The Effects of War Risk on U.S. Financial Markets

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Abstract

This paper measures the effects of the risks associated with the war in Iraq on various U.S. financial variables using a heteroskedasticity-based estimation technique. The results indicate that increases in war risk caused declines in Treasury yields and equity prices, a widening of lower-grade corporate spreads, a fall in the dollar, and a rise in oil prices. This “war risk” factor accounted for a considerable portion of the variances of these financial variables over the three months leading up to the arrival of coalition forces in central Baghdad.

JEL Classification: G14, G10  
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Introduction

Financial markets commentary over the first several months of 2003 repeatedly pointed to the potential for war with Iraq and its eventual realization as primary explanations of daily movements in U.S. asset prices. However, almost all of the “evidence” presented was based on the anecdotal accounts of market participants, and few market observers offered precise estimates of these effects. The lack of formal evidence in large part reflects that the risks associated with the war are unobservable, which makes it difficult to estimate their effects.

This paper attempts to empirically measure the effects of war-related news on U.S. financial markets. For simplicity, we collapse the war-related news into a single “war risk” factor that captures the most important aspects of that news, such as the likelihood of war and its expected duration and success. To measure the effects of this factor, we rely on a heteroskedasticity-based estimator similar to that explored in Rigobon and Sack (2002, 2003). The advantage of this estimator is that it allows one to identify the impact of war risk without having to quantify that risk.

In fact, implementing this estimator only requires that we are able to determine a set of days on which the variance of war-related news was elevated. These days can be easily identified based on developments that significantly affected the outlook for the war—for example, days on which President Bush addressed the nation regarding the war, or the day that Secretary Powell presented evidence on Iraq to the U.N. Security Council, or days on which significant progress by coalition forces was reported. The effects of the war risk factor can be estimated from the shift in the second moments of the financial variables on the days of war news, as those variables should be more volatile due to their responses to the war news.

Note that the first moments of the financial variables on these days are less informative. In fact, the average change in most of the variables is not significantly different from zero. One reason is that the war-related news on the days that we identified can have either sign. This again points to the primary advantage of our estimator—that we do not have to quantify, or even sign, the incoming news about the war. This feature is appealing in the current application, because it is much easier to determine when war-related news took place than it is to quantify that news.

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1 Our paper does not discuss the benefits or costs of the war, but instead focuses only on measuring its impact on financial markets. Papers that address the costs of the war include Nordhaus (2002), Davis, Murphy, and Topel (2003), and reports from the Congressional Budget Office (2002) and the House Budget Committee (2002).

2 For example, there was a discussion about catastrophic outcomes such as the chance that Saddam would have fired biological weapons on Israel, or the Saudi government could have been overthrown. All these events belong to the war risk factor that are not exclusively related to the probability of a war with the US.

3 The procedure of identification through heteroskedasticity was first introduced by Philip Wright (1928) and has been recently rediscovered by Sentana and Fiorentini (2001) and Rigobon (2003a). The first application of these estimators to U.S. financial markets can be found in Rigobon and Sack (2003), although the method used in this paper more closely follows the estimator developed in Rigobon and Sack (2004). Ellingsen and Soderstrom (2001), Bohl, Siklos, and Werner (2003), and Evans and Lyons (2003) employ similar estimators.

4 We come back to this point later in the paper when we estimate OLS regressions and show that most estimates are not statistically significant or they have the wrong sign.
The results indicate that war-related news had significant effects on a number of financial variables over this period. In particular, increases in war risk caused considerable declines in Treasury yields and equity prices, a widening of corporate yield spreads, a fall in the dollar, and a rise in oil futures prices. However, we do not find a significant response of liquidity premiums for on-the-run Treasury securities or of gold prices. Taken together, the evidence indicates that greater war risk has been associated with a shift by investors away from many risky assets, but not with a widespread flight into all safe assets or into the most liquid assets.

Finally, we find that the war risk factor explains a considerable portion of the variances of many of these financial variables over the three-month period leading up to the arrival of coalition forces in central Baghdad. According to the results, this was a period of remarkable intensity of war-related news, and that any attempt to explain asset price behavior over this period must take this factor into consideration.

2 Econometric Challenges
This paper focuses on the influence of war risk on a number of U.S. financial variables (described below). Two primary difficulties arise in attempting to measure the effects of war risk on financial markets. First, this risk is an unobservable variable, in that the war-related news on any given day cannot be precisely quantified. Second, other factors are continuously influencing asset prices in addition to war risk.

To add some structure to the problem, we assume that daily changes in the financial variables considered can be characterized by a system of linear equations. For simplicity, we derive the estimator using two variables at a time. Changes in those two financial variables, denoted as \( \Delta x_t = [\Delta x_{1t}, \Delta x_{2t}] \), are assumed to be determined as follows:

\[
A \cdot \begin{bmatrix} \Delta x_{1t} \\ \Delta x_{2t} \end{bmatrix} = B \cdot \begin{bmatrix} z_{1t} \\ z_{2t} \\ z_{3t} \\ \vdots \end{bmatrix},
\]

where the vector \( z_t = [z_{1t}, z_{2t}, z_{3t}, \ldots] \) contains all of the factors that influence the financial variables, such as changes in monetary and fiscal policy, macroeconomic developments, and news regarding the possibility of war. Some of these factors might be (partially) observable, while others are not. The focus of this paper is on measuring the impact of the risk of war, which we denote \( z_{1t} \).

An immediate issue is the interpretation of the war risk factor. War-related news over this sample presumably had many dimensions, including the likelihood of war, its potential success and duration, and whether it will be carried out unilaterally or by a broader coalition. Under our approach, this information is combined into a single factor, so that the results capture the impact of the most important aspects of the war-related news. As discussed in more detail below, it appears that the war risk factor that we

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5 We assume that the factors have zero mean, given that they influence changes in the financial variables. The specification can accommodate idiosyncratic shocks to individual variables as part of the vector \( z_t \).
identify is most closely associated with risks about the likelihood and duration of the war. Of course, these risks are not easily quantified, which poses one of the primary challenges for measuring their effects.

Equation (1) allows for contemporaneous spillovers between the financial variables (the matrix $A$). We instead concentrate on the reduced form of this system of equations:

$$
\begin{bmatrix}
\Delta x_{1t} \\
\Delta x_{2t}
\end{bmatrix}
= D \cdot 
\begin{bmatrix}
z_{1t} \\
z_{2t} \\
... 
\end{bmatrix},
$$

where $D = A^{-1} \cdot B$. The matrix $D$ in equation (2) captures the overall impact of the factors on the financial variables (after accounting for their influences on one another). We denote the elements of this matrix as follows:

$$
D = \begin{bmatrix}
1 & d_{12} & d_{13} & ... \\
d_{21} & d_{22} & d_{23} & ...
\end{bmatrix},
$$

where $d_{ij}$ represents the impact of the $j$th factor on the $i$th financial variable. The first column of the matrix $D$ captures the impact of the war risk factor on the two financial variables. Because $z_{it}$ is unobservable, the model is only identified up to a normalization, and hence we set the impact on the first variable to unity.\(^6\) The impact of the war-risk factor on the second variable is captured by the coefficient $d_{21}$, which is the parameter that this paper attempts to estimate (for a number of different financial variables).

