the available tools to convince neutrals of the legitimacy of their actions and to get them on their side". Governments tried to buy into Swiss newspapers to influence the news in their favor. Given – as Stephen puts it – the "cultural divide" within Switzerland we can assume that all sides of the conflict were represented, so that news from the fronts was available to traders.[5] On Switzerland's dense foreign exchange market, the bits and pieces of information each trader got from newspapers or other sources found their way into decisions to buy and sell. The change in the value of the currency then was associated with what the traders knew about which side was winning at any given time.

Ferguson (1998, pp. 367-372) suggested that the outcome of World War I did not depend on which side was able to kill more of the other side's soldiers.[6] Instead, Ferguson (1998, pp. 386-7) saw in the higher numbers of war prisoners, or of soldiers surrendering, the lost morale of the German troops. Building on Ferguson's elaborations, Hall (2004) provides the first empirical evidence that exchange rates fluctuations during the First World War may be explained by the number of soldiers captured on the Western Front. He finds that having more of its soldiers captured

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[5]Stephens (2014) further notes that "when German soldiers burnt down the famous library in Leuven on August 25, 1914, as part of their attempts to destroy the Belgian city, the Tribune de Genve accused them of 'barbarism', whereas the Zürcher Post referred to the 'alleged' destruction of Leuven. The German-language press in general tried to justify the attack by pointing to an uprising of Belgian 'guerrillas'."

[6]In fact, German soldiers caused relatively higher casualties, when considering the whole war period and it took Germany only a third of financing to do. Nevertheless, Germany lost the war (Ferguson 1998, pp. 336-337).

indeed led to a depreciation of a country's currency, suggesting that war prisoners were indeed considered to depress the morale of troops or to signal imminent military defeat. Hall further finds that a country's currency appreciated if the number of that country's killed and wounded soldiers was high. Given the peculiarities of trench warfare on the Western Front, he suggested that information on such casualties was interpreted as indicative of which side was taking the offensive to gain land and position.

3 Data

3.1 Exchange rates and notes in circulation

Hall (2004, p. 1716) explains in great detail that the Swiss foreign exchange market was a dominant market during the war years. Following this research, we use exchange rate data from the Swiss Bank Corporation report to examine the extent to which exchange rates were influenced by news from the Eastern Front. The report includes the monthly averages of offer and demand prices for the major belligerent currencies (Swiss Bank Corporation, 1919, App. VIII). Monthly data on notes in circulation is taken from John Parke Young's "European Currency and Finance" Vol. I and II (Young 1925). As we focus on the Western and Eastern Fronts in our analysis, we shall also use data for the Russian Rouble exchange rate and the Russian notes in circulation.[7]

Figure 1 presents the development of the Swiss Franc exchange rates of the German Mark, the Austro-Hungarian Krona, the British Pound, the French Franc, the Italian Lira, and the Russian Rouble. All currencies lost value against the Swiss Franc during the war. For the sake of comparison we standardized the time series. Figure 2 graphs the evolution of the standardized notes in circulation series in terms of Swiss Franc notes over time. Specifically, we scale the data on notes in circulation for each belligerent country by the notes in circulation in Switzerland. The figure shows that in all countries money supply rose faster than in Switzerland during World War I.

Taken together, Figures 1 and 2 suggest that – in line with the quantity theory of money – in all belligerent countries a relative increase in notes in circulation was associated with a depreciation of their currencies relative to the Swiss Franc. However, correlation coefficients between 75 and 90 % indicate that exchange rate changes did not perfectly reflect changes in notes in circulation.[8]

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[7]Unlike many other Eastern European countries (like Poland) Russia was on a gold standard from 1897 to 1914. Therefore, it makes sense to include the Rouble exchange rate in the sample.

[8]In this regard, Hall (2004) shows that the first principle components of notes in circulation and exchange rates are closely related, while second principal components do not correlate. This result also holds when including the Russian Rouble. A replication of these results may be provided

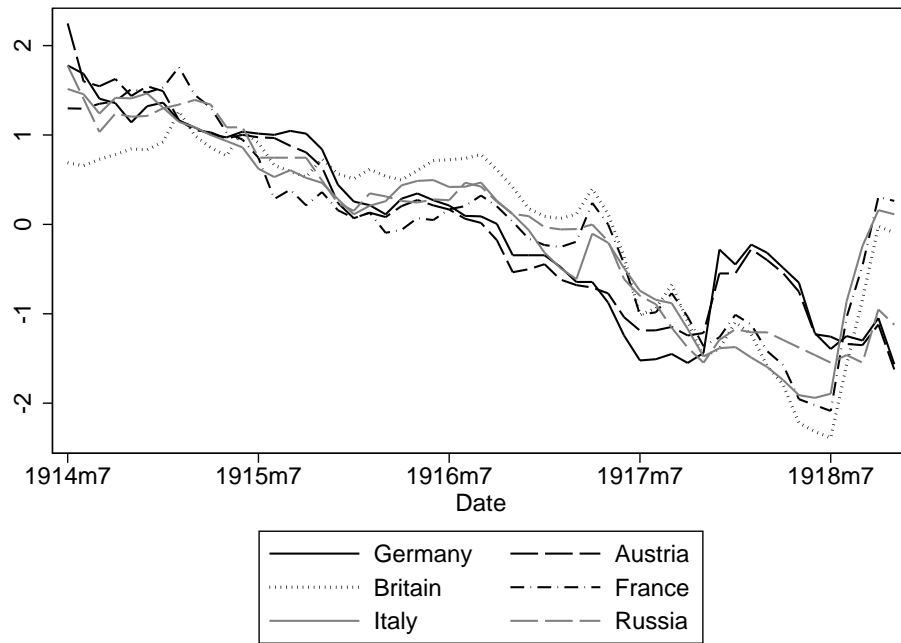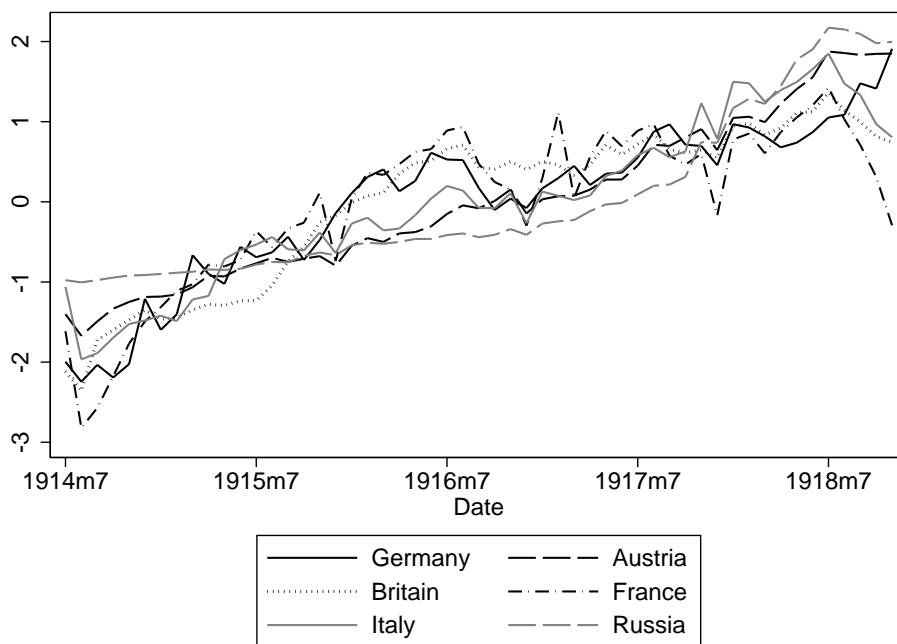Figure 1: Standardized Monthly Exchange Rates

