Major Power Capabilities and Interstate Wars:

Anne Etienne

etienne@unt.edu

Department of Political Science

ECON 5660

INTRODUCTION

Since the end of World War II, the international system (a system that comprises all nations in the world) has experienced a decrease in the occurrence of international wars accompanied by a steady increase of intrastate wars (also referred to as civil war, civil conflict), conflicts that occur within a nation-state rather than between two or more nation states. Many scholars have attempted to identify the characteristics that lead to civil war onset (Anyanwu, 2003; Fearon and Laitin, 2003; Gurr, 1968; Lake, 2003; Mansfield and Snyder; Posen, 1993 2002; Sambonis, 2001; Saxton, 2005; Tilly, 2003) by mainly focusing on the characteristics of countries and how these either promote or preclude the occurrence of a civil war. However, the effects of systemic factors (the aggregate characteristics of the international system rather than characteristics of its members individually) on civil war onset remains impressively understudied. Additionally, scholars have overlooked the potential causes of the frequency of civil wars within the international system over time. In order to fill these gaps, this study aims at answering the following question: Does the hegemon's level of capabilities impact the number of civil wars occurring within the international system? The international system represent the world under which countries operate and interact; the hegemon represents the stronger state in the said system – in this paper, the hegemenon is the United States for the entire time period – and the capabilities of the hegemon represent the portion of total world power (the aggregated international power) that the hegemon owns in terms of electricity consumption, military power, and population indices. The paper is organized in the following manner: first, the data sources are identified and explained; second, some background on times series variables and processes are defined; then, the characteristics of the data are presented; the fourth section presents the statistical analyses and the interpretation thereof; the final questions addresses implications, conclusions and avenues for future research.

DATA

In this study, I propose that the capabilities of the main power in the international system represent a leading variable of the frequency of interstate wars over time. Thus, the degree of capabilities is my independent variable and frequency of interstate war is the dependent variable. I utilize the Correlates of War (COW) data on National Material Capabilities and use the data for the US since it has been identified as the hegemon for the period under study – 1946 through 2001 (Singer *et al.*, 1972; Singer, 1987 – the original dataset and the subsequent revisions remain updated through the COW project on an ongoing basis). As the official website indicates, "[t]he National Material Capabilities data set contains annual values for total population, urban population, iron and steel production, energy consumption, military personnel, and military expenditure of all state members, currently from 1816-2001. The widely-used Composite Index of National Capability (CINC) is based on these six variables and included in the data set." This dataset is accessible online (available at http://cow2.la.psu.edu/). I use the CINC as an indicator of US capabilities; this indicator is a fraction that represents the proportion of total international capability possessed by a given country. For the US, this variable takes values ranging from 0.131 to 0.364.

In order to account for the number of interstate wars occurring within the international system each year, I use the Uppsala Armed Conflict Dataset on civil conflict (Eriksson *et al.*, 2003; Gleditsch *et al.*, 2002). This research group constructed a "Monadic Table" that presents civil unrest occurring in every country each year; additionally, each observation contains a "count" column that adds all civil unrest for each country per year. Of relevance to this study are the last two types of conflict they identify, mainly “internal armed conflict” and “internationalized internal armed conflict”; the former represents wars between a government and an opposition group while the second refers to the same phenomenon with the addition that the opposition is backed by a foreign government. The Uppsala project classified an event as a “war” when a country reaches at least 25 conflict-related civilian deaths within any given year. Because this project focuses on the effect of a systemic component (the share of total capabilities owned by the hegemon), the aggregated value of this variable represents the dependent variable. As such, the “war” series contains the yearly summation of civil wars in the international system. This variable takes values that range from 14 to 81. I can now start looking at the characteristics of both variables in terms of stationarity.

TIMES SERIES STATISTICS AND MODELS

Unlike traditional cross-sectional data, time series variables contain several unique dynamics that a researcher needs to identify in order to adequately come up with a model that addresses time-series characteristics. When faced with this kind of data, the investigator first needs to determine whether a series is stationary of not. A stationary process is a stochastic process whose probability distribution at fixed time or position is the same for all times or positions; as such, the unconditional variance and mean of such a process remains constant at different points in time. Furthermore, a variable is non-stationary, it usually contains a unit root whereby one or more of the coefficients in an autoregressive model of order 1 (explained below) has a value superior or equal to one (for other types of autoregressive models, one needs to conduct a unit root test to decipher whether a series is stationary or not). If a unit root is present in the model, the latter has a stochastic trend and is integrated – denoted as I(0), I(1), I(2), etc. An integrated series necessitate being differenced (by subtracting the previous value of the variable to the current one for one difference) in order to be stationary; an I(0) series denotes a variable that is stationary “as is”, an I(1) necessitate one difference in order to be stationary, and so on. As a result, a stationary variable represents the sole type of variable for which one can estimate a reasonable model. However, many time series data have non-stationary characteristics insofar as they may have time-dependent heteroskedasticity (non-constant variance overtime) an aspect which necessitates some manipulation of the variable in question in order to render it stationary. Usually, differencing the original version of a non-stationary variable suffice to make it stationary. There exist several tools and techniques to decipher whether a series is stationary or not.

The first step in identifying whether a variable is stationary or not consists in graphing it over time. When graphing a series, one can decipher whether a variable is stationary or not. If the data appears to have a constant variance and mean over time, then it most likely is stationary. On the other hand, if the data behaves in an unpredictable manner (it either appears to have an inconstant variance over time, or a time trend, or both), then mist likely is non-stationary. Such a variable can be described as a “random walk”, of which there are three types. A “simple random walk” depicts a variable that has no intercept and has non-constant variance over time. A “random walk with drift” has an intercept and shares the other characteristics of a “simple random walk”. Finally, a “random walk with time trend and drift” has an intercept and also some sort of time-dependent variation: the values of the variable either accrue or decrease across time. Once a series has been examined from a graphical perspective, the researcher conducts further tests to decide whether the series is indeed stationary of not from a statistical perspective, and if so, what sort of steps need be undertaken.

The first statistical tool available consists of looking at the autocorrelation plots (ACF) of the series. This plot simply shows autocorrelations for data values at different points in time: it presents the different lags of the series and presents the levels to which the values of the series at time *t* are correlated to previous values. If the ACF quickly declines to zero, it indicates that the series most likely mist likely is stationary. However, if it really slowly declines to zero, it signifies that the series is non-stationary. The partial autocorrelation of a value at lag *k* shows the correlation between the variable at time *t* and *t-k* that is not accounted for by lags *1* through lag *k-1*. Additionally to helping identifying the kind of model needed for a series, the PACF also help finding the number of augmentations needed for a Dickey-Fuller test (subsequently DF or ADF for Augmented Dickey-Fuller test).

Once the ACF and PACF of a series have been studied and identified, the next step consists in conducting the DF. A DF tests whether a unit root is present in an autoregressive model (on AR process may have unit roots). The ADF is an improved version of the original test that deals with more complicated time series variables (this is the test used in this paper). There exist three types of test: a single mean test, an intercept and mean test, and a time trend test. Those three tests directly relate to the three different types of random walks, therefore, the type of test to use is based on the plot of the data. Additionally, the test has several possible augmentations. The appropriate number of augmentations is determined by the PACF: one looks at the number of significant lags in the PACF and uses that at the number of needed augmentations. In this paper, the null hypothesis states that he variable is non-stationary. Thus, if one fails to reject the null, one concludes that the series is non-stationary. If the series is non-stationary, it needs be differenced (by basically subtracting the current value by the previous value, losing one observation in the data) and tested again for stationarity. Several differences may be needed though most time series variable are integrated of order 1 (or I(1)), meaning that they need one difference to become stationary. After making the series stationary, the researcher attempts to select the "best-fitting" model for the series.

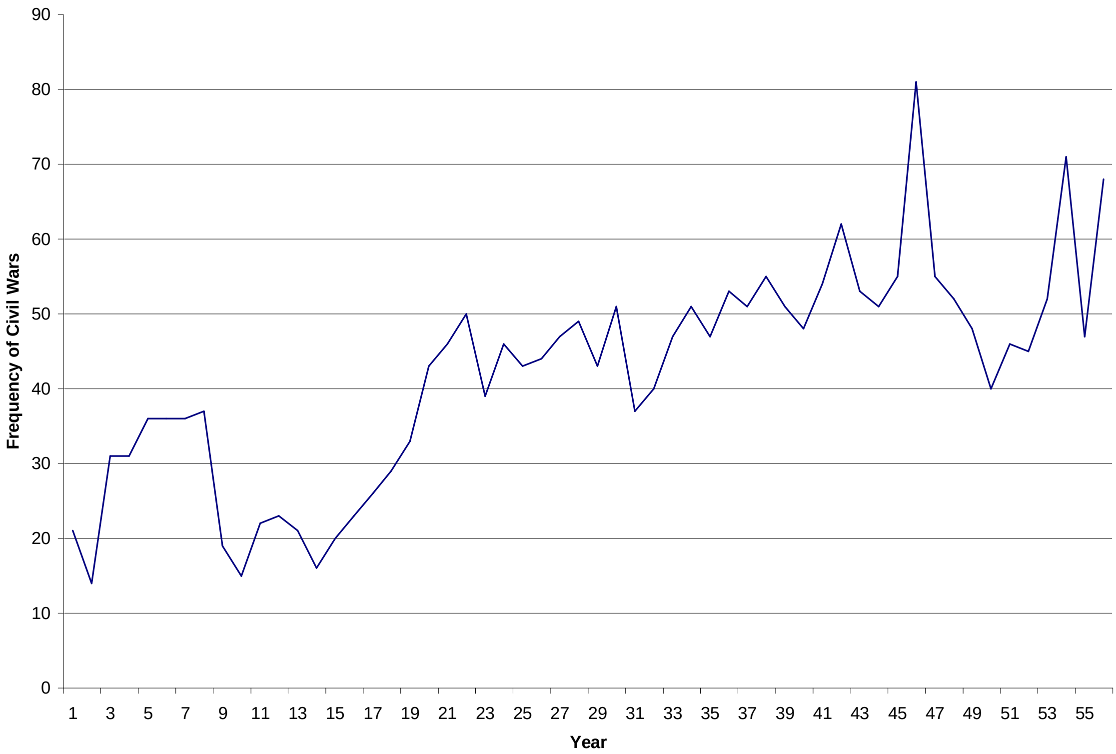
The primary tools for deciding whether a series necessitates a WN, AR, or MA process are the ACFs and PACFs. A WN process has "no flavor" and has an ACF and PACF that never is statistically significant. The equation form of such a model is $Y_t = \varepsilon_t$ and such a model cannot be estimated for the behavior of the series is totally unpredictable. An AR process has an ACF function that gradually, but relatively quickly, declines to zero. On the other hand, its PACF function is significant for *p* lags. The value of *p* helps determine the order of the AR process, i.e., the number of lagged values of the series that should have a statistical significance. Such a model simply tests the correlation between a variable and its past values. The equation form of these models is: $Y_t = \beta_0 + \beta_1 Y_{t-1} + \ldots + \beta_p Y_{t-p} + \varepsilon_t$. An MA process has an ACF that is significant for *q* lags and a PACF that gradually, but relatively quickly, declines to zero. The value of *q* determines the order of the MA. Such a process states that the values of the dependent variable depend on shocks in the past: $Y_t = \theta_0 + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \ldots - \theta_q \varepsilon_{t-q}$. Additionally, a variable may contain both AR and MA components and is thus said to an ARMA process. The ACF and PACF function cannot help determine whether a variable necessitates an ARMA process. Thus, in order to decipher whether a model is AR, MA, or ARMA, it is helpful to use information based criterion such as an Aikake Information Criteria (AIC) by estimating different models and figuring out which has the best AIC. However, on theoretical grounds, this study proposes to elucidate on the potential relationship between two variables rather than doing a simple AR, MA, or ARMA on a variable of interest. Consequently, the above-mentioned models are inadequate and a transfer function is more appropriate.