If the underlying factors $z_i$ were observable, then equation (2) could simply be estimated using an ordinary-least-squares regression. This approach is taken by Leigh, Wolfers, and Zitzewitz (2003), who quantify war risk by looking at the values of Saddam securities—financial contracts that make a payment if Saddam Hussein is removed from power by a particular date.\(^7\) Those authors argue that the value of these securities serves as an effective proxy for the likelihood of war. But while their results (discussed below) are interesting, their approach has several shortcomings. First, as they note, the Saddam securities have much lower liquidity than the financial instruments that are often used to extract information in other applications.\(^8\) Second, those securities measure only particular dimensions of war risk, and as has been shown by Amihud and Wohl (2004), the nature of this variable shifts in the middle of their sample. Therefore, it might not effectively summarize all of the war-related news influencing financial markets. For this reason, we feel that there are advantages to employing an estimator that does not require one to take such a strong stand on the definition of war risk. In the econometric approach

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6. Without this normalization, the scale of the war risk factor would not be determined.
7. These securities trade on a website run by Tradesports.
8. Indeed, the monthly volume in Saddam securities reported in that paper was about $27,000. By comparison, average monthly trading volume over the first half of 2003 was $419 billion for S&P futures, and $3.8 and $16.7 trillion of notional value for federal funds and eurodollar futures, respectively.
that follows, we will view war risk as a completely unobservable variable, in which case the simple regression approach is not feasible.

While it may be difficult to quantify war risk, it is instead quite easy to identify days on which there was significant news about the war. By reading newspapers and various financial market commentary, we collected a list of 21 dates on which war-related events appeared to be the primary determinant of asset price movements, which is shown in Table 1. We will refer to these days of intense war-related news as “war days.” This set of days will be the key component of the identification approach used below.

As a first pass, one might be tempted to simply look at the net changes in the financial variables on these war days. Table 2 reports the average changes in the financial variables on the war days relative to all other days from January 6, 2003 to April 7, 2003 (the period spanned by the war days). We can test whether the shift in the first moments on war days is statistically significant by regressing the changes in the financial variables on a dummy variable indicating those days. As reported in the table, for nearly all of the financial variables considered, the average change does not differ significantly on the war days from the other days in the sample.

One reason for this finding is that the days listed in Table 1 include some associated with increases in the risk of war and others associated with decreases, so that the net direction of the cumulative war news on these days is not clear. Moreover, on some days it is even difficult to determine the sign of the news, and so any attempt to separate out the news by its direction would be subjective. For example, how should one sign the war risk impact when Secretary Powell made his presentation before the U.N. on February 5, 2003? Lastly, one must consider that other factors are continually influencing the financial variables, even on the war days. As a result of these considerations, we argue that a simple methodology based on first moments is not able to identify any war-related effects on financial markets.

The approach employed in this paper is instead based on the information provided by the second moments of the variables, which we view as being more informative about the effects of war risk than the means. Indeed, what clearly stands out from Table 2 is that the variances of the financial variables increased sharply on the war days—by a significant amount for most of the financial variables, and by several multiplies for many of them. This behavior is likely driven by the greater intensity of war-related news on those days, suggesting that such news had a significant impact on these financial variables.

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To be sure, there are other important events regarding the possibility of war, such as the day that President Bush first called on the world to confront Iraq in front of the U.N. General Assembly (9/12/02), the day that resolution 1441 passed the U.N. Security Council (11/8/02), and the day following the first attacks against Iraq (3/20/03). However, those events were largely anticipated and therefore did not represent news about the war on those days.

One might think that war risks mounted, on balance, over the sample considered. Nevertheless, it is still possible that the net news on the 21 days considered is close to zero. For example, it could be that the war risk accumulated through a series of small movements on days not identified in Table 1.

An exception is oil prices. Oil prices were volatile on our war days, but they were volatile on other days as well. This in part reflects that oil prices were heavily influenced by a strike in Venezuela, which added to the volatility on days other than our war days.
Table 2 highlights the claim above that it is easier to determine when news took place than it is to quantify, or even sign, that news. Fortunately, being able to determine these days with higher variance of the war-related news is sufficient to determine the effects of the level of the war risk factor on financial variables. In the next section, we develop the methodology.

3 A Heteroskedasticity-Based Estimation Method

In this section we develop an estimator that is robust to the two primary difficulties mentioned above—that war risk is an unobservable variable, and that other factors are continuously influencing asset prices as well. The approach only requires us to determine a set of days on which the variance of war risk was elevated, which we take those to be the “war days” listed in Table 1. Of course, it is likely that news about the war trickles out on other days as well, but the intensity of war-related news is presumably much higher on the war days. To implement this estimation method, we also need to identify a set of “non-war days”—ones with low variance of the war risk factor. For that set, we choose days that are as close as possible to, but not included in, those listed in Table 1. We denote the set of war days as $H$ (for high variance) and the set of non-war days as $L$ (for low variance).

Determining these sets of days is sufficient to identify the effects of the level of the war risk factor on all financial variables. The identification comes from the assumption that it is only the variance of the war risk factor that changes on the war days. Other factors are still assumed to be present, but with the same intensity as on non-war days. In addition, we impose the assumption that the war risk factor is unaffected by other factors. This assumption implies that, for example, U.S. macroeconomic news or innovations to oil prices for non-war-related reasons do not affect war risk, which seems plausible.

The identification assumption can be formally written as follows. Let $\delta_{H,t}$ denote a dummy variable equal to 1 on the war days, and $\delta_{L,t}$ a dummy variable equal to 1 on the non-war days. Define the variance-covariance matrices for the common factors on war and non-war days, $\Sigma_H$ and $\Sigma_L$, as follows:

$$\Sigma_H = E[z_t \cdot z_t', | \delta_{H,t} = 1]$$

$$\Sigma_L = E[z_t \cdot z_t', | \delta_{L,t} = 1].$$

(4)  (5)

Our identification assumption is that the difference between these variance-covariance matrices, $\Delta \Sigma$, is driven only by the change in the intensity of war-related news:

$$\Delta \Sigma = \Sigma_H - \Sigma_L = \lambda e_1 \cdot e_1,'$$

where $e_1$ is the first column of the identity matrix with dimension equal to the number of factors in $z_t$, and $\lambda$ is the change in the variance of the war risk factor from non-war days to war days.