Figure 2: Standardized Notes in Circulation

3.2 Casualties

To examine if casualties on both fronts affected exchange rates during World War I we collected and compiled new data for the Eastern Front by from the German Reichsarchiv's (1926-1944) multi-volume documentation "Der Weltkrieg 1914 bis 1918 - Die militärischen Operationen zu Lande" as well as the Austrian War Office's anthology "Österreich-Ungarns letzter Krieg 1914 - 1918". Data can be found by period rather than by battle, which allows us to construct a monthly dataset. In particular, we collected data on German, Russian and Austrian-Hungarian prisoners of war in addition to data on German, Austrian-Hungarian and Russian killed and wounded (KW) on the Eastern Front. We merged our dataset with George Hall's (2004) data on British and German prisoners of war (POW) and with the numbers of French, British and German killed and wounded (KW) on the Western Front. The result is a comprehensive dataset on casualties for all three countries of the Entente and for the Central Powers on both fronts.[9]

As imperfect as the dataset may be[10] – given that the documentations by the German Reichsarchiv, Austrian War Office as well as that of the British War Office were based mainly on reports from the fronts and from military records in the immediate aftermath of World War I, the data compiled should be closer to what could have been known during World War I than recently updated data, which does not exist in this much detail.

Figure 3 presents our casualty data for both fronts. We see that compared to

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on request.

[9]We 'broadly' cross-checked the data for the Eastern Front using a report Loring prepared for the U.S. Army Concepts Analysis Agency (Loring 1983). Unfortunately, this source does not include all battles on the Eastern Front. It further does not differentiate the casualty data with respect to killed, wounded or soldiers taken prisoner like it is done in the British War Office data (1922), which Hall used to generate monthly casualty series.

[10]We are fully aware that any data on World War I casualties and POWs is far from perfect. As Jankowski (2013, p. 259) remarks in a critical review of such data: "Even when loss figures were compiled for individual battles they were rarely consistent." In fact, the numbers provided by the Reichsarchiv as well as by any other archive have been revised over and over again. In the 1920s, for instance, the Reichsarchiv suggests that there were 428,000 German casualties at Verdun. The French reported 535,000 losses in the early 1920s. In 2006, researchers suggested that losses were more or less of equal size (Jankowski 2014, p. 261). See Prost (2014) and Whalen (2014) on "War Losses" in the International Encyclopedia of the First World War or Cox and Ellis (2001) for an overview of losses by country or service.

casualties on the Western Front, casualties on the Eastern Front were higher and more frequent in the early years of the war. According to "The Cambridge History of the First World War Vol. 1" (Afflerbach 2014), the Battle of Tannenberg in August 1914,[11] the conquest of Przemysl from January to March 1915, the Battles at Gorlice-Tarnow in May 1915 and the Russian Brusilov offensive in the summer of 1916 are considered to have been of particular importance on the Eastern Front. The spikes reveal that during these battles many soldiers were captured. The number of Russian soldiers killed and wounded was particularly high during the Russian summer offensive.

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[11]We checked our data against other sources. For instance for Tannenberg the Feldzug-Chronik (1915, p. 19) suggests that there were 90,000 Russian POWs and Schalast (1916, p. 4) suggests 100,000 Russian POWs. However, in Hindenburg-Anekdoten (1915, p. 24) a letter to Hindenburg mentions 40,000 POWs.

Figure 3: War Casualties on Western and Eastern Front

War Prisoners: Western Front

War Prisoners: Eastern Front

Killed and Wounded: Western Front

Killed and Wounded: Eastern Front
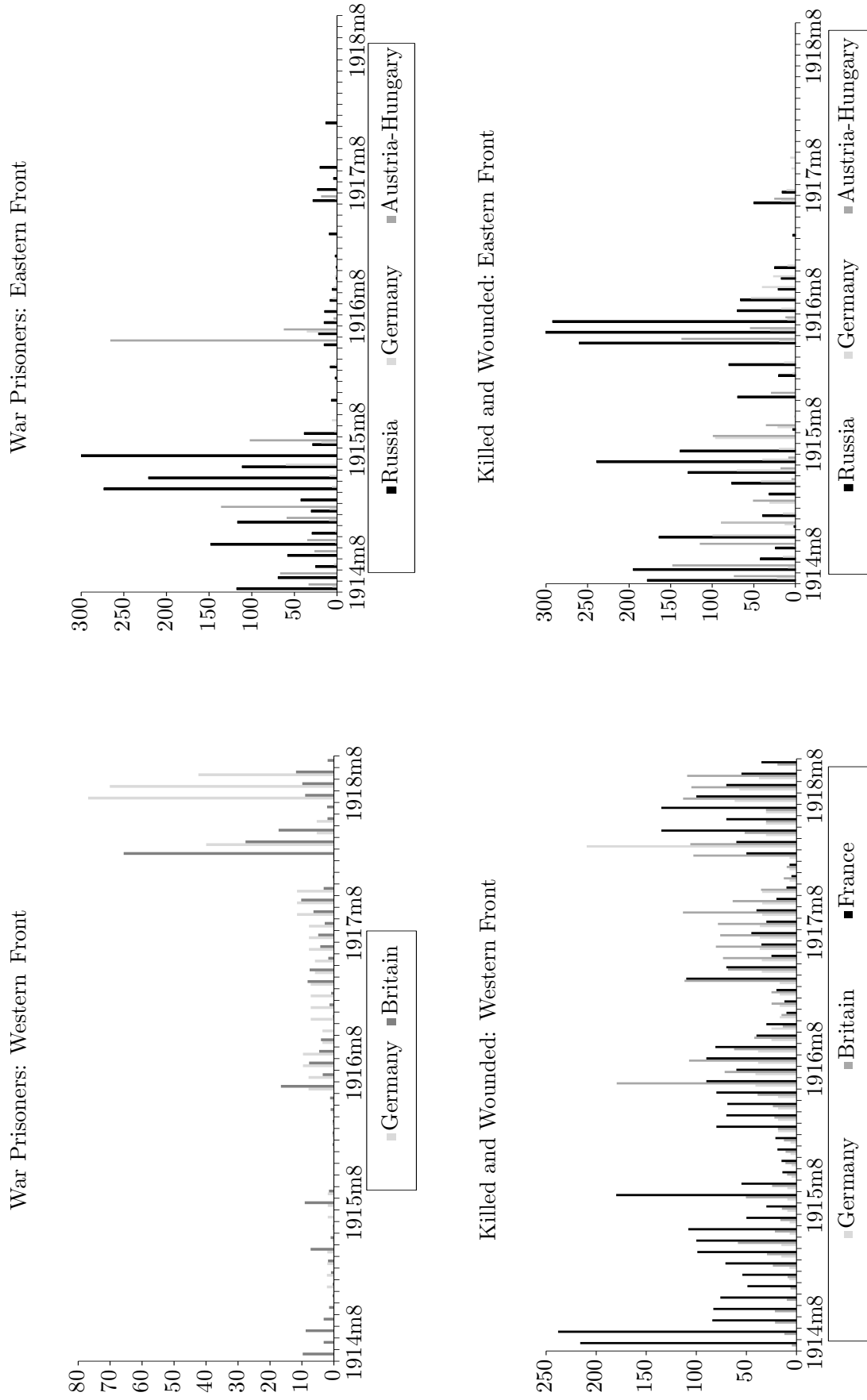
The figures summarize the number of casualties in thousands per month.