A transfer function takes the following form: $Y_t = \beta_0 + \beta_1 X_t + \ldots + \beta_p X_{t-p} + \varepsilon_t$, where *p* relates to the last lagged dependent variable included in the model. X is the leading indicator of Y: changing values of X overtime account for changing values of Y overtime. Ideally, theory should help determine whether one wants to use a transfer function or not. Unfortunately, even good theory may postulate that a there exist a relationship between X and Y – whereby X supposedly causes Y – statistics may prove otherwise. In order to determine whether a posited transfer function is appropriate, one looks at the cross-correlation of the two proposed variables. Cross-correlations help measure the extent to which two series are related. The cross-correlation functions shown by SAS show both negative and positive lags; if the negative lags are significant, the two variables are not fit for a transfer function. On the other hand, if only positive lags are significant, then, the variables should fit a transfer model. Additionally, the number for which the lags are significant determine the number of lagged values of X that need to be included in the model. Now that the specifics of time-series data and the different types of potentially applicable models here have been identify, it ensues that the first task consists in testing for stationarity for both variables.

DATA CHARACTERISTICS

The first necessary step entails identifying the characteristics of the dependent variable, i.e., the frequency of civil war (all commands and log window outputs are included in the Appendix). Figure 1 show the plot for this variable. Evidently, it appears that the number of civil war from 1946 to 2001 has a time trend and an intercept. This preliminary finding seems to indicate that the "civil wars" series contains heteroskedastic components but the finding remains too weak to ascertain that the series is non-stationary, necessitating further tests. These tests will help elucidate whether the variable is stationary or not and whether it needs being differenced in order to become stationary. As explained in the previous section, the next step involves deriving the ACF and PACF for the non-differenced series; then, the appropriate ADF unit root test is identified.

Figure 1: Frequency of Civil Wars, 1946-2001.



Graph 1 shows the behavior of the "civil wars" ACF. The series gradually, and rather quickly, declines to zero, which could be an indicator of an AR process or, alternatively, of a non-stationary series.

Graph 1: Autocorrelation Function for Frequency of Civil Wars

```
  Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
    1       151.585        0.74372    |                .    |***************     |       0.133631
    2       137.010        0.67221    |             .       |*************       |       0.193936
    3       116.320        0.57070    |            .        |***********         |       0.231839
    4       104.089        0.51069    |          .          |**********          |       0.255698
    5     98.554733        0.48354    |         .           |**********.         |       0.273306
    6     88.252414        0.43299    |        .            |*********  .        |       0.288177
    7     91.578922        0.44931    |        .            |*********  .        |       0.299570
    8       104.221        0.51134    |        .            |********** .        |       0.311371
    9     79.657958        0.39082    |       .             |********    .       |       0.326022
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   10     73.952578        0.36283    |         .          |*******     .        |        0.334283
   11     52.511867        0.25764    |        .           |*****        .       |        0.341243
   12     56.033528        0.27492    |        .           |*****        .       |        0.344699
   13     46.541158        0.22834    |        .           |*****        .       |        0.348593
   14     38.872130        0.19072    |        .           |****         .       |        0.351254
```

In order to figure out which type of unit root test is required, the level of significance of the PACF indicates this. This paper already demonstrated that the series has both an intercept and a time trend. The PACF presented in Graph 2 only contains one significant lag (mainly, the first one), therefore, we need to check whether the Augmented Dickey Fuller unit root test is significant for one lag with intercept and unit trend. The unit root test with these specifications has a degree of significance of .0976. Normally, one would want a 95% confidence in this number; however, due to the limited amount of data, this value may suffice for the purpose of this paper. Further stationarity tests over the dependent variable will help decide whether it needs to be differenced in order to be stationary.

Graph 2: Partial Autocorrelation Function for Frequency of Civil Wars

```
Lag     Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
  1         0.74372    |               .    |***************     |
  2         0.26650    |               .    |*****               |
  3         0.01396    |               .    |    .               |
  4         0.04114    |               .    |*   .               |
  5         0.09768    |               .    |**  .               |
  6        -0.00031    |               .    |    .               |
  7         0.13162    |               .    |*** .               |
  8         0.24589    |               .    |*****               |
  9        -0.27515    |             ******|     .               |
 10        -0.04337    |               .   *|    .               |
 11        -0.10618    |               .  **|    .               |
 12         0.13280    |               .    |*** .               |
 13        -0.04977    |               .   *|    .               |
 14        -0.02398    |               .    |    .               |
```

Figure 2 portrays the plot of the differenced version of the “civil wars” variable. The process of differencing evidently helped remove most of the variation and rendered the variable evidently more stochastic than its original version. Thus, this differenced variable contains no time trend; it does, however, possess an intercept, aspect to keep in mind for the ADF. Deriving the ACF, PACF, and ADF unit root test for the differenced dependent variable will shed light on the nature of the differenced version of the dependent variable.

Figure 2: Frequency of Civil Wars, 1946-2001 – After One Difference

Graph 3 shows the pattern of the ACF. With the differenced version of the variable, the ACF becomes white noise for the most part and only has significance for the first lag and the eighth lag. This indicates that differencing succeeded in removing the heteroskedastic components of the original version of the series.

Graph 3: First-Differenced Autocorrelation Function for Frequency of Civil Conflicts.

```
 Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
   1    -31.598732        -.37034    |             *******|    .                |     0.134840
   2      0.697412        0.00817    |                .   |     .               |     0.152214
   3      0.015705        0.00018    |                .   |     .               |     0.152222
   4     -1.792944        -.02101    |                .   |     .               |     0.152222
   5      4.160060        0.04876    |                .   |*    .               |     0.152275
   6    -11.178176        -.13101    |                .  ***|    .               |     0.152558
   7    -13.154759        -.15417    |                .  ***|    .               |     0.154590
   8     28.508328        0.33412    |                .   |*******             |     0.157361
   9    -22.886437        -.26823    |               . *****|     .              |     0.169770
  10      5.332352        0.06250    |               .    |*     .              |     0.177308
  11    -13.370512        -.15670    |               .   ***|     .              |     0.177708
  12     13.756376        0.16122    |               .    |***   .              |     0.180203
  13     -5.456571        -.06395    |               .     *|     .              |     0.182807
```

The PACF along with the plot of the variable indicate that one needs to conduct a unit root test with an intercept and time trend and one augmentation term (see Graph 4 for the PACF). The ADF with drift one and (there is an intercept but apparently no time trend based figure 2) with one augmentation meets an appropriate level of statistical significance (0.001) which seems to suggests that the appropriate variable for the proposed model necessitate one difference. Based all the above diagnoses, it appears that the main variable under investigation in this study needs to be differenced one in order to become stationary. Therefore, the model utilized below will use the differenced version of this variable.

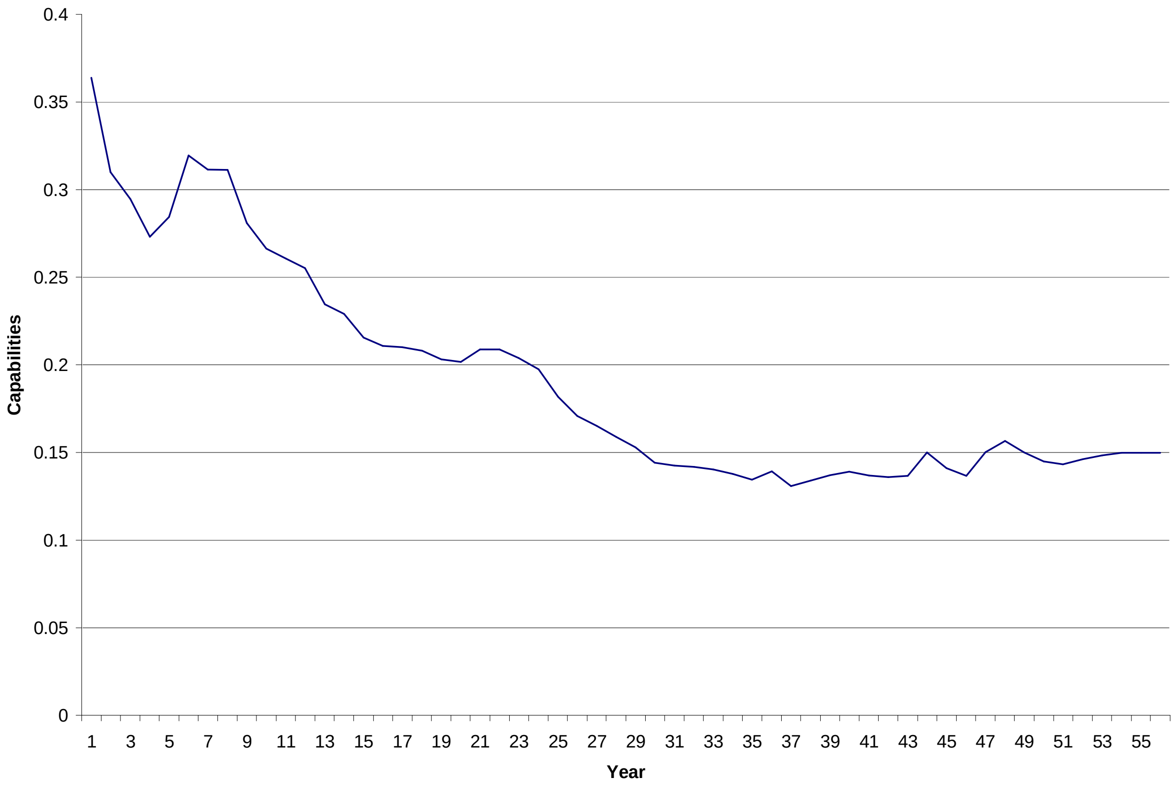
Graph 4: First-Differenced Partial Autocorrelation Function for Frequency of Civil Conflicts.

```
Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
  1       -0.37034    |             *******|    .               |
  2       -0.14948    |               . ***|    .               |
  3       -0.06128    |               .   *|    .               |
  4       -0.05020    |               .   *|    .               |
  5        0.02586    |               .    |*   .               |
  6       -0.12372    |               .  **|    .               |
  7       -0.30217    |              ******|    .               |
  8        0.17270    |               .    |*** .               |
  9       -0.13175    |               . ***|    .               |
 10       -0.08898    |               .  **|    .               |
 11       -0.25537    |               *****|    .               |
 12       -0.00456    |               .    |    .               |
 13       -0.15190    |               . ***|    .               |
```

