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IS THE "SURGE" WORKING? SOME NEW FACTS

Michael Greenstone

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ABSTRACT

There is a paucity of facts about the effects of the recent military "Surge" on conditions in Iraq and whether it is paving the way for a stable Iraq. Selective, anecdotal and incomplete analyses abound. Policy makers and defense planners must decide which measures of success or failure are most important, but until now few, if any, systematic analyses were available on which to base those decisions. This paper applies modern statistical techniques to a new data file derived from more than a dozen of the most reliable and widely-cited sources to assess the Surge's impact on three key dimensions: the functioning of the Iraqi state (including violent civilian casualties); military casualties; and financial markets' assessment of Iraq's future. The new and unusually rigorous findings presented here should help inform current evaluations of the Surge and provide a basis for better decision making about future strategy.

The analysis reveals mixed evidence on the Surge's effect on key trends in Iraq. The security situation has improved insofar as violent civilian fatalities have declined without any concurrent increase in casualties among coalition and Iraqi troops. However, other areas, such as oil production and the number of trained Iraqi Security Forces have shown no improvement or declined. Evaluating such conflicting indicators is challenging.

There is, however, another way to assess the Surge. This paper shows how data from world financial markets can be used to shed light on the central question of whether the Surge has increased or diminished the prospect of today's Iraq surviving into the future. In particular, I examine the price of Iraqi state bonds, which the Iraqi government is currently servicing, on world financial markets. After the Surge, there was a sharp decline in the price of those bonds, relative to alternative bonds. This decline signals a 40% increase in the market's expectation that Iraq will default. This finding suggests that, to date, the Surge is failing to pave the way toward a stable Iraq and may in fact be undermining it.

Michael Greenstone
Department of Economics
Massachusetts Institute of Technology
50 Memorial Drive E52-359
Cambridge, MA 02142-1347
and NBER
mgreenst@mit.edu

"We need a surge of facts."
Tony Snow, Press Secretary for President George W. Bush, July 12, 2007

Is the war in Iraq worth its cost? The rationales for the war include that it plays a central role in protecting the nation against threats from al-Qaeda, ensuring a reliable supply of oil to the world market, preventing a humanitarian crisis in Iraq, providing an environment that allows for a stable Middle East, and ensuring the future of a sovereign Iraqi state. As of September 1st 2007, approximately 27,662 US soldiers have been wounded and 3,735 have been killed in the course of the war's prosecution. The US has spent about $403 billion (Sunshine 2007) to date on the war and related activities, and it has been estimated that its ultimate costs could exceed $2 trillion (Bilmes and Stiglitz 2006). The current debate about the war in Iraq is centered on whether the Surge is working.

There is a paucity of facts about the effects of the recent military "Surge" on conditions in Iraq and whether it is paving the way for a stable Iraq. Selective, anecdotal and incomplete analyses abound. Policy makers and defense planners must decide which measures of success or failure are most important, but, until now, few if any systematic analyses were available on which to base those decisions. This paper applies modern statistical techniques to a new data file derived from more than a dozen of the most reliable and widely-cited sources to assess the Surge's impact on three key dimensions: the functioning of the Iraqi state (including violent civilian casualties); military casualties; and financial markets' assessment of Iraq's future. The new and unusually rigorous findings presented here should help inform current evaluations of the Surge and provide a basis for better decision making about future strategy.

The central challenge for this analysis is to determine what would have happened in Iraq in the absence of the Surge. In the ideal, there would be two completely identical Iraqs--- one in which the Surge took place and another in which it did not. These two Iraqs could be compared to determine the Surge's causal impacts. As a feasible alternative, this paper compares outcomes in the period before the Surge to the same outcomes in the period after the Surge's initiation. In some cases the outcome variables were trending upwards or downwards in advance of the Surge. In order to avoid confounding these pre-existing trends with the effect of the Surge, this paper tests for changes in these trends.

The analysis shows mixed evidence on the Surge's effect on the current functioning of the Iraqi state. Perhaps the crudest expression of the security situation in Iraq is the rate of violent civilian fatalities. I find a substantial reduction in violent civilian fatalities in Baghdad and the rest of Iraq. Further, there isn't a decline and there may be an increase in the number of hours of electricity available to Iraqi consumers (although not in Baghdad). On the less positive side, the size of the Iraqi Security Force was about 10% lower 25 weeks after the Surge began than would have been predicted by trends prior to the Surge. Additionally, the analysis finds that after the Surge oil production didn't increase and may have decreased. Oil is Iraq's primary source of income.

The second category of outcomes examines the impact of the Surge on casualties suffered both by coalition soldiers and Iraqi Security Forces. The analysis indicates that the Surge had little impact on the number of casualties suffered by coalition and Iraqi Security Force troops. There is even some evidence of a decline in the number of non-fatal casualties per day among US soldiers. Since the number of US troops in Iraq was increasing in this period, these findings are noteworthy.

The stated purpose of the Surge was to create the conditions necessary for a stable Iraq to emerge. These first two categories provide mixed evidence on the Surge's effect on the current functioning of the Iraqi state. Making sound decisions about how to proceed in Iraq based on such conflicting indicators is extraordinarily challenging. For example, does the positive news on security outweigh the negative findings about Iraqi Security Forces (or the failures on many of the 18 congressionally mandated benchmarks)? In the face of this uncertainty, analyst judgment and politics may play too large a role.

There is, however, another way to assess the Surge. This paper shows how data from world financial markets can be used to shed light on the central question of whether the Surge has increased or diminished the prospect of a functioning Iraq. In particular, I examine the price of Iraqi state bonds that the Iraqi government is currently servicing on world financial markets.[1] Importantly, these bonds trade on world financial markets; for example, hedge funds hold a substantial fraction of them and their price

[1] In a novel paper, Chaney (2007) uses variation in prices of these Iraqi bonds during the January 2006 through August 2006 period to assess the most effective pacification policies in Iraq. This paper has several important findings but perhaps the most important ones are that sectarian violence is associated with declines in the prices of these bonds, while signs of political progress in Iraq are associated with increases in bond prices.

on the secondary market is quoted in Bloomberg's financial data services. The appeal of using financial markets is that traders' only concern is to make profitable decisions and this necessarily requires making correct projections. There isn't room for personal biases in this setting. Consequently, it isn't surprising that these markets have a good track record at predicting uncertain future events (Wolfers and Zitzewitz 2004).

Overall, the bond market findings fail to support the view that the Surge is helping to pave the way for the emergence of a stable Iraq and may in fact be undermining it. After the Surge, the Iraqi bonds' yield increased by 115 to 170 basis points, relative to comparison bonds. This translates into an approximate 40% increase in the expected annual probability of default. In other words, the world financial markets are saying that Iraq's prospects declined after the Surge.

Examining bond yields to learn about the effectiveness of the Surge requires several assumptions, including that financial markets efficiently and accurately aggregate public and private information from diverse sources. Further, the meaning of this exercise would be undermined if the documented movements in bond yields reflect domestic US politics. I find that the increases in default risk remain even after controlling for the probability that a Democrat will be elected President in 2008. This finding does not eliminate the domestic politics explanation, but it substantially weakens the case for it.

There are several caveats to this analysis that bear highlighting. First, due to the absence of data that predates the invasion of Iraq, the analysis can only inform the question of the Surge's efficacy. This paper is not directly informative about the broader question of the impact of the Iraq war. Second, the data on the current functioning of Iraq fail to cover many outcomes that would be both of great interest and potentially more informative than the available ones. Third, even among the available data, there are legitimate questions about quality and reliability. This is especially the case with the violent civilian casualty data.

The remainder of the paper proceeds as follows. Section II provides a brief background on the Surge. Section III briefly describes the data file compiled for the analysis (there is a much more extensive discussion in the Data Appendix) and IV outlines the statistical models. Section V discusses the results. Section VI concludes.

II. Background on the Surge

This section has three goals. First, it provides a brief review of the factors that led to the initiation of the military strategy that is known as the Surge. Second, it motivates the choice of February 14, 2007 as the starting date of the Surge. Third, it provides some details regarding the Surge's implementation on the ground in Iraq.

On January 10, 2007, President Bush announced that the number of troops deployed in Iraq would be increased by roughly 30,000. The stated short run goal of this troop increase was to provide the manpower necessary so that the US military could reduce the sectarian violence that was centered in Baghdad.[2] The theory being that by improving security, the Surge could achieve its ultimate goal of providing the Iraqi government the opportunity to grow and govern more effectively, ultimately leading to a stable Iraq. (See Figure 1 for a map of Iraq and Baghdad's central physical location and large population share.) The President enunciated this goal and its motivation when he said, "The most urgent priority for success in Iraq is security, especially in Baghdad. Eighty percent of Iraq's sectarian violence occurs within 30 miles of the capital. This violence is splitting Baghdad into sectarian enclaves and shaking the confidence of all Iraqis" (Bush 2007). This focus represented a shift in policy that was cemented by the shift in leadership that followed as General David Petraeus replaced General George Casey as commander of Multi-National Forces-Iraq on February 10, 2007.

The sectarian conflict that the Surge aims to control has an extensive history in Iraq. The violence of Saddam Hussein's Sunni dominated government against Shiites and Kurdish Iraqis is just one manifestation. In late 2003, following the US invasion in that year, a Sunni insurgency was growing that would focus on attacking Shi'a to leverage political control (al-Khalidi & Tanner 2006).

[2] "In Iraq today, the term 'sectarian violence' is a euphemism for Shi'a-Sunni violence. The Kurds are not part of the current explosion in sectarian strife. And while past and future problems involving sectarian violence in Kurdish areas – as well as sectarian violence against Kurds in South and Central Iraq – are not to be discounted, the main source of sectarian displacement are attacks on Sunnis and Shi'a by Shi'a and Sunni radical groups respectively" (al-Khalidi & Tanner, 2006).

Over the next few years, there were several key events that underscored the increasing sectarian violence. On March 2, 2004, during the Shiite festival of Ashoura, two bombings near shrines in Karbala, a city holy to Shi'a Muslims, killed 85 and wounded 100. Almost simultaneously, suicide bombers at the Kazimiya shrine in Baghdad killed at least 58 people and wounded 200 (Pacific Disaster Management Information Network, 2004). By mid-2005, Sunni and Shi'a victims of execution-style killings were regularly being discovered throughout Iraq (al-Khalidi & Tanner, 2006). In September of the same year, a car bomb in Kadhimiya, a predominantly Shi'a district of Baghdad, killed more than 100 people; while, in October, an attack at a Shi'a mosque in Hilla on the first day of Ramadan killed 87 people ("Scores killed in Baghdad Attacks," 2005; al-Khalidi & Tanner, 2006). In November, American soldiers found 173 mostly Sunni prisoners held in the basement of an Interior Ministry building where they had "apparently been abused by the largely Shi'a police force" (al-Khalidi & Tanner, 2006).

The bombing of the Al-Askariya "Golden Mosque" in Samarra on February 22, 2006 raised concerns about the sectarian violence to new levels. The Golden Mosque is one of the holiest sites in Shi'a Islam. The bombing is viewed by some observers as a tipping point that initiated a new equilibrium with higher levels of sectarian violence.

The bombing and its aftermath also helped to crystallize the view that the US military's strategy at that time was not succeeding. Until then, the US's strategy in Baghdad largely consisted of conducting raids aimed at clearing insurgents from difficult areas and neighborhoods and then turning those areas over to the Iraqi security forces. Over time, it became clear that the Iraqi security forces were not able to effectively protect these neighborhoods after the US raids. Further, the ISF's efforts to build local services that would improve the quality of life within the neighborhoods were also failing.

It is in this context that President Bush increased the number of troops in Iraq. Figure 2 reports the time series of the number of US and Coalition Troops in Iraq since May 2003. The figure documents that the number of US troops in January 2007 was 132,000 and has increased every month since then so that it was 162,000 in August 2007.[3] The figure also makes clear that the US accounts for the vast

[3] The vertical line in Figure 2 is drawn to intersect the January 2007 data points. All points to the right of the vertical line occur after the initiation of the Surge.

majority of the coalition: the US share ranges from a low of 82% in December 2003 to a high of 93% in August 2007.

These additional troops allowed the military to initiate a new strategy that was focused on achieving security in Baghdad. This strategy has two major components—Operation Enforcing the Law[4] and Operation Phantom Thunder. Together, these operations aim to stabilize areas by first removing insurgent groups and stopping violence, then maintaining this initial stability over a period of time before giving the Iraqi Security Forces complete responsibility for them.

Operation Enforcing the Law became operational on February 14, 2007. The commander of Multi-National Division– Baghdad, Major General Joseph Fil, described this operation:

> *This new plan involves three basic parts: clear, control and retain. The first objective within each of the security districts in the Iraqi capital is to clear out extremist elements neighborhood by neighborhood in an effort to protect the population. And after an area is cleared, we're moving to what we call the control operation. Together with our Iraqi counterparts, we'll maintain a full-time presence on the streets, and we'll do this by building and maintaining joint security stations throughout the city. [. . .]. An area moves into the retain phase when the Iraqi security forces are fully responsible for the day-today security mission. At this point, coalition forces begin to move out of the neighborhood and into locations where they can respond to requests for assistance as needed. During these three phrases, efforts will be ongoing to stimulate local economies by creating employment opportunities, initiating reconstruction projects and improving the infrastructure. (Press Conference with Maj. Gen. Joseph Fil Jr., 2007)*

This plan requires not just the raids calculated to break down insurgent groups and the resources that were characteristic of military operations pre-2007, but also a force that remains in the cleared area until it is secure and the Iraqi Security forces are sufficiently large and well-trained to control the area on their own.

The second piece of the Surge strategy, Operation Phantom Thunder, became operational on June 15, 2007. This operation's goal is to stem the flow of weapons and insurgents in and out of Baghdad (Kagan, July 2007). According to General Odierno, Operation Phantom Thunder and the smaller operations that fall under it "are intended to eliminate accelerants to Baghdad violence from enemy support zones in the belts that ring the city" with the goal of enabling the Iraqi government to function and move towards stabilizing the country politically (Press Conference with Lt. Gen. Ray Odierno,

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[4] Operation Enforcing the Law is the official name for Operation Fardh Al-Qanoon which is also known as the Baghdad Security Plan (BSP) and has been referred to as Operation Law and Order ("Baghdad Security Plan Officially Named," 2007).

2007). Regions within these belts[5] are targeted because of their established insurgent strongholds, placement along major roads and lines of communication, proximity to Baghdad, and other factors that make them vulnerable to destabilizing forces that might move into or out of the capital city.

In summary, this paper defines the Surge as the addition of the 30,000 extra troops and the implementation of Operations Enforcing the Law and Phantom Thunder. As this section has documented, the Surge constitutes a major shift in US military policy in Iraq that aims to reduce the sectarian violence centered in Baghdad with the hope that this will allow the Iraqi government to grow, govern more effectively, and ultimately become a functioning independent country. The remainder of this paper assesses whether the Surge's initiation on February 14, 2007 affected the functioning of the Iraqi state, coalition casualties, and the world financial market's prediction about the prospects for a stable Iraq.

III. Data and Summary Statistics

The data file used to conduct the analysis comes from more than a dozen data sources. I learned about many of them from the Brooking Institution's Iraq Index, which has played an instrumental role in providing valuable information about the war in Iraq for several years. Other data series were found in the Department of State's Iraq Weekly Status Report (IWSR). I discovered some other data sources on my own. In general, I collected the data series used in this analysis from their original sources by following up on the citations found in the Iraq Index and the Weekly Status Report. All of the original sources are detailed in the extensive Data Appendix at the end of this paper.