4 Empirical analysis

4.1 Detrending exchange rate series

To test if exchange rate fluctuations between belligerent country currencies around the general money-induced devaluation trend were associated with war news, we calculate a common trend of the standardized exchange rates and subtract that trend from each individual standardized exchange rate series.[12] The common trend is calculated, following Hall (2004), based on the following equation:

$$X_t = f_t + \gamma z_t + v_t^i \tag{1}$$

where X_t is a 6×1 vector containing the standardized exchange rates of each country: $X_t = [x_t^{Germany}, x_t^{Britain}, x_t^{France}, x_t^{Italy}, x_t^{Austria}, x_t^{Russia}]$; f_t is the common trend which is assumed to be I(1) and of the form $f_t = f_{t-1} + \varepsilon_t$, where ε_t is white noise; z_t is a (stationary) common factor $z_t = \rho z_{t-1} + \vartheta_t$ with $0 < \rho < 1$ and ϑ_t white noise. The idiosyncratic component is assumed to be serially correlated such that $v_t^i = D v_{t-1} + \eta_t$. The coefficients, the common trend (f_t) and common factor (z_t) are estimated using the time varying Kalman-filter.[13]

The estimated common trend $\hat{f}_t$ is highly correlated with the notes in circulation presented in Figure 2. The correlation coefficients of the notes in circulation in each country and $\hat{f}_t$ are between 0.8 and 0.94. All of them are statistically significant. This finding has two important implications. The first implication is that the *common* downward trend predicts to a great extent the overall realizations of all 6 exchange rates. The second implication is that by subtracting the common trend $\hat{f}_t$ from each of the exchange rates, we are concentrating on those fluctuations

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[12]This exercise implies that the standardized exchange rate series share a common trend, that is, that they are cointegrated. This assumption is supported by standard econometric tests. Using the Engle-Granger cointegration test, we fail to reject the null hypothesis that the variables are not cointegrated. Using the Johansen cointegration test we reject the null hypothesis that there are zero cointegration relationships and fail to reject the null hypothesis that there at most 1 cointegration relationships. Therefore, we accept that there is one cointegration relationship between the standardized exchange rate series.

[13]For a detailed explanation of the estimation procedure and its advantages see Hall (2004, p. 1720 ff.).

around the trend which are not related to the common monetary expansion of war-time. After subtracting the common trend $\hat{f}_t$ from each standardized exchange rate, we obtain a 6×1 vector containing the detrended exchange rate series of each country: $X_t^{CT} = [x_t^{CT\_Germany}, x_t^{CT\_Britain}, x_t^{CT\_France}, x_t^{CT\_Italy}, x_t^{CT\_Austria}, x_t^{CT\_Russia}]$. We present the detrended series in Figure 4.

Figure 4: Detrended Exchange Rates
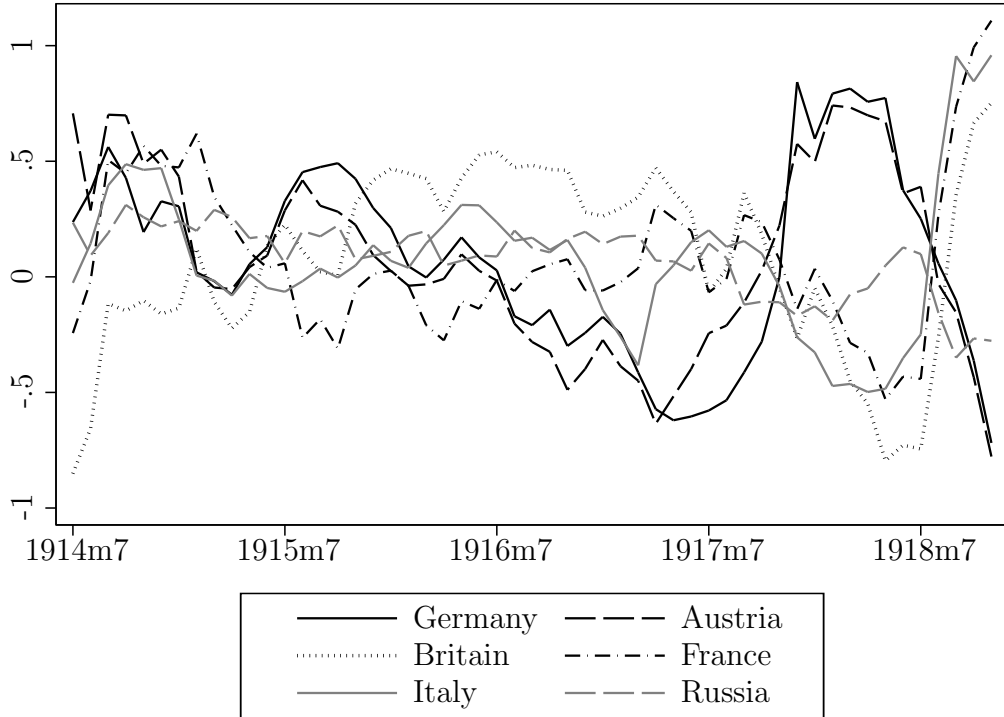
4.2 Did war news matter?