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12 More specifically, we chose the day before each war day, unless that day is also a war day. If so, we chose the day after the war day. Choosing low-variances days that are close to the high-variance days helps to minimize any changes in variance arising from the other factors.

13 For example, fiscal policy seemed somewhat tied to war-related developments. However, the causality likely goes from the war-risk to the fiscal accounts and not the other way around.
We can compute the variance-covariance matrix of the two financial variables for the set of war news days, denoted \( \Omega_H \), and likewise for a set of non-war days, denoted \( \Omega_L \), as follows:

\[
\Omega_H = E[\Delta x_i \cdot \Delta x_i | \delta_{H,t} = 1] = D \cdot \Sigma_H \cdot D'
\]

\[
\Omega_L = E[\Delta x_i \cdot \Delta x_i | \delta_{L,t} = 1] = D \cdot \Sigma_L \cdot D'.
\]

Under our maintained assumptions, the change in the variance-covariance matrix between these sets of days, \( \Delta \Omega = \Omega_H - \Omega_L \), must be driven entirely by the change in the variance of the war risk factor:

\[
\Delta \Omega = \lambda_1 \cdot \begin{bmatrix} 1 & d_{21} \\ d_{21} & d_{21}^2 \end{bmatrix}.
\]

As equation (10) makes clear, the shift in the variance-covariance matrix of the financial variables on the days of intense war news is shaped by two parameters—the amount of heteroskedasticity in the war risk factor (\( \lambda \)) and the relative responsiveness of the financial variables to that factor (\( d_{21} \)). Thus, we can use the observed shift in this variance-covariance matrix to derive estimates of those parameters. We are primarily interested in measuring the sensitivity of the financial variables to war risk, or the parameter \( d_{21} \). The estimation can proceed either by instrumental variables or by generalized method of moments, as described in the next two subsections.

### 3.1 Implementation through Instrumental Variables

To derive estimators from equation (10), we must first replace the shift in the variance-covariance matrix, \( \Delta \Omega \), with its sample estimate, denoted \( \hat{\Delta} \hat{\Omega} \):

\[
\hat{\Delta} \hat{\Omega} = \left( \frac{1}{T_H} \right) \sum_{t=1}^{T} \delta_{H,t} \Delta x_i \cdot \Delta x_i ' - \left( \frac{1}{T_L} \right) \sum_{t=1}^{T} \delta_{L,t} \Delta x_i \cdot \Delta x_i ' ,
\]

where \( T_H \) and \( T_L \) are the number of war and non-war days, respectively, in the sample. Given our procedure for selecting those days, \( T_H \) and \( T_L \) are equal, although this is not necessary for the estimation. As is obvious from equation (10), the parameter \( d_{21} \) can then be estimated by either of the following equations:

\[
d_{21} = \Delta \hat{\Omega}_{22} / \Delta \hat{\Omega}_{21},
\]

\[
d_{21} = \Delta \hat{\Omega}_{21} / \Delta \hat{\Omega}_{11},
\]

where \( \Delta \hat{\Omega}_{ij} \) denotes the \((i, j)\) element of the matrix \( \Delta \hat{\Omega} \). The results from these two estimators would be equal if the assumptions imposed held perfectly—namely, that the factors other than war risk are homoskedastic over our two sets of days and that the structure of the model is linear. A third estimator, equal to \( \sqrt{\Delta \hat{\Omega}_{22} / \Delta \hat{\Omega}_{11}} \), is also
available, but we do not focus on this one since it is just the geometric average of (12) and (13).\textsuperscript{14}

As shown in Rigobon and Sack (2004), these two estimators can be computed using an instrumental variables (IV) estimation approach. Define an instrument \( \omega_1 \) to be a vector containing the change in the first financial variable, \( \Delta x_1 \), on all war news days, and the negative of its change, \(- \Delta x_1\), on the set of non-war days. Consider regressing the change in the second financial variable, \( \Delta x_2 \), on the change in the first financial variable, \( \Delta x_1 \), over both sets of days using this instrument. The standard IV estimator is

\[
\hat{d} = (\omega_1' \cdot \Delta x_1)^{-1} \cdot (\omega_1' \cdot \Delta x_2),
\]

which equals

\[
\hat{d} = \frac{\sum_{t=1}^T \delta_{H,t} \Delta x_{1t} \Delta x_{2t} - \sum_{t=1}^T \delta_{L,t} \Delta x_{1t} \Delta x_{1t}}{\sum_{t=1}^T \delta_{H,t} \Delta x_{1t} \Delta x_{1t} - \sum_{t=1}^T \delta_{L,t} \Delta x_{1t} \Delta x_{1t}},
\]

which is identical to the estimator (13).\textsuperscript{15}

Likewise, consider an alternative instrument \( \omega_2 \) to be a vector defined in the same way as \( \omega_1 \), only using the second financial variable. With this instrument, the IV estimator becomes

\[
\hat{d} = \frac{\sum_{t=1}^T \delta_{H,t} \Delta x_{2t} \Delta x_{2t} - \sum_{t=1}^T \delta_{L,t} \Delta x_{2t} \Delta x_{2t}}{\sum_{t=1}^T \delta_{H,t} \Delta x_{2t} \Delta x_{2t} - \sum_{t=1}^T \delta_{L,t} \Delta x_{2t} \Delta x_{2t}},
\]

which is identical to the estimator (12). It can be shown that both \( \omega_1 \) and \( \omega_2 \) are valid instruments for this regression under the assumptions that have been imposed.\textsuperscript{16}

The IV approach for computing the heteroskedasticity-based estimator has the advantage that it is simple to implement. Moreover, all of the properties of the IV estimator apply, including the asymptotic distribution of the parameter estimate. Note, however, that each of these estimators is taking advantage of only part of the information from the second moment restrictions in (10). We next turn to an alternative estimation approach that takes advantage of all of the restrictions.

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\textsuperscript{14} This third equation will be considered by the generalized method-of-moments approach described below.

\textsuperscript{15} To allow an unequal number of war and non-war days, one would simply have to scale the instrument by the inverse of the number of days in each subsample.