The data are grouped into three categories that form the basis of the subsequent analysis categories. The first involves functioning of the Iraqi state. The variables in this category include the number of violent civilian fatalities, the size of Iraqi Security Forces, crude oil production, and hours of electricity available to Iraqis. The second category is military casualties. These variables include coalition fatalities, non-fatal US casualties, and Iraqi Security Forces fatalities. The third category is the

[5] The outer ring [of the belt around Baghdad] runs from Taji (north of Baghdad between the 11 or 12 o'clock position), clockwise to Tarmiyah (one), Buhriz (two), Besmaya (three), Salman Pak (five), Mahmudiyah (six), Sadr al Yusifiyah (eight), Fallujah (nine) and Karmah (ten)" (Kagan, July 2007).

world financial markets' assessment of the future of the Iraqi state. The key variables for this category are the prices and yields of the Iraqi government bond issued in January 2006 that pays coupons twice a year and matures in 2028.

Table 1 presents summary statistics on a number of outcome variables. Panel A reports the values of several dependent variables at key dates. Panel B presents means of some important variables over three time periods. In the "All" column, the sample begins with the earliest observation and continues through the last available one. In the "1.5 Years Prior" and "1 Year Prior" columns, the samples begin 1.5 and 1 year before the initiation of the Surge and continue through the last available observation.

Finally, the collection of this data file has taken hundreds of person-hours. I am in the process of writing documentation for these files and will post them on my web site as soon as possible to facilitate future research on the Iraq war.

IV. Methodology

The central challenge for this analysis is to determine the causal impact of the Surge on the functioning of the Iraqi state. The hypothetical ideal for this study would be a parallel universe with another Iraq in which the US did not initiate a Surge. This parallel would provide a counterfactual for what would have happened in Iraq without the Surge. It would then be straightforward to compare the variables of interest in the current Iraq and in the parallel Iraq to assess the causal impacts of the Surge.[6]

In the absence of this impractical ideal, this paper compares outcome variables before and after the Surge began. The basic idea is simple: the best available counterfactual for what happened after the Surge in Iraq is what was happening in Iraq before the initiation of the Surge. In some cases the outcome variables were trending upwards or downwards in advance of the Surge. To avoid confounding these pre-existing trends with the Surge, the paper tests for changes in these trends. The key idea is that it is

[6] The appeal of classical experiments is that they reveal the causal impact of an intervention (e.g., a new drug) without a parallel universe. By randomly assigning the treatment, classical experiments guarantee that the treatment and control groups are identical so that ex-post comparisons reveal casual impacts.

possible to estimate the Surge's causal impacts only if the untestable assumption— that Iraq prior to the Surge is indeed a valid counterfactual for post-Surge Iraq— holds after controlling for pre-existing trends.

This paper implements two statistical tests for all of the variables examined. The first is referred to as the "mean shift model." This approach simply tests for whether the variable's mean changed after the Surge. For example, in an examination of the number of Iraqi civilian fatalities due to violence per day, this approach tests whether the mean number of fatalities per day before and after the Surge is equal. Its assumption is that all determinants of fatalities per day, besides the Surge, are constant before and after the Surge.

Specifically, the mean shift model involves fitting the following equation:

(1) $y_t = \alpha_0 + \beta\ 1(\text{Surge})_t + \varepsilon_t,$

where y is the outcome variable and t indicates a day or week. The variable of interest is 1(Surge) which is an indicator variable equal to 1 for days on or after February 14, 2007. The parameter β measures the change in the outcome relative to the period before the Surge. Thus in the case of the daily Iraqi civilian fatality rate, a positive estimate of β would indicate that this rate was higher in the period after the Surge. The subsequent analysis reports on estimates of β and a heteroskedastic consistent standard error.[7]

A shortcoming of the mean shift model is that in the presence of pre-existing trends, the estimated β will reflect the trend and any independent impact of the Surge. A trend break model allows for a pre-existing trend in the variable and then tests whether this trend changes. Consequently, it is a more robust method than the mean shift model.

Specifically, I estimate the following equation:

(2) $y_t = \alpha + \delta\,(t - \text{February 14, 2007}) + \beta\,((t - \text{February 14, 2007}) * 1(\mathit{Surge})_t) + \varepsilon_t,$

where y and t are as before. The variable (t – February 14, 2007) is a time trend (i.e., it equals 0 on February 14, 2007).[8] The variable ((t – February 14, 2007) * 1($Surge$) $_t$) is the interaction of the time trend and an indicator variable equal to 1 for days on or after February 14, 2007. The parameter of

[7] I also experiment with Newey-West standard errors that allow for unspecified heteroskedasticy and autocorrelation with 3 lags. These standard errors were very similar to the purely heteroskedastic-consistent ones.

[8] For example, it equals -1 on February 13, 2007 and -2 on February 12, 2007. Going forward, it equals 0 on February 14, 2007, 1 on February 15, 2007, 2 on February 16, 2007, etc.

interest is β and it measures the average slope change in the outcome that occurred after the Surge began. The key assumption needed for this method to identify the causal effect of the Surge is that after controlling for the pre-existing trend in the outcome variable, the Surge is the only change in the determinants of the outcome. As a robustness check, I will also report on models that add month fixed effects to allow for seasonality in the outcomes.

The parameter δ provides an opportunity to test the validity of the mean shift model specified in equation (1). Specifically, a rejection of the null hypothesis of a zero pre-period trend would lead to a rejection of the mean shift model. The subsequent analysis uses this test to identify cases where the data fail to support the validity of the mean shift model. In these cases, the trend break model's results are the preferred ones.

Another reason that this model is appealing in the context of the Surge is that it took several months for the Surge to become fully operational and it allows the impact of the Surge to increase over time.[9] In the subsequent analysis, I report β times the largest value of (t – February 14, 2007) in the available data file, which is typically at least 5 months after February 14, 2007.

Finally, one other issue merits attention. Wars are not conducted in stable environments, and the Iraq war is no exception. There appears to be a trade-off between bias and precision. On the one hand, as the set of days prior to the Surge used as a counterfactual grows larger, the resulting estimates become more precise. On the other hand, however, conditions have changed quickly throughout the war, and it may be inappropriate to treat observations from long before the Surge as useful in forming a valid counterfactual for what happened during the Surge.

I experimented with several start dates for the analysis and will present two throughout the paper. The first is 1 year before the Surge's initiation and the second is 1.5 years before. The former predates the bombing of the Askariya shrine in Samarra on February 22, 2006 by a week. This bombing helped to crystallize the sectarian violence instigated by the insurgents through fomenting a cycle of reprisals; it is associated with a marked increase in violence in Iraq. It seems plausible to assume that this period forms

[9] Specifically, the new troops began arriving in February 2007, but the full complement of about 30,000 troops weren't stationed in Iraq until several months later (perhaps June).

the correct counter-factual for the period after the Surge. The longer pre-period allows for a more precise estimation of the outcomes in a pre-period where the overall level of violence was lower. Since the bombing of the Askariya shrine in Samarra changed the political and security dynamics substantially, the results from the shorter 1 year pre-period are emphasized, but results based on both pre-periods are presented for completeness.

V. Results

This section is divided into three subsections. The first subsection examines whether the Surge has affected the current functioning of the Iraqi state. The second examines the human cost on the coalition and Iraqi security forces that are prosecuting the war. The final subsection examines the impact of the Surge on the yields and the implied default probabilities of Iraqi bonds.

A. Functioning of the Iraqi State

Violent Civilian Fatalities. Table 2 reports the impact of the Surge on the daily number of fatalities of Iraqi civilians using the Iraq Body Count data set. This database encompasses fatalities of "non-combatants killed by military or paramilitary action and the breakdown in civil security following the invasion [of Iraq]" (www.iraqbodycount.org). The subsequent tables will be structured similarly, so the entries and their meaning are described in detail here.

Panel A reports the estimated shift in the mean number of fatalities per day (β) from the mean shift model in equation (2). Its standard error is reported below it in parentheses. A * next to the entry indicates that the null hypothesis that the estimate is equal to zero can be rejected at the 5% level, while ** means that the null can be rejected at the 1% level. For the entries that don't have either a * or a **, it isn't possible to reject the null hypothesis at conventional significance levels.

Panel B reports results from fitting the trend break model specified in equation (2). The latest day with available violent civilian casualty data is July 17, 2007 and this corresponds to the 153rd day after the Surge began. So, the first two rows present 153 multiplied by the estimate of β with the corresponding standard error in parentheses. Consequently, the entry reports the estimated change in the number of violent civilian fatalities per day by July 17, 2007 due to the change in trend break after the Surge's initiation. A negative entry means that the Surge is associated with a reduction in fatalities.

The entry in the "Pre-trend" row reports the estimate of the coefficient δ with its estimated standard error below in parentheses. This provides an opportunity to assess whether there was a trend in daily fatalities in the period leading up to the initiation of the Surge. A positive parameter estimate indicates that fatalities per day were increasing before the Surge. As noted above, a rejection of the null hypothesis of a zero pre-trend means that results from the trend break model are more reliable.

The table has three sets of columns. Column (1a) reports results when the sample is all violent civilian fatalities in Iraq per day and the sample begins 1.5 years, or 548 days, before the Surge's initiation. The only difference in column (1b) is that the sample begins 1 year, or 365 days, prior to the Surge. Columns (2a) and (2b) conduct the analogous analysis with data on fatalities per day from Baghdad only. This may be of especial interest since the Surge's activities were concentrated in Baghdad. Finally, columns (3a) and (3b) report on the remainder of Iraq.

Now turning to the results for all of Iraq, it is evident that there was a strong upward pre-trend. This undermines the validity of the mean shift model, leading me to concentrate on the trend break results. These results indicate that there were approximately 56-61 fewer fatalities per day 153 days after the Surge than there would have been if the pre-trend had continued.[10] These estimates would easily be judged to be statistically different from zero by conventional criteria. This is a very high fraction of the overall mean of the dependent variable, but daily fatality counts were quite high in the last few weeks before the Surge. For example, the mean of the dependent variable in the last month before the Surge was 92.9 violent civilian deaths per day. Notably in the case of this dependent variable, the choice of start date for the sample doesn't affect the results in a meaningful way.

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[10] The inclusion of month fixed effects in the trend break specification in columns (1a) and (1b) has no substantive impact on the predicted decline in civilian fatalities. In particular, the coefficients (standard errors) are -76.5 (28.0) and -64.9 (43.9), respectively. It is evident that the inclusion of month fixed effects decreases the precision of the estimates.

The second and third sets of columns reveal that roughly 60% of this decline occurs in Baghdad. It is noteworthy that the decline outside of Baghdad is also statistically significant. This result contradicts the "squirt" theory that the Surge would push violence to other parts of Iraq.

Figure 3 provides an opportunity to better understand the whole country results from the sample that begins 1 year before the Surge. The squares represent the average daily number of fatalities over independent 7-day periods (e.g., the left most square is the average over days t =-365 through t = -359). The figure also presents the fitted values from the estimation of the trend break model. There is a vertical line at t= 0, which is the date that the Surge began.

This figure explains the source of the results in Table 2. Specifically, the upward trend in fatalities in the pre-period is evident. Most notably, there is a sharp downward break in trend after the initiation of the Surge. The figure provides compelling evidence of a decline in violent civilian fatalities after the Surge's initiation.

Overall, the violent civilian fatality results demonstrate that the Surge is associated with an important decline in violent civilian fatalities.[11] It is certainly possible that some of these results are due to the reported increases in migration out of Baghdad and Iraq more generally, but the sharpness of the results makes it unlikely that that this is the entire story. In many respects, this result confirms the popular theory of domestic policing that putting more cops on the beat reduces the crime rate.

Finally, the source for these data (i.e., IraqBodycount.org) uses only the most reliable reports on violent civilian casualties, so their numbers likely understate the true number of violent civilian casualties, perhaps substantially so. Consequently, this section's estimates may understate the impact of the Surge on total violent civilian fatalities. A recent cross sectional survey conducted in Iraq suggests that the Iraq Body Count numbers may understate total violent civilian casualties substantially, but the numbers from

[11] The website www.icasualties.org also publishes a data file on civilian fatalities. An examination of the methodologies suggests that the Iraq Body Count data file is likely to be more reliable. One advantage of the icasulties data file is that more recent data is available: it includes data through 191 days after February 14, 2007. I collected the icasualties data set for all of Iraq, and it produces results that are qualitatively very similar to those in Table 2. Specifically, the post-trend evaluated at t =191 and its standard error is -52.6 (23.7) and -67.8 (27.1) from the All of Iraq column (1a) and (1b) specifications, respectively.

this study's results are considered controversial.[12] The bottom line is that a perfect source for violent civilian casualties is unavailable. Even in the face of measurement error, IraqBodyCount's use of a consistent methodology means that it may be reasonable to assume that this analysis is able to detect the impact of the Surge on <u>trends</u> in violent civilian fatalities.

Size of Iraqi Security Forces. Another important indicator of the functioning of the Iraqi state is the number of members of the Iraqi Security Force (ISF). For this paper's purposes, the ISF is defined as the number of the personnel of the police, national police, other security forces working for the Ministry, Army, Air Force, and Navy. This variable is measured weekly, although it is missing for several weeks.

Table 3 reports the regression results. Since there is clear evidence of a pre-existing upward trend, I focus on the trend break model results. Specifically, this model indicates that ISF personnel were increased by about 2,000 per week prior to the Surge. The results show that there was a downward trend break after the Surge such that there were 25,000 – 28,000 fewer ISF troops 25 weeks later than there would have been had the pre-trend continued.[13] These estimates suggest that 25 weeks after the Surge the number of ISF personnel was about 10% less than would have been predicted by pre-existing trends. Figure 4 displays this result graphically.[14]

Crude Oil Production. Table 4 and Figure 5 present the results for millions of barrels of crude oil production per day, which is measured weekly. The mean production is about 2.1 million barrels per day in this period. There is little evidence that the Surge affected oil production from the specifications reported in the table. However, versions of these same specifications that include month fixed effect indicate declines in oil production of roughly 20%, relative to pre-existing trends. Specifically, the point

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[12] A nationwide household survey of 1,849 households conducted between May and July 2006 suggests that about 655,000 more Iraqis died than would have been predicted by pre-War trends between March 2003 and the time of the survey (Burnham, Lafta, Doocy, and Roberts 2006). This estimate is roughly 10 times larger than the estimate from Iraq Body Count, however several observers have questioned the reliability of the numbers from the Lancet studies (Guha-Sapir, Degomme, Pedersen 2007).

[13] The point estimates (standard errors) from versions of the columns (1) and (2) trend break specifications that add month fixed effects are -30,997 (4,619) and -14,648 (6,397), respectively.

[14] Figure 4 is an excellent example of how the mean shift model can confound pre-existing trends with the true impact of the Surge. A simple comparison of pre and post mean ISF personnel levels would lead to the conclusion that the Surge increased troop levels (in fact, this is the conclusion from the mean shift model). The figure helps to underscore that this conclusion is unlikely to be valid because of the sharp upward pre-period trend.

estimates (standard errors) from versions of the columns (1) and (2) trend break specifications that include month fixed effects are -0.4454 (0.0708) and -0.3707 (0.0697).

Hours of Electricity per Day. Most electricity generation takes place outside of Baghdad; and, since the war began, electricity producing regions have been reluctant to fully share electricity with the capital city. This is borne out in the means of the dependent variables. The average of hours of electricity per day in Baghdad is around 6 to 6.5 relative to about 11 in the country as a whole (separate data for the non-Baghdad region alone is unavailable). Before describing the electricity results, I note that the reliability of these data have been called into question on several occasions and that they are missing for 11 of the 25 weeks in the period after the Surge began (Levey and Zavis 2007).