After investigating the characteristics of the dependent variable and deciding that it needs one difference to become stationary, we undergo the same process with the independent variable of this study, mainly, hegemonic capabilities.

The same order as for the dependent variable to determine the characteristics of the independent variable (here identified as CAP in SAS). Figure 2 shows the graph of the capabilities of the hegemon – the United States – from 1946 to 2001. Similarly to the dependent variable, the independent variable clearly has both a time trend and an intercept; the only difference comes from the direction of the curve, i.e., the frequency of war seems to constantly increase over time while the relative capabilities of the hegemon follow a declining path over the time period under investigation. This graphical display may indicate that this variable is non-stationary, which leads to further statistical tests in order to decipher whether such is the case.

Figure 3: Hegemon's Capabilities, 1946-2001.



In a similar fashion to the dependent variable, the ACF gradually and relatively slowly declines to zero (See Graph 5). Again, this may indicate that the variable is either some sort of AR process or that it is non-stationary in its raw form. Yet, just looking at the ACF does not help generate satisfying conclusions about the nature of the independent variable insofar as the decline to zero seems a little too abrupt to ascertain that the variable is non-stationary.

Graph 5: Autocorrelation Function for Hegemon's Capabilities

```
 Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
   1     0.0034478        0.90665    |               .    |******************  |       0.133631
   2     0.0032167        0.84589    |           .        |*****************   |       0.217290
   3     0.0030128        0.79226    |         .          |****************    |       0.269758
   4     0.0028898        0.75993    |        .           |***************     |       0.308523
   5     0.0027524        0.72380    |      .             |**************      |       0.340311
   6     0.0024779        0.65161    |     .              |************* .     |       0.366772
   7     0.0022060        0.58011    |     .              |************  .     |       0.386892
   8     0.0019120        0.50281    |    .               |**********     .    |       0.402125
   9     0.0016974        0.44636    |   .                |*********       .   |       0.413200
  10     0.0015100        0.39707    |   .                |********        .   |       0.421722
  11     0.0013140        0.34555    |   .                |*******         .   |       0.428346
  12     0.0011055        0.29070    |   .                |******          .   |       0.433296
  13    0.00094833        0.24938    |   .                |*****           .   |       0.436764
  14    0.00077848        0.20472    |  .                 |****             .  |       0.439300
```

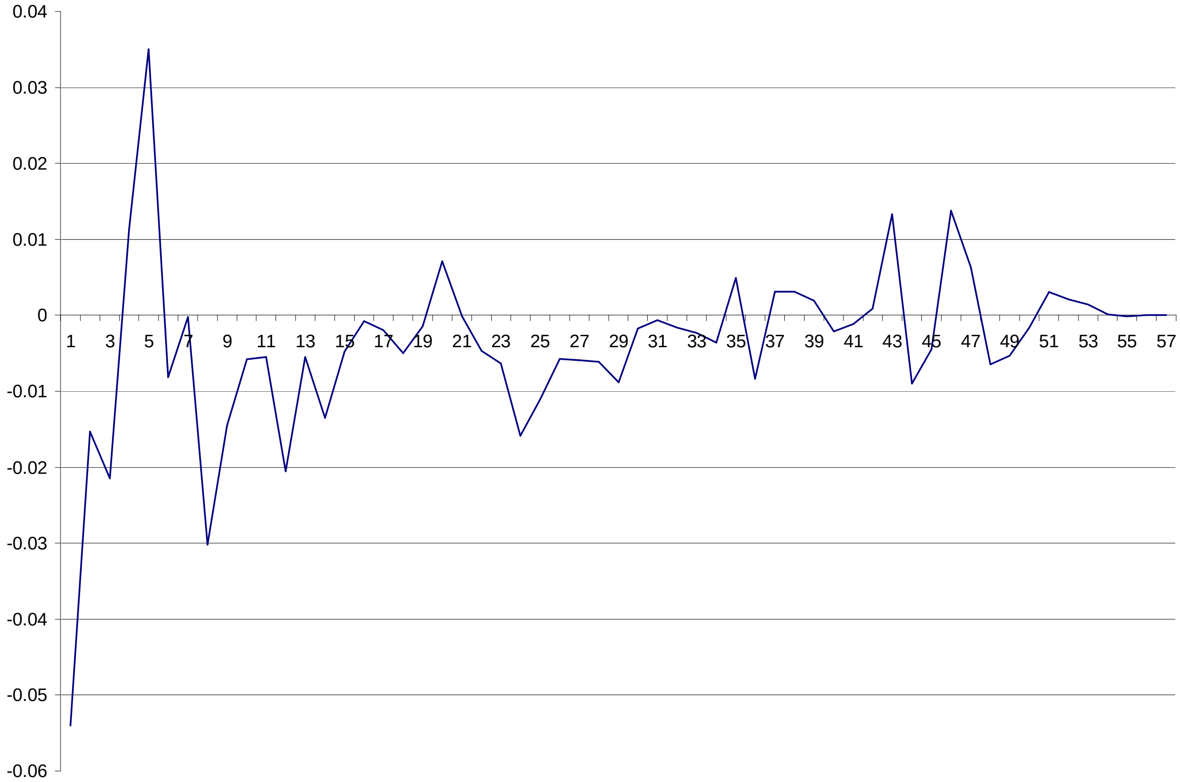
The PACF function is significant for the first lag only (see Graph 4) and loses significance directly thereafter, which indicates that it is an AR(1) process and that the ADF necessitates one augmentation term. The Augmented Dickey Fuller unit roots test with an intercept and time trend and one augmentation term has a statistical significance of 0.93. We therefore fail to reject the null that the series is non-stationary, which entails that it must first be differenced at least once to see whether such a variable will have become stationary

Graph 6: Partial Autocorrelation Function for Hegemon's Capabilities

```
 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
   1        0.90665    |               .    |******************  |
   2        0.13413    |               .    |*** .               |
   3        0.03773    |               .    |*   .               |
   4        0.11100    |               .    |**  .               |
   5        0.00765    |               .    |    .               |
   6       -0.21306    |               .****|    .               |
   7       -0.09660    |               .  **|    .               |
   8       -0.11733    |               .  **|    .               |
   9        0.00055    |               .    |    .               |
  10        0.02731    |               .    |*   .               |
  11        0.01388    |               .    |    .               |
  12       -0.00774    |               .    |    .               |
  13        0.07620    |               .    |**  .               |
  14       -0.04847    |               .   *|    .               |
```

Once differenced, the plot of the independent variable still has an intercept but it loses its time trend – therefore, when looking at the ADF unit root test, one needs to look at it with a drift only (see Figure 4 for the plot of the differenced "hegemon's capabilities" variable). However, the plot of the variable still shows a lot of variation since the series appears to vary greatly at the beginning of the time period under study to then vary at a moderate rate and around zero – which means that the series becomes rather stable towards the end of the time under study. With regards to the statistical tests necessary to address this differenced version, the ADF unit root test will be one with only a drift insofar as no time trend appears on the graphical expression of the series.

Figure 3: Hegemon's Capabilities, 1946-2001 – After One Difference



After one difference, the ACF for the hegemon's capabilities series becomes mostly white noise though its first lag seems to meet statistical significance (see Graph 7 for the ACF). Consequently, differencing the variable appears to have successfully removed the heteroskedasticity from the original version.

Graph 7: First-Differenced Autocorrelation Function for Hegemon's Capabilities.

```
 Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
   1    0.00003156        0.23155    |               .    |*****               |       0.134840
   2    9.28911E-6        0.06816    |              .     |*    .              |       0.141885
   3    -0.0000259        -.19037    |              . ****|     .              |       0.142479
   4    -0.0000330        -.24240    |              .*****|     .              |       0.147031
   5    0.00001357        0.09955    |              .     |**   .              |       0.154126
   6    0.00001060        0.07781    |              .     |**   .              |       0.155291
   7    0.00001387        0.10176    |              .     |**   .              |       0.155998
   8    7.77656E-6        0.05706    |              .     |*    .              |       0.157200
   9    2.22065E-6        0.01629    |              .     |     .              |       0.157576
  10    4.57472E-6        0.03357    |              .     |*    .              |       0.157607
  11    0.00002246        0.16478    |              .     |***  .              |       0.157737
  12    9.51935E-6        0.06985    |              .     |*    .              |       0.160836
  13    9.77856E-6        0.07175    |              .     |*    .              |       0.161387
```

The PACF shows that the series needs one augmentation for the ADF unit root test (see Graph 8 for the PACF). This test meets statistical significance at the .001 level, leading to the rejection the null that the series is non stationary. In essence, this series needs be differenced once in order to be stationary. In the section that follows – the analysis – the models utilize the first difference version of both the dependent and independent variables.