\textsuperscript{16} One could therefore also estimate the regression by combining the two instruments, which might be advantageous if one of the sets of instruments is relatively weak. The strength of the instruments depends on their correlations with the independent variable \( \Delta x_1 \). In one case, this correlation equals the change in the variance of \( \Delta x_1 \); in the other, it equals the change in the covariance between \( \Delta x_1 \) and \( \Delta x_2 \).
3.2 Implementation through GMM

Equation (10) contains three restrictions on the shift in the second moments of the financial variables, which can be used to estimate the two parameters, \( \lambda \) and \( d_{21} \). Under the IV approach above, only two of the moment restrictions were used at a time, so that the parameter \( d_{21} \) was just identified in each case. Accordingly, that approach allowed three separate estimates the parameter. An alternative approach is to employ an estimator that considers all three moment restrictions at once.\(^{17}\)

To do so, we employ a generalized method-of-moments (GMM) estimation procedure, in which the parameters \( d_{21} \) and \( \lambda \) are chosen to minimize the following loss function:

\[
L = \left[ \text{vech} \left( \Delta \hat{\Omega} - \lambda d \cdot d' \right) \right] \left[ \text{vech} \left( \Delta \hat{\Omega} - \lambda d \cdot d' \right) \right],
\]

where \( d = [1 \ d_{21}]' \). In implementing the GMM estimation, we use the optimal weighting matrix \( W \), equal to the inverse of the estimated variance-covariance matrix of the moment conditions (which is calculated by first performing the GMM estimation with an identity weighting matrix).

Because the number of moment conditions is greater than the number of parameters to be estimated, this approach also allows us to perform the standard test of overidentifying restrictions. Indeed, it was noted above that the various IV estimates should be identical under the maintained assumptions that the heteroskedasticity is concentrated in the war risk factor and that the linear structure of the model holds. The test of overidentifying restrictions provides us with a statistical test of these assumptions.

4 Results

We apply the above estimators to various U.S. financial variables that are potentially influenced by war risk. Those variables include two- and ten-year Treasury yields, the spread between the ten-year nominal and inflation-indexed Treasury yields (or the break-even inflation rate), the liquidity premium on the ten-year Treasury note, the S&P 500 index, the BBB corporate yield spread, the high-yield yield spread, oil prices, gold prices, and the dollar.\(^{18}\) We collected daily data for these series from January 6, 2003 to April 7, 2003, the period spanned by our war days.

\(^{17}\) Note that there are three moment conditions when two variables are used at once. Alternatively, we could employ a GMM estimator that considers \( N \) variables at once, in which case there would be additional overidentifying restrictions. However, this approach would require computing the shift in a variance-covariance matrix for all \( N \) financial variables, which would have \( N(N+1)/2 \) elements. Given our small sample, we believe that this matrix would be too imprecisely measured to yield reliable estimates.

\(^{18}\) The Treasury yields reported are par off-the-run yields from an estimated yield curve; the corporate yields are indexes computed by Merrill Lynch, and the corporate yield spreads are measured relative to the Treasury yield curve; the liquidity premium is the amount by which the on-the-run yield falls below the off-the-run yield curve; the prices of oil futures and gold are taken from Bloomberg; and the dollar is a broad trade-weighted index calculated by the Federal Reserve Board.
4.1 The Effects of War Risk

In the following analysis, we estimate the effects of the war risk factor using two variables at a time, as described above, where the first (normalized) variable is always taken to be the two-year Treasury yield. The results are reported in Table 3. In presenting the results, we show the impact of a change in $z_1$ by –0.25. Thus, all reported coefficients represent movements induced by an increase in war risk that is large enough to cause a 25 basis point drop in the two-year yield.

The table shows the estimated coefficients from the two IV estimators and the GMM estimator. As can be seen, the coefficients obtained under these various methods are typically close to one another, indicating that the structure that we have assumed is not strongly violated in the data. That conclusion is also supported by the test of overidentifying restrictions from the GMM estimation (not shown), which does not reject those restrictions for any of the variables considered. In the instances in which the point estimates do differ, the IV estimator based on the $\omega_2$ instrument seems to deviate from the other two. This suggests that the moment condition associated with that estimator is less precise and is hence down-weighted by the GMM estimator. To shorten the discussion of the results, we focus on the estimates found from the IV estimator with the instrument $\omega_1$.

The primary finding of this paper is that many of the financial variables considered are significantly affected by the war risk factor. An increase in war risk of the magnitude considered results in a jump in the price of the year-ahead oil futures contract by 2.9 percent, as one might expect. The increase in war risk also appears to weigh on the prices of risky assets in U.S. financial markets. In particular, equity prices fall 4.8 percent, and corporate yield spreads rise. The widening of yield spreads for investment-grade (BBB) issuers is statistically significant but small in magnitude, while that for lower-quality issuers is considerable, with the high-yield spread climbing 34 basis points. In terms of the Treasury yield curve, greater war risk pushes down the ten-year yield by about the same magnitude as the two-year yield, with 9 basis points of that movement reflecting a decline in break-even inflation. Lastly, the increase in war risk induces a sizeable weakening of the dollar, by 0.6 percent.

Somewhat surprisingly, though, war risk has a statistically weaker effect on the price of gold (a marginally insignificant rise), and absolutely no effect on the liquidity premium on the on-the-run ten-year Treasury note. One could interpret these last findings as indicating that increases in war risk have not generated a widespread flight by investors towards all safe and liquid assets. This interpretation raises the possibility that the negative effects on the prices of equities and corporate bonds, Treasury yields, and the dollar partly reflect a perception among investors that the prospect of war (and the associated increases in energy prices) posed downside risk to the U.S. economy, rather than a shift in investors’ risk preferences.

At this point it is worth touching on the interpretation of the war risk factor. As noted above, news about the war on any given day is presumably multidimensional.

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19 As shown in Table 2, the volatility of gold increased notably on the war days, indicating that some effect was present. However, these movements in gold prices apparently were not systematic enough to generate a significant coefficient.
Under our approach, this information is combined into a single factor, so that the results capture the impact of the most important aspects of the war-related news.\(^{20}\) Judging from financial market commentary on the days listed in Table 1, it appears that increases in the war risk factor are most closely associated with greater uncertainty about the timing of the war and a greater likelihood that the conflict will last for an extended period. Two days in our sample provide clear examples. On March 21, the perception that the war would be short and successful apparently led to a decrease in the war risk factor, with the two-year Treasury rising 7 basis points, equity prices jumping 2.3 percent, high-yield spreads narrowing 15 basis points, the dollar appreciating 0.3 percent, and oil futures dropping 2.3 percent. On March 24, by contrast, perceived military setbacks over the preceding weekend led to what appears to be a sharp increase in the war risk factor, with the two-year Treasury yield falling 12 basis points, equities plunging 3.5 percent, high-yield spreads rising 11 basis points, the dollar falling 0.39 percent, and oil futures jumping 2.2 percent. Nevertheless, while this seems like a plausible interpretation of the war risk factor, it is worth repeating that an advantage of our estimator is that one does not have to make such a determination.