Table 5 and Figure 6 report the association between the Surge and average hours of electricity available per day in Baghdad and the entire country. Both dependent variables are trending downwards in the pre-Surge period. The results from the preferred trend break model show little evidence of a meaningful change in hours of electricity per day in Baghdad. However, the results for all of Iraq indicate that the Surge was associated with a 20%-25% increase in hours of electricity for Iraqis living outside Baghdad. The meaning of these results is tempered by the fact that the electricity data is unavailable for 11 of the 25 post-Surge weeks (i.e., May 8, 2007 through July 31, 2007). Further, the results for all of Iraq are weaker for versions of columns (2a) and (2b) that include month fixed effects. Specifically, the point estimates, with standard errors in parentheses, are 1.74 (0.73) and 0.56 (1.00) respectively.

B. Military Casualties

Coalition Fatalities. Table 6 reports on the impact of the Surge on coalition fatalities through 186 days after the Surge's initiation. For all of Iraq, there was an average of 2.66 coalition fatalities per day in the longer sample and 2.77 in the shorter sample. The mean numbers for daily fatalities inside and outside of Baghdad were roughly 0.85 and 1.85, respectively. It is evident that fatalities were increasing in the period preceding the Surge, so the trend break model is more appropriate.

The trend break results find little meaningful evidence of a change in daily fatalities after the Surge. This is partially because the estimates are imprecise, which makes it difficult to detect change.

However, the estimates are also sensitive to sample choice. For example, the point estimate is essentially zero in the sample that begins 1.5 years before the Surge, while it is -0.9 in the sample that begins 1 year before.[15] Notably, the overall result is due to a statistically significant decline in coalition fatalities outside of Baghdad. Many of these findings, especially the noisiness of the data, are evident in Figure 7.

Overall, it appears that the Surge had little impact on the number of coalition fatalities per day in Iraq. However, since the number of troops in this period increased substantially, the daily fatality rate (e.g., fatalities per 100,000 soldiers) declined.

US Non-Fatal Casualties. Table 7 reports on the number of wounded soldiers per day in Iraq. There are separate results for all non-fatal casualties, casualties that prevent soldiers from returning to action within 3 days, and casualties that allow soldiers to return within 3 days. Over the samples, there are 18-19 non-fatal casualties per day, with slightly less than half resulting in soldiers' inability to return to action within 3 days. For all three dependent variables, there is evidence that the incidence of these casualties was increasing in advance of the Surge.

The trend break results suggest that there is a modest decline in the number of non-fatal casualties per day among US troops. In the shorter and preferred sample, the point estimate implies an almost 20% reduction that occurs, just about entirely, among the less serious casualties. This is shown graphically in the accompanying Figure 8. The longer sample indicates a smaller decline and one that is statistically indistinguishable from zero.[16] As with the fatality data, these findings would be stronger if the outcome variable were normalized by the number of troops in Iraq.

Iraqi Security Force Fatalities. Table 8 and Figure 9 present results on the estimated impact of the Surge on the number of Iraqi Security Force Fatalities per day. There is little evidence of pre-Surge trends in this variable, so neither model can be rejected in advance. Both models and samples fail to find evidence of a meaningful change in the number of fatalities per day. The inclusion of month fixed effects does not alter this conclusion.

[15] The point estimates (standard errors) from the trend break versions of columns (1a) and (1b) are 0.564 (0.543) and -0.405 (0.744), respectively.
[16] The inclusion of month fixed effects causes the point estimate (standard error) to increase to -3.06 (1.31) in column (1a). In (1b), the estimate becomes -2.76 (1.31). Thus, this richer model finds a decline in the rate at which soldiers are wounded in both samples.

C. World Financial Markets' Assessment of Iraq's Future

The ultimate purpose of the Surge is to create the conditions that will allow for a stable Iraq to emerge. Thus far, the paper has documented that the Surge has been effective at improving the security situation in Iraq without an appreciable increase in casualties among coalition and Iraqi troops. However, some other indicators of the current functioning of the Iraqi state (e.g., oil production and the number of Iraqi Security Forces) have failed to show improvements. Thus, to this point, this exercise has produced mixed evidence on the impact of the Surge on the current functioning of the Iraqi state. Further, there is no readily available model that synthesizes these conflicting results to determine whether the Surge is achieving its ultimate goal of improving the prospects for an autonomous Iraq.

This subsection shows that data from world financial markets can be used to transparently shed light on the central question of whether the Surge has altered the prospects that a functioning Iraq will exist in the future. In particular, I examine the prices of Iraqi state bonds that are currently being serviced by the Iraqi government and of credit default swaps for those bonds.[17] The goal is to infer how the Surge changed the world financial market's predictions about the probability that Iraq would default on these bonds. Thus, if taken literally, this subsection solves the problem of trying to draw an inference about Iraq's future prospects from the many variables analyzed above and the numerous ones that are not amenable to this paper's methodological approach.

Background. Before analyzing these time series, it is informative to know the history of the Iraqi bonds, some details on how bonds are priced on secondary bond markets, and why it is reasonable to assume that world financial markets can efficiently aggregate the available information on Iraq's future. Prior to Iraq's invasion of Kuwait in 1990, Iraq issued about $130 billion in debt. After the Gulf war, the

[17] I also considered using data from the Iraqi Stock Exchange but decided that this market was a local one with poor liquidity and that it would be difficult to interpret any results. For example, the market only meets twice a week and trading appears to be very thin. As evidence of this the total dollar value of all trading in February 2007 was less than $5 million and only 45 of the 94 had any shares traded. Further, I was able to obtain data on a time series for an index but I was unable to determine how the index was constructed, which companies were included, and whether it was ever reconstituted. Finally, in principle, it is possible that shareholders wouldn't be damaged by a failure of the Iraqi government (in contrast, a failure of the Iraqi government would almost certainly lead to a default on the Iraqi bonds).

country defaulted on this debt. When the US led coalition invaded Iraq in 2003, the holders of this debt were spread around the world. The Paris Club held claims of approximately $40 billion; Persian Gulf creditors had another $65 billion; and the remainder was in the hands of commercial creditors (Chaney 2007).

After the end of combat operations in May 2003, the US government brokered a deal to exchange $1000 in the existing bonds for $200 worth of new bonds for those creditors who held at least $35 million in Iraqi bonds so that the new Iraqi government would not be hamstrung by this debt. As a result of this debt relief agreement, the Iraqi government issued roughly $2.66 billion in US dollar denominated notes in January 2006. These new bonds pay fixed coupons of 2.9% twice a year and have a maturity of January 15, 2028.

Once these bonds were issued, they entered the world financial markets. All indications are that there is a liquid and competitive market for them. For example, they began to trade on world financial markets on January 20, 2006, and their prices and yields are reported in Bloomberg's financial services database. A trader at JP Morgan said that

> *As much as 90% may have gone from the original holders (banks, trading companies, engineering firms etc., i.e., not investment funds) to investment funds. And of that [the bond are] are about evenly split between hedge funds and "real money" accounts (maybe slightly more in "real money").* [Quoted in Chaney (2007), page 4]

Further there has been substantial trading of these bonds; about $4.1 billion of these bonds were traded in the first quarter of 2006, when they were issued, and roughly $1.6 billion in the second quarter (Chaney 2007). Finally, the average bid-ask spread as a percentage of the average of the bid and the ask price has been just 0.6% over the course of the bonds' trading history.

Why would the world financial market's assessment of the value of these bonds be informative about the Surge's impact on Iraq's prospects? The reason is that owning a bond entitles the holder to a stream of payments. In the case of the Iraqi bond, each $100 of face value of these bonds entitles holders to receive $2.90 on the 15th of every January and July through January 15, 2028 plus an additional $100 on January 15, 2028.

In a liquid market, the current value or price of a bond's stream of payments depends on the perceived default risk and the yield curve. The former captures the probability that a bond's issuer will stop making the scheduled payments before the maturity date. An increase in the probability of default would reduce a bond's value, because the bondholder's expected payments will have declined. The latter measures the riskless interest rate (e.g., US Treasury bills) at each of the time intervals between the present and the scheduled payments. Here, an increase in the yield curve would reduce the bond's value because the future payments would be more heavily discounted and therefore less valuable today. [18]

Secondary bond markets aggregate the available information on the probability of default and future values of the yield curve to determine the value of bonds (or their scheduled set of payments). Since the initiation of trading, the price of a $100 face value Iraqi bond has ranged between $56.18 and $73.98. The lower prices reflect periods where the market's perception of the probability of default was higher or the yield curve was higher. Thus, the secondary bond market provides a venue for market participants to reach an agreement on the expected probability of default and the yield curve.

Prices and Yields of Iraqi Bonds. With this background, I now turn to a comparison of how the difference or spread between the yields of the Iraqi state bonds and three alternative bonds changed after the Surge began. Each of the alternative bonds is intended to serve as a control to avoid confounding the impact of the Surge with other drivers of default risk or shifts in the yield curve. The first alternative is a Qatari bond due in 2030 with a 9.6% coupon rate. The appeal of this as an alternative is that, like Iraq, Qatar's economy is heavily dependent on oil revenues, so, in addition to having a similar maturity date, this will at least partially adjust for changes in the probability of default due to changes in oil prices.

The second alternative bond is the Lehman Emerging Market Bond Index Yields, which adjusts for changes in yields due to macroeconomic factors that affect default risk of developing countries generally. The maturity date for this index was 2020 on August 27, 2007, so it isn't a perfect match on at least one dimension. The Qatari bond and Lehman Index are also appealing, because the Surge period

[18] Since the Iraqi bonds are denominated in US currency, fluctuations in the value of the Iraqi currency do not affect prices.

partially coincides with the subprime mortgage lending crisis that caused a “flight to quality” for US treasuries.

The third alternative bond is the US Inflation Indexed Treasury Bond due in 2028. This bond has a nearly identical maturity date to the Iraqi bond and is used as an alternative to avoid confounding the impact of the Surge with changes in the yield curve.

Figure 10 graphs these three spreads daily where days are again normalized so that day zero is February 14, 2007. The spread between the Iraqi bond and the US bond is shown on the right axis of Figure 10, since its yield is substantially lower than the others.

One key difference between bond prices (or yields) and the other outcome variables is that efficient markets theory implies that it is not necessary to control for pre-existing trends in prices. This is because financial markets are forward looking and all relevant information is reflected in the asset’s price at every point in time. Thus, this theory implies that pre-existing trends in prices do not predict future prices. Further, the current prices reflect any future events that affect prices and are predictable.

Since financial markets are forward looking, there is no perfect start date for the analysis. President Bush announced the Surge on January 10, 2007, but the Surge’s activities didn’t begin until February 14, 2007. Further, there is some evidence that the military had begun planning for the Surge in late December, and it is possible that bond traders were aware of this planning. To account for all of these potential start dates, the graph begins with t = -50. It is apparent that the choice of start date isn’t important because there is little variation in the spreads during this 50 day period.[19] For consistency with the rest of the paper, I will emphasize results that compare spreads at t = 0 (which is where the vertical line is drawn) to the last available yields in our data file at t =191 (August 24, 2007).

The figure reveals that the spread between the Iraqi bond and all three alternatives grew substantially in the period after the Surge. It increased by 153 basis points when the Qatari bond is the alternative and 114 and 170 basis points when the comparisons are the Lehman index and US bond,

[19] There is a decline in spreads of about 20 basis points between t = -50 (December 26, 2006) and t = -35 (January 12, 2007) where the latter is two day’s after President Bush’s speech announcing the Surge. It may be appropriate to attribute this decline to the Surge. However, even if this is the case, it is swamped by the increase in spreads that occur after the Surge is initiated; so attributing this to the Surge would not affect the qualitative results.

respectively. Interestingly, the increase in spread is almost entirely driven by an increase in the yields of the Iraq bonds, which increased by 174 basis points in this period, rather than changes in the yields of the alternatives.[20] Notably, these are easily the largest spreads since the Iraqi bonds began trading.

The increase in the spreads appears to be due to genuine increases in the market's expectation of a default (and not due to changes in oil prices, the supply of capital to developing countries or changes in the yield curve). With a few assumptions, it is possible to back out an estimate of the change in the market's expected default rate. If we assume that the market for these bonds is perfectly competitive and that the expected default rate is constant across periods[21], then following Ma et. al (1989) we derive the following relation:

$$\left(\sum_{t=1}^{n}\frac{p^t C + p^{t-1}(1-p)g(C+1)}{(1+i)^t}\right) + \frac{p^n}{(1+i)^n} = \left(\sum_{t=1}^{n}\frac{C}{(1+r)^t}\right) + \frac{1}{(1+r)^n}$$

Here, *n* is the number of periods (i.e. coupons), *p* is the probability of not defaulting in each period, *C* is the coupon rate as a percentage of the face value, *i* is the risk-free interest rate, *r* is the yield of the risky asset, and *g* is the proportion of the face value plus the coupon recovered in the case of a default. The left-hand side is the expected present discounted value of a dollar's worth of risky asset held to maturity. The right-hand side is the certainty equivalent of the payoffs of the risky asset, discounted by the risky asset's yield. Under perfect competition, these must be equal.

The software *Mathematica* is used to solve this equation for *p*, given different observations of *n*, *i*, and *r* for each day.[22] The yield series of the Iraqi bond is used for r and the yield of the 20-year

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[20] An alternative approach to inferring the role is to conduct a cash flow analysis of the value of the Iraqi bond with the t = 0 and t = 191 yield curves. This exercise demonstrates that changes in the yield curve have little impact on the value of the Iraqi bond in this period. This finding is not surprising in light of the flat and roughly constant yield curve over this period.

[21] This method for inferring the expected default risk requires the assumption that the probability of default is constant in each period. This assumption is likely to cause the numbers in Figure 11 to understate the expected default rate in the next few years (because if the Iraqi government survives until 2027, then the probability of surviving until 2028 is surely higher than the probability that Iraq survives from today until one year from now, given what we know today). Thus, the probability of default approximated using this formula is likely to be an *under*estimate of the probability that Iraq survives from today to one year from today or other periods closer to the present.

[22] There are a variety of ways to account for the fact that each day that passes reduces the number of days until the next coupon, and thus increases the probability that the next coupon will be redeemed (as well as reduces the amount by which we should be discounting the coupon). For example, in the above formula, *t* can be replaced by *(d-124.5)/182.5*, where *d* is the number of days until the bond's due date and 182.5 is half of a year. Such a

Treasury bond is used for i. The bond pays coupons every 6 months at a rate of 2.9%. After the invasion of Iraq, the Paris Club decided to reduce Iraq's sovereign debt by 80%. Assuming that a similar deal will be offered to future governments of Iraq should the current one fail, we use a recovery rate of $g = 0.2$.

Figure 11 plots the annual probability of default, which is $1\text{-}p^2$ (because there are two coupon payments per year), against the date relative to the Surge's initiation. The results are striking. The annual probability of a default ranges between 5.65% and 6.10% in the days before the Surge and is 5.75% at t = 0. After the Surge begins, it is never this low again implying that even in the early days of the Surge the market didn't believed that it would improve Iraq's future prospects. Perhaps even more notable, the expected annual default probability rises to 8.14% by the end of the period. This is an approximately 40% increase in the expected default rate. The clear conclusion is that the world financial markets believe that the probability that Iraq will default on its bond increased after the Surge's initiation.

Credit Default Swap Premiums for Iraqi Bonds. To supplement these results, I now turn to data from a relatively new financial instrument, credit default swaps. These instruments provide a direct measure of the market's expected default risk and therefore mitigate concerns about confounding change in default risk and the yield curve in the above analysis. In a credit default swap, the purchaser pays the seller a fixed premium each period until either default occurs or the swap contract matures. In exchange, the seller is obligated to buy back from the buyer the defaulted bond at its par value if the issuer defaults on its obligation. In essence, these credit default swaps are insurance against default for buyers that are provided by sellers.