4.2.1 Simple correlations: A first look

To arrive at a first impression of whether exchange rate fluctuations are associated with military news we correlate the detrended exchange rate series with our casualties data (i.e., the prisoners of war and the soldiers killed and wounded series).

Table 1 offers a first intuitive insight. We note that correlations using casualty data for the Western Front are more precise (higher statistical significance). British POW, for instance, are positively correlated with the Entente's currencies and negatively

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correlated with all other exchange rates. The correlations with the Franc and the Lira are the only ones that are not statistically significant. In addition, the correlation of the Russian POW data and the German and Austrian exchange rates is negative and statistically significant. In contrast, the correlation coefficients with regard to the Pound and the Lira are negative, albeit not significant at commonly used levels.

Table 1: Correlation Between Detrended Exchange Rates and Casualties

	Germany	Austria	Britain	France	Italy	Russia
Western Front						
British POW	0.27*	0.25*	-0.27*	-0.13	-0.20	-0.28**
German POW	-0.12	-0.16	0.020	0.27*	0.32**	-0.57***
French KW	0.18	0.18	-0.28**	0.031	0.16	0.21
British KW	-0.31**	-0.28**	0.17	0.088	0.14	-0.43***
German KW	-0.0063	-0.020	-0.11	-0.17	-0.15	-0.33**
Eastern Front						
German POW	0.24	0.11	0.21	0.014	-0.27	-0.37*
Russian POW	0.33*	0.30*	-0.25	0.071	-0.031	0.18
Austrian POW	0.028	-0.15	0.27	-0.045	0.20	-0.052
German KW	0.26	0.088	-0.034	-0.0095	0.033	0.22
Russian KW	0.24	0.13	0.25	-0.094	0.22	-0.33*
Austrian KW	0.39	0.37	0.066	0.45*	0.76***	0.058

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2.2 Common factor and war news

We analyze if war news suggesting that particular side was winning the war appreciated its currency relative to the currency of the losing side. Following Hall, we, therefore, now concentrate on analyzing the dynamic common factor $\hat{z}_t$ of the detrended exchange rates series, which is estimated using equation 1. This factor captures those fluctuations in the exchange rate series that are common to all currencies but not included in the common trend f_t. The intuition is that after removing the trend in the exchange rates that is related to the monetary expansion during war-time, the remaining common component of the series may be associated with news from the battlefield that affected all countries and drove expectations of exchange rates between their currencies. We graph the common factor in Figure 7.

For our casualty data to provide an insight into which side was winning the war at each point in time, we calculate a Net POW series, in line with Hall (2004) and as first suggested by Ferguson (1998), subtracting the German and Austrian POW series from the Entente series. Thus, for the Western Front we calculate $BritishPOW - GermanPOW = NetPOW$. We do the same for the Eastern Front. Here we add the Austrian and German POW series and subtract them from the Russian POW series. Finally, we add the two net series to get the net number of POW for both fronts. As there were many more casualties on the Eastern than on the Western Front we have standardized the series for this purpose. We expect the Net POW series to be negatively correlated with the common factor. When, for example, more Germans than Entente soldiers were captured, the latter were considered to be on the winning side and therefore we expect the currencies of the Entente' countries to appreciate.

We then construct a Net Body Count series for both fronts in a similar fashion.[14] Hence, for the Western Front we subtract the data on Germans killed and wounded in action from the sum of killed and wounded French and British soldiers. For the Eastern Front we subtract the sum of Austrian and German soldiers killed and wounded from the Russians. Finally, we also add the two net series (after standardizing) to have a series that covers both fronts.

Next we correlate the common factor with our net casualties data. Table 2 summarizes our results. Our Net POW data for both fronts is negatively correlated with the factor, implying that when more Germans surrendered, the currencies of the Entente' countries appreciated against the currencies of the Central Powers. The upper panel of Figure 5 illustrates that higher realizations of the common factor are associated with lower numbers of Net POWs.

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[14]Hall (2004) adopted the idea from Ferguson (1998, p. 301, 302).

Table 2: Common Factor and War News

	Factor
Western Front	
Net POW	-0.51***
Net Body Count	0.29**
Eastern Front	
Net POW	-0.23*
Net Body Count	0.019
Both Fronts	
Net POW	-0.52***
Net Body Count	0.16

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Although our Net POW data for the Eastern Front correlates with the factor, the correlations are weaker (less precise coefficients). This finding backs historical accounts that emphasize that contemporary media and propaganda were more concerned with events on the Western Front. In fact, Switzerland has been a multi-lingual country, giving traders access to French, English, German and Italian, but not to Russian news. Therefore, traders may have had less reliable information on events on the Eastern Front and, hence, considered military news from the Western Front more useful in predicting the outcome of the war.

Like Hall (2004), we find a robust correlation between our Net Body Count series and our common factor when focusing on the Western Front. Hall suggested that in a trench war the winning side incurs higher losses on the offensive. In a trench war, soldiers sit and wait to take over the trenches of their opponents, one after another, creeping forward. Soldiers who have taken the offensive are vulnerable targets. Therefore, a higher number of killed and wounded soldiers may have signaled which side was on the offensive. A rise in Net Body Count, therefore, may be interpreted as positive news for the Entente forces, bringing about an appreciation of their currencies.

For the Eastern Front, however, we cannot find this association. By using the data for both fronts we do not arrive at a significant correlation coefficient either. We

