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The Macroeconomic Impacts of the 9/11 Attack: Evidence from Real-Time Forecasting

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Abstract. Estimates of the consequences of human-made and natural disasters are crucial for informing decision making by both public and private actors. The 9/11 attack stands out as a particularly important event whose consequences need to be well understood. This study evaluates the macroeconomic impacts of the 9/11 attack on U.S. real GDP growth and the unemployment rate by examining how forecasts of these variables were revised after the attack occurred. By this approach, the immediate impact of the 9/11 attack was to reduce real GDP growth in 2001 by 0.5%, and to increase the unemployment rate by 0.11% (reduce employment by 598,000 jobs.) Results are robust to controlling for how economic forecasts typically change over the course of the forecasting horizon in normal and recession years. Impacts on 2002 outcomes are more difficult to identify. Forecasted real GDP growth in 2002 fell dramatically immediately after the 9/11 attack but then recovered fully. The recovery in the forecast could have been due to unforeseen responses that mitigated the impact of the attack, but it also could have been due to erroneous forecasting and a poor understanding of how the attack would impact the economy. The forecasted unemployment rate in 2002 rose sharply immediately after the 9/11 attack, but unlike real GDP growth, it never subsequently returned to a pre-9/11 level. Forecasters seemed to have anticipated the 2002 "jobless recovery" early in that year.

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Homeland Security

Office of Immigration Statistics
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I. The Economic Impacts of Disasters: Overview

Identifying the full range of the economic and social impacts of natural and human-caused disasters and quantifying them wherever possible is a crucial task for public-policy analysts. The risk of potential disasters cannot be accurately described unless the consequences of disasters are properly identified and quantified.[2] Assessing disaster consequences is challenging. Rose (2009) develops a comprehensive framework for assessing disaster impacts based on economic principles and provides extensive references to the literature. Disasters cause direct impacts that include fatalities, injuries, and property and infrastructure destruction. Immediate economic disruptions result from the inability of consumers and businesses to adapt to changed circumstances after a disaster. The ability to quantify these impacts through simulation models or analysis of historical data is generally good. Estimates of the direct impacts of actual disasters are often produced very quickly after a disaster takes place, and estimates of immediate economic disruption have in some cases been estimated or simulated. Prospective disasters can be analyzed using a range of simulation models that employ engineering, economic, or agent-based frameworks. Disasters can also potentially have medium- and longer-run impacts on local, regional, and national economies that are significant enough to warrant quantification.

A range of difficult issues confronts the assessment and quantification of disaster impacts.[3] First, the private and public sectors respond to a disaster with actions intended to mitigate its consequences. Businesses relocate to continue operating, previously untapped sources of productivity are exploited to boost output from undamaged resources, and governments provide resources to facilitate continuity and recovery.[4] Should simulation of disaster impacts include or exclude potential mitigation responses, or should analysis of historical disasters attempt to identify the impact of mitigation responses separate from the impact of the disaster itself? A disaster might also induce other kinds of responses related to behavioral change that raise the same issue, most notably a "fear factor."[5,6] Second, how does one define and bound the extent of disaster impacts and resulting responses to be analyzed with respect to time, geographic space, and affected populations? For small disasters, this bounding issue can be relatively straightforward, but for larger disasters, it may pose a serious challenge.

In this study, I will attempt to quantify the macroeconomic impacts of one of the most important catastrophic disasters in modern times, the terrorist attacks carried out on September 11, 2001. Rather than analyze historical data or use a model to simulate the impacts of the 9/11 attack, I will analyze how forecasts of macroeconomic outcomes changed in response to the attack. This approach isolates the impact of the attack on the projections of professional forecasters and is thus based on the result of feeding the 9/11 shock into the models that those experts were using to forecast the economy at the time.[7] The approach can thus be termed "real-time forecasting" or "real-time simulation." Forecasts made immediately prior to the 9/11 attack presumably were taking into account all available information to develop a baseline prediction on macroeconomic outcomes, and how these forecasts changed immediately after the attack reflect the anticipated impact of the disaster.[8] This approach does

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[2] The U.S. Department of Homeland Security defines risk to be the multiplicative product of threat, vulnerability, and consequences. Even relative (as opposed to absolute) risk assessment requires relative consequence assessment and thus consequence quantification.

[3] See Rose (2009) for a thorough discussion of these issues and a framework for assessing disaster impacts.