Graph 8: First-Differenced Partial Autocorrelation Function for Hegemon's Capabilities.

```
 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
   1        0.23155    |               .    |*****               |
   2        0.01537    |               .    |    .               |
   3       -0.22139    |               .****|    .               |
   4       -0.16845    |               . ***|    .               |
   5        0.24327    |               .    |*****               |
   6        0.00473    |               .    |    .               |
   7       -0.04366    |               .   *|    .               |
   8        0.05534    |               .    |*   .               |
   9        0.10164    |               .    |**  .               |
  10        0.00460    |               .    |    .               |
  11        0.18299    |               .    |****.               |
  12        0.01631    |               .    |    .               |
  13        0.03122    |               .    |*   .               |
```

ANALYSIS

After looking at the characteristics of the dependent and independent variables, the next step requires analyzing whether the two variables fit a transfer function. The computation of the cross-correlation between the frequency of civil wars and the share of total world capabilities possessed by the United States accomplishes this task. Additionally, this study needs to include the lags of the dependent variable that should have an impact on its current values – the number of necessary lagged values emanates from the results of the ACF and PACF for the differenced dependent variable. Referring back to the ACF and PACF of the differenced version of the dependent variable, (Graph 3 and Graph 4), only the first lag is significant in both function and then the series becomes non-significant. These findings does not help identify whether, on its own, the civil war variable necessitate and AR(1), MA(1), or an ARMA process. An information criteria tool, through the use of a MINIC procedure – a procedure that automatically identifies the best fitting model for a stationary variable – assist us in determining the best model (see appendix). The MINIC procedure indicates that the series is an AR(1), therefore, in the event the variables are amenable to a transfer function, the equation will also include the first lag of the dependent variable on the right hand side of the equation. The cross correlation function should help us decide whether 1) the variables fit a transfer function and, if this is the case, 2) how many lags of the independent variable must be included in the model.

Graph 9 shows the results of the cross-correlations between frequency of wars and hegemonic capabilities. Though the cross-correlations between the frequency of wars and the capabilities of the US are all insignificant for the negative lags (which is what we would look for), they are *also* insignificant for positive lags, which seems to indicate that there is no relationship between the two variables.

Graph 9: Cross-Correlations Between Frequency of War and Hegemonic Capabilities.

```
 Lag     Covariance   Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
 -13     -0.0072749       -.06746    |              .   *|    .              |
 -12     -0.0051275       -.04755    |              .   *|    .              |
 -11      0.0031552       0.02926    |              .    |*   .              |
 -10     -0.0026967       -.02501    |              .   *|    .              |
  -9     -0.0057553       -.05337    |              .   *|    .              |
  -8     -0.0055020       -.05102    |              .   *|    .              |
  -7     -0.0044435       -.04121    |              .   *|    .              |
  -6      0.0016754       0.01554    |              .    |    .              |
  -5     -0.0045185       -.04190    |              .   *|    .              |
  -4      -0.013816       -.12813    |              . ***|    .              |
  -3       0.011691       0.10842    |              .    |**  .              |
  -2       0.021196       0.19656    |              .    |****.              |
  -1      0.0057528       0.05335    |              .    |*   .              |
   0      0.0079291       0.07353    |              .    |*   .              |
   1      -0.016972       -.15739    |              . ***|    .              |
   2      0.0062852       0.05829    |              .    |*   .              |
   3      -0.023124       -.21444    |              .****|    .              |
   4     -0.0080739       -.07487    |              .   *|    .              |
   5      0.0081079       0.07519    |              .    |**  .              |
   6       0.011253       0.10436    |              .    |**  .              |
   7      0.0097008       0.08996    |              .    |**  .              |
   8      -0.012533       -.11623    |              .  **|    .              |
   9     -0.0067542       -.06263    |              .   *|    .              |
  10       0.016511       0.15311    |              .    |*** .              |
  11      -0.015547       -.14417    |              . ***|    .              |
  12       0.011536       0.10698    |              .    |**  .              |
  13      0.0021428       0.01987    |              .    |    .              |
```

In spite of this shortcoming and based on the theory proposed above (mainly that a decrease in the capabilities of the hegemonic power should lead to an increase in the occurrence of civil conflicts), four illustration purposes, this project depicts the results of the AR(1) model as well as that of the transfer function model including the lagged dependent and independent variables. For both models, and contrarily to what the plots seem to suggest, the intercept is irrelevant, therefore, only results excluding the intercept are shown (results with the intercept appear in the appendix). Also, because PRIO has data on conflicts till 2004, I will forecast the next three periods to compare and contrast them with the actual values. The results of the analysis appear in Table 1.

Table 1: Estimates from the AR(1) and Transfer Function)

	AR(1)	Transfer Function
War Lagged	-0.397*** (0.01)	-0.383*** (0.01)

Capabilities Lagged	-	-105.30 (0.20)
2002 Forecast	59.71 (8.65)	59.94 (8.69)
2003 Forecast	62.98 (10.12)	-
2004 Forecast	61.69 (12.07)	-
N	55	

* p<.10; ** p<.05; *** p<.01. The p-values are in parentheses for the coefficient estimates; the standard error is in parentheses for the forecasts.

As table 1 illustrates, hegemonic capabilities do not have a significant effect on the number of civil conflicts in the international system. In spite of this lack of significance, the relationship is in the expectation direction since a one unit increase in the hegemon's capabilities leads to a decrease of 105 civil conflicts in the system. On the other hand, and in both models, the lagged value of the dependent variable seems to explain move of the variation in current values therefore. Both coefficients are significant at the .01 level. Thus, a one unit increase in the change of frequency of civil wars in the most recent period leads to a decrease of .397 in the change of frequency in civil war – which means that roughly 40% of the change in the dependent variable is explained by its lagged value.

The forecasts for 2002 indicate that, based on the AR(1) model, one should expect to observe between 42.41 and 77.01 (by subtracting and adding the double of the standard error to the actual forecast). PRIO accounted for 48 conflicts in 2002, a number included in the range of confidence of the forecast presented here. This first forecast can thus be said to be adequately accurate. For 2003, the model predicts a number of wars that falls between 42.74 and 83.22 – with 95% confidence. PRIO accounted for 46 in 2003, again, a number that falls with the 95% confidence interval here though barely. Additionally, the 2003 forecast contains a huge confidence interval; consequently, one can barely say that this forecast is accurate enough for there exists a strong gap between 42 wars and 83 wars. As for 2003, the forecasts indicate that the world should experience somewhere between 37.55 and 85.83 – with 95% confidence. For the same year, PRIO reported 91 wars, a number that does not even fall within our level of confidence. A shortcoming of forecasting comes from the fact that they become less and less efficient as we move into the future for there are less and less "actual" observations on which to base the later forecasts. Overall, the range of the forecasts (maybe with the exception of the forecast 2002) appear too wide for anyone to be confident as to their accuracy.

DISCUSSION & FUTURE RESEARCH

This research project attempted to test whether there exists a relationship between the capabilities of the world's hegemonic power and the frequencies of civil conflicts therein. More precisely, this project posited that it expected a negative relationship between the two whereby a decrease in the major power's capabilities should diminish her ability to prevent and pre-empt conflict on the international scene, leading to an increase in civil wars. In order to determine whether the postulated hypothesis holds, data was gathered from competent sources and statistical analyses over the characteristics of those data ensued. The results demonstrate that there is no apparent relationship between the two proposed variables and that, instead, past civil wars explain the current amount of civil wars within the system. These contradictory (or rather non-supportive) findings raise several problems.

First, the models utilized remain very limited in their scope and the inclusion of variables. Much more factors than just past civil wars and the hegemon's power should account for the frequency of civil war at the global level. Second, the number of observations reduces the degrees of freedom and potentially precludes our ability to actually outline an existing relationship. Finally, the characteristics of the variables remain unclear. Both appear to be non-stationary in their raw form (and the unit root tests also seem to suggest this) but they may only necessitate partial difference in order to become stationary (as opposed to the full differencing that was conducted throughout this project). Thus, future research on the topic should attempt to address the points raise in 1) adding further variables through precise theorizing, 2) look for alternative sources of data in order to hopefully cover a longer time period, and 3) adequately manage to find the "true" characteristics of all variables included in the model.

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APPENDIX

The commands to read the data are:

```
/* These are the commands for final paper */
title 'Anne Etienne';
filename indata 'C:\Documents and Settings\Anne Etienne\Desktop\Classes\Time
Series\paper.csv';
data war;
infile indata delimiter=',';
input date cap war;
format date year4.;
run;
```

I got the following window upon reading the data into SAS:

```
267  /* These are the commands for final paper */
268  title 'Anne Etienne';
269  filename indata 'C:\Documents and Settings\Anne Etienne\Desktop\Classes\Time Series\paper.csv';
270  data war;
271  infile indata delimiter=',';
272  input date cap war;
273  format date year4.;
274  run;
NOTE: The infile INDATA is:
      File Name=C:\Documents and Settings\Anne Etienne\Desktop\Classes\Time Series\paper.csv,
      RECFM=V,LRECL=256
NOTE: 56 records were read from the infile INDATA.
      The minimum record length was 15.
      The maximum record length was 15.
NOTE: The data set WORK.WAR has 56 observations and 3 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds
```

I used the following command to check for the unit roots and to get the ACF and PACF of the number of civil wars in the international system as well as for these characteristics with regards to the US capabilities:

```
proc arima;
identify var=war stationarity=(ADF=(0,1,2,3));
identify var=war(1) stationarity=(ADF=(0,1,2,3));
run;
identify var=cap stationarity=(ADF=(0,1,2,3));
identify var=cap(1) stationarity=(ADF=(0,1,2,3));
run;
```

SAS generated the following log window after this command:

```
NOTE: PROCEDURE ARIMA used (Total process time):
      real time           1:51.62
      cpu time            0.61 seconds
283  proc arima;
284  identify var=war stationarity=(ADF=(0,1,2,3));
285  identify var=war(1) stationarity=(ADF=(0,1,2,3));
286  run;
287  identify var=cap stationarity=(ADF=(0,1,2,3));
288  identify var=cap(1) stationarity=(ADF=(0,1,2,3));
289  run;
```