### 4.2 The Relative Importance of War Risk

The results from Table 3 can be used to assess the importance of war risk relative to other factors affecting asset prices. According to the set-up above, the greater amount of war-related news on the specified days increases the variance of \(\Delta x_j\) by \(d_{j1}^2 \cdot \Delta \sigma^2(z_j)\).

Given the normalization for the first financial variable, this increase is equal to \(d_{j1}^2 \cdot \Delta \text{Var}(\Delta x_j)\). To measure \(\Delta \text{Var}(\Delta x_j)\), we use the shift in the variance of the two-year Treasury yield in the two samples.\(^{21}\) With that measure and the point estimates of \(d_{j1}\), we obtain an estimate of the shift in the variance of each financial variable that is attributable to the increased volatility of the war risk factor on the specified days.

The shift in the war-induced variance has to be smaller than the level of the war-induced variance on the war days, and would only be the same if there were no war-related news on other days. Thus, the portion of the variance of the \(j\)th financial variable that is attributable to war-related news must be greater than \(d_{j1}^2 \cdot \Delta \text{Var}(\Delta x_j) / \text{Var}(\Delta x_j)\).

This measure, which is reported in the first column of Table 4, is quite high for those variables that had significant coefficients, indicating that war risk accounted for a sizable portion of the variances of those variables.

Moreover, because the war days are much more volatile than the other days in the sample, the war risk factor accounts for a considerable portion of the cumulative movements in the financial variables throughout this period. Indeed, consider the behavior of each financial variable for the three-month period covered by our sample (January 6, 2003 to April 7, 2003). This period includes 64 business days, of which 21 represent the war days specified above. Assuming that the daily changes in a given financial variable are serially independent, we can compute the variance of the

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\(^{20}\) Our approach could be extended to a multidimensional war risk factor if one were willing to make assumptions about the variances of its individual components. However, we believe that imposing such assumptions is infeasible.

\(^{21}\) These variances are measured simply by the average size of \(\Delta x_j^2\) in the two samples. The resulting measure does not differ much from the estimate of \(\hat{\lambda}\) from the GMM estimator.
cumulative change in that variable over this period, and then determine how much of this variance can be attributed to the increase in the volatility of the war risk factor on the 21 days specified. The results, shown in the second column, indicate that the war risk factor still accounts for a sizable portion of the variances of many of these variables even looking over the entire three-month period.

Lastly, it is interesting to note that our conclusions are qualitatively similar to those of Amihud and Wohl (2004) and Leigh, Wolfers, and Zitzewitz (2003), even though our approach differed considerably from theirs. Indeed, Leigh, Wolfers, and Zitzewitz also find sizable effects of war risk on oil and equity prices (they do not consider the other financial variables that we do), and they argue that much of the variation in those prices in late 2002 and early 2003 can be attributed to changes in the likelihood of war.

### 5. Robustness

The results presented above are robust to a variety of changes to the specification or the details of the estimation, as explored in this section.

#### 5.1 Changes in the specification

We begin by looking at the robustness of the results to two aspects of the estimation—the normalization and the number of variables included. For brevity, in this and the following sub-sections we highlight only the more relevant considerations and do not show the point estimates in each case.

The first dimension of robustness to be considered is the normalization involved. We have chosen the two-year Treasury yield as the reference variable in the estimation. This assumption is innocuous for the results. For example, if we instead normalize the war risk to have a negative 5 percent effect on the S&P 500 index (which is approximately the response we obtain with the current specification), the estimates of the effects on the other financial variables are almost identical. The normalization essentially just rescales the coefficients. A related consideration is the size of the reported coefficients. We have presented all results in terms of a shock that pushes down the two-year yield by 25 basis points. This is a large innovation—three times the standard deviation seen on the war days. Of course, this too simply amounts to rescaling the coefficients, as the results could have been shown for an innovation of any size. Finally, we estimated the model using shorter interest rates – three and six month rates – and the qualitative results remain the same. Again, there is always the issue of scaling given that a shock that moves the three-month rate by 25 basis points is of different magnitude as the one that moves the two-year rate by 25 basis points.

One aspect of the normalization that is important is to normalize the results on a variable that we are confident reacts to war risk. Consider, for example, if we had chosen the three-month Treasury rate instead of the two-year yield. It is likely that the three-month rate reacted by less to war-related news, since it is largely pinned down by the current monetary policy setting and very near-term policy expectations. (Monetary policy might be expected to adjust to war risk, but perhaps not immediately.) In that case, the responses of other assets relative to the three-month rate would not have been measured very well. However, we are fairly confident that the two-year Treasury yield was influenced by war-related news, and the relative responses of the other financial variables are measured quite well.
The second dimension of robustness considered is the number of variables included in the estimation. An immediate question that should arise from our specification is why we have estimated the system using pairs of financial variables rather than using all the variables at the same time. In previous papers we have implemented similar methodologies using several asset prices at the same time. In this particular application, however, we have a relatively limited amount of data, and so this approach is impossible. Indeed, our methodology requires the estimation of two covariance matrices (one for war days and one for non-war days). With 10 variables in the system, the covariance matrix requires at least 56 observations to estimate it (in which case we end up with only one degree of freedom). Unfortunately, we do not have enough days with war-related news to implement this methodology, and we have to rely on pairwise comparisons.

5.2 Misspecification of the war risk days

The previous sub-section discussed some robustness exercises that should have been expected to produce similar outcomes. In this sub-section we concentrate on a less obvious exercise: changes in the set of war days.

It is important to start with the observation that the methodology used above is robust to small misspecifications in the determination of war days. That is, even if our sample choice has not perfectly isolated the days with war news, our estimates are consistent (as long as the sample choice is not so bad that it eliminates the heteroskedasticity, as discussed below). This is a crucial property of the methodology, because the procedure we have chosen to determine the days with war news is clearly arbitrary. We believe it is a reasonable procedure, but others would likely choose a slightly different set of days if given the same task. This section will demonstrate—first analytically and then empirically—that small disagreements on the set of days do not change the point estimates.

Recall that our estimation (and identification) is achieved by subtracting two covariance matrices, which produces the following equation (equivalent to equations 9 and 10):

\[ \Delta \Sigma = D \cdot (\Sigma_H - \Sigma_L) \cdot D' = \lambda \cdot \begin{bmatrix} 1 & d_{21} \\ d_{21}^T & d_{21}^T \end{bmatrix}, \]

where we are interested in estimating both \( \lambda \) and \( d_{21} \). In this model, misspecification of the war days causes the estimated covariances to deviate from the true ones. We will show that even though the estimated matrices do not coincide with the true ones, the estimates of \( d_{21} \) are still consistent. This result comes from the fact that the misspecified covariance matrices are linear combinations of the underlying true covariance matrices. Because our estimate solves a system of equations, then the misspecified covariances imply a linear combination of the original system of equations, and hence the solution is the same.