[4] Chernick (ed) (2004) describes the resiliency of affected businesses in New York City after the 9/11 attack. Horwich (2000) shows how the largest container port in Japan, Kobe, recovered rapidly after a devastating earthquake in 1995, in part by extracting higher productivity from undamaged infrastructure.

[5] Rose (2009) discusses at length the "fear factor" associated with large-scale terrorist attacks that can substantially alter behavior and patterns of economic activity over an extended timeframe. The "fear factor" reflects the "accident (disaster) as a signal" theory of Slovic et al (1984) in which a disaster creates impacts by increasing the perceived probability of other disasters (with potentially larger consequences) happening in the future. See also Slovic (1987). The 9/11 and anthrax attacks of 2001 clearly did increase the perceived probability of future terrorist attacks and are a classic example of the "disaster as a signal."

[6] The challenge of fully assessing the impacts of disasters is broader than ensuring that one uses a model that covers all affected places and people, or all affected sectors of the economy. The analyst must also determine what set of exogenous variables is impacted by the disaster and must therefore be shocked in the simulation, or conditioned on in the analysis of historical data.

[7] These models could have been formal quantitative models or judgmental models based on informal interpretation of emerging trends.

[8] Unless other major shocks were impacting forecasts at the same time, an issue that will be addressed.

not fully overcome the mitigation identification issue, because immediately after the attack, forecasters presumably made some predictions on responses to the disaster and their impacts on outcomes. However, as will be shown, the approach is potentially useful in terms of identifying unanticipated mitigation and resilience.

Previous research suggests that even large-scale natural disasters may not have significant negative impacts on macroeconomic outcomes in the short run. Albala-Bertrand (1993) evaluates 28 natural disasters that occurred during 1960–79 in 26 countries and finds evidence for positive macroeconomic impacts in the short and medium run (one and three years respectively) following the disaster.[9] Horwich (2000) evaluates the impacts of the earthquake that struck Kobe, Japan on January 17, 1995 and finds that even though Kobe was a major manufacturing center and the largest shipping port of a highly trade-dependent economy whose port, factory, and housing infrastructure were heavily damaged, the earthquake produced no detectable macroeconomic impacts.[10] Benson and Clay (2004) argue that natural disasters do have negative macroeconomic consequences in some cases, but that this depends on the size of the national economy and its degree of vulnerability. Truly catastrophic natural disasters such as a major pandemic would presumably have very large macroeconomic impacts, but evidence is scarce. The immediate economic impacts of the Spanish flu pandemic of 1918–1919, for example, have not been quantified.[11]

Results are different with respect to the outbreak of external war, internal civil conflict, and terrorist attacks, which previous research suggests do have significant negative macroeconomic impacts. For example, Blomberg et al (2004) analyze panel data on 177 countries during 1968–2000 and find that the outbreak of external war or internal conflict has a significant negative impact on real GDP growth in the year of the event, and terrorist attacks have a smaller but nonetheless significant negative impact. They also find that an increase in terrorist activity redirects economic activity from investment to government spending, and that the negative impact of terrorist events is larger in less-developed countries. Given the available evidence, it would not necessarily be surprising if the 9/11 attack had significant consequences at the macroeconomic level in the short run.

Evidence on the longer-run impacts of disasters is scant. Abadie and Gardeazabal (2003) find that the long-running terrorist campaign in the Basque region of Spain reduced that region's per-capita real income by 10% relative to a non-terrorism control.[12] Abadie and Gardeazabal (2008) analyze cross-country data and find that an increase in perceived terrorism risk causes a significant drop in foreign direct investment.[13] Longer-run consequences of the 1918 influenza pandemic include stronger economic growth and wage growth through 1930 in U.S. states that had higher deaths per capita, but also reduced educational attainment, lower income, and higher rates of physical disability for babies who were born during the pandemic.[14] After the 1995 earthquake, Kobe suffered a permanent

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[9] See Albala-Bertrand (1993), chapter 3 (pp.56–89). He finds in particular that GDP, capital formation, and capital inflows tend to increase after a disaster, and that unemployment is unaffected (pp.86–87). Almost all of these disasters took place in developing countries.

[10] Horwich (2000) explains the paradox by arguing that "the picture that emerges from the macroprofile is one in which any loss of gross aggregate output due to the quake is largely replaced by market-based factor and product substitutions." (p.525) He identifies a range of factors that made Kobe and the Japanese economy highly resilient to the disaster.