I gathered the following output:

```
                    Name of Variable = war
                 Mean of Working Series    41.96429
```

```
                              Standard Deviation        14.27656
                              Number of Observations          56
                                       Autocorrelations
Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
  0       203.820        1.00000    |                    |********************|              0
  1       151.585        0.74372    |               .    |***************     |       0.133631
  2       137.010        0.67221    |            .       |*************       |       0.193936
  3       116.320        0.57070    |           .        |***********         |       0.231839
  4       104.089        0.51069    |          .         |**********          |       0.255698
  5     98.554733        0.48354    |         .          |**********.         |       0.273306
  6     88.252414        0.43299    |        .           |*********  .        |       0.288177
  7     91.578922        0.44931    |        .           |*********  .        |       0.299570
  8       104.221        0.51134    |        .           |********** .        |       0.311371
  9     79.657958        0.39082    |       .            |********    .       |       0.326022
 10     73.952578        0.36283    |       .            |*******     .       |       0.334283
 11     52.511867        0.25764    |      .             |*****        .      |       0.341243
 12     56.033528        0.27492    |      .             |*****        .      |       0.344699
 13     46.541158        0.22834    |      .             |*****        .      |       0.348593
 14     38.872130        0.19072    |      .             |****         .      |       0.351254
                                 "." marks two standard errors

                                    Inverse Autocorrelations
              Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
                1       -0.32888    |             *******|    .               |
                2       -0.16277    |               . ***|    .               |
                3       -0.03030    |               .   *|    .               |
                4        0.05549    |               .    |*   .               |
                5       -0.05369    |               .   *|    .               |
                6        0.11450    |               .    |**  .               |
                7        0.08281    |               .    |**  .               |
                8       -0.31286    |              ******|    .               |
                9        0.09923    |               .    |**  .               |
               10       -0.02293    |               .    |    .               |
               11        0.15413    |               .    |*** .               |
               12       -0.11626    |               .  **|    .               |
               13        0.01333    |               .    |    .               |
               14        0.01444    |               .    |    .               |

                                    Partial Autocorrelations
              Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
                1        0.74372    |               .    |***************     |
                2        0.26650    |               .    |*****               |
                3        0.01396    |               .    |    .               |
                4        0.04114    |               .    |*   .               |
                5        0.09768    |               .    |**  .               |
                6       -0.00031    |               .    |    .               |
                7        0.13162    |               .    |*** .               |
                8        0.24589    |               .    |*****               |
                9       -0.27515    |              ******|    .               |
               10       -0.04337    |               .   *|    .               |
               11       -0.10618    |               .  **|    .               |
               12        0.13280    |               .    |*** .               |
               13       -0.04977    |               .   *|    .               |
               14       -0.02398    |               .    |    .               |

                             Autocorrelation Check for White Noise
 To        Chi-             Pr >
Lag      Square     DF     ChiSq     --------------------Autocorrelations--------------------
  6      123.16      6    <.0001      0.744     0.672     0.571     0.511     0.484     0.433
 12      184.46     12    <.0001      0.449     0.511     0.391     0.363     0.258     0.275

                           Augmented Dickey-Fuller Unit Root Tests
   Type           Lags        Rho    Pr < Rho        Tau    Pr < Tau           F    Pr > F
   Zero Mean         0    -0.1435      0.6468      -0.09      0.6486
                     1     0.4029      0.7764       0.38      0.7913
                     2     0.4320      0.7836       0.46      0.8094
                     3     0.4202      0.7805       0.48      0.8142
   Single Mean       0   -11.4120      0.0800      -2.40      0.1449        3.14    0.2798
                     1    -6.9170      0.2622      -1.95      0.3075        2.44    0.4564
```

```
                   2     -4.9435      0.4245      -1.42      0.5655      1.43    0.7099
                   3     -4.1770      0.5053      -1.23      0.6571      1.12    0.7860
 Trend             0    -29.9302      0.0028      -4.38      0.0051      9.60    0.0010
                   1    -21.3715      0.0310      -3.19      0.0976      5.11    0.1695
                   2    -22.7070      0.0215      -2.90      0.1711      4.21    0.3460
                   3    -28.6571      0.0038      -2.87      0.1808      4.15    0.3578

                              Name of Variable = war

                   Period(s) of Differencing                        1
                   Mean of Working Series                    0.854545
                   Standard Deviation                        9.237115
                   Number of Observations                          55
                   Observation(s) eliminated by differencing        1

                                  Autocorrelations

Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error

  0     85.324298        1.00000    |                    |********************|             0
  1    -31.598732        -.37034    |             *******|    .               |      0.134840
  2      0.697412        0.00817    |              .     |     .              |      0.152214
  3      0.015705        0.00018    |              .     |     .              |      0.152222
  4     -1.792944        -.02101    |              .     |     .              |      0.152222
  5      4.160060        0.04876    |              .     |*    .              |      0.152275
  6    -11.178176        -.13101    |              .  ***|     .              |      0.152558
  7    -13.154759        -.15417    |              .  ***|     .              |      0.154590
  8     28.508328        0.33412    |              .     |*******             |      0.157361
  9    -22.886437        -.26823    |             . *****|      .             |      0.169770
 10      5.332352        0.06250    |             .      |*     .             |      0.177308
 11    -13.370512        -.15670    |             .   ***|      .             |      0.177708
 12     13.756376        0.16122    |             .      |***   .             |      0.180203
 13     -5.456571        -.06395    |             .     *|      .             |      0.182807

                           "." marks two standard errors

                              Inverse Autocorrelations

              Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

                1        0.51302    |               .    |**********          |
                2        0.38573    |               .    |********            |
                3        0.31355    |               .    |******              |
                4        0.34170    |               .    |*******             |
                5        0.29982    |               .    |******              |
                6        0.35514    |               .    |*******             |
                7        0.28997    |               .    |******              |
                8        0.10957    |               .    |**  .               |
                9        0.25393    |               .    |*****               |
               10        0.21695    |               .    |****.               |
               11        0.20619    |               .    |****.               |
               12        0.07808    |               .    |**  .               |
               13        0.08737    |               .    |**  .               |

                              Partial Autocorrelations

              Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

                1       -0.37034    |             *******|    .               |
                2       -0.14948    |               . ***|    .               |
                3       -0.06128    |               .   *|    .               |
                4       -0.05020    |               .   *|    .               |
                5        0.02586    |               .    |*   .               |
                6       -0.12372    |               .  **|    .               |
                7       -0.30217    |              ******|    .               |
                8        0.17270    |               .    |*** .               |
                9       -0.13175    |               . ***|    .               |
               10       -0.08898    |               .  **|    .               |
               11       -0.25537    |               *****|    .               |
               12       -0.00456    |               .    |    .               |
               13       -0.15190    |               . ***|    .               |

                        Autocorrelation Check for White Noise

 To        Chi-             Pr >
Lag      Square     DF     ChiSq     --------------------Autocorrelations--------------------

  6        9.24      6    0.1605     -0.370     0.008     0.000    -0.021     0.049    -0.131
 12       27.06     12    0.0076     -0.154     0.334    -0.268     0.062    -0.157     0.161
```