Figure 5: Correlation Factor and Casualties: Both Fronts
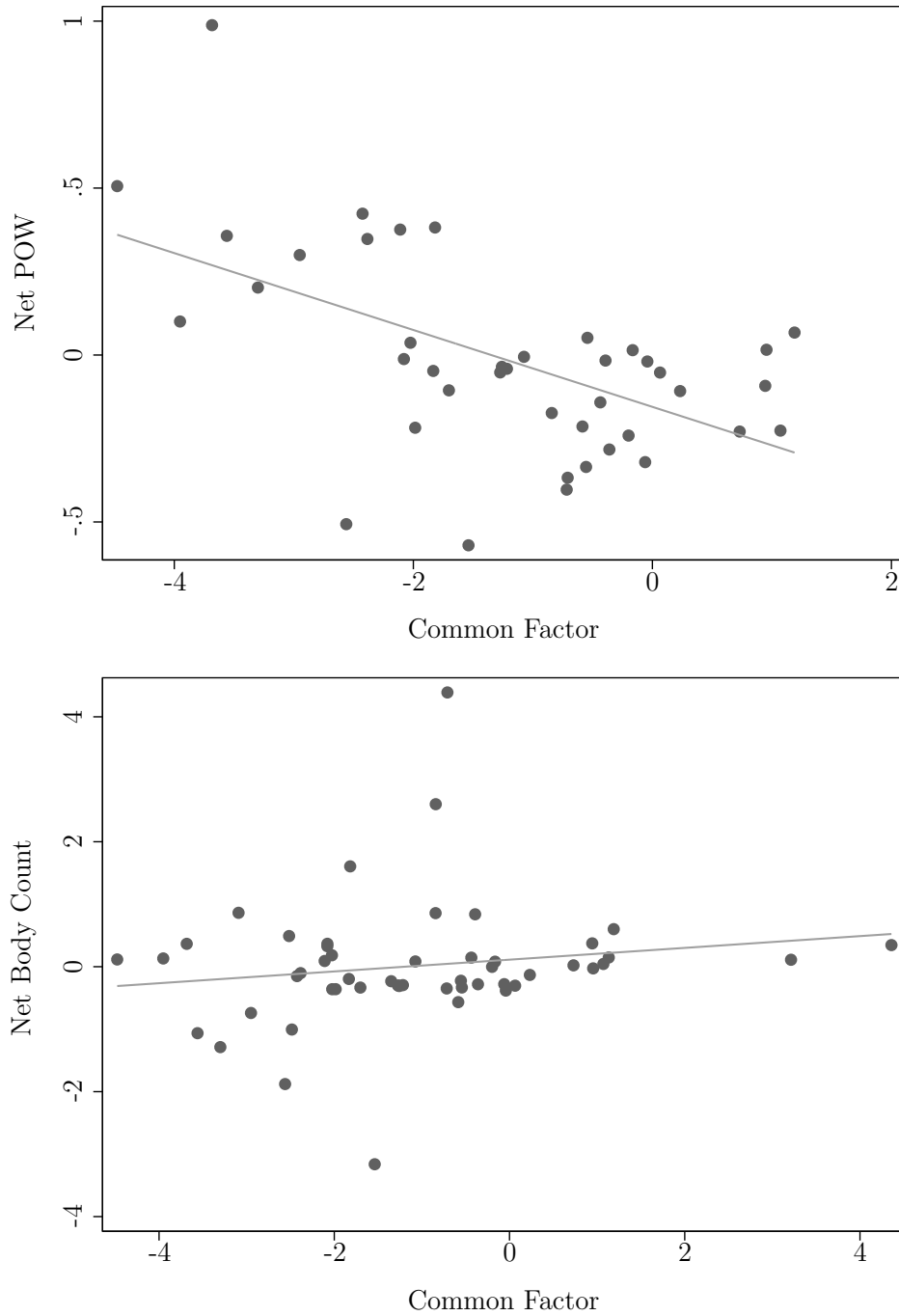
illustrate this weak correlation of Net Body Counts and the exchange rate factor in Figure 5. The lack of correlation for the Eastern Front supports Hall's interpretation for the Western Front. The differences in warfare between the two fronts were substantial.

For the first months of the war the Germans concentrated on the Western Front. They stationed 7/8 of their troops there in August 1914 (Groß 2009, p. 51). The German strategy aimed for a quick strike in the West and relied on a small force as well as the Austrian-Hungarian army to hold the East (Schlieffen-Plan). By the end of 1914 the fighting on the Western Front had become mired in a trench war.

This was not the case on the Eastern Front, where the Germans were initially on the defensive (see, e.g., Bihl 2009, p. 89 or Conze 1981, p. 60). Stone (1998, p. 94) suggests that the Eastern Front remained a war of maneuver because of a lack of reserves and "defensive fire-power," particularly of the Russians. For example, the Germans were on the defensive when they killed and captured large numbers of Russian troops near Tannenberg in September 1914. Similarly, the famous German Gorlice-Tarnow-Offensive in May 1915 ended in a significant defeat for the Russian army with many more Russians killed than Germans.

To support the importance of war news on the two fronts, Table 3 documents the results of a simple linear regression of the common factor on our war news variables. Column 2 shows the decomposition of the goodness of fit (R^2) using the Shapley value as suggested by Huettner and Sunder (2012).[15] The overall R^2 of the model is 0.378. As expected, the Net POW for the Western Front made the largest contribution to the overall R^2 (67.4%). The coefficient is negative and statistically significant. The Net POW for the Eastern Front has a smaller but not-negligible contribution to the overall R^2 (12.57%).

The coefficient of the variable is statistically significant and negative. The

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[15]The main idea of the decomposition is that the marginal contribution of a certain regressor to the overall Goodness of Fit (GOF) measure can be expressed by the difference in the GOF with and without including the regressor in the specification. The value of the marginal contribution, however, depends on the ordering in which the regressors are excluded from the specification. Huettner and Sunder (2012) show that the Shapley value of a certain variable is equal to its average marginal contribution assuming that all possible orderings are equally probable.

Table 3: OLS Regression of Common Factor with R^2 – Decomposition

	Factor	$R^2(\%)$
Net POW Western Front	-0.504**	67.40
	[-2.59]	
Net Body Count Western Front	0.0866*	19.79
	[1.88]	
Net POW Eastern Front	-0.0434***	12.57
	[-2.86]	
Net Body Count Eastern Front	0.00310	0.24
	[0.15]	
Constant	-12783.9***	
	[-5.48]	
Observations	51	
R^2	0.378	

t statistics in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The common factor was multiplied by 10,000 to match the scale of the war news data.

contribution of the Net Body Count data is smaller. For the Western Front, the variable contributes to almost 20% of the overall explained variation of the common factor while the Net Body Count variable for the Eastern Front contributes only 0.24% to R^2. In sum, the POW and Net Body Count variables for the Western Front explain more than 87% of the common factor's variation attributed to the war news. The contribution of the Eastern front is somewhat less than 13%.

It is quite likely that foreign exchange traders gave news on casualties from a front more weight at some times than at others. The number of casualties may have received more attention from foreign exchange traders later in the war when man-power was already reduced. Further, the relative importance of the two fronts had possibly changed. Obviously, following the Treaty of Brest-Litovsk in the summer of 1917 that removed Russia from the war, there were no more casualties on the Eastern Front. To test for such changes over time we run a recursive regression of the common factor on our war news data. Our initial estimation period uses only the data for the first war year. Holding the starting date fixed we increase the window size recursively a month at a time until the end of the war (when all data is included).

Figure 6 depicts how the contributions of war news data to R^2 evolved over time. For descriptive purposes we added the R^2 – contributions of POW and Net Body Count variables for each front. In the upper panel of Figure 6, we document the percentage of the overall R^2 that war news from each front explain up to a specific month. The lower panel of Figure 6 presents the contributions of the war news from each front multiplied by the overall R^2 of the regressions. The goal here is to take into account the goodness of fit of the model in each period.