Formally, assume that the true war days result in covariance matrices denoted as \( \Sigma_H, \Sigma_L \), where the first one is associated with the war days and the second one with non-war days. Suppose the set of days chosen as war days is not exactly the same as the true set of war days. If the chosen sample has a fraction \( \gamma \) of war days and a fraction \( 1-\gamma \) of non-war days, then the covariance matrix for the chosen sample is given by
\[ \hat{\Sigma}_H = \gamma \Sigma_H + (1 - \gamma) \Sigma_L. \]  
\( \hat{\Sigma}_L = (1 - \gamma) \Sigma_H + \gamma \Sigma_L. \]  
\[ \hat{\Sigma}_H - \hat{\Sigma}_L = (2\gamma - 1)(\Sigma_H - \Sigma_L). \]  

Symmetrically, the sample denoted as non-war days includes the rest of the data, and its covariance matrix is then

As can be seen, if \( \gamma \) is different from 0.5, then the misspecified change in covariance matrices is proportional to the true change in the covariance matrices. In that case, equation (18) will produce the correct estimate of \( d_{x_1} \); the parameter is still identified, and the estimator is consistent. The misspecification of the sample ends up causing a bias only in the estimate of \( \lambda \), which is not a parameter of primary interest for us.

The system would not be identified if the set of days were chosen so poorly that the heteroskedasticity disappears—that is, when \( \gamma \) is 0.5. It should not be surprising that the identification procedure does not work in this case, given that our whole strategy depends on finding splits in the data where the shocks are heteroskedastic. If this split is unable to find heteroskedasticity, then our procedure has no chance of identifying the response parameter. Fortunately, this is a testable assumption: If \( \lambda \) is statistically different from zero, it means that our split is reasonable enough to result in heteroskedasticity.

To further convince the reader, we present results when the war days are changed. We present only the results based on GMM, which allows us to estimate the degree of heteroskedasticity in addition to the response coefficients. The results are shown in Table 5. The first column shows our baseline results that we obtained under the original sets of days (reported earlier in Table 3). The second column includes the results when we expand the set of non-war days, keeping the original war days unchanged. Remember that we had previously identified the non-war days as the days prior to the war days. Here we instead define that set to include all of the days in our sample other than the war days. Finally, the third column expands the set of war days to include those days highlighted as including relevant war events by Leigh, Wolfers, and Zitzewitz (2003).

As can be seen, the effects on the financial variables follow the same patterns as in our baseline estimation, although the magnitudes differ some. Most of the estimates are close in magnitude and they are not statistically different across specifications. The only exception is the response of the oil futures price, which are sufficiently different to reject the hypothesis that they are the same as in the baseline case. The sensitivity of the response of oil to the choice of days may reflect that other important events were taking place around this time, including a strike in Venezuela.

5.3 Misspecification on the different dimensions of the war risk

As highlighted in the introduction and in all the previous discussion, war risk is a concept that involves many dimensions, including the likelihood of the war, its expected success and duration, and its likely cost. In this paper we have included all of these dimensions in one single factor and have assumed that all have the same effect on asset prices. This is an assumption, and as such, it is vital to discuss the consequences to our estimates if they were not true.
This issue also comes up in Amihud and Wohl (2004) and Leigh, Wolfers, and Zitzewitz (2003), who give different interpretations to movements in the Saddam security depending on whether the war had begun or not. They argue that before the war started, the security reflected the probability that the war would take place, while after the war started it measured its likely length. They assume that the cut-off takes place exactly when the war starts. However, an equally possible interpretation is that the relative importance of the two sources of risk changed over time in a more complicated manner. Moreover, other sources of risk may have been present that the Saddam security did not capture. Therefore, it is essential to consider the possibility that war risk includes many dimensions that are difficult to measure.

Our methodology would have difficulty distinguishing between the various sources of war risk. Doing so would require making assumptions about the heteroskedasticity of each individual source of risk, which we view as infeasible. Instead, we compute the average response to all of them. Nevertheless, one of the properties of our procedure is that it allows a formal test of the assumptions underlying our estimator. If the impact of different sources of war risk on the financial variables were to vary importantly, then the overidentification assumption of our estimator should be rejected.

To illustrate the point, assume that there are two sources of war risk:

\[
\begin{bmatrix}
\Delta x_{1t} \\
\Delta x_{2t}
\end{bmatrix} = D \cdot \begin{bmatrix} z_{1t} \\
z_{2t} \\
\vdots
\end{bmatrix},
\]

where \( z_{1t}, z_{2t} \) are now both related to war risks. The response matrix \( D \) is given by

\[
D = \begin{bmatrix}
1 & 1 & d_{13} & \cdots \\
d_{21} & d_{22} & d_{23} & \cdots
\end{bmatrix},
\]

where we have normalized the effect of each factor on the first variable to unity. Assume that, because war risk has two components, the variances of both \( z_{1t}, z_{2t} \) shift on the days we identified. If both shocks are heteroskedastic the changes in the second moments of the financial variables are:

\[
\Delta \text{Var}(\Delta x_1) = \Delta \sigma_{z_1} + \Delta \sigma_{z_2}
\]
\[
\Delta \text{Var}(\Delta x_2) = d_{21}^2 \Delta \sigma_{z_1} + d_{22}^2 \Delta \sigma_{z_2}
\]
\[
\Delta \text{Cov}(\Delta x_1, \Delta x_2) = d_{21} \Delta \sigma_{z_1} + d_{22} \Delta \sigma_{z_2}
\]

where \( \Delta \sigma_{z_1} \) is the change in the variance of the first unobservable variable. Our methodology provides two estimates of the impact of war risk, as follows:

\[
\hat{d} = \frac{\Delta \text{Cov}(\Delta x_1, \Delta x_2)}{\Delta \text{Var}(\Delta x_1)} = d_{21} \frac{\Delta \sigma_{z_1}}{\Delta \sigma_{z_1} + \Delta \sigma_{z_2}}
\]
\[
\hat{d} = \frac{\Delta \text{Var}(\Delta x_2)}{\Delta \text{Cov}(\Delta x_1, \Delta x_2)} = d_{21}^2 \frac{\Delta \sigma_{z_1}}{\Delta \sigma_{z_1} + d_{22}^2 \Delta \sigma_{z_2}}
\]

Note that both of these estimates are combinations of the true coefficients on the two factors, \( d_{21} \) and \( d_{22} \).
The two estimates will differ from one another unless one of the following conditions holds:

1) $d_{21} = d_{22}$
2) $\Delta \sigma_{z1} = 0$ or $\Delta \sigma_{z2} = 0$,

in which case the two coefficient estimates will be equal to each other and to the true coefficient. Note, however, that these two cases indicate that there is only one source of war risk. In the first case, the two unobserved variables have the exact same effect on the financial variables, and they can be aggregated into a single factor. The second case explicitly shuts down one of the unobserved variables.