[11] See Garrett (2008) for a summary of available findings on the 1918 influenza pandemic. Direct impacts of the pandemic on economic activity seem to have been short-term and hurt some sectors (services) but benefited others (healthcare).

[12] It is not clear to what extent this shift reduced overall income for Spain as a national whole.

[13] There is little available evidence on the potential consequences of a truly catastrophic terrorist attack such as an atomic bomb explosion in a major city. The only historical experience with atomic bombings is that of Hiroshima and Nagasaki in World War II. Davis and Weinstein (2002) show that the populations of Hiroshima and Nagasaki recovered to levels consistent with pre-war trends by 1975 and 1955 respectively. It would be quite challenging to quantify the immediate and longer-run economic impacts of these historical events, given data availability and the need to control for other impacts of the war. As for simulation evidence, Solomon and Marston (eds) (1986) present findings on prospective consequences that could have resulted from nuclear war between the U.S. and the Soviet Union, including fatalities, immediate injuries, longer-term health impacts (eg increased cancer rates), infrastructure destruction, economic impacts and whether and how post-conflict recovery could have taken place, psychological impacts, and unraveling of social capital. It is not clear to what extent this evidence is useful for evaluating a terrorist attack involving a single atomic weapon.

[14] See Garrett (2008). Longer-run consequences of the Black Death bubonic plague that swept through Europe in the 14th century included dramatic social, political and economic change that may have reverberated for centuries, but it is not clear in what ways this medieval experience might be relevant for modern societies.

shift in its relative importance among Japanese container ports.[15] These impacts, however, are not macroeconomic impacts that capture all substitutions and adjustments made at the national level. Benson and Clay (2004) cite evidence that countries and regions that are subjected to natural disasters more frequently tend to have lower rates of economic growth, but they note the difficulties involved in doing this kind of research.[16]

The 9/11 attack produced a range of impacts and responses that affected local, regional, and national economic outcomes. Chapter IV of OECD (2002) provides a thorough review of the initial short-run economic impacts of the 9/11 attack and responses to it. In addition to the direct impacts of fatalities and injuries, destroyed property, and business interruption in New York City, it reviews the emergence of the "fear factor" stressed by Rose (2009) and the range of fiscal and monetary policy responses undertaken by the U.S. government that sustained economic activity.[17] It concludes that even though forecasters responded to the attack with "one of the largest one-time collective downward revisions in recent history" (p.119), the short-run impact was far less than feared initially.[18] The evidence presented in this study, however, suggests that there was a significant negative short-run impact of 9/11 that is detectable at the macroeconomic level. Even though the New York City economy displayed a remarkable degree of resiliency after the attack, and strong responses were undertaken to mitigate the attack's overall consequences, the immediate consequences were nonetheless negative and economically significant.

II. Real-Time Forecasting and the Macroeconomic Impacts of the 9/11 Attack

The impacts of the 9/11 attack on the U.S. economy are evaluated in this study by determining whether forecasts of macroeconomic performance changed significantly in the immediate aftermath of the attack. Any significant revision captures how forecasters initially assessed the impact of the attack on macroeconomic outcomes. The degree to which initial forecast revisions appeared to be permanent or transitory is also assessed, albeit more informally. It should be recognized at the outset that the 9/11 attack was immediately followed by the anthrax attack that played out over several weeks after September 18, 2001. It cannot be ruled out that the impacts identified in this paper were also partly attributable to the anthrax attack, and it is not possible to identify separate impacts for the two attacks.

It should also be noted that because macroeconomic performance is being assessed, the overall impact of the 9/11 attack on the entire U.S. domestic economy is being evaluated here. Impacts at the macroeconomic level take into account substitution of production and consumption activities across geographic regions and sectors and net out positive and negative shocks related to these substitutions.[19]

The data analyzed here are the consensus forecasts for annual real GDP growth and the unemployment rate as reported by the firm Consensus Economics (CE). This firm has been collecting forecasts for macroeconomic variables from individual forecasters since October 1989.[20] CE's pool of individual

[15] Kobe went from being the most important port in Japan to the fourth most important in terms of container traffic, and sixth most important in terms of metric tons shipped, in 2006.

[16] See Benson and Clay (2004), p.25.

[17] See OECD (2002) p.119 on the fear factor, and pp.119–124 on mitigating responses. Note also table IV.2 on p.133 that shows how public spending increased after major disasters in several countries during 1980–2001, and the impact on GDP that these injections could have been expected to make. In the case of the 9/11 attack, public spending increased by 10.2% from the third to the fourth quarter of 2001, and the contribution to GDP was 1.8%.