We see that until August 1915, casualties on the Eastern and Western Front explain equal shares and a total of about 40% of the variation in the exchange rate factor. Then news from the Western Front start to explain a larger share of the overall R^2, mainly because the contribution of the Eastern Front declined (see lower panel). Indeed, fewer soldiers were captured at this time on the Eastern Front. During the summer and fall of 1916 we see a spike in both POW and soldiers killed and wounded on the Eastern Front, particularly after the Brusilov offensive. At the time, foreign exchange traders seemed to give more weight to the news from the Eastern Front. The model's explanatory power rises (see lower panel) and the share of R^2 explained by the Eastern (Western) Front grows (falls) as suggested in the upper panel.

As time passed, however, war news from the Eastern Front contributed less and less to explanations of exchange rates. Yet, they retained their explanatory power. From the end of 1916 the model explains a larger part of the variation of the common factor (lower panel). It is at this time that the number of war prisoners on the Western Front was particularly high. With the addition of data for 1918, however, the overall explanatory power of the model falls again, suggesting that news on casualties grew in importance only until late 1917. It is quite likely that the Treaty of Brest-Litovsk and the final strikes of the Allied forces had a much larger impact on exchange rates than did actual news on casualties.

Figure 6: R^2 – Contribution of War News at the Western vs Eastern Fronts
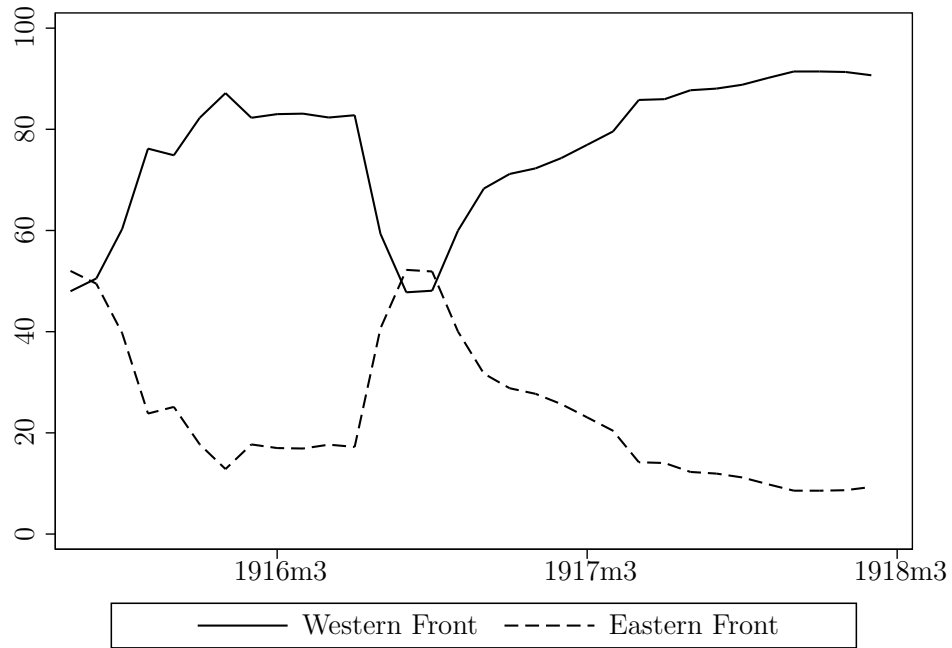
Note: Each line shows the sum of the contributions (in percent) of the POW and NBC variables in each Front in a linear regression using data until each month beginning in July 1915. The two series add to 100 each month.
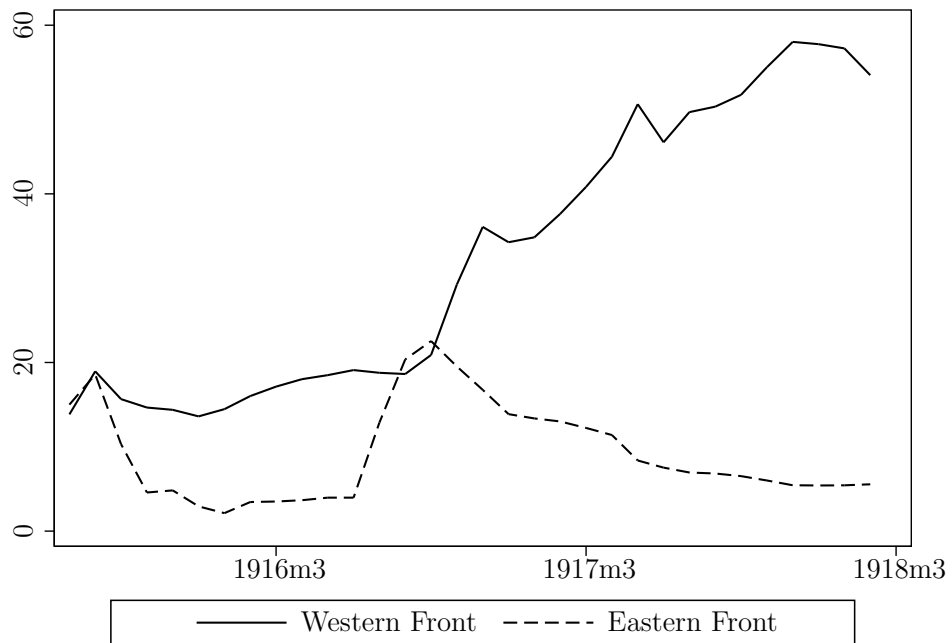
Note: Each line shows the sum of the contributions of the POW and Net Body Count variables multiplied by the overall R^2 of each of the regressions done using data until each month (beginning in July 1915). The two series add to the overall R^2 of each regression in each month.

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4.2.3 Robustness

So far we have used all of the available data to examine the link between war news from the Western and Eastern Front and exchange rates. There are good reasons, however, to believe that the results maybe sensitive to the time span under consideration. First, following the collapse of Russia's Provisional Government in October 1917, the new Soviet government of Vladimir Lenin negotiated to withdraw Russia from the war. That was the beginning of the end of World War I on the Eastern Front. Second, following a Decree of Peace in October 1917, the Treaty of Brest Litovsk was signed on March 3, 1918 between Russia and Germany. To account for these major changes on the Eastern Front, we evaluate the robustness of our results in two subsamples. The first subsample ends in March 1918; the second subsample ends in September 1917, just before the Bolshevik Revolution. The results are summarized in Table 4.

Column 1 of Table 4 shows no fundamental changes in our correlations. Shortening the sample improves the correlation between the factor and the net prisoners of war series. Cutting off the victory of the Allied forces on the Western Front, naturally, dampens the correlation between the factor and the Western Front POW series. The Net Body Count series continues to be relevant only when we consider the Western Front alone in line with the argument that this is a result of trench warfare.