If there are two (or more) important sources of war risk with different effects on financial variables, the two estimates should differ, and we should reject the test of overidentifying restrictions. As discussed above, we do not reject these restrictions. This finding indicates that any differences in the effects of the various dimensions of war risk are not big enough to cause a rejection of the model. Our results suggest that news about the war, though surely multidimensional, generally had about the same relative effects on the financial variables considered regardless of the precise content of the news. This is an important finding for our paper and other papers that have assumed that the impact of war risk can be captured by a constant coefficient.

In summary, although we cannot isolate the different sources of war risk, doing so may not be too important. Thus, it is reasonable to estimate the overall impact of all sources of war risk, as we did above.

6 Conclusions

This paper provides empirical evidence that the risks associated with the war in Iraq had a significant impact on a number of U.S. financial variables over the first several months of 2003. The basis for our methodology is that one can determine a particular set of days during this period on which news about the outlook for the war was particularly prominent. We show that determining this set of days is sufficient to estimate the impact of the war risk factor, even if that factor itself cannot be measured.

The findings accord well with much of the anecdotal evidence offered by financial market participants over this period. Of course, the more formal estimation approach taken here has the advantages of quantifying those effects and determining whether they are statistically significant. The results indicate that increases in war risk caused a rise in oil prices, a fall in Treasury yields and equity prices, a widening of corporate yield spreads, and a decline in the dollar. By contrast, we do not find that war risk had a significant impact on the price of gold or on the liquidity premium on the on-the-run ten-year Treasury note.

Overall, war-related risks appear to have been a very important factor in determining movements in U.S. financial variables over the three months leading up to the arrival of coalition troops in central Baghdad. Indeed, of those variables that were found to have a significant response, war risk accounted for a considerable portion—with

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22 Of course, one possibility is that this test has limited power. However, as is shown in Rigobon (2000, 2002, 2003b) and also in Rigobon and Sack (2002, 2004), the overidentifying assumptions were rejected in other applications, suggesting that this type of test does have some power in other circumstances.
a lower bound of between 11 and 53 percent—of the variances of their cumulative movements over that period.

The methodology developed here could be used in many other applications to measure the effects of factors that are not easily quantified but whose timing is known. In the macroeconomics literature, such applications include estimating the impact of the statements of monetary policy officials or the impact of various latent risk factors (like the one considered here). Other applications can be found in corporate finance. For example, these estimators could be used to measure the effects of earnings guidance (most of which does not provide specific numerical values) or other announcements about corporations’ balance sheets or business strategies.

7 References


House Budget Committee (2002), Assessing the Cost of Military Action Against Iraq: Using Desert Shield/Desert Storm as Basis for Estimates, Democratic Staff.


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23 A recent publication by the National Investor Relations Institute (2002) indicated that only 12 percent of the companies they surveyed provided a specific numerical target in their earnings guidance; 47 percent provided a range for earnings, and 51 percent discussed factors that drive earnings.


**Table 1**  
Days of High Variance of War-Related News

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/9/03</td>
<td>U.N. inspectors report finding no chemical weapons</td>
</tr>
<tr>
<td>1/16/03</td>
<td>Reports that Saddam Hussein might consider exile</td>
</tr>
<tr>
<td></td>
<td>U.N. weapons inspectors find empty chemical warheads</td>
</tr>
<tr>
<td>1/17/03</td>
<td>Saddam Hussein gives speech stating that Iraq is ready for war</td>
</tr>
<tr>
<td>1/27/03</td>
<td>Blix report: &quot;Iraq appears not to have come to a genuine acceptance of the disarmament&quot;</td>
</tr>
<tr>
<td>1/29/03</td>
<td>President Bush gives State of Union Address</td>
</tr>
<tr>
<td></td>
<td>Secretary Powell says U.S. would assist Saddam Hussein if he sought exile</td>
</tr>
<tr>
<td>1/30/03</td>
<td>President Bush comments on continued lack of Iraqi cooperation</td>
</tr>
<tr>
<td>2/5/03</td>
<td>Secretary Powell makes U.N. presentation in effort to build a broad coalition</td>
</tr>
<tr>
<td>2/10/03</td>
<td>Reports that Iraq will unconditionally allow surveillance flights</td>
</tr>
<tr>
<td>2/12/03</td>
<td>Secretary Powell says impasse has reached &quot;moment of truth&quot;</td>
</tr>
<tr>
<td>2/13/03</td>
<td>Rumors that President Bush set deadline to attack without resolution</td>
</tr>
<tr>
<td>2/14/03</td>
<td>Blix report interpreted as reducing chance of immediate war</td>
</tr>
<tr>
<td>3/5/03</td>
<td>Secretary Powell makes tough comments on Iraq</td>
</tr>
<tr>
<td>3/7/03</td>
<td>Reports that bin Laden close to being captured</td>
</tr>
<tr>
<td>3/10/03</td>
<td>Turkey rejects U.S. use of military bases</td>
</tr>
<tr>
<td>3/13/03</td>
<td>CNN reports that Iraq might surrender before conflict begins</td>
</tr>
<tr>
<td>3/17/03</td>
<td>President Bush expected to announce an ultimatum with a short deadline for war</td>
</tr>
<tr>
<td></td>
<td>Change in terror alert from elevated to high (explicitly related to the prospect of war)</td>
</tr>
<tr>
<td>3/21/03</td>
<td>The war commences; early efforts appear very successful</td>
</tr>
<tr>
<td>3/24/03</td>
<td>Coalition forces face apparent setbacks over preceding weekend</td>
</tr>
<tr>
<td>3/28/03</td>
<td>Bush, Blair make comments suggesting a long war</td>
</tr>
<tr>
<td>4/2/03</td>
<td>Coalition forces approach Baghdad</td>
</tr>
<tr>
<td>4/7/03</td>
<td>Coalition troops enter central Baghdad</td>
</tr>
</tbody>
</table>
Table 2
Means and Variances of Changes in Financial Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>--- Means ---</th>
<th>--- Variances ---</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>War days (1)</td>
<td>Other days (2)</td>
</tr>
<tr>
<td>Two-year Treasury Yield</td>
<td>0.019</td>
<td>-0.012</td>
</tr>
<tr>
<td>Ten-year Treasury Yield</td>
<td>0.025</td>
<td>-0.013</td>
</tr>
<tr>
<td>Break-even Inflation</td>
<td>0.009</td>
<td>0.001</td>
</tr>
<tr>
<td>Liquidity Premium</td>
<td>0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>0.237</td>
<td>-0.192</td>
</tr>
<tr>
<td>BBB Yield Spread</td>
<td>-0.005</td>
<td>-0.008</td>
</tr>
<tr>
<td>High-yield Yield Spread</td>
<td>-0.024</td>
<td>-0.021</td>
</tr>
<tr>
<td>Oil Futures Price</td>
<td>-0.110</td>
<td>0.053</td>
</tr>
<tr>
<td>Gold Price</td>
<td>-0.571</td>
<td>0.092</td>
</tr>
<tr>
<td>Dollar</td>
<td>0.041</td>
<td>-0.042</td>
</tr>
</tbody>
</table>