Augmented Dickey-Fuller Unit Root Tests

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-75.5019	<.0001	-10.54	<.0001		
	1	-90.6174	<.0001	-6.57	<.0001		
	2	-113.219	0.0001	-5.08	<.0001		
	3	-200.656	0.0001	-4.34	<.0001		
Single Mean	0	-75.8928	0.0005	-10.58	0.0001	56.07	0.0010
	1	-94.6124	0.0005	-6.62	0.0001	21.94	0.0010
	2	-126.193	0.0001	-5.13	0.0002	13.18	0.0010
	3	-272.666	0.0001	-4.40	0.0009	9.70	0.0010
Trend	0	-75.9887	<.0001	-10.48	<.0001	54.99	0.0010
	1	-94.5592	<.0001	-6.55	<.0001	21.51	0.0010
	2	-125.227	0.0001	-5.07	0.0007	12.96	0.0010
	3	-252.877	0.0001	-4.33	0.0060	9.60	0.0010

```
                         Name of Variable = cap
                   Mean of Working Series    0.191778
                   Standard Deviation        0.061666
                   Number of Observations          56
                            Autocorrelations
Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
  0     0.0038027        1.00000    |                    |********************|              0
  1     0.0034478        0.90665    |              .     |******************  |       0.133631
  2     0.0032167        0.84589    |          .         |*****************   |       0.217290
  3     0.0030128        0.79226    |        .           |****************    |       0.269758
  4     0.0028898        0.75993    |       .            |***************     |       0.308523
  5     0.0027524        0.72380    |     .              |**************      |       0.340311
  6     0.0024779        0.65161    |    .               |************* .     |       0.366772
  7     0.0022060        0.58011    |    .               |************  .     |       0.386892
  8     0.0019120        0.50281    |   .                |**********     .    |       0.402125
  9     0.0016974        0.44636    |  .                 |*********       .   |       0.413200
 10     0.0015100        0.39707    |  .                 |********        .   |       0.421722
 11     0.0013140        0.34555    |  .                 |*******         .   |       0.428346
 12     0.0011055        0.29070    |  .                 |******          .   |       0.433296
 13    0.00094833        0.24938    |  .                 |*****           .   |       0.436764
 14    0.00077848        0.20472    | .                  |****             .  |       0.439300
                                  "." marks two standard errors
```

```
                              Inverse Autocorrelations
              Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
                1       -0.40302    |           ********|    .               |
                2       -0.07368    |              .   *|    .               |
                3        0.07962    |              .    |**  .               |
                4       -0.02360    |              .    |    .               |
                5       -0.17478    |              . ***|    .               |
                6        0.08423    |              .    |**  .               |
                7       -0.07981    |              .  **|    .               |
                8        0.08526    |              .    |**  .               |
                9        0.03090    |              .    |*   .               |
               10       -0.02128    |              .    |    .               |
               11       -0.02318    |              .    |    .               |
               12        0.08148    |              .    |**  .               |
               13       -0.08823    |              .  **|    .               |
               14        0.02878    |              .    |*   .               |
```

```
                              Partial Autocorrelations
              Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
                1        0.90665    |              .    |******************  |
                2        0.13413    |              .    |*** .               |
                3        0.03773    |              .    |*   .               |
                4        0.11100    |              .    |**  .               |
                5        0.00765    |              .    |    .               |
                6       -0.21306    |              .****|    .               |
                7       -0.09660    |              .  **|    .               |
                8       -0.11733    |              .  **|    .               |
                9        0.00055    |              .    |    .               |
               10        0.02731    |              .    |*   .               |
               11        0.01388    |              .    |    .               |
               12       -0.00774    |              .    |    .               |
```

```
              13        0.07620    |               .    |**  .               |
              14       -0.04847    |               .   *|    .               |

                         Autocorrelation Check for White Noise
  To        Chi-             Pr >
 Lag      Square     DF     ChiSq    --------------------Autocorrelations--------------------
   6      227.06      6    <.0001     0.907     0.846     0.792     0.760     0.724     0.652
  12      306.24     12    <.0001     0.580     0.503     0.446     0.397     0.346     0.291

                       Augmented Dickey-Fuller Unit Root Tests
   Type           Lags        Rho    Pr < Rho        Tau    Pr < Tau          F    Pr > F
   Zero Mean         0    -1.4471      0.3993      -3.52      0.0007
                     1    -0.9356      0.4804      -2.03      0.0416
                     2    -0.9193      0.4832      -1.92      0.0534
                     3    -0.8687      0.4923      -2.55      0.0116
   Single Mean       0    -4.6742      0.4525      -3.68      0.0069      10.47    0.0010
                     1    -2.6664      0.6891      -1.82      0.3674       2.87    0.3476
                     2    -2.7207      0.6820      -1.80      0.3779       2.66    0.4007
                     3    -2.1399      0.7550      -1.99      0.2917       4.08    0.0870
   Trend             0    -6.3891      0.6939      -2.34      0.4036       6.96    0.0377
                     1    -3.3169      0.9176      -1.08      0.9229       1.65    0.8466
                     2    -3.4383      0.9113      -1.06      0.9259       1.61    0.8546
                     3    -0.6222      0.9907      -0.29      0.9888       2.23    0.7347

                             Name of Variable = cap
                 Period(s) of Differencing                          1
                 Mean of Working Series                       -0.0039
                 Standard Deviation                          0.011674
                 Number of Observations                            55
                 Observation(s) eliminated by differencing          1
                                  Autocorrelations
Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
  0    0.00013628        1.00000    |                    |********************|              0
  1    0.00003156        0.23155    |               .    |*****               |       0.134840
  2    9.28911E-6        0.06816    |              .     |*    .              |       0.141885
  3    -0.0000259        -.19037    |              . ****|     .              |       0.142479
  4    -0.0000330        -.24240    |              .*****|     .              |       0.147031
  5    0.00001357        0.09955    |              .     |**   .              |       0.154126
  6    0.00001060        0.07781    |              .     |**   .              |       0.155291
  7    0.00001387        0.10176    |              .     |**   .              |       0.155998
  8    7.77656E-6        0.05706    |              .     |*    .              |       0.157200
  9    2.22065E-6        0.01629    |              .     |     .              |       0.157576
 10    4.57472E-6        0.03357    |              .     |*    .              |       0.157607
 11    0.00002246        0.16478    |              .     |***  .              |       0.157737
 12    9.51935E-6        0.06985    |              .     |*    .              |       0.160836
 13    9.77856E-6        0.07175    |              .     |*    .              |       0.161387
                           "." marks two standard errors

                            Inverse Autocorrelations
             Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
               1       -0.18879    |               .****|    .               |
               2       -0.18924    |               .****|    .               |
               3        0.19259    |               .    |****.               |
               4        0.23489    |               .    |*****               |
               5       -0.25171    |               *****|    .               |
               6        0.04172    |               .    |*   .               |
               7        0.01788    |               .    |    .               |
               8       -0.06580    |               .   *|    .               |
               9       -0.06419    |               .   *|    .               |
              10        0.05110    |               .    |*   .               |
              11       -0.13171    |               . ***|    .               |
              12       -0.00169    |               .    |    .               |
              13       -0.02421    |               .    |    .               |

                            Partial Autocorrelations
             Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
               1        0.23155    |               .    |*****               |
               2        0.01537    |               .    |    .               |
               3       -0.22139    |               .****|    .               |
```

```
      4      -0.16845    |                 . ***|    .                |
      5       0.24327    |                 .    |*****                |
      6       0.00473    |                 .    |    .                |
      7      -0.04366    |                 .   *|    .                |
      8       0.05534    |                 .    |*   .                |
      9       0.10164    |                 .    |**  .                |
     10       0.00460    |                 .    |    .                |
     11       0.18299    |                 .    |****.                |
     12       0.01631    |                 .    |    .                |
     13       0.03122    |                 .    |*   .                |
```

```
                         Autocorrelation Check for White Noise
 To        Chi-             Pr >
Lag      Square     DF     ChiSq    --------------------Autocorrelations--------------------
  6       10.19      6    0.1168     0.232     0.068    -0.190    -0.242     0.100     0.078
 12       13.47     12    0.3356     0.102     0.057     0.016     0.034     0.165     0.070
```

```
                       Augmented Dickey-Fuller Unit Root Tests
 Type          Lags         Rho   Pr < Rho       Tau   Pr < Tau          F    Pr > F
 Zero Mean        0    -38.6077     <.0001     -6.91     <.0001
                  1    -34.0931     <.0001     -4.69     <.0001
                  2    -66.1990     <.0001     -5.29     <.0001
                  3    -65.6449     <.0001     -3.99     0.0002
 Single Mean      0    -41.4473     0.0005     -7.11     0.0001      25.61    0.0010
                  1    -39.6393     0.0005     -4.93     0.0002      12.23    0.0010
                  2    -97.9559     0.0005     -5.78     0.0001      16.83    0.0010
                  3    -202.261     0.0001     -4.75     0.0003      11.30    0.0010
 Trend            0    -44.6670     <.0001     -7.24     <.0001      26.92    0.0010
                  1    -46.8576     <.0001     -5.15     0.0005      13.44    0.0010
                  2    -170.929     0.0001     -6.32     <.0001      20.16    0.0010
                  3    261.0757     0.9999     -6.05     <.0001      18.35    0.0010
```

The command for the cross-correlation function is:

```
proc arima;
identify var=war(1) crosscor=(cap(1));
run;
```

The log window reads:

```
NOTE: PROCEDURE ARIMA used (Total process time):
      real time           1:03:27.54
      cpu time            1.14 seconds
290  proc arima;
291  identify var=war(1) crosscor=(cap(1));
292  run;
```

I gathered this output:

```
                              Name of Variable = war
               Period(s) of Differencing                        1
               Mean of Working Series                    0.854545
               Standard Deviation                        9.237115
               Number of Observations                          55
               Observation(s) eliminated by differencing        1
                                   Autocorrelations
 Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
   0     85.324298        1.00000    |                    |********************|             0
   1    -31.598732        -.37034    |             *******|    .                |      0.134840
   2      0.697412        0.00817    |               .    |     .               |      0.152214
   3      0.015705        0.00018    |               .    |     .               |      0.152222
   4     -1.792944        -.02101    |               .    |     .               |      0.152222
   5      4.160060        0.04876    |               .    |*    .               |      0.152275
   6    -11.178176        -.13101    |               .  ***|    .               |      0.152558
   7    -13.154759        -.15417    |               .  ***|    .               |      0.154590
   8     28.508328        0.33412    |               .    |*******              |      0.157361
   9    -22.886437        -.26823    |              . *****|     .              |      0.169770
  10      5.332352        0.06250    |              .     |*     .              |      0.177308
  11    -13.370512        -.15670    |              .  ***|     .              |      0.177708
```

```
12     13.756376        0.16122    |             .      |***    .            |       0.180203
13     -5.456571        -.06395    |             .     *|       .            |       0.182807
                            "." marks two standard errors

                               Inverse Autocorrelations
             Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
               1        0.51302    |               .    |**********          |
               2        0.38573    |               .    |********            |
               3        0.31355    |               .    |******              |
               4        0.34170    |               .    |*******             |
               5        0.29982    |               .    |******              |
               6        0.35514    |               .    |*******             |
               7        0.28997    |               .    |******              |
               8        0.10957    |               .    |**   .              |
               9        0.25393    |               .    |*****               |
              10        0.21695    |               .    |****.               |
              11        0.20619    |               .    |****.               |
              12        0.07808    |               .    |**   .              |
              13        0.08737    |               .    |**   .              |

                               Partial Autocorrelations
             Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
               1       -0.37034    |            *******|     .              |
               2       -0.14948    |              . ***|     .              |
               3       -0.06128    |              .   *|     .              |
               4       -0.05020    |              .   *|     .              |
               5        0.02586    |              .    |*    .              |
               6       -0.12372    |              .  **|     .              |
               7       -0.30217    |             ******|     .              |
               8        0.17270    |              .    |***  .              |
               9       -0.13175    |              . ***|     .              |
              10       -0.08898    |              .  **|     .              |
              11       -0.25537    |              *****|     .              |
              12       -0.00456    |              .    |     .              |
              13       -0.15190    |              . ***|     .              |

                         Autocorrelation Check for White Noise
 To        Chi-             Pr >
Lag      Square     DF     ChiSq    --------------------Autocorrelations--------------------
  6        9.24      6    0.1605    -0.370     0.008     0.000    -0.021     0.049    -0.131
 12       27.06     12    0.0076    -0.154     0.334    -0.268     0.062    -0.157     0.161

                          Variable cap has been differenced.
                             Correlation of war and cap
                  Period(s) of Differencing                           1
                  Variance of input =                          0.000136
                  Number of Observations                             55
                  Observation(s) eliminated by differencing           1
                                    Crosscorrelations
      Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
      -13    -0.0072749        -.06746    |               .   *|    .               |
      -12    -0.0051275        -.04755    |               .   *|    .               |
      -11     0.0031552        0.02926    |               .    |*   .               |
      -10    -0.0026967        -.02501    |               .   *|    .               |
       -9    -0.0057553        -.05337    |               .   *|    .               |
       -8    -0.0055020        -.05102    |               .   *|    .               |
       -7    -0.0044435        -.04121    |               .   *|    .               |
       -6     0.0016754        0.01554    |               .    |    .               |
       -5    -0.0045185        -.04190    |               .   *|    .               |
       -4     -0.013816        -.12813    |               . ***|    .               |
       -3      0.011691        0.10842    |               .    |**  .               |
       -2      0.021196        0.19656    |               .    |****.               |
       -1     0.0057528        0.05335    |               .    |*   .               |
        0     0.0079291        0.07353    |               .    |*   .               |
        1     -0.016972        -.15739    |               . ***|    .               |
        2     0.0062852        0.05829    |               .    |*   .               |
        3     -0.023124        -.21444    |               .****|    .               |
        4    -0.0080739        -.07487    |               .   *|    .               |
        5     0.0081079        0.07519    |               .    |**  .               |
```

```
   6       0.011253         0.10436    |                  .    |**   .                   |
   7      0.0097008         0.08996    |                  .    |**   .                   |
   8      -0.012533         -.11623    |                  .  **|     .                   |
   9     -0.0067542         -.06263    |                  .   *|     .                   |
  10       0.016511         0.15311    |                  .    |***  .                   |
  11      -0.015547         -.14417    |                  . ***|     .                   |
  12       0.011536         0.10698    |                  .    |**   .                   |
  13      0.0021428         0.01987    |                  .    |     .                   |

                                "." marks two standard errors
```