We then test if Hall's results change using our dataset for both fronts. Therefore, we correlate the war news with the common factor computed using for exchange rates of countries fighting on the Western Front as presented by Hall (2004). Column 2 of Table 4 shows that the signs of the coefficients remain stable. In particular, taking into account data for both fronts, the Net Body Count series ceased to be significantly correlated with the exchange rate factor without the Rouble. This is attributable to the casualties on the Eastern Front, where a higher number of killed and wounded did not consistently signal that a side had taken the offensive.

Table 4: Common Factor and War News

	Factor CT	Factor CT (West)
Western Front (October 1918)		
Net POW	-0.51***	-0.54***
Net Body Count	0.29**	0.43***
Eastern Front (October 1918)		
Net POW	-0.23*	-0.12
Net Body Count	0.019	-0.016
Both Fronts (October 1918)		
Net POW	-0.52***	-0.46***
Net Body Count	0.16	0.20
Western Front (March 1918)		
Net POW	-0.22	-0.37**
Net Body Count	0.37**	0.26*
Eastern Front (March 1918)		
Net POW	-0.27*	-0.15
Net Body Count	0.061	0.00073
Both Fronts (March 1918)		
Net POW	-0.35**	-0.32**
Net Body Count	0.16	0.075
Western Front (September 1917)		
Net POW	-0.47***	-0.50***
Net Body Count	0.25*	0.41***
Eastern Front (September 1917)		
Net POW	-0.25*	-0.12
Net Body Count	0.040	-0.00080
Both Fronts (September 1917)		
Net POW	-0.49***	-0.43***
Net Body Count	0.15	0.20

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2.4 The evolution of World War I and the common factor

Our analysis suggests that increases in numbers of German war prisoners coincided with the devaluation of the German Mark against the currencies of the Allied forces captured by a rise in the common factor. Foreign exchange traders seem to have used the number of casualties to predict the outcome of the war, which affected exchange rates. Casualties are, of course, not the only war news that may have had an impact. To paint a more comprehensive picture we show that our common factor moves along with both our casualties data and other important battle results and war news. Therefore, in Figure 7 we present the estimated common factor $\hat{z}_t$ and the Net POW data in a single graph for illustration. We use this figure to interpret the factor's movement with special focus on the Eastern Front, complementing Hall's (2004) analysis for the Western Front. For the sake of comparison we also plot the common factor considering only the Western Front (without the Rouble exchange rate).

We see that the factor that includes the Russian exchange rate moves stronger at the beginning of the war. In fact, the common factor drops until September 1914 where it hits its minimum only to return to its local maximum in spring 1915. From May 1916 onwards the series seems to increase until March 1917, where it reaches its global maximum. Thereafter, the factor drops rapidly until spring 1918, followed by a steep increase of the factor at the end of the time series. We can make sense of the exchange rate developments using military events.[16]

1914 - The first months

In August 1914, the Russian army moved to invade Eastern Prussia and Galicia, beginning the war on the Eastern Front. The offensive failed. The downward movement and negative values of the series at the beginning of the war coincide with considerable German victories in the battles of Tannenberg and at the Masurian

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[16]The description of events derives from the Reichsarchiv documentation. We checked dates and comments on the evolution of the war in Mommsen (2004), Conze (1981), Hirschfeld (2014) and Stone (1998).

Lakes where the German army was able to defeat the Russian army and fend off its invasion of Eastern Prussia. Further, early successes of the Schlieffen Plan on the Western Front, when Germany swept towards Paris, until the Battle of the Marne in mid-September of 1914 may explain the behavior of the factor. The vast majority of war prisoners was taken on the Eastern Front at this time.

Despite the German advances in the northern part of the Eastern Front, Russia renewed its offensive efforts, focusing on the south. In the battles of Lemberg (August 23 until September 12, 1914) the Austro-Hungarian army came under severe pressure. Following the fall of Lemberg (September 2) and the last battle of Rava Ruska, the Austro-Hungarian army had to retreat more than 160 kilometers within two weeks back to the line of the Carpathian Mountains, suffering tremendous casualties. More than 100,000 soldiers were captured. Galicia was evacuated and the fortress of Przemysl was besieged by the Russian forces. In a chaotic retreat, the Austrian Summer Siege ended with high staggering losses for the Central Powers, coinciding with an upward movement of the factor (including Rouble).[17]

To relieve pressure from the Austro-Hungarian armies in the south, German Field Marshal Hindenburg launched an offensive on Warsaw in September. However, the German army was forced to retreat in the Battle of the Vistula River one month later. This battle was the prelude for the Battle of Lodz in November 1914. The Battle of Lodz was both a tactical success for the Russian army and a strategic victory for Germany. On the one hand, a Russian offensive had been stopped and with it, a Russian break-through into Silesia. On the other hand, evacuating Lodz and falling back into a general retirement, Russia itself was able to avoid a break-through of the Central Powers towards Warsaw (see, e.g., Eggenberger 1985, pp. 245-246).

By the end of 1914, Russia had made considerable advances in the south and was deep in Galicia and the Bukovina, besieging the fortress of Przemysl. Consequently, the Austro-Carpathian Front was endangered.

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[17]Here we followed the documentation from the German Reichsarchiv. Hirschfeld et al. (2014, p. 68) provide even higher numbers and imply that the Austro-Hungarian k.u.k. army was heavily reduced and, lacking trained soldiers, had to employ more and more civilians.

1915

From December until March, the Central Powers tried to regain Galicia. The offensive known as the Carpathian Winter War began on January 23, 1915. Due to extreme winter conditions the offensive was cancelled, hundreds of thousands soldiers perished, and the fortress of Przemysl with 120,000 Austro-Hungarian soldiers surrendered on March 22, 1915.[18] Again, the common factor moves along with the Russian advances and successes. The series increases from October 1914 until March 1915, with the fall of Przemysl.

In May 1915, the break-through at Gorlice-Tarnow was a turning point on the Eastern Front and led to a decisive German victory over the Russian army (Afflerbach 2014, p. 254). It seems to overshadow Italy's entry into the war on the Allied side.[19] Indeed not much had changed in the West so that as a consequence of advances the common factor dropped significantly (exchange rate moved in Central Power's favor) in May to fall again after a short stabilization in June 1915. The drop in July and August coincided with Germany's Narew Offensive, when the German army broke through the frontline and occupied Warsaw in August. Afterwards, the Germans took the Fortress of Kovno, a key point for the Russian army in the north, Brest-Litovsk, Bialystok, Grodno, Vilna, and Nowo-Georgiewsk in August. General von Falkenhayn reported that Russia had lost Galicia, Congress Poland, the Duchy of Courland along with incalculable amounts of material. Hundreds of thousands of soldiers were taken prisoner within three months. Russia could be of no help to Italy and was locked in the Balkans (von Falkenhayn, 1920, p. 108).