To further explore the impact of the surge on default risk, I collected data on prices (i.e. premiums) for 5-year credit default swaps for the Iraqi bond and the CDX Emerging Market Diversified Series, which is an index of 5-year credit default swaps for an index of bonds from emerging markets.[23]

substitution is computationally unfavorable. I created similar series by rounding the expression $(d\text{-}182.5)/182.5$ and substituting it for t in the numerator or both the numerator and denominator. One problem that arises is that when such a substitution is made, the equation has multiple solutions for p that are real and between 0 and 1 (one solution is implausible, the other is very close to what we get making no substitution). In light of this finding, I decided not to make any adjustment for the number of days to the next coupon (of course, I adjust for the number of coupons remaining). However, none of the adjustments change the basic message of the graph.

[23] The index is reconstituted every 6 months, which can cause relatively minor jumps as bonds are added and subtracted at the reconstitution dates. I focus on 5-year CDS prices because a private conversation with a Lehman Brothers trader indicated that these are the most liquid CDS products.

About 75% of the constituent credit default swaps are sold on government issued debt and the remainder are from private companies located in emerging countries. The index is constructed by CDS Index CO LLC, a consortium of 16 investment banks, and Markit Group Limited, a provider of independent data.[24] The indices are priced in basis points per year, so a price of 100 basis points implies that insurance against default for 1 year costs 1% of the face value of the bond.

The full line in Figure 12 plots the spread in the prices between the Iraqi CDS and the Emerging Market CDS index. It is apparent that the spread is substantial. For example, the price of a CDS for Iraq varied between 514 and 530, while the index's varied between 73 and 88 basis points between t = -50 and t = 0. This underscores that the expected default rate of the Iraqi bonds was very high, even by emerging market standards.

The high price of the Iraqi CDS poses a challenge for determining the impact of the surge, especially in the context of the subprime mortgage crisis that unfolded over part of this period and raised the expected default rate of all risky bonds. I was unable to identify individual sovereign bonds with CDS prices similar to the Iraqi CDS price prior to the Surge. Further, some of the higher priced ones (e.g., Venezuela) had idiosyncratic shocks to default risk in this period.[25] Thus, I believe the most defensible strategy is to use the Emerging Market index (which includes Venezuela) as a counterfactual for Iraqi CDS prices. It is evident, however, that the perfect counterfactual for Iraq is unavailable.

Returning to Figure 12, there is a dramatic increase in the spread after the Surge began. Specifically, it increases from 436 basis points on February 14, 2007 to 676 basis points on August 24, 2007. Further, the spread never falls below the level at the initiation of the Surge. The similarity between the evolution of the spread and the implied annual default rate in Figure 11 is striking.[26]

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[24] Both time series came from Markit which aggregates data from over 85 dealing firms. Markit's data on CDP prices are the most reliable available, because they collect trading data from several investment banks and then clean the data to create this time-series.

[25] Venezuela instituted legislation aimed at nationalizing large sectors of the oil sector in this period. This has led to a dispute with Exxon and Conoco Phillips, which have refused to agree to Venezuela's terms. The outcome of this dispute is currently unknown but expensive litigation in international courts and the seizing of Venezuelan owned refineries in the US are possible outcomes. The bond market has interpreted these events negatively and the price of CDS for Venezuelan bonds has increased dramatically.

[26] It is possible to infer the expected default probabilities from the CDS premiums for the Iraqi state bonds with a few assumptions (e.g., the recovery rate upon a default) (O'Kane and Turnbull 2003). These calculations indicate that the expected default rate increased by about 50% from 6.68% on February 14, 2007 to 10.13% on August 24,

What factors determine the financial market's expected probability of default for the Iraqi bonds? The default risk is a function of at least two factors. The first is the current and projected future stability in Iraq. The second is the continued presence of the US military, which is likely a function of current and projected stability in Iraq and domestic US politics. If the movements in default risk in Figures 11 and 12 are due to domestic US politics, which are unrelated to the current and projected stability in Iraq, then this exercise cannot be used to judge the Surge.

With this issue in mind, it is important to highlight that a substantial portion of the increase in the spreads occurs around t = 150, which is July 14, 2007. Two big events occurred right around then. First, the Administration released their "Initial Benchmark Assessment Report" on July 12th. This failed to find that the Surge had led to substantial progress toward meeting many of the 18 congressionally mandated benchmarks for progress in Iraq. This event provided new information on the current functioning of the Iraqi state. While it may have strengthened the case for withdrawing US troops from Iraq, it is evident that the causal factor here was the new information, not a shift in domestic politics.

Second, the Senate Democrats tried to force a vote on a resolution that would have withdrawn troops from Iraq. Supporters of the resolution failed to overcome the filibuster, but the cloture motion did receive 52 votes (on July 18th), enough to pass the resolution if it had come to a vote. The outcome of this vote is a political event. However, it is unclear whether the outcome of a vote that was almost entirely decided along party lines and did not alter policy surprised the market. Even if it did, it is unclear whether the market concluded that the US would stay for a shorter or longer period of time so the impact on default risk seems unclear.

Figure 12 provides a more quantitative way to assess whether internal US politics caused the increase in the implied annual default risk of Iraqi bonds. This graph is derived from a regression of the CDS spread against a constant and the price of a prediction market contract that pays $100 if a Democrat

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1997. This increase is similar in magnitude to the estimated 40% increase in the expected default rate from the yields on the Iraqi bond yields. It is noteworthy that during this same period the expected default rates for Qatar and Egypt increased from 0.23% to 0.26% and 0.98% to 1.04%, respectively. These two comparisons were the ones provided to me. However, they may not form the best counterfactual for Iraq.

is elected president in 2008.[27] The estimated coefficient on the contract price is 15.9 and would easily be judged to be statistically different from zero by conventional criteria (t-statistic of 3), so the spread is positively associated with this variable.[28] The dashed line plots the predicted default rate and the difference between the full line and dashed line is the estimated residual. This difference is the component of the spread that cannot be explained by the contract price.

Since Democrats in general and the leading Democratic presidential candidates in particular are aggressively calling for leaving Iraq, it seems reasonable to assume that the prediction market contract is a proxy for the probability that the US will substantially reduce its military presence in Iraq. For the purpose of this analysis, I make the conservative assumption that movements in this variable are entirely due to changes in US domestic issues.[29]

The striking finding is that the actual CDS spread increased dramatically but the predicted spread was essentially flat. Put another way, the increase in the CDS spread in this period is largely unrelated to changes in expectations about the 2008 Presidential election. For example, the increase in the residual from t = 0 to t = 191 accounts for about 88% of the increase in the expected default rate.[30] This result does not eliminate the possibility that the increase in the expected default risk is due to changes in domestic US politics, but it substantially weakens the case for this explanation.[31]

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[27] The contract is offered through https://www.intrade.com/v2/ which is a marketplace for numerous prediction markets. These prediction markets have an impressive track record of aggregating disperse information into efficient forecasts about future events (Surowiecki 2004; Wolfers and Zitzewizt 2004).

[28] Over the relevant sample, t =-50 through t = 191, the value of the contract ranges from $53.0 to $59.0. Its value on t = 0 was $56.3 and it was $58.0 on t = 191.

[29] In practice, this assumption implies that the possibility that the public's assessment of the degree of stability in Iraq affects the probability that a Democrat will be elected President in 2008. This assumption is almost certainly incorrect, because some of the support for Democrat Presidential candidates seems based on dissatisfaction with the War in Iraq. However, it allows me to stack the deck in favor of the hypothesis that domestic political factors are the source of movements in the expected default rate.

[30] This result is nearly identical with alternative models (e.g., estimating the parameters with data from the period before the Surge only, including the current price of the contract and three lags, and modeling the contract price with a cubic polynomial). If t = -50 is used as the starting date, then the increase in the residual accounts for about 66% of the increase in the spread.

[31] I also investigated using data on contracts that Democrats will hold a majority in the Senate and House in 2008. These contracts are thinly traded during this period. For example, there were a number of periods lasting several days with zero trades. Overall, mean daily volume for the senate and house contracts are 2.4 and 0.3 contracts, respectively, compared to 68.4 for the presidential contracts. The point is that the thinness of these markets undermines the credibility of an exercise using these data (although using them doesn't affect the qualitative findings).

It is worth considering how the Surge could worsen expectations about Iraq's future even though I cannot test the different possibilities. One possibility is that the Surge hardened the positions of the combatants in Iraq (e.g., the US military's new alliances with the Sunnis may deepen Shi'a's resentments) and that this has lowered the prospects for a stable Iraq. Another is that the improvements in the security situation have not been followed by meaningful political gains. Thus, the Surge may have revealed that the depth of the political problem in Iraq is greater than previously was recognized. Further, the revelation of the magnitude of this problem may have increased the probability that Congress or a new President will remove US troops sooner than was expected.

The first of these possibilities is consistent with the Surge directly undermining the prospects for a stable Iraq, while the other suggests that the Surge allowed for a clearer picture about the future. Regardless of which explanation is correct, the most noteworthy finding from this analysis is that after the Surge the spread between the prices for CDS for the Iraqi bonds and the emerging markets index never declined. The same is true for the implied annual probability of default in Figure 11. Thus to date, world financial markets have never believed that the Surge will increase the prospects for a stable Iraq and may in fact be undermining them.

Before proceeding to the conclusion, it is important to make clear a link that has been unstated thus far. This subsection's analysis implicitly equates a default on the Iraqi bonds with a failure of the Surge to achieve its goals. Indeed, governments have defaulted on sovereign debt before without complete state failure. However, the political and security situation in Iraq and its neighborhood is extraordinary. It is difficult to imagine a scenario in which the Iraqi government defaults on its bonds even as a stable political and security environment is achieved.[32]

VI. Conclusions

[32] A so called "soft" or "hard" partition of the current Iraq doesn't imply a default. Such a scenario could well include an oil revenue sharing agreement that would commit to servicing the debt.

There is a paucity of facts about the effects of the recent military “Surge” on conditions in Iraq and whether it is paving the way for a stable Iraq. Selective, anecdotal and incomplete analyses abound. Policy makers and defense planners must decide which measures of success or failure are most important, but until now few if any systematic analyses were available on which to base those decisions. This paper applies modern statistical techniques to a new data file derived from more than a dozen of the most reliable and widely-cited sources to assess the Surge’s impact on three key dimensions.

The analysis reveals mixed evidence on the Surge’s effect on key trends in Iraq. The security situation has improved insofar as violent civilian fatalities have declined without any concurrent increase in casualties among coalition and Iraqi troops. However, other areas, such as oil production and the number of trained Iraqi Security Forces have shown no improvement or declined. Making sound decisions about how to proceed in Iraq based on such conflicting indicators is challenging and uncertain. Moreover, this uncertainty may allow analyst judgment and politics to play too large a role.

There is, however, another way to assess the Surge. This paper has shown how data from world financial markets can be used to shed light on the central question of whether the Surge has increased or diminished the prospect of a functioning Iraq. An appeal of using financial markets is that traders’ only concern is to make profitable decisions and this necessarily requires making correct projections. There isn’t room for personal biases in this setting and it therefore isn’t surprising that financial markets have a good track record of predicting future events.

I examine the price of Iraqi state bonds, which the Iraqi government is currently servicing, on world financial markets. After the Surge, there is a sharp decline in the price of the Iraqi bonds, relative to alternative bonds. This decline signaled an increase of approximately 40% in the market’s expected annual probability of default. This finding suggests that, to date, the Surge is failing to pave the way toward a stable Iraq and may in fact be undermining it. In many respects, it is consistent with recent assessments that fail to find that the Surge has led to substantial progress in meeting many of the 18 congressionally mandated benchmarks for progress in Iraq (GAO 2007).[33]

[33] Most of these benchmarks are measures of political progress. Notably, Chaney (2007) found that political progress in Iraq is associated with increases in the price of the Iraqi bonds in the January – August 2006 period. The point is that world financial markets appear to believe that political progress is crucial for a stable Iraq to emerge.

This paper has produced a series of new facts on the Surge's impact. It is straightforward to update these facts as new data becomes available. Further, the new facts can be used to aid decision making about the future of the Surge.

More broadly, the paper shows that even in unconventional wars, it is feasible to measure and analyze important outcomes to learn about the war's success. Finally like Chaney (2007), it highlights that world financial markets may be a useful new source of information to judge a war's success.

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DATA APPENDIX

This data appendix provides information on the data sources for this paper. It includes separate subsections on each of the outcome variables analyzed.

I. Iraqi Security Forces Troop Strength

Weekly data on the size and makeup of the Iraqi Security Forces (ISF) comes from the Department of State's Iraq Weekly Status Report (IWSR). This report provides updates on the progress toward eight "pillars" of the US policy in Iraq. The weekly reports were downloaded from http://www.state.gov/p/nea/rls/rpt/iraqstatus/.

Each report contains a slide entitled "[2.] Transition Iraq to Security Self-Reliance – Iraqi Security Forces". The slide contains a chart that shows the number of persons trained and equipped in each division of the ISF. At the bottom of the slide, an "as of" date is given (e.g. "Data as of February 5, 2007"). This date is recorded in the variable *isf_date*. The number of days that this date is later than February 14, 2007 is given in *elec_count*.

Three parts constitute the Ministry of the Interior's forces: Police, National Police, and Other Ministry of the Interior Forces. These are recorded in the variables *police*, *nat_police*, and *other_moi*, respectively. Before July 7, 2006, National Police and Other Ministry of the Interior Forces were combined in Other Ministry of the Interior Forces observations. Three parts constitute the Ministry of Defense's forces: Army, Air Force, and Navy. These are recorded in the variables *army*, *navy*, and *air_force*, respectively.

An important characteristic of the data is that the Ministry of the Interior numbers do include unauthorized absence personnel, whereas the Ministry of Defense numbers do not include unauthorized absence personnel. Thus, the MoI numbers are inflated above the actual strength of the force because they include force members who have been equipped and trained but have left the force without permission.

These numbers do not include what the IWSR estimates as 144,000 facilities protection services personnel working in 27 ministries. Army numbers include Special Operations Forces and Support Forces.

The IWSR lists its source as "DoD Iraq Weekly Status Report" or "DoD Input to Iraq Weekly Status Report".

Observations that are exact duplicates (including *isf_date*) were discarded. What follows is a list of other observations that have changed dates or been eliminated and the reasons:

> -- there were two observations for 12/28/2005, kept the one that was not identical to the observation for 12/7/2005 (presumably, they forgot to update the numbers and the second observation was reported more recently)
>
> -- replaced the first observation for 7/7/2006 with the second because the second had more detail as to how MoI forces were broken down and was otherwise identical (and was reported more recently)
>
> -- replaced the first observation for 9/13/2006 with the second because the second was more recently reported

-- moved the second observation for 9/18/2006 to the week of 9/20/2006 and discarded the first observation

-- removed the observation for 2/20/2007 because it was identical to that for 2/19/2007 and they were in the same week

-- there were two observations for 3/5/2007, kept the one that was not identical to the observation for 2/20/2005 and 2/19/2005 (presumably, they forgot to update the numbers and the second observation was reported more recently)

-- all dates 6/13/2007 and beyond are extrapolated (one week behind the date of the report)

-- moved the observation for 6/19/2006 to the week of 6/21/2006 and the observation for 6/26/2006 to the week of 6/28/2006

II. Oil production

Weekly oil production data comes directly from the Department of State's Iraq Weekly Status Report (IWSR), which provides updates on the progress toward eight "pillars" of the US policy in Iraq. The weekly reports were downloaded from http://www.state.gov/p/nea/rls/rpt/iraqstatus/.

Each report contains a slide entitled "[5.] Help Iraq Strengthen Its Economy – Crude Oil Production". The slide contains a chart with an entry for each of the last nine weeks and the current week. Each entry is the weekly average of millions of barrels per day of crude oil produced. The current week's entry is also reproduced beneath the chart.