Here are the commands for the MINIC procedure for war:

```
proc arima;
identify var=war(1) minic p=(0:4) q=(0:4);
run;
```

SAS generates this log window:

```
NOTE: PROCEDURE ARIMA used (Total process time):
      real time           14:02.95
      cpu time            1.18 seconds
293  proc arima;
294  identify var=war(1) minic p=(0:4) q=(0:4);
295  run;
```

I gather the following output:

```
                                       Name of Variable = war
                        Period(s) of Differencing                          1
                        Mean of Working Series                      0.854545
                        Standard Deviation                          9.237115
                        Number of Observations                            55
                        Observation(s) eliminated by differencing          1
                                          Autocorrelations
   Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
     0     85.324298        1.00000    |                    |********************|             0
     1    -31.598732        -.37034    |             *******|    .               |      0.134840
     2      0.697412        0.00817    |              .     |     .              |      0.152214
     3      0.015705        0.00018    |              .     |     .              |      0.152222
     4     -1.792944        -.02101    |              .     |     .              |      0.152222
     5      4.160060        0.04876    |              .     |*    .              |      0.152275
     6    -11.178176        -.13101    |              .  ***|     .              |      0.152558
     7    -13.154759        -.15417    |              .  ***|     .              |      0.154590
     8     28.508328        0.33412    |              .     |*******             |      0.157361
     9    -22.886437        -.26823    |             . *****|      .             |      0.169770
    10      5.332352        0.06250    |             .      |*     .             |      0.177308
    11    -13.370512        -.15670    |             .   ***|      .             |      0.177708
    12     13.756376        0.16122    |             .      |***   .             |      0.180203
    13     -5.456571        -.06395    |             .     *|      .             |      0.182807
                                "." marks two standard errors

                                       Inverse Autocorrelations
                 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
                   1        0.51302    |               .    |**********          |
                   2        0.38573    |               .    |********            |
                   3        0.31355    |               .    |******              |
                   4        0.34170    |               .    |*******             |
                   5        0.29982    |               .    |******              |
                   6        0.35514    |               .    |*******             |
                   7        0.28997    |               .    |******              |
                   8        0.10957    |               .    |**   .              |
                   9        0.25393    |               .    |*****               |
                  10        0.21695    |               .    |****.               |
                  11        0.20619    |               .    |****.               |
                  12        0.07808    |               .    |**   .              |
                  13        0.08737    |               .    |**   .              |

                                       Partial Autocorrelations
                 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
```

```
         1       -0.37034    |             *******|    .               |
         2       -0.14948    |               . ***|    .               |
         3       -0.06128    |               .   *|    .               |
         4       -0.05020    |               .   *|    .               |
         5        0.02586    |               .    |*   .               |
         6       -0.12372    |               .  **|    .               |
         7       -0.30217    |              ******|    .               |
         8        0.17270    |               .    |***.               |
         9       -0.13175    |               . ***|    .               |
        10       -0.08898    |               .  **|    .               |
        11       -0.25537    |               *****|    .               |
        12       -0.00456    |               .    |    .               |
        13       -0.15190    |               . ***|    .               |
```

```
                          Autocorrelation Check for White Noise
 To        Chi-             Pr >
 Lag      Square     DF     ChiSq    --------------------Autocorrelations--------------------
   6        9.24      6     0.1605    -0.370     0.008     0.000    -0.021     0.049    -0.131
  12       27.06     12     0.0076    -0.154     0.334    -0.268     0.062    -0.157     0.161
```

```
                             Minimum Information Criterion
                      Lags      MA 0      MA 1      MA 2      MA 3      MA 4
                      AR 0   4.28561  4.160572  4.231941  4.302681  4.359798
                      AR 1  4.132086  4.198996   4.23183  4.302676  4.347672
                      AR 2   4.17198  4.241038   4.30231  4.367242  4.416883
                      AR 3  4.233321  4.293858   4.36578  4.438208  4.400625
                      AR 4  4.296039  4.351859  4.424705  4.490416  4.470538
                             Error series model:  AR(8)
                             Minimum Table Value: BIC(1,0) = 4.132086
```

The command for estimating the models are:

```
proc arima;
identify var=war(1) crosscorr=(cap(1));
estimate p=1 method=ML;
estimate p=1 input=(1$ cap) method=ML;
run;
```

The log window reads:

```
NOTE: PROCEDURE ARIMA used (Total process time):
      real time           8:51.10
      cpu time            0.60 seconds
305  proc arima;
306  identify var=war(1) crosscorr=(cap(1));
307  estimate p=1 method=ML;
308  estimate p=1 input=(1$ cap) method=ML;
309  run;
```

I get this output:

```
                                    Name of Variable = war
                      Period(s) of Differencing                             1
                      Mean of Working Series                         0.854545
                      Standard Deviation                             9.237115
                      Number of Observations                               55
                      Observation(s) eliminated by differencing             1
                                        Autocorrelations
 Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
   0     85.324298        1.00000    |                    |********************|             0
   1    -31.598732        -.37034    |             *******|    .               |      0.134840
   2      0.697412        0.00817    |              .     |     .              |      0.152214
   3      0.015705        0.00018    |              .     |     .              |      0.152222
   4     -1.792944        -.02101    |              .     |     .              |      0.152222
   5      4.160060        0.04876    |              .     |*    .              |      0.152275
   6    -11.178176        -.13101    |              .  ***|     .              |      0.152558
   7    -13.154759        -.15417    |              .  ***|     .              |      0.154590
   8     28.508328        0.33412    |              .     |*******             |      0.157361
   9    -22.886437        -.26823    |             . *****|      .             |      0.169770
  10      5.332352        0.06250    |             .      |*     .             |      0.177308
```

```
11    -13.370512        -.15670    |             .   ***|      .              |       0.177708
12     13.756376        0.16122    |             .      |***   .              |       0.180203
13     -5.456571        -.06395    |             .     *|      .              |       0.182807
                                "." marks two standard errors
```

```
                       Inverse Autocorrelations
 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
   1        0.51302    |               .    |**********          |
   2        0.38573    |               .    |********            |
   3        0.31355    |               .    |******              |
   4        0.34170    |               .    |*******             |
   5        0.29982    |               .    |******              |
   6        0.35514    |               .    |*******             |
   7        0.28997    |               .    |******              |
   8        0.10957    |               .    |**   .              |
   9        0.25393    |               .    |*****               |
  10        0.21695    |               .    |****.               |
  11        0.20619    |               .    |****.               |
  12        0.07808    |               .    |**   .              |
  13        0.08737    |               .    |**   .              |

                       Partial Autocorrelations
 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
   1       -0.37034    |             *******|    .               |
   2       -0.14948    |               . ***|    .               |
   3       -0.06128    |               .   *|    .               |
   4       -0.05020    |               .   *|    .               |
   5        0.02586    |               .    |*   .               |
   6       -0.12372    |               .  **|    .               |
   7       -0.30217    |              ******|    .               |
   8        0.17270    |               .    |*** .               |
   9       -0.13175    |               . ***|    .               |
  10       -0.08898    |               .  **|    .               |
  11       -0.25537    |               *****|    .               |
  12       -0.00456    |               .    |    .               |
  13       -0.15190    |               . ***|    .               |

                 Autocorrelation Check for White Noise
 To        Chi-             Pr >
Lag      Square     DF     ChiSq    --------------------Autocorrelations--------------------
  6        9.24      6    0.1605    -0.370     0.008     0.000    -0.021     0.049    -0.131
 12       27.06     12    0.0076    -0.154     0.334    -0.268     0.062    -0.157     0.161

                  Variable cap has been differenced.
                     Correlation of war and cap
          Period(s) of Differencing                        1
          Variance of input =                       0.000136
          Number of Observations                          55
          Observation(s) eliminated by differencing        1
```

```
                                        Crosscorrelations
 Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
 -13    -0.0072749        -.06746     |               .   *|    .               |
 -12    -0.0051275        -.04755     |               .   *|    .               |
 -11     0.0031552        0.02926     |               .    |*   .               |
 -10    -0.0026967        -.02501     |               .   *|    .               |
  -9    -0.0057553        -.05337     |               .   *|    .               |
  -8    -0.0055020        -.05102     |               .   *|    .               |
  -7    -0.0044435        -.04121     |               .   *|    .               |
  -6     0.0016754        0.01554     |               .    |    .               |
  -5    -0.0045185        -.04190     |               .   *|    .               |
  -4     -0.013816        -.12813     |               . ***|    .               |
  -3      0.011691        0.10842     |               .    |**  .               |
  -2      0.021196        0.19656     |               .    |****.               |
  -1     0.0057528        0.05335     |               .    |*   .               |
   0     0.0079291        0.07353     |               .    |*   .               |
   1     -0.016972        -.15739     |               . ***|    .               |
   2     0.0062852        0.05829     |               .    |*   .               |
   3     -0.023124        -.21444     |               .****|    .               |
   4    -0.0080739        -.07487     |               .   *|    .               |
   5     0.0081079        0.07519     |               .    |**  .               |
   6      0.011253        0.10436     |               .    |**  .               |
   7     0.0097008        0.08996     |               .    |**  .               |
   8     -0.012533        -.11623     |               .  **|    .               |
   9    -0.0067542        -.06263     |               .   *|    .               |
  10      0.016511        0.15311     |               .    |*** .               |
  11     -0.015547        -.14417     |               . ***|    .               |
  12      0.011536        0.10698     |               .    |**  .               |
  13     0.0021428        0.01987     |               .    |    .               |
                                  "." marks two standard errors

                                  Maximum Likelihood Estimation
                                            Standard                 Approx
      Parameter      Estimate        Error     t Value     Pr > |t|       Lag
      MU              0.78963      0.83585        0.94       0.3448         0
      AR1,1          -0.40334      0.13202       -3.06       0.0022         1

                                 Constant Estimate      1.108127
                                 Variance Estimate      75.05315
                                 Std Error Estimate     8.663322
                                 AIC                    395.7243
                                 SBC                     399.739
                                 Number of Residuals          55

                                   Correlations of Parameter
                                           Estimates
                                  Parameter         MU     AR1,1
                                  MU             1.000     0.030
                                  AR1,1          0.030     1.000

                               Autocorrelation Check of Residuals
 To        Chi-              Pr >
Lag      Square     DF       ChiSq     --------------------Autocorrelations--------------------
  6        4.77      5      0.4441     -0.047     -0.128     -0.048     -0.017     -0.007     -0.234
 12       14.92     11      0.1860     -0.097      0.268     -0.148     -0.081     -0.163      0.111
 18       16.76     17      0.4707      0.007     -0.035     -0.038      0.121      0.027      0.067
 24       19.14     23      0.6930     -0.024     -0.012      0.068      0.027     -0.117      0.068

                                    Model for variable war
                              Estimated Mean               0.789634
                              Period(s) of Differencing           1

                                     Autoregressive Factors
                                 Factor 1:  1 + 0.40334 B**(1)

                                  Maximum Likelihood Estimation
                                 Standard                Approx
Parameter       Estimate            Error     t Value     Pr > |t|      Lag    Variable    Shift
MU               0.48336          0.92335        0.52       0.6006        0    war             0
```

```
AR1,1          -0.38773       0.13611      -2.85       0.0044        1     war             0
NUM1          -88.16126      89.41047      -0.99       0.3241        0     cap             1

                             Constant Estimate       0.670776
                             Variance Estimate       76.53625
                             Std Error Estimate        8.7485
                             AIC                      390.561
                             SBC                      396.528
                             Number of Residuals           54

                            Correlations of Parameter Estimates
                      Variable                  war        war        cap
                      Parameter                  MU      AR1,1       NUM1
                      war             MU      1.000      0.017      0.360
                      war          AR1,1      0.017      1.000     -0.034
                      cap           NUM1      0.360     -0.034      1.000

                             Autocorrelation Check of Residuals
 To        Chi-                Pr >
Lag      Square      DF      ChiSq     --------------------Autocorrelations--------------------
  6        4.74       5     0.4489     -0.041     -0.129     -0.030      0.013      0.011     -0.239
 12       14.99      11     0.1832     -0.157      0.234     -0.152     -0.091     -0.170      0.112
 18       16.99      17     0.4549      0.014     -0.032     -0.033      0.114      0.034      0.091
 24       19.49      23     0.6726     -0.002      0.012      0.072      0.028     -0.126      0.062

                             Model for variable war
                        Estimated Intercept         0.483362
                        Period(s) of Differencing          1
                                Autoregressive Factors
                             Factor 1:   1 + 0.38773 B**(1)

                                  Input Number 1
                        Input Variable                   cap
                        Shift                              1
                        Period(s) of Differencing          1
                        Overall Regression Factor   -88.1613
```