Following the Austro-Hungarian autumn offensive that started in Eastern Galicia and Volhynia, the Austrian army lost thousands of soldiers and the Germans were forced to transfer forces from the Eastern and Western Front to support the

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[18]See Stone (1998, pp. 112-116).

[19]Given the relatively poor condition of the Italian army, Italy was then unable to beat Austria as planned. Instead, a frontier of trench warfare in the Alps emerged (Hirschfeld et al. (2014, pp. 71-72). Ferguson (1998, p. 99) suggests that the Germans did not have a great interest to have Italy on its side.

Austrians. Bulgaria entered the war on the side of the Central Powers in October 1915 and defeated the Serbian army in a seven-week campaign (Reichsarchiv Vol. IX, p. 245, 290).

1916/1917

In the intensive New Year's Battle at the Dnjestr and Styrpa in December 1915 and January 1916, Russia tried to break through the Austrian frontier but had to cancel its offensive. Several more Russian offensives followed. Our factor increased until summer 1917 and was briefly interrupted in April 1916. In February, Germany started its offensive against the fortress of Verdun with initial rapid gains as the French, as in the capture of Fort Douaumont, were unprepared (Jankowski 2013, p. 69) but both both sides sustained heavy losses. Relieving pressure on the Western Front, the Tsar Nicholas II started an offensive at Lake Narotch in March 1916 that made substantial gains (Stone 1998, p. 189).[20]

The common factor series picks up the German advances on the Western Front with a dropdown in April and May. After that the series remains positive for more than one year. This is an interesting point. Even though the Entente campaigns often failed on the Eastern Front (the Brusilov-Offensive in summer 2016 was a military success for Russia)[21] and on the Western Front (British Somme and French Nivelle campaign)[22], the common factor series kept on moving up until it peaked in March 1917. It seems that traders no longer believed the Central Powers could win the war. Two facts may explain this. On the one hand, the Entente coordinated a general offensive on all European fronts beginning in the early summer 1916. Although not very successful, a joint offensive of such magnitude scope could have been viewed positively by contemporaries, raising expectations of a decisive move to end the war. On the other hand, rumors of an US entry to the war prior to its actual announcement in April 1917 affected exchange rates in favor of the Allied forces. The February

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[20]The Reichsarchiv's (Vol X, p. 437) elaboration emphasizes that Russia's attack finally failed (indeed the Germans regained the territory in fall).

[21]See Stone (1998, pp. 251f).

[22]See Hirschfeld et al. (2014, p. 714.).

Revolution, in contrast, did not seem to negatively influence the factor.

After the Nivelle Offensive on the Western Front was cancelled at the end of May 1917, the common factor drops sharply *inter alia* with the outbreak of a mutiny in the French army. Further, Russia's Kerensky Offensive aimed at stabilizing Russia failed in July 1917, producing massive losses of Russian soldiers.[23] The failure of this offensive was accompanied by an increasing rejection of the government and Kerensky, contributing to a shift towards the Bolshevists. Lenin was able to use this situation to advantage, and seize power a few months later. In this sense, the Kerensky Offensive led directly to the October Revolution and to the peace negotiations in Brest-Litovsk.

Final months

With the Russian October Revolution and the Austrians defeating the Italian army in the 12th Battle of Isonzo and the battle of Codroipo-Latisana the common factor drops sharply. The armistice of Brest-Litovsk in March 1918 brought the official end of World War I on the Eastern Front. The outcome of the war depended henceforth only on results on the Western Front. In summer and fall 1918, the Germans were defeated. The last days of the war coincided with a depreciation of the Mark and Krona against the currencies of the other belligerent countries, captured by a rise of the common factor.

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[23]See, e.g., Hirschfeld et al. (2014, p. 612) for a description of the Kerensky Offensive.

Figure 7: Factors and Net Prisoners of War (POW)

Factors on right scale. Net POWS on lefthand scale. Net POWS in 10,000 soldiers, For Eastern Front in 10,000 soldiers, For Western Front in 1,000 soldiers.

5 Summary

Because it was more likely that the losing party would struggle to generate the necessary primary surpluses to service war debts and make use of the printing press instead, foreign exchange market traders had an incentive to use news from the battlefield to predict the outcome of the war and therewith the future course of exchange rates. Previous researchers have neglected news from the Eastern Front in studying exchange rates because, a century after, we know that World War I was decided on the Western Front. The foreign exchange traders of the time, however, did not have this information. Therefore, this paper has analyzed whether or not war news, specifically the number of soldiers killed, wounded, or captured, from both the Western and Eastern Fronts were linked to exchange rate fluctuations during World War I.

To examine this link between exchange rates and war news we have introduced a novel dataset that contains information on prisoners of war in addition to soldiers killed and wounded each month on the Eastern Front. We have collected the data from documentations of the German Reichsarchiv and Austrian War Office. Merging our dataset with that for the Western Front employed in Hall (2004), we have been able to construct a rich dataset on war casualties for France, Britain, and Russia as well as Germany and Austria-Hungary on both fronts.

Using our dataset we have shown that exchange rate fluctuations among the currencies of countries fighting in World War I were associated with the number of casualties on both the Western and the Eastern Fronts. Therefore, battle results on the Eastern Front, too, seem to have mattered to foreign exchange traders. In particular, higher numbers of German and Austrian war prisoners went along with a depreciation of the currencies of the Central Powers against those of the Allied forces, and vice versa. The paper, therefore, adds empirical support to the Ferguson's (1998) argument that the number of troops surrendering to the opponent signaled which side was closer to losing the war.

However, exchange rates were more closely related to the numbers of war prisoners

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on the Western than on the Eastern Front. On the one hand, this is in line with historical accounts that suggest that contemporary media and propaganda was more concerned with events on the Western Front during the war. Therefore, traders may have had less reliable information about events on the Eastern Front and concentrated more heavily on news from the Western Front in their forecasts regarding the outcome of the war. On the other hand, it may suggest that foreign exchange traders did believe that the key to winning the war was in the West.

Finally, our paper strengthens Hall's (2004) interpretation of the finding that higher numbers of killed and wounded soldiers of the Entente countries on the Western Front led to the appreciation of their countries' currencies against those of the Central Powers as in the trench war the winning side naturally incurred higher losses by being on the offensive, and vice versa. Indeed, using our data on killed and wounded on the Eastern Front, where we saw a very diverse war of maneuver, we have not been able to find the same association with exchange rates.

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