When there was a conflict between the text and the chart, the number given on the chart was used. There were two instances of this: the observation for 9/10/06 should be 2.37 (from chart in weekly report), but it is given as 2.47 in the actual weekly report, the observation for 7/22/07 should be 2.10, but it is given as 2.06 in the actual weekly report.

The IWSR lists its source as "Department of State, NEA-I-ECON, 202-647-9885".

III. Electricity availability

Electricity availability data comes directly from the Department of State's Iraq Weekly Status Report (IWSR), which provides updates on the progress toward eight "pillars" of the US policy in Iraq. The weekly reports were downloaded from http://www.state.gov/p/nea/rls/rpt/iraqstatus/.

Each report contains a slide entitled "[4.] Help Iraq Build Government Capacity and Provide Essential Services – Electricity Overview". This slide contains a line graph of the daily load served and estimated demanded in megawatt-hours (MWh). It also contains several bullet points that provide additional figures. One such figure is the average of available hours of electricity in Baghdad and nationwide over the past week (exact dates for which are given.)

The IWSR gives as its source a point-of-contact consisting of a name and a phone number. The point-of-contact changes from time to time; in 2007 it read "POC Bob Means (202) 647-9815". The IWSR stopped reporting this number after May 7, 2007, though the slide and graph are still present. It was resumed on July 31, 2007 with a caveat "Average hours of power via electricity grid after meeting demand for essential services."

IV. Weekly United States Forces Wounded

The US wounded data were downloaded from http://icasualties.org/oif/woundedByWeek.aspx. From the icasualties.org website:

> *The Department of Defense does not release the names of the wounded, nor do they provide details on how and when soldiers are wounded. Therefore, we are not able to provide a list for each and every wounded soldier.*
>
> *The DoD does provide a weekly summary, stating updated totals for the number wounded and returned to action within 72 hours and the number wounded not returned to action. We arrive at a weekly total by subtracting the new total from the previous weeks. This methodology is not precise because it does not account for possible restatements of total from previous week.*
>
> *The Department of Defense also maintains a separate list detailing the number of wounded by month and service branch. We transfer these totals to our database each month and provide the same data in html format. There are some inconsistencies in this reporting - numbers in this chart bounce back and forth from one month to the next.*
>
> *While compiling items for our news section, we often find articles about wounded servicemen and we have provided an archive of these articles. Within this list you may find multiple mentions of the same person, as well as references to soldiers who have since succumbed to their wounds.*

The number of wounded who were returned to duty within 72 hours and the number of wounded who were unable to return with 72 hours are downloaded from the icasualties.org website. These two variables are also summed to obtain the total wounded each week.

This "flow" data comes from differences in the stock variables reported by the Department of Defense on a quasi-weekly basis. One problem with these series is that changes in these variables from week to week may reflect soldiers who were wounded in the previous week <u>and</u> revisions in the number of wounded soldiers from previous weeks. The latter is the variable of interest, while the former adds measurement error. The measurement error is unlikely to serve as a source of bias, because it seems likely to have been constant before and after the Surge.

V. Coalition Fatalities

Daily data on coalition deaths comes from iCasualties.org. We downloaded the data from http://icasualties.org/oif/Details.aspx, which lists each death individually. We then aggregated the data by day.

iCasualties follows a rigorous recording methodology. A US death is recorded when one of four events occurs: (1) a news story or obituary that reports the death of a US service member is released (this must also be confirmed by the DoD), (2) Centcom or the Multi-National Force in Iraq (MNF) releases the name of a soldier who has died (Centcom releases must be confirmed by the DoD), (3) the DoD itself releases the name of a soldier who has died, (4) the name of a soldier not already recorded appears in the weekly updated Department of Records listing of Operation Iraqi Freedom (OIF) fatalities.

UK fatalities are recorded when the Ministry of Defense confirms that a soldier has died. For non-American, non-British fatalities, the iCasualties website states:

> *Deaths for non English speaking countries prove to be the most difficult for gathering information. Here we rely on our readers to point us in the right direction and try (often in vain) to translate announcements into the bits of information we need for documentation.*

Complete documentation of iCasualties.org's methodology is available at http://icasualties.org/oif/Methodology.aspx.

VI. Yields for Inflation-Indexed Treasury Bond Due 2028

The series for *us2028* was downloaded from http://research.stlouisfed.org/fred2/series/DTP30A28/downloaddata?cid=47. The Fed denotes this series as DTP30A28. It contains daily yields for the 30-Year 3-5/8% Treasury Inflation-Indexed Bond, due on 4/15/2028.

VII. United States Treasury Yield Curve

United States yield curve data comes from the U.S. Treasury's website. Nominal rates were downloaded from http://www.ustreas.gov/offices/domestic-finance/debt-management/interest-rate/yield.shtml.

The yield rates are constant maturity rates. This means that they are interpolated from an estimate of the yield curve. According to the Treasury's website, "The Treasury yield curve is estimated daily using a cubic spline model. Inputs to the model are primarily bid-side yields for on-the-run Treasury securities."

In this way, the Treasury provides yields for the following maturities: 1, 3 and 6 months and 1, 2, 3, 5, 7, 10, 20, and 30 years. Furthermore, we linearly interpolated rates that were not reported by the Treasury. If the rate for a particular maturity was not reported, we created a line running through the nearest maturities on either side of the missing maturity and read the rate off of this line. For example, if the 7-year rate was given as 4% and the 10-year rate was given as 7%, then we assigned (2/3) * 4% + (1/3) * 7% = 5% to the 8-year rate and (2/3) * 4% + (1/3) * 7% = 6% to the 9-year rate.

VIII. Iraqi, Qatari, and Lehman Emerging Markets Index Bond Price and Yield Time Series Data from Bloomberg Financial Data Service.

We downloaded daily prices and yields for an Iraqi state bond due in 2028 (annual coupon of 5.8%) and a Qatari bond (annual coupon of 9.75%) due in 2030 from the Bloomberg financial data service. Both the Iraqi and Qatari bonds are denominated in US dollars. The CUSIP for the Iraq bond is EF2306852 and it is EC2682416 for the Qatar bond.

We also obtained a times series of prices and yields for the US Lehman Emerging Markets Bond Index from Bloomberg. The Lehman Index includes fixed and floating-rate US dollar denominated debt from emerging markets. It had a maturity of March 5, 2020 as of August 27, 2007 when the data used in the analysis was downloaded.

IX. Coalition Troop Levels

The monthly data for troop strength comes from the Brookings Iraq Index table titled "COALITION TROOP STRENGTH IN IRAQ SINCE MAY 2003." The August 27, 2007, version of the Index was accessed at http://www3.brookings.edu/fp/saban/iraq/index.pdf. The table was assembled by Brookings from a variety of news sources (a list is available in the footnotes of the Iraq Index).

X. Violent Civilian Fatalities from IraqBodyCount.org

Our primary source for data on violent civilian fatalities comes from the IraqBodyCount.org (IBC) website. The principal researchers are Hamit Dardagan and John Sloboda. It is important to note upfront that the website is partisan—that is, anti-war—but their methodology is conservative and seeks to provide an accurate lower bound for the number of violent civilian deaths reported.

The data were downloaded from http://www.iraqbodycount.org/database/. Documentation of the IBC's methodology is available at http://www.iraqbodycount.org/background.php#methods and it is briefly summarized here.

The database records each incident in which civilian deaths due to violence occurred separately. To create a daily time series, we summed the deaths from incidents occurring on the same day. For some incidents, the date was uncertain. In such cases we always chose the most recent possible date of the incident that was listed in the website.

IBC collects news stories from a variety of trusted news sources with internet access. Currently, they use 38 such sources. A trusted news source is one widely cited or referenced by other sources, with a daily updated website, full archives of stories, and fully public English-language access.

From each acceptable news story in which Iraqi civilians were reported as killed, IBC extracts the date, time, and location of the incident, as well as the military target (as stated by military sources), the weapon(s) used, and the number of violent civilian deaths (in two measures as described below). IBC records the deaths from an incident if and only if there are at least two news sources that report the incident.

Once there are two news sources reporting an incident, two measures are constructed, *reportedminimum* and *reportedmaximum*. In *reportedmaximum*, the highest number of violent civilian deaths from any of the reporting sources is recorded. Unless a news source reports a lower number of deaths, the *reportedminimum* is equal to *reportedmaximum*. If multiple numbers are reported, the lowest is entered as *reportedminimum*. This can be zero if "zero deaths" is reported. However, a wording like "unable to confirm any violent civilian deaths" is not a report of zero deaths and thus is not entered in either column. Moreover, when the report does not mention civilians specifically, this number is entered in the *reportedmaximum* variable but zero is entered into the *reportedminimum* variable unless the proportion of violent civilian deaths is given or a similar detail is given.) If a "family" is reported killed, this is entered as three deaths.

IraqBodyCount.org also adds old incidents or hospital counts as much as 4 years old retroactively, which raises two issues. First, in order to update the database, we must integrate old and new incidents. This is done using the identifier provided by IBC. IBC does not specify that this identifier is unique, but a computer-based check reveals that very few incidents with the same identifier have a different value for the location field between the two data snapshots that we looked at. Those values that are different are usually just reworded or more- or less-specific locations.

The second issue is that the fact that IBC adds old incidents retroactively may represent inaccuracies in the more current data. Comparing data gathered on 7/9/2007 and 8/21/2007 yields the following results.

These are the cumulative incidents added between these two datasets that are listed as occurring BEFORE the date given.

6/1/2003 -> 21
1/1/2004 -> 21
6/1/2004 -> 21
1/1/2005 -> 31
6/1/2005 -> 54
1/1/2006 -> 179
6/1/2006 -> 802
1/1/2007 -> 1312
6/1/2007 -> 1689

The analysis is conducted with the mean of *reportedminimum* and *reportedmaximum*. The mean of *reportedminimum* over the course of the entire database (which begins on March 21, 2003) is 41.6 deaths per day, while the mean of *reportedmaximum* is 45.4 deaths per day. Thus, the differences are small and average about 9% of the mean of *reportedminimum* and *reportedmaximum*. Moreover, they are equivalent on 59.6% of the days in the period from the first day of the database (January 1, 2003).

I coded a variable that differentiates between incidents in Baghdad and those not in Baghdad. This variable was coded as 1 if the location field includes "Baghdad" (but not "near Baghdad" or "20 km north of Baghdad") in its value and 0 otherwise.

XI. Violent Civilian Fatalities from Icasualties.org

The icasualites.org web site also publishes a database of violent civilian casualties. Their methodology for counting fatalities appears less rigorous than the Iraq Body Count's methodology, so the paper's analysis concentrates on the results using the IBC data.[34] Nevertheless, I estimated the mean shift and trend break models with these data and this led to results that are qualitatively very similar to the results from the IBC. These results are described in detail in the section of this paper that examines violent civilian casualties.

The icasualties data contains the following disclaimer:

> *The numbers compiled here are not definitive, but they do provide a good baseline for measuring daily reported fatalities. No one should be surprised that monthly deaths tolls from hospitals and morgues prove to be higher than what we have compiled – it should be understood by all that the actual level of violence is higher than what the press is able to report.*

Complete documentation of iCasualties.org's methodology is available at http://icasualties.org/oif/Methodology.aspx.

[34] For example, the icasualties web site contains the following disclaimer: "For a detail list of Iraqi Deaths please see The Iraqi Body Count."

Table 1: Summary Statistics About Iraq and the Surge

A. Key Statistics			
Number of US Soldiers in Iraq, February 2007	135,000		
Number of US Soldiers in Iraq, August 2007	162,000		
Number of Iraqi Security Forces, February 14, 2007	323,180		
Number of Iraqi Security Forces, August 8, 2007	359,700		
Iraqi Bond Yield January 10, 2007	9.60%		
Iraqi Bond Yield February 14, 2007	9.58%		
Iraqi Bond Yield August 27, 2007	11.32%		
B. Means Calculated Over Alternative Time Periods	**All**	**1.5 Years Prior**	**1 Year Prior**
Mean Daily Iraqi Civilian Fatalities Due to Violence	44.70	65.26	73.83
(Baghdad only)	26.54	40.93	45.32
(Outside Baghdad Only)	18.15	24.33	28.51
Mean Number of Iraqi Security Forces	279,019	283,474	308,562
Mean Millions of Barrels per Day Crude Production	2.07	2.07	2.11
Average Hours of Electricity per Day in Baghdad	6.54	6.52	6.12
Average Hours of Electricity per Day in All of Iraq	11.24		10.77
Mean Daily Coalition Fatalities	2.37	2.67	2.77
Baghdad Only	0.60	0.80	0.89
Outside Baghdad Only	1.77	1.86	1.88
Mean Daily Wounded US Soldiers (serious wound)	7.57	7.54	8.24
Mean Daily Wounded US Soldiers (not serious wound)	9.26	10.65	10.94
Mean Iraqi Bond Yield	9.62%		9.66%
Standard Deviation of Iraqi Bond Yield	0.59%		0.56%
Mean of (Iraqi Yield – Qatari Yield)	3.63%		3.66%
Standard Deviation of (Iraqi Yield – Qatari Yield)	0.60%		0.59%

Notes: Panel A reports on the value of some of the subsequent dependent variables at some key dates. Panel B calculates means of some of the variable over three time periods. In the “All” column, the sample begins with the earliest observation and continues through the last available one. In the “1.5 Years Prior” and “1 Year Prior” columns, the samples begin 1.5 and 1 year before the initiation of the Surge and continue through the last available observation.

Table 2: Estimated Impact of Surge on Iraqi Civilian Fatalities Due to Violence, Through 153 Days After the Surge Began

	All of Iraq		Baghdad Only		Remainder of Iraq	
Sample Begins with	t = -548	t = -365	t = -548	t = -365	t = -548	t = -365
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
A. Mean Shift Model						
1(Surge)	-2.4	-14.5*	-10.2	-17.2**	7.8**	2.7
	(6.1)	(6.8)	(5.5)	(6.3)	(2.4)	(2.4)
R-squared Statistic	0.0001	0.0043	0.0015	0.0066	0.0221	0.0034
B. Trend Break Model						
Trend Break	-61.1**	-55.5**	-40.1**	-33.9**	-20.9**	-21.5**
Evaluated at t = 153	(15.1)	(13.3)	(14.2)	(11.7)	(5.2)	(5.9)
Pre-Trend	0.100**	0.079*	0.049	0.027	0.052**	0.052**
	(0.030)	(0.038)	(0.029)	(0.036)	(0.005)	(0.008)
R-squared Statistic	0.0190	0.0105	0.0058	0.0052	0.1404	0.0600
Mean of Dependent Variable	65.3	73.6	40.7	44.9	24.6	28.7
N	702	519	702	519	702	519

Notes: The entries report estimation results from the fitting of equations (1) and (2) for violent civilian fatalities per day. t references a day. Heteroskedastic-consistent standard errors are reported in parentheses. The Surge is defined to begin on February 14, 2007, so t = 0 on this date. The data source is iraqbodycount.org. See the Data Appendix for further details on these data.
** significant at 1-percent level, * significant at 5-percent level.

Table 3: Estimated Impact of Surge on Number of Iraqi Security Forces (Based on Data through 25 Weeks After the Surge)

	t = -78 (1)	t = -52 (2)
A. Mean Shift Model		
1(Surge)	85,186**	57,536**
	(7,025)	(5,784)
R-squared Statistic	0.4998	0.582
B. Trend Break Model		
Post-Trend	-28,165**	-25,166**
Evaluated at t = 25	(3,593)	(4,616)
Pre-Trend	1,901**	1,842**
	(35)	(68)
R-squared Statistic	0.9874	0.965
Mean of Dependent Variable	283,474	308,562
N	69	52

Notes: The entries report estimation results from the fitting of equations (1) and (2) for registered ISF personnel, which is measured weekly (so t references a week). Heteroskedastic-consistent standard errors are reported in parentheses. The Surge is defined to begin on February 14, 2007. Iraqi security forces are the sum of police, national police, other security forces working for the Ministry of the Interior, army, air force, and navy personnel. These data are derived from the Department of State's Iraq Weekly Status Report. More details are contained in the Data Appendix.
** significant at 1-percent level, * significant at 5-percent level.