[18] In a report of the Congressional Research Service, Makinen (2002) also reviews the economic impacts of 9/11 and concludes that the attack did not make a "significant dent in the nation's economic output." (p.53).

[19] The analysis also does not take into account substitution across national boundaries. It is theoretically possible to evaluate the impact of a disaster on the world economy, but this would require data on real income and unemployment at the global level at a monthly or quarterly frequency, and such data does not exist.

[20] CE collects forecasts on many more macroeconomic variables than real income growth and the unemployment rate, including personal consumption expenditures and business investment (components of national income from the use side), corporate profits (component of national income from the income side), industrial production, consumer and producer prices, employment cost, car sales, housing starts, current account balance, and the federal budget balance. We evaluate real income growth and unemployment because these two indicators seem to be of most interest to policymakers and analysts and serve as key summary indicators on economic performance at the national level.

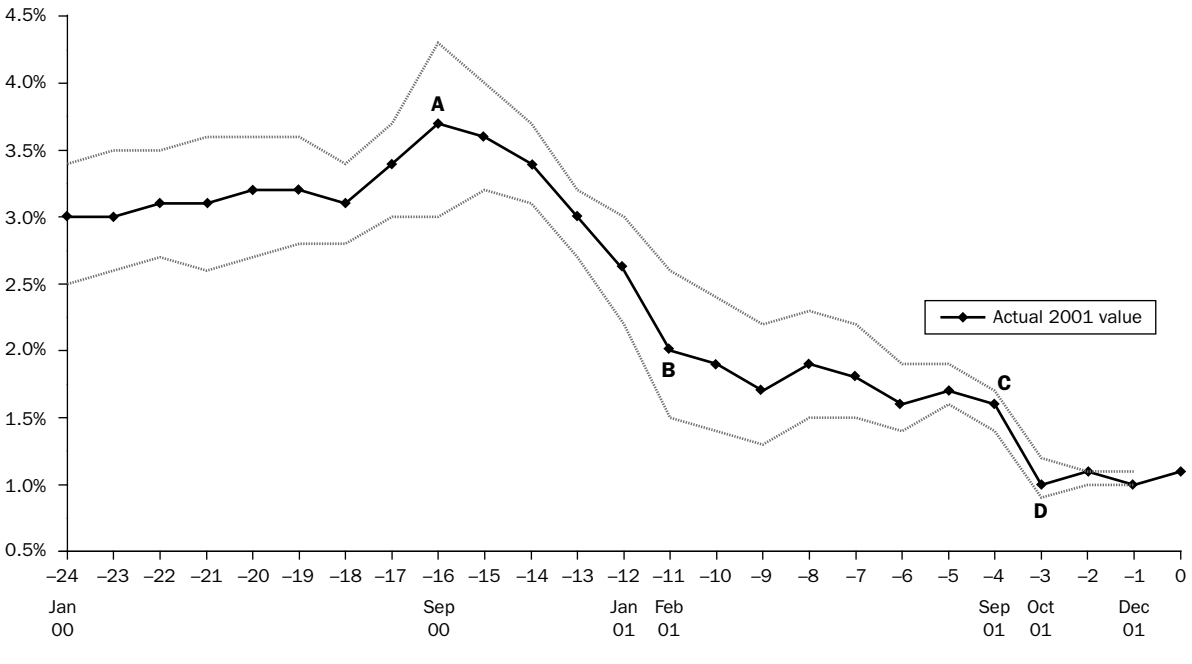
forecasters includes financial institutions, large manufacturing firms, industry associations, consulting firms, and academic groups, and the pool's composition has usually changed slightly from month to month and more substantially from year to year. Rather than analyze forecasts at the individual forecaster level in a panel setting, I evaluate the average of individual forecasts, which is termed the consensus forecast or the poll forecast. Evaluating the consensus forecast has the advantage of averaging out biases and forecasting errors that individual forecasters are subject to, but this is achieved at the expense of discarding potentially useful information contained in individual forecasts.[21]

It should also be noted that there are other sources of macroeconomic forecast data: the Blue Chip Survey of Professional Forecasters (quarterly and annual forecasts obtained at a monthly frequency starting in 1976), the Survey of Professional Forecasters (quarterly forecasts obtained at a quarterly frequency starting in 1968), and *The Economist* magazine (annual forecasts obtained at a monthly frequency starting in 1995). All of these sources obtain forecasts from a pool of participating organizations or individuals.[22] When available, forecast revision evidence from these other sources will be cited below.