* denotes significance at 5 percent level; ** at 1 percent level. All Treasury yields and corporate yield spreads are measured in percentage point changes; the S&P 500, oil prices, gold prices, and the dollar are measured in percent changes. "War days" are days of significant war-related news.
Table 3

**Estimated Impact of Increase in War Risk**
(Normalized to cause a 25 bp drop in two-year Treasury yield)

<table>
<thead>
<tr>
<th>Variable</th>
<th>IV w/ $\omega_1$ (Eqn 13)</th>
<th>IV w/ $\omega_2$ (Eqn 12)</th>
<th>GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten-year Treasury Yield</td>
<td>-0.26</td>
<td>-0.25</td>
<td>-0.25</td>
</tr>
<tr>
<td></td>
<td>(14.52)</td>
<td>(14.41)</td>
<td>(12.69)</td>
</tr>
<tr>
<td>Break-even Inflation</td>
<td>-0.09</td>
<td>-0.03</td>
<td>-0.08</td>
</tr>
<tr>
<td></td>
<td>(3.47)</td>
<td>(0.72)</td>
<td>(3.13)</td>
</tr>
<tr>
<td>Liquidity Premium</td>
<td>-0.00</td>
<td>-0.06</td>
<td>-0.00</td>
</tr>
<tr>
<td></td>
<td>(0.71)</td>
<td>(0.45)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>-4.79</td>
<td>-6.16</td>
<td>-5.01</td>
</tr>
<tr>
<td></td>
<td>(4.65)</td>
<td>(3.89)</td>
<td>(2.91)</td>
</tr>
<tr>
<td>BBB Yield Spread</td>
<td>0.06</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(4.38)</td>
<td>(3.98)</td>
<td>(4.01)</td>
</tr>
<tr>
<td>High-yield Yield Spread</td>
<td>0.34</td>
<td>0.32</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>(5.84)</td>
<td>(5.11)</td>
<td>(16.28)</td>
</tr>
<tr>
<td>Oil Futures Price</td>
<td>2.86</td>
<td>-0.60</td>
<td>2.58</td>
</tr>
<tr>
<td></td>
<td>(2.57)</td>
<td>(0.23)</td>
<td>(1.42)</td>
</tr>
<tr>
<td>Gold Price</td>
<td>1.71</td>
<td>7.96</td>
<td>1.73</td>
</tr>
<tr>
<td></td>
<td>(1.62)</td>
<td>(1.61)</td>
<td>(0.95)</td>
</tr>
<tr>
<td>Dollar</td>
<td>-0.58</td>
<td>-1.03</td>
<td>-0.60</td>
</tr>
<tr>
<td></td>
<td>(3.65)</td>
<td>(3.39)</td>
<td>(0.762)</td>
</tr>
</tbody>
</table>

Table reports estimates of $d_{j,1}$, or the impact of the war risk factor on each financial variable (multiplied by $-0.25$). Absolute t-statistics are shown in parenthesis. All Treasury yields and corporate yield spreads are measured in percentage point changes; the S&P 500, oil prices, gold prices, and the dollar are measured in percent changes.
<table>
<thead>
<tr>
<th>Variable</th>
<th>War days</th>
<th>All days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten-year Treasury Yield</td>
<td>79.2</td>
<td>53.0</td>
</tr>
<tr>
<td>Break-even Inflation</td>
<td>53.5</td>
<td>24.8</td>
</tr>
<tr>
<td>Liquidity Premium</td>
<td>2.7</td>
<td>1.2</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>48.9</td>
<td>28.7</td>
</tr>
<tr>
<td>BBB Yield Spread</td>
<td>60.5</td>
<td>18.3</td>
</tr>
<tr>
<td>High-yield Yield Spread</td>
<td>68.0</td>
<td>39.2</td>
</tr>
<tr>
<td>Oil Futures Price</td>
<td>35.7</td>
<td>11.5</td>
</tr>
<tr>
<td>Gold Price</td>
<td>9.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Dollar</td>
<td>37.4</td>
<td>19.8</td>
</tr>
</tbody>
</table>

All Treasury yields and corporate yield spreads are measured in percentage point changes; the S&P 500, oil prices, gold prices, and the dollar are measured in percent changes. “War days” are days of significant war-related news.
Table 5
Robustness of Results: GMM Estimates
(Normalized to cause a 25 bp drop in two-year Treasury yield)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Results</th>
<th>--- Extended Samples ---</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-war Days</td>
<td>War Days</td>
</tr>
<tr>
<td>Ten-year Treasury Yield</td>
<td>-0.25 (12.86)</td>
<td>-0.30 (10.16)</td>
</tr>
<tr>
<td>Break-even Inflation</td>
<td>-0.08 (3.35)</td>
<td>-0.01 (0.24)</td>
</tr>
<tr>
<td>Liquidity Premium</td>
<td>-0.00 (0.24)</td>
<td>-0.50 (0.30)</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>-5.01 (2.91)</td>
<td>-5.69 (1.99)</td>
</tr>
<tr>
<td>BBB Yield Spread</td>
<td>0.06 (4.01)</td>
<td>0.03 (1.48)</td>
</tr>
<tr>
<td>High-yield Yield Spread</td>
<td>0.34 (16.28)</td>
<td>0.36 (9.78)</td>
</tr>
<tr>
<td>Oil Futures Price</td>
<td>2.58 (1.42)</td>
<td>7.37 (3.78)</td>
</tr>
<tr>
<td>Gold Price</td>
<td>1.73 (0.95)</td>
<td>7.03 (3.38)</td>
</tr>
<tr>
<td>Dollar</td>
<td>-0.60 (0.76)</td>
<td>-1.61 (1.45)</td>
</tr>
</tbody>
</table>

Table reports estimates of $d_{j,t}$, or the impact of the war risk factor on each financial variable (multiplied by –0.25). Absolute t-statistics are shown in parenthesis. All Treasury yields and corporate yield spreads are measured in percentage point changes; the S&P 500, oil prices, gold prices, and the dollar are measured in percent changes.