Table 4: Estimated Impact of Surge on Millions of Barrels per Day of Crude Oil Production Measured Weekly (Based on Data through 25 Weeks After the Surge)

	t = -78 (1)	t = -52 (2)
A. Mean Shift Model		
1(Surge)	0.001	-0.066
	(0.033)	(0.035)
R-squared Statistic	0.0000	0.0288
B. Trend Break Model		
Post-Trend	-0.1827	-0.0063
Evaluated at t = 25	(0.0973)	(0.1208)
Pre-Trend	0.002	-0.002
	(0.001)	(0.002)
R-squared Statistic	0.0465	0.0540
Mean of Dependent Variable	2.07	2.11
N	103	78

Notes: The entries report estimation results from the fitting of equations (1) and (2) for crude oil production measured in millions of barrels per week (so t references a week). Heteroskedastic-consistent standard errors are reported in parentheses. The Surge is defined to begin on February 14, 2007. These data are derived from the Department of State's Iraq Weekly Status Report. Details on the data sources are reported in the Data Appendix. ** significant at 1-percent level, * significant at 5-percent level.

Table 5: Estimated Impact of Surge on Average Hours of Electricity per Day Available in Baghdad and All of Iraq (Based on Data through 25 Weeks After the Surge)

	Baghdad Only		All of Iraq	
	t = -78	t = -52	t = -78	t = -52
	(1a)	(1b)	(2a)	(2b)
A. Mean Shift Model				
1(Surge)	-0.814**	-0.364	-0.81*	-0.28
	(0.323)	(0.301)	(0.38)	(0.38)
R-squared Statistic	0.0214	0.0111	0.0303	0.007
B. Trend Break Model				
Post-Trend	1.584	-0.377	2.47**	2.53*
Evaluated at t = 25	(0.888)	(0.949)	(0.86)	(0.98)
Pre-Trend	-0.035**	-0.015	-0.045**	-0.049**
	(0.010)	(0.013)	(0.007)	(0.011)
R-squared Statistic	0.1553	0.031	0.3650	0.254
Mean of Dependent Variable	6.52	6.12	11.23	10.77
N	89	64	88	63

Notes: The entries report estimation results from the fitting of equations (1) and (2) for hours of electricity per day in Iraq measured weekly (so t references a week). Heteroskedastic-consistent standard errors are reported in parentheses. The Surge is defined to begin on February 14, 2007. Note, these data are unavailable for the weeks t = 12 through t = 22. There are also a few other weeks missing. More details on the data are contained in the Data Appendix.

** significant at 1-percent level, * significant at 5-percent level.

Table 6: Estimated Impact of Surge on Coalition Fatalities, Through 186 Days After the Surge Began

	Total		**Baghdad Only**		**Remainder of Iraq**	
	t = -548	t = -365	t = -548	t = -365	t = -548	t = -365
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
A. Mean Shift Model						
1(Surge)	0.861**	0.809**	0.790**	0.749**	0.071	0.060
	(0.227)	(0.241)	(0.138)	(0.145)	(0.175)	(0.184)
R-squared Statistic	0.021	0.021	0.062	0.057	0.0002	0.0002
B. Trend Break Model						
Post-Trend	0.015	-0.951	0.463	0.047	-0.448	-0.998*
Evaluated at t = 186	(0.531)	(0.650)	(0.324)	(0.385)	(0.389)	(0.478)
Pre-Trend (1/100)	0.205**	0.468**	0.121**	0.235**	0.084	0.233*
	(0.065)	(0.113)	(0.032)	(0.057)	(0.053)	(0.091)
R-squared Statistic	0.028	0.044	0.065	0.067	0.004	0.013
Mean of Dependent Variable	2.66	2.77	0.801	0.895	1.861	1.875
N	735	552	735	552	735	552

Notes: The entries report estimation results from the fitting of equations (1) and (2) for coalition fatalities per day in Iraq measured daily (so t references a day). Heteroskedastic-consistent standard errors are reported in parentheses. The Surge is defined to begin on February 14, 2007. More details on the data are contained in the Data Appendix.

** significant at 1-percent level, * significant at 5-percent level.

Table 7: Estimated Impact of Surge on Wounded Soldiers per Day for All of Iraq, Through 182 Days After the Surge Began

	Total		**Unable to Return to Action within 3 Days**		**Returned to Action within 3 Days**	
	t = -548	t = -365	t = -548	t = -365	t = -548	t = -365
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
A. Mean Shift Model						
1(Surge)	2.89**	1.75**	2.70**	1.98**	0.19	-0.23
	(0.48)	(0.55)	(0.39)	(0.44)	(0.36)	(0.43)
R-squared Statistic	0.034	0.015	0.051	0.030	0.0003	0.0004
B. Trend Break Model						
Post-Trend	-1.14	-3.46**	-0.38	-0.44	-0.76	-3.02*
Evaluated at t = 182	(1.12)	(1.24)	(1.03)	(1.16)	(1.00)	(1.17)
Pre-Trend (1/100)	1.071**	1.591**	0.701**	0.680**	0.369**	0.911**
	(0.137)	(0.233)	(0.121)	(0.183)	(0.120)	(0.195)
R-squared Statistic	0.092	0.073	0.074	0.033	0.017	0.029
Mean of Dependent Variable	18.2	19.2	7.5	8.2	10.6	10.9
N	736	553	736	553	736	553

Notes: The entries report estimation results from the fitting of equations (1) and (2) for wounded US soldiers per day. This variable is reported as an average approximately once per week, so the equations are weighted by the numbers of days that each observation represents. Heteroskedastic-consistent standard errors are reported in parentheses. The number of observations is reported in the bottom row and it is the number of days covered by the observations. The Surge is defined to begin on February 14, 2007. More details on the data are contained in the Data Appendix.

** significant at 1-percent level, * significant at 5-percent level.

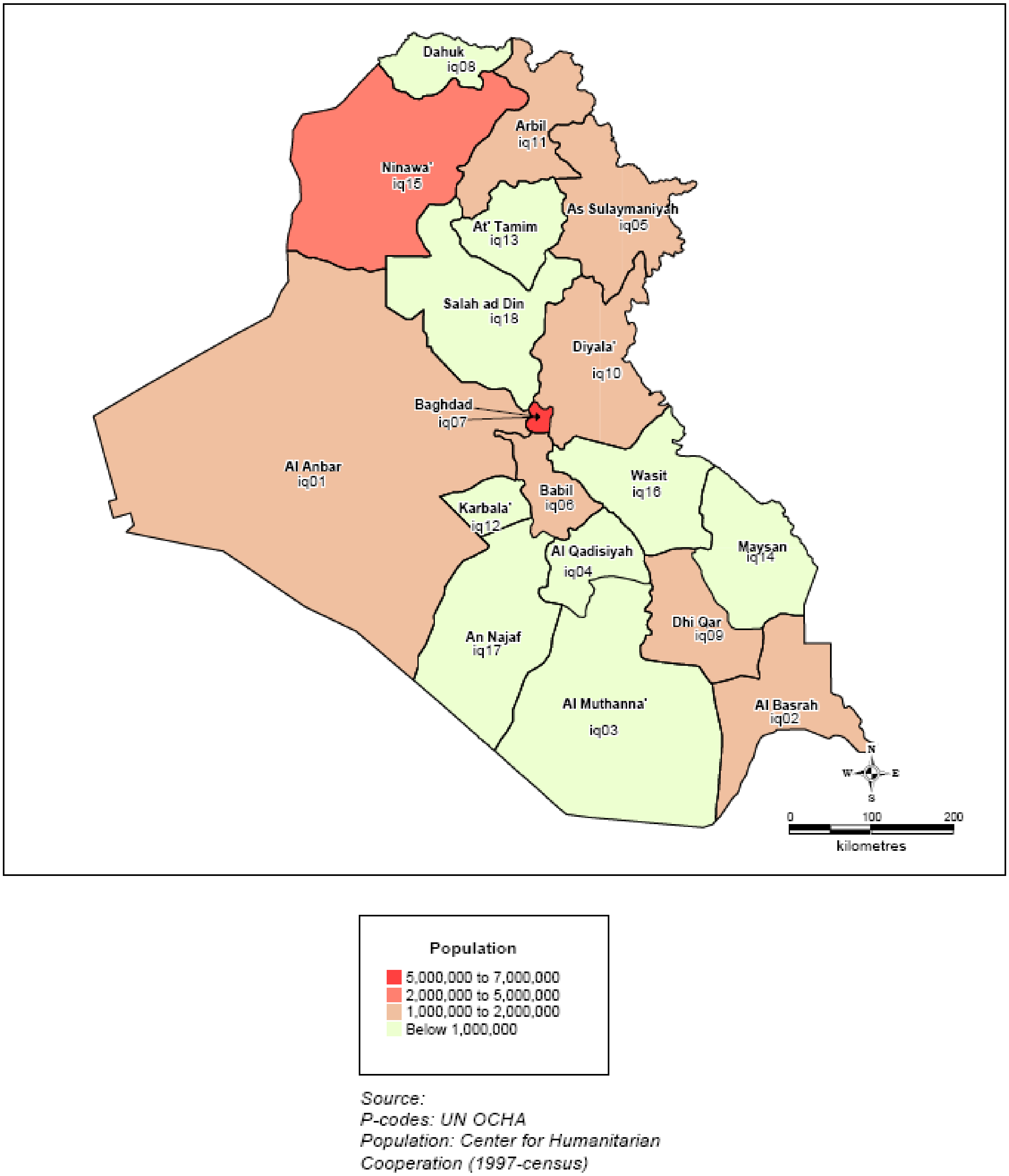
Table 8: Estimated Impact of Surge on Iraqi Security Force Fatalities per Day for All of Iraq, Through 189 Days After the Surge Began

	t = -548	t = -365
	(1a)	(1b)
A. Mean Shift Model		
1(Surge)	0.653	1.067
	(0.883)	(0.898)
R-squared Statistic	0.0012	0.0036
B. Trend Break Model		
Post-Trend	1.981	1.099
Evaluated at t = 189	(1.176)	(1.318)
Pre-Trend(1/100)	-0.319	-0.109
	(0.185)	(0.309)
R-squared Statistic	0.0035	0.0007
Mean of Dependent Variable	6.12	5.90
N	740	557

Notes: The entries report estimation results from the fitting of equations (1) and (2) for Iraqi Security Force fatalities per day in Iraq measured daily (so t references a day). Heteroskedastic-consistent standard errors are reported in parentheses. The Surge is defined to begin on February 14, 2007. More details on the data are contained in the Data Appendix.

** significant at 1-percent level, * significant at 5-percent level.

Figure 1: 1997 Population of Iraq and Its Governorates



Source: http://unosat.web.cern.ch/unosat/freeproducts/iraq/governorates_pcodes_population.pdf. 1997 is the most recent Iraqi Census.

Figure 2: Number of US and Coalition Troops in Iraq, by Month (Relative to Initiation of Surge in February 2007)

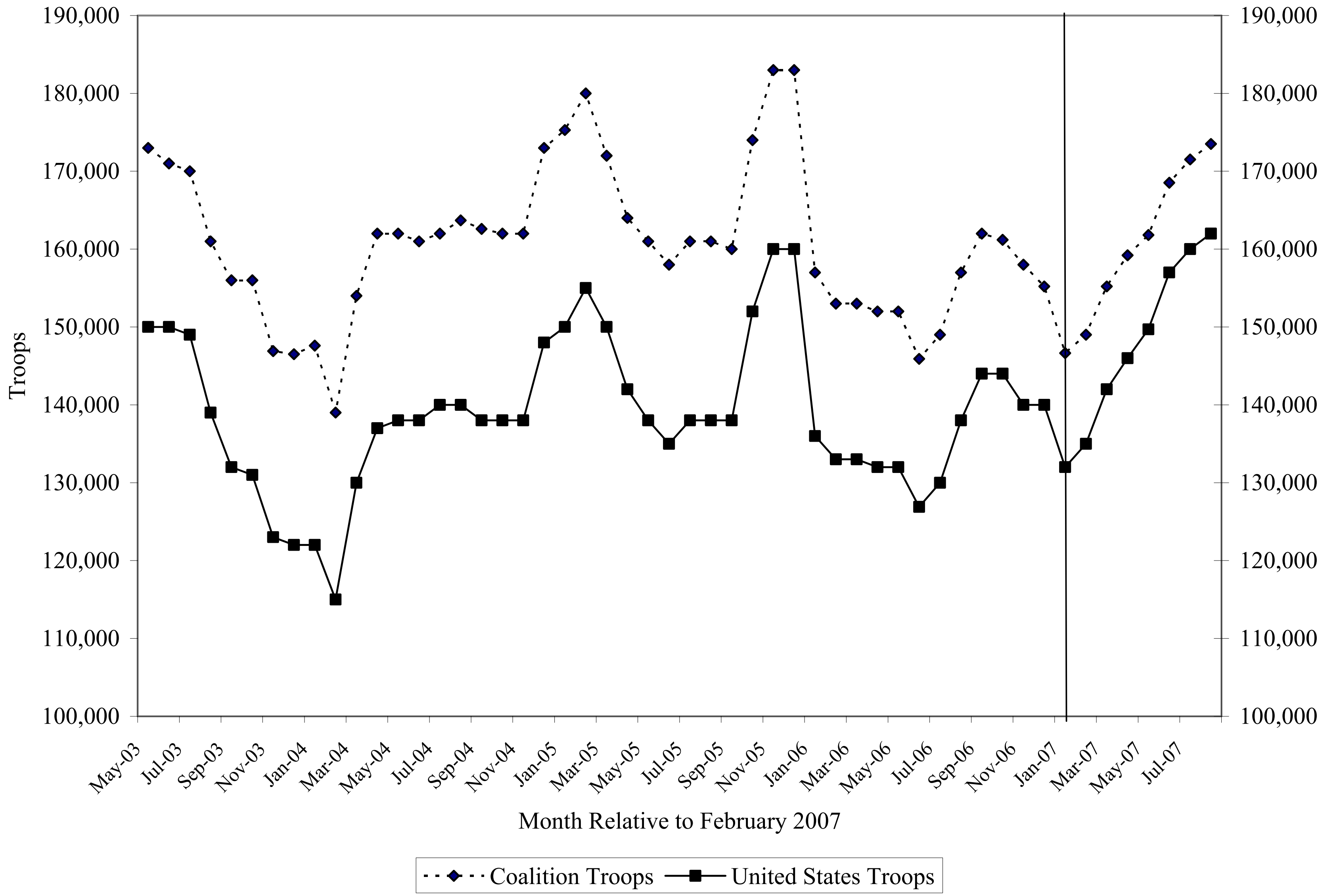
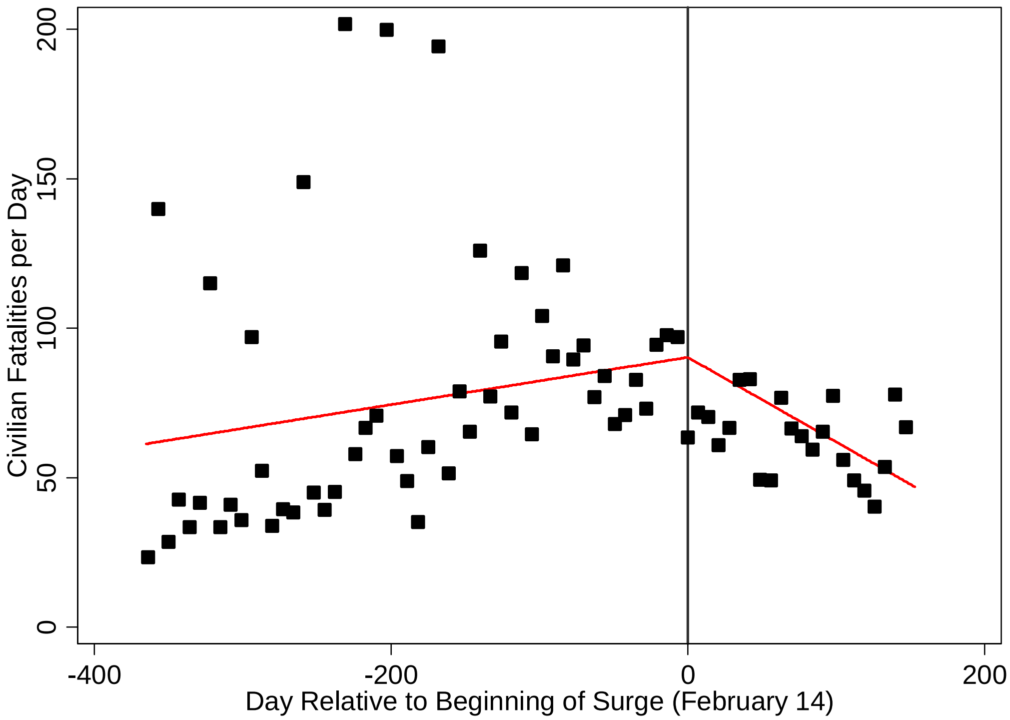
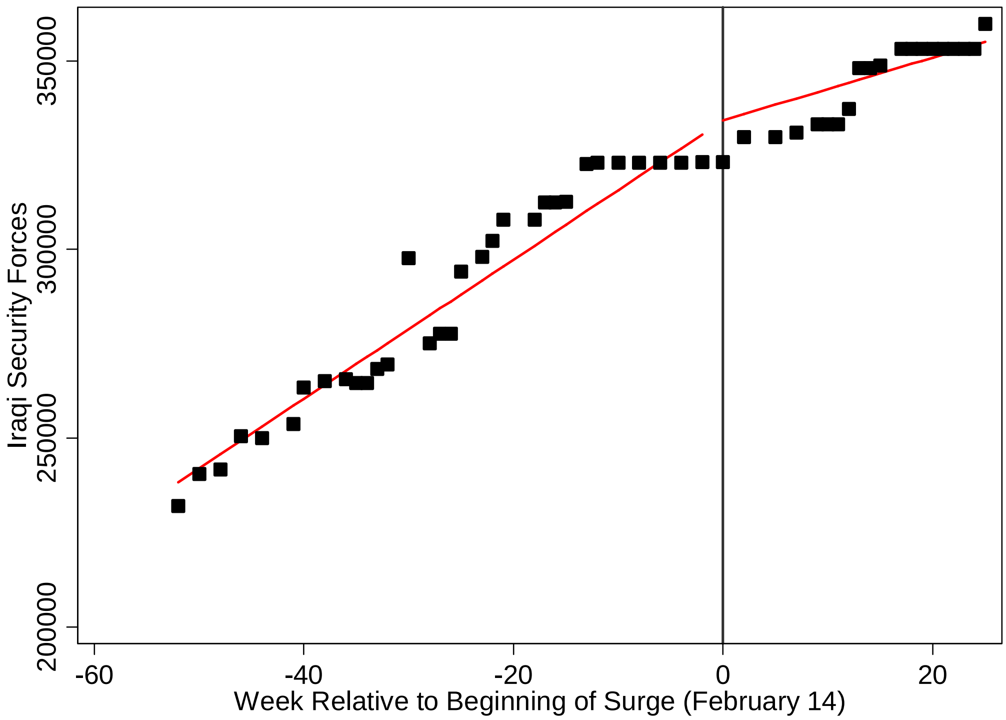