Impact of 9/11 on 2001 Macroeconomic Outcomes

Figure 1 below graphs the CE consensus forecast for U.S. annual real GDP growth in 2001. Also graphed are two lines that show plus and minus one standard deviation from the mean forecast value.

Figure 1.
***Consensus Economics* Poll Forecast: Real GDP Growth in 2001**



[21] This advantage of a consensus forecast is related to the phenomenon of "the wisdom of crowds" as described in detail in Surowiecki (2004). In the case of financial and economic forecasting, forecasters may have incentives to introduce bias into their projections. Batchelor (2007) reviews the theoretical rationales for forecaster bias and empirically evaluates the degree to which Consensus Economics forecasts of real GDP and inflation are affected by bias. He finds that "individual forecasters appear to cultivate reputations for relative optimism or pessimism in real GDP forecasts" (p.3) and that although in some countries there is an optimism bias in the consensus forecast of real GDP growth, this is not true for the U.S. consensus forecast. Pesaran et al (2006) provide an extensive overview on forecast surveys and related literature.

[22] It would be natural to expect some overlap between the forecaster pools used by these sources. *The Economist* magazine forecaster pool is small and appears to be a subset of forecasters found in the Consensus Economics, Blue Chip, and Survey of Professional Forecasters pools. There is some overlap between the Consensus Economics and Survey of Professional Forecasters pools (roughly one-third in 2001).

Forecasters first began projecting the 2001 growth rate in January 2000, when the initial consensus forecast for 2001 growth was 3%. As developments unfolded over 2000, forecasters' expectations about growth in 2001 changed, and forecasted growth reached a high point at A in September 2000. At that point, forecasters began to realize that 2001 was likely to be a recession year, and they steadily revised their forecasts downward from A to B. From February 2001 to September 10, 2001, the date when forecasts were delivered to CE for the month of September, forecasters continued to slightly lower their growth expectations from B to C. Immediately after the 9/11 attack took place, the consensus forecast jump-shifted from C to D, and the forecasted growth rate fell from roughly 1.6% to 1.1%. The forecast then remained essentially unchanged through December 2001, and the December 2001 forecast was almost exactly equal to the actual real GDP growth rate for 2001.

These revision dynamics suggest two things. First, given that forecasters were projecting an annual growth rate and that actual growth in the first half of 2001 was already known by September 2001, the –0.5% revision in the consensus forecast from September to October reflected anticipated impacts on growth in the third and fourth quarters of the year.[23] Second, the jump-shift in the forecast for 2001 was permanent and not transitory.[24] Forecasters can of course make mistakes, and the immediate post-9/11 revision could have reflected an erroneous evaluation of the impacts of a disaster on the economy. Forecasters also might not have anticipated actions and policies undertaken by private- and public-sector actors that mitigated the negative economic impacts of 9/11. If forecasting mistakes were made and/or mitigating actions were not anticipated, the immediate post-disaster forecast revision would have dissipated over time (controlling for the flow of new information and shocks affecting the economy after the disaster.) However, the 9/11-induced forecast revision did not dissipate, suggesting that forecasters' initial projection of the impact of 9/11 on real GDP growth in 2001 was accurate, and that the 9/11 attack reduced U.S. real GDP growth in 2001 by 0.5%.[25]

This finding is based on data from the CE pool of forecasters, but other forecaster pools suggest an identical impact size. Figure 2 below compares the CE consensus forecast with that of *The Economist* magazine, whose forecaster pool appears to be a subset of the CE pool.[26] The difference in their consensus forecasts on the eve of the 9/11 attack was minimal, and both consensus forecasts suggest that 9/11 impacted growth in 2001 by –0.5%. The Survey of Professional Forecasters pool, which overlapped with the CE pool by about one-third in 2001, also explicitly documented that their average revision to real GDP growth in 2001 attributable to the 9/11 attack was –0.5%.[27] The fact that these three forecaster pools yielded identical estimates of the immediate revision to real growth after 9/11 is reassuring. It should also be noted that the National Bureau of Economic Research stated that "Before the (9/11) attacks, it is possible that the decline in the economy (in 2001) would have been too mild to qualify as a recession. The attacks clearly deepened the contraction (in 2001) and may have been an important factor in turning the episode into a recession."[28]