I use the following commands to run the models without an intercept and to forecast the output:

```
proc arima;
identify var=war(1) crosscorr=(cap(1));
estimate p=1 method=ML noint;
forecast lead=3;
estimate p=1 input=(1$ cap) method=ML noint;
forecast lead=3;
run;
```

SAS shows the following log window:

```
proc arima;
identify var=war(1) crosscorr=(cap(1));
estimate p=1 method=ML noint;
forecast lead=3;
estimate p=1 input=(1$ cap) method=ML noint;
forecast lead=3;
run;
```

I get this output:

```
                                Name of Variable = war
                  Period(s) of Differencing                           1
                  Mean of Working Series                       0.854545
                  Standard Deviation                           9.237115
                  Number of Observations                             55
                  Observation(s) eliminated by differencing           1

                                    Autocorrelations
Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1      Std Error
  0     85.324298       1.00000    |                    |********************|             0
```

```
  1    -31.598732        -.37034     |             *******|    .               |       0.134840
  2      0.697412        0.00817     |              .     |     .              |       0.152214
  3      0.015705        0.00018     |              .     |     .              |       0.152222
  4     -1.792944        -.02101     |              .     |     .              |       0.152222
  5      4.160060        0.04876     |              .     |*    .              |       0.152275
  6    -11.178176        -.13101     |              .  ***|     .              |       0.152558
  7    -13.154759        -.15417     |              .  ***|     .              |       0.154590
  8     28.508328        0.33412     |              .     |*******             |       0.157361
  9    -22.886437        -.26823     |             . *****|      .             |       0.169770
 10      5.332352        0.06250     |             .      |*     .             |       0.177308
 11    -13.370512        -.15670     |             .   ***|      .             |       0.177708
 12     13.756376        0.16122     |             .      |***   .             |       0.180203
 13     -5.456571        -.06395     |             .     *|      .             |       0.182807
                                 "." marks two standard errors

                                    Inverse Autocorrelations
                 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
                   1        0.51302     |               .    |**********          |
                   2        0.38573     |               .    |********            |
                   3        0.31355     |               .    |******              |
                   4        0.34170     |               .    |*******             |
                   5        0.29982     |               .    |******              |
                   6        0.35514     |               .    |*******             |
                   7        0.28997     |               .    |******              |
                   8        0.10957     |               .    |**  .               |
                   9        0.25393     |               .    |*****               |
                  10        0.21695     |               .    |****.               |
                  11        0.20619     |               .    |****.               |
                  12        0.07808     |               .    |**  .               |
                  13        0.08737     |               .    |**  .               |
```

```
                           Partial Autocorrelations
 Lag    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
   1       -0.37034    |             *******|    .               |
   2       -0.14948    |               . ***|    .               |
   3       -0.06128    |               .   *|    .               |
   4       -0.05020    |               .   *|    .               |
   5        0.02586    |               .    |*   .               |
   6       -0.12372    |               .  **|    .               |
   7       -0.30217    |              ******|    .               |
   8        0.17270    |               .    |*** .               |
   9       -0.13175    |               . ***|    .               |
  10       -0.08898    |               .  **|    .               |
  11       -0.25537    |               *****|    .               |
  12       -0.00456    |               .    |    .               |
  13       -0.15190    |               . ***|    .               |

                    Autocorrelation Check for White Noise
 To        Chi-          Pr >
Lag      Square    DF    ChiSq    --------------------Autocorrelations--------------------
  6        9.24     6   0.1605    -0.370      0.008     0.000    -0.021     0.049    -0.131
 12       27.06    12   0.0076    -0.154      0.334    -0.268     0.062    -0.157     0.161

                        Correlation of war and cap
            Period(s) of Differencing                          1
            Variance of input =                         0.000136
            Number of Observations                            55
            Observation(s) eliminated by differencing          1

                              Crosscorrelations
 Lag    Covariance    Correlation    -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
 -13    -0.0072749        -.06746    |               .   *|    .               |
 -12    -0.0051275        -.04755    |               .   *|    .               |
 -11     0.0031552        0.02926    |               .    |*   .               |
 -10    -0.0026967        -.02501    |               .   *|    .               |
  -9    -0.0057553        -.05337    |               .   *|    .               |
  -8    -0.0055020        -.05102    |               .   *|    .               |
  -7    -0.0044435        -.04121    |               .   *|    .               |
  -6     0.0016754        0.01554    |               .    |    .               |
  -5    -0.0045185        -.04190    |               .   *|    .               |
  -4     -0.013816        -.12813    |               . ***|    .               |
  -3      0.011691        0.10842    |               .    |**  .               |
  -2      0.021196        0.19656    |               .    |****.               |
  -1     0.0057528        0.05335    |               .    |*   .               |
   0     0.0079291        0.07353    |               .    |*   .               |
   1     -0.016972        -.15739    |               . ***|    .               |
   2     0.0062852        0.05829    |               .    |*   .               |
   3     -0.023124        -.21444    |               .****|    .               |
   4    -0.0080739        -.07487    |               .   *|    .               |
   5     0.0081079        0.07519    |               .    |**  .               |
   6      0.011253        0.10436    |               .    |**  .               |
   7     0.0097008        0.08996    |               .    |**  .               |
   8     -0.012533        -.11623    |               .  **|    .               |
   9    -0.0067542        -.06263    |               .   *|    .               |
  10      0.016511        0.15311    |               .    |*** .               |
  11     -0.015547        -.14417    |               . ***|    .               |
  12      0.011536        0.10698    |               .    |**  .               |
  13     0.0021428        0.01987    |               .    |    .               |
                        Maximum Likelihood Estimation
                                  Standard                  Approx
     Parameter        Estimate       Error    t Value    Pr > |t|      Lag
     AR1,1            -0.39469     0.13177      -3.00      0.0027        1

                         Variance Estimate      74.90602
                         Std Error Estimate     8.654827
                         AIC                    394.6363
                         SBC                    396.6436
                         Number of Residuals          55

                        Autocorrelation Check of Residuals
```

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	4.13	5	0.5303	-0.041	-0.109	-0.039	-0.013	-0.002	-0.225
12	13.82	11	0.2432	-0.088	0.279	-0.130	-0.054	-0.145	0.125
18	15.96	17	0.5264	0.023	-0.015	-0.023	0.132	0.038	0.078
24	18.31	23	0.7405	-0.016	-0.004	0.073	0.036	-0.109	0.073

Model for variable war
Period(s) of Differencing 1
No mean term in this model.

Autoregressive Factors
Factor 1: 1 + 0.39469 B**(1)

Forecasts for variable war

Obs	Forecast	Std Error	95% Confidence Limits	
57	59.7116	8.6548	42.7485	76.6748
58	62.9829	10.1169	43.1541	82.8117
59	61.6918	12.0724	38.0304	85.3532

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag	Variable	Shift
AR1,1	-0.38414	0.13533	-2.84	0.0045	1	war	0
NUM1	-105.30265	82.94862	-1.27	0.2043	0	cap	1

Variance Estimate	75.47026
Std Error Estimate	8.687362
AIC	388.8489
SBC	392.8269
Number of Residuals	54

Correlations of Parameter Estimates

Variable	Parameter	war AR1,1	cap NUM1
war	AR1,1	1.000	-0.038
cap	NUM1	-0.038	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	4.59	5	0.4677	-0.041	-0.126	-0.028	0.017	0.013	-0.236
12	14.57	11	0.2029	-0.156	0.235	-0.146	-0.083	-0.162	0.120
18	16.61	17	0.4813	0.021	-0.025	-0.027	0.115	0.037	0.093
24	19.15	23	0.6926	0.000	0.018	0.078	0.030	-0.124	0.061

Model for variable war
Period(s) of Differencing 1
No mean term in this model.

Autoregressive Factors
Factor 1: 1 + 0.38414 B**(1)

Input Number 1

Input Variable	cap
Shift	1
Period(s) of Differencing	1
Overall Regression Factor	-105.303

WARNING: More values of input variable cap are needed.
The value for option LEAD= has been reduced to 1.

Forecasts for variable war

Obs	Forecast	Std Error	95% Confidence Limits	
57	59.9421	8.6874	42.9152	76.9690