Figure 3: Daily Fatalities of Iraqi Civilians Due to Violence from 1 Year Before the Surge Began through 153 Days After the Surge Began



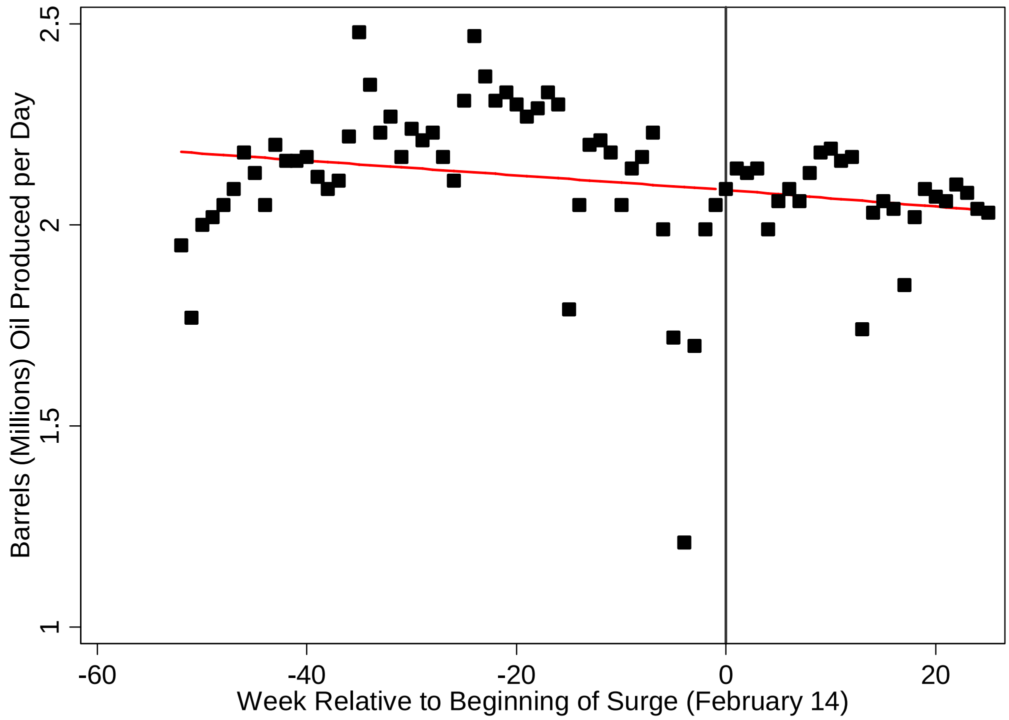
Notes: The data points are the average daily civilian fatalities due to violence per week in the period beginning one year before the initiation of the Surge through 153 days after the Surge. The line is the fitted values from a regression of daily coalition fatalities against a constant, a time trend, and the interaction of the time trend and an indicator variable equal to 1 for days after February 14, 2007. See Table 2 and the text for further details.

Figure 4: Number of Iraqi Security Forces from 1 Year Before the Surge Began through 25 Weeks After the Surge Began



Notes: The data points are the number of Iraqi Security Forces measured weekly in the period beginning one year before the initiation of the Surge through 186 days after the Surge. The line is the fitted values from a regression of the number of Iraqi Security Forces against a constant, a time trend, and the interaction of the time trend and an indicator variable equal to 1 for days after February 14, 2007. See Table 3 and the text for further details.

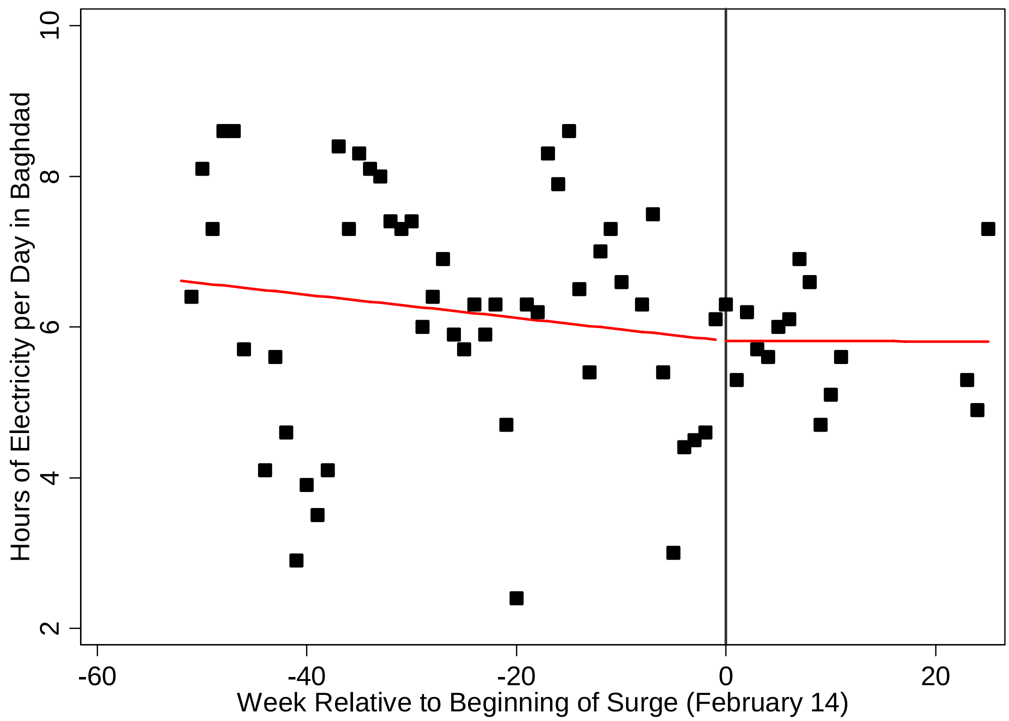
Figure 5: Millions of Barrels of Oil Produced per Day (Measured Weekly) from 1 Year Before the Surge Began through 25 Weeks After the Surge Began



Notes: The data points are the barrels (in millions) of oil produced per day (measured weekly) in the period beginning one year before the initiation of the Surge through 186 days after the Surge. The line is the fitted values from a regression of the barrels (in millions) of oil produced per day (measured weekly) against a constant, a time trend, and the interaction of the time trend and an indicator variable equal to 1 for days after February 14, 2007. See Table 4 and the text for further details.

Figure 6: Hours per Day (Measured Weekly) of Electricity in Baghdad and All of Iraq from Year Before the Surge Began through 25 Weeks After the Surge Began

A. Baghdad



B. All of Iraq

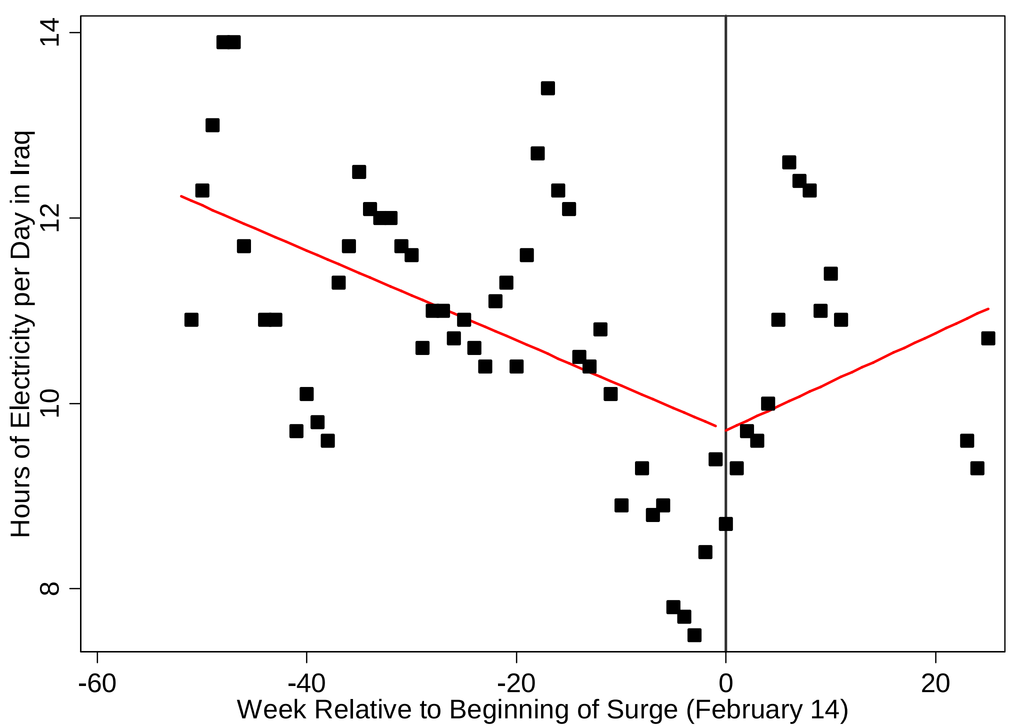
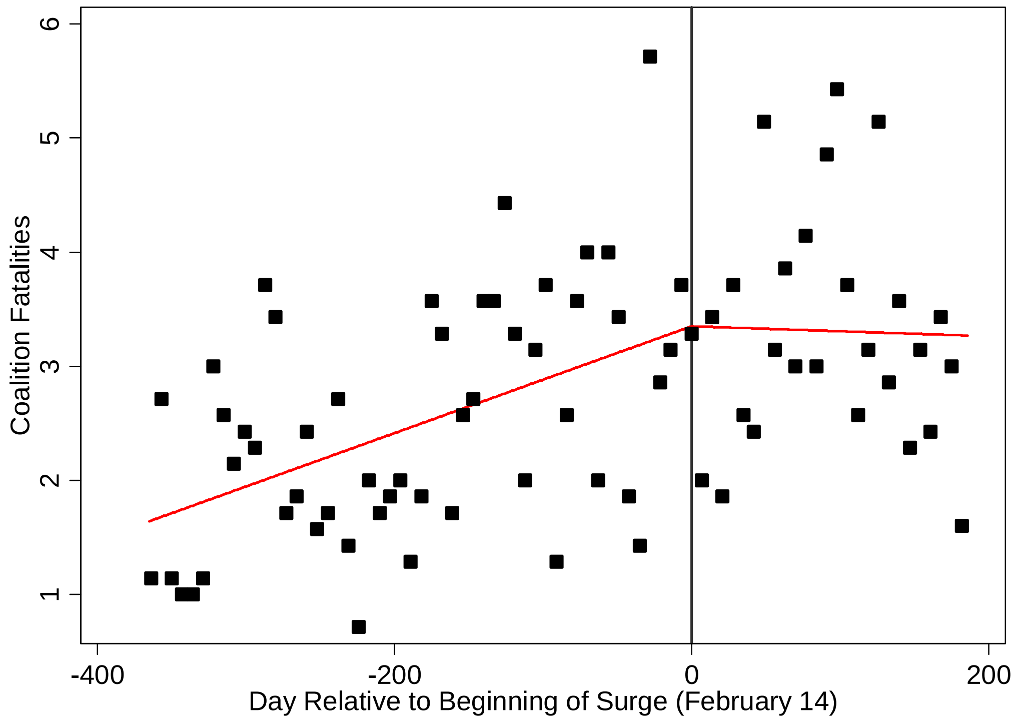
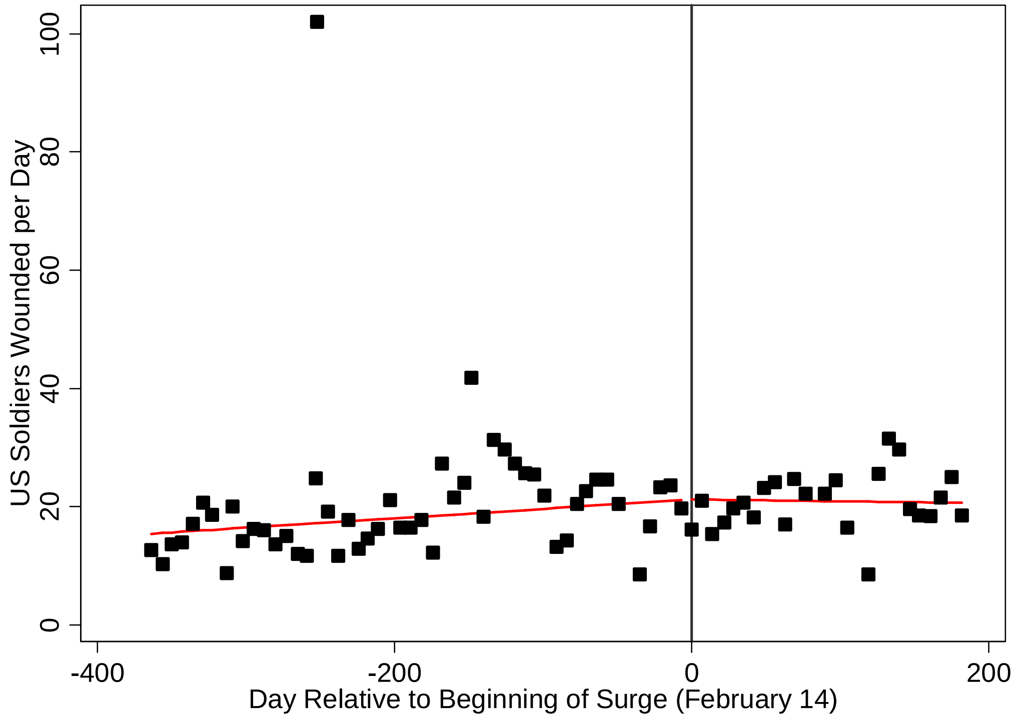


Figure 7: Daily Fatalities of Coalition Soldiers from 1 Year Before the Surge through 186 Days After the Surge Began



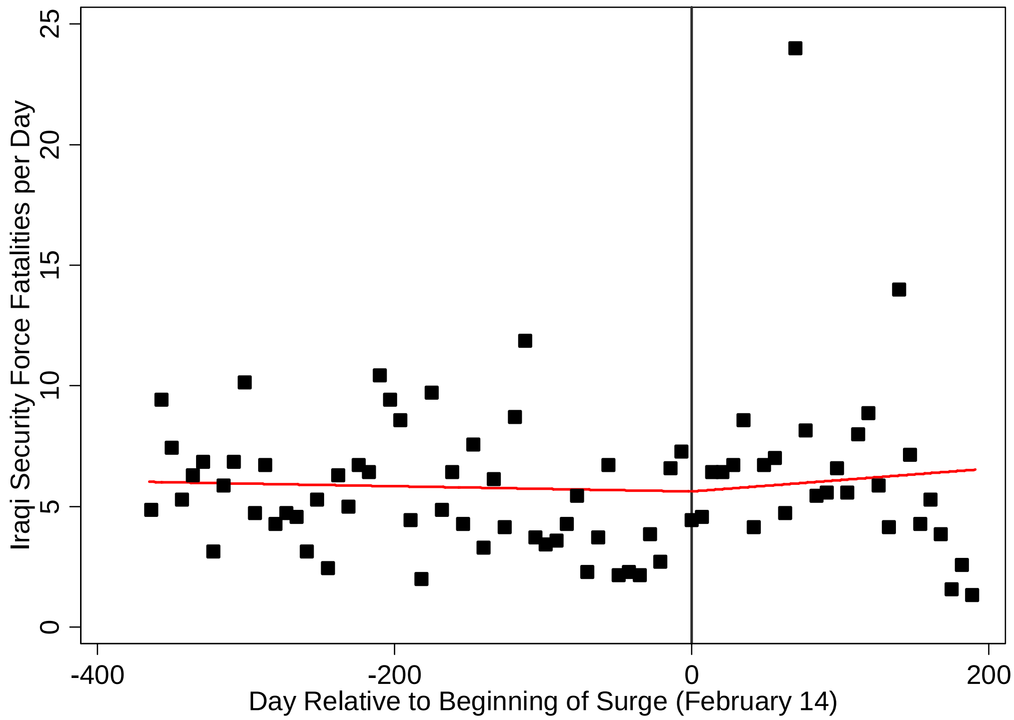
Notes: The data points are the average daily fatalities of coalition soldiers per week in the period beginning one year before the initiation of the Surge through 186 days after the Surge. The line is the fitted value from a regression of daily coalition fatalities against a constant, a time trend, and the interaction of the time trend and an indicator variable equal to 1 for days after February 14, 2007. See Table 6 and the text for further details.

Figure 8: Daily Wounded US Soldiers from 1 Year Before the Surge through 182 Days After the Surge Began



Notes: The data points are the average daily non-fatal casualties per week in the period beginning one year before the initiation of the Surge through 186 days after the Surge. The line is the fitted value from a regression of daily coalition non-fatal casualties against a constant, a time trend, and the interaction of the time trend and an indicator variable equal to 1 for days after February 14, 2007. See Table 7 and the text for further details.

Figure 9: Daily Fatalities of Iraqi Security Forces from 1 Year Before the Surge through 189 Days After the Surge Began



Notes: The data points are the average daily fatalities per week in the period beginning one year before the initiation of the Surge through 189 days after the Surge. The line is the fitted value from a regression of daily Iraqi security force fatalities against a constant, a time trend, and the interaction of the time trend and an indicator variable equal to 1 for days after February 14, 2007. See Table 8 and the text for further details.

Figure 10: Spread Between Yields of Iraqi State Bond Due in 2028 and Alternative Bonds

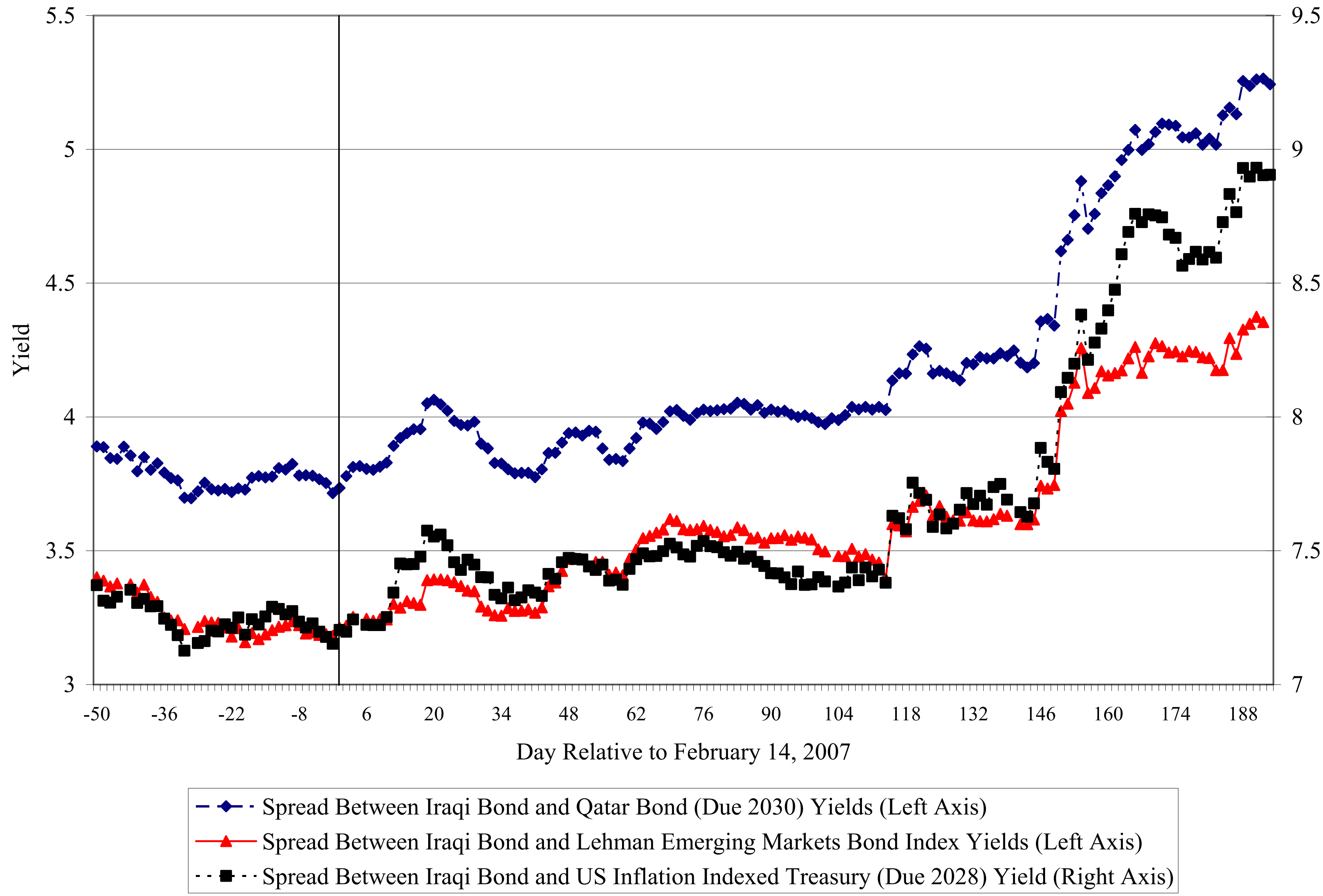
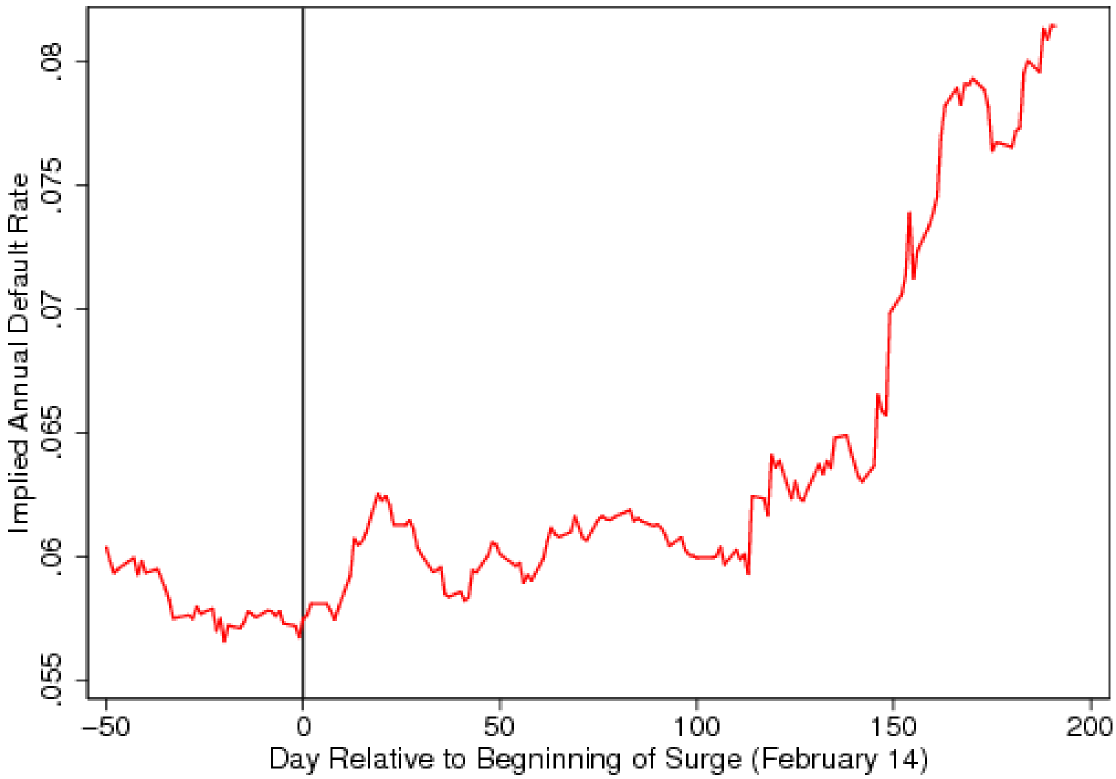
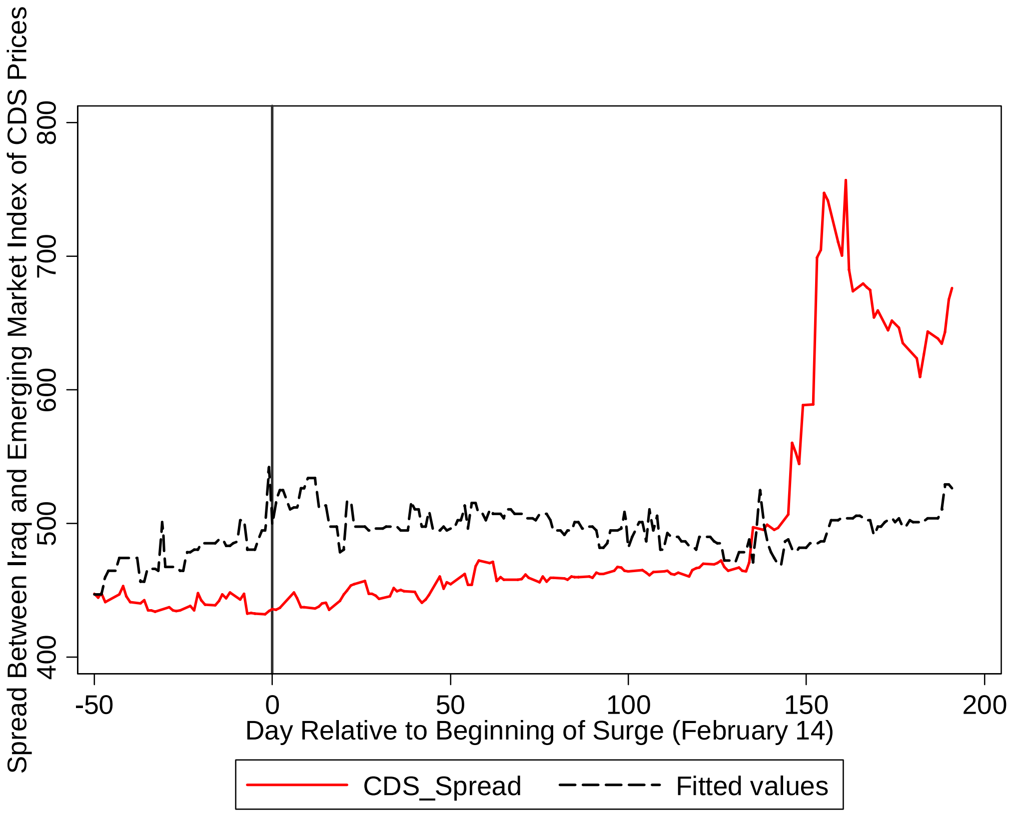


Figure 11: The Implied Annual Default Rate of Iraqi State Bonds



Notes: This graph is derived from the yield series of the Iraqi bond due in 2028. The y-axis reports the implied annual default rate of Iraqi state bonds. A value of .06 means that there is a 6% chance of a default per year. See the text for technical details.

Figure 12: The Role of Domestic US Politics on the Spread Between 5-Year Credit Default Swap Premiums for Iraqi Bonds and an Index of Emerging Market Bonds



Notes: The full line plots the spread between the credit default swap premiums for the Iraqi bonds and an Index of Emerging Market bonds. The dashed line reports the fitted value from a regression of the default probability against a constant and the price of a contract that pays $100 if a Democrat is elected president in 2008. The contract prices were downloaded from the web site https://www.intrade.com/v2/. Specifically, it is based on the contact with the name "PRESIDENT.DEM2008" that is described as "Democratic Party Candidate to Win 2008 Presidential Election". See the text for further details.