The consensus CE forecast for the unemployment rate in 2001 is graphed in figure 3 (including one-standard-deviation bounds.) As would be expected, the forecasted unemployment rate moved inversely with real GDP growth, and as forecasters realized in late 2000 that a growth slowdown was coming, the forecasted unemployment rate rose. By September 10, 2001, the forecast had stabilized at a rate of just below 4.6%. As in the case of real GDP growth, the 9/11 attack produced an immediate jump-shift forecast revision to a level of 4.73%, or a rise of 0.15%. This revision was permanently

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[23] The official US government source of data on GDP, the Bureau of Economic Analysis, released its initial, revised and final estimates of GDP growth in the second quarter of 2001 in July, August, and September of 2001 respectively.

[24] OECD (2002) notes the jump-shift in the forecast for growth in October 2001 (p.119 and figure IV.2), but does not recognize that this was a permanent forecast revision.

[25] It cannot be ruled out that forecasters' initial projection of the impact of 9/11 was incorrect, but other shocks hit the economy in the last quarter of 2001 that maintained the forecast at a level of 1.1%. There is little evidence that this was the case, as will be discussed further below.

[26] *The Economist* magazine pool for US forecasts in 2001 apparently consisted of four forecasters that were also found in the CE pool, and one forecaster that was not.

[27] See *Survey of Professional Forecasters: Fourth Quarter* 2001, p.3. This Survey's forecaster pool in 2001 included 12 forecasters that were in the CE pool, and 26 that were not. The report did not mention the anthrax attacks, only the 9/11 attack.

[28] See "The Business-Cycle Peak of March 2001," Business Cycle Dating Committee, NBER.

Figure 2.

Consensus Poll Forecasts for U.S. Real GDP Growth in 2001: *Consensus Economics* and *The Economist* magazine

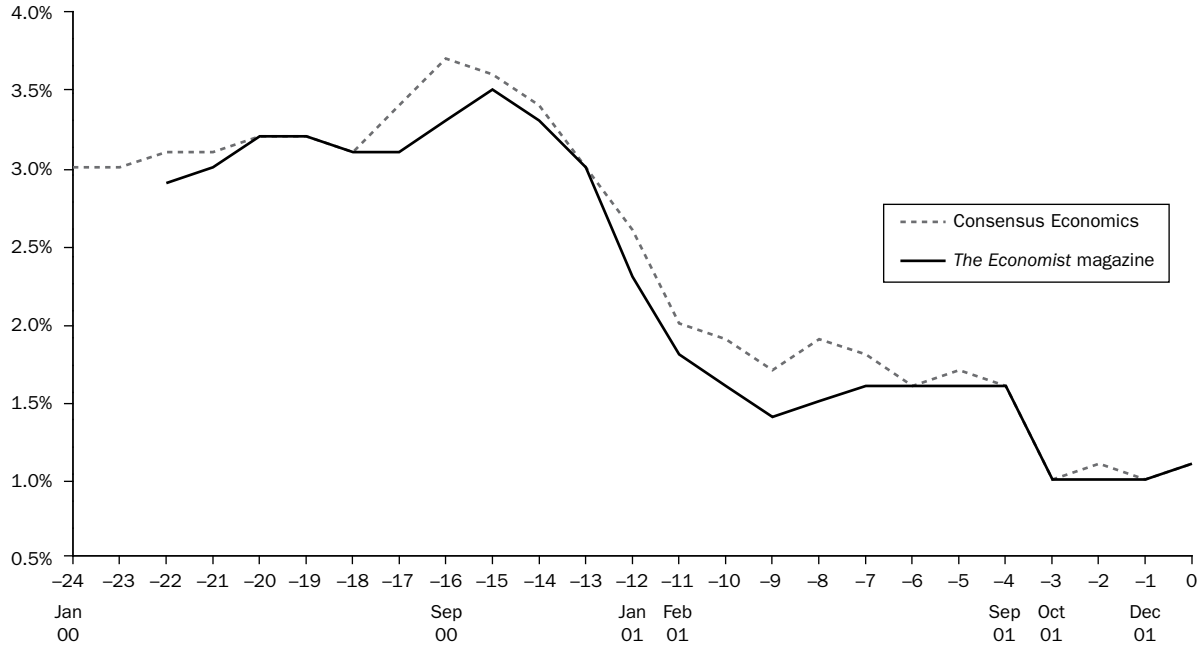


Figure 3.

Consensus Economics Poll Forecast: Unemployment in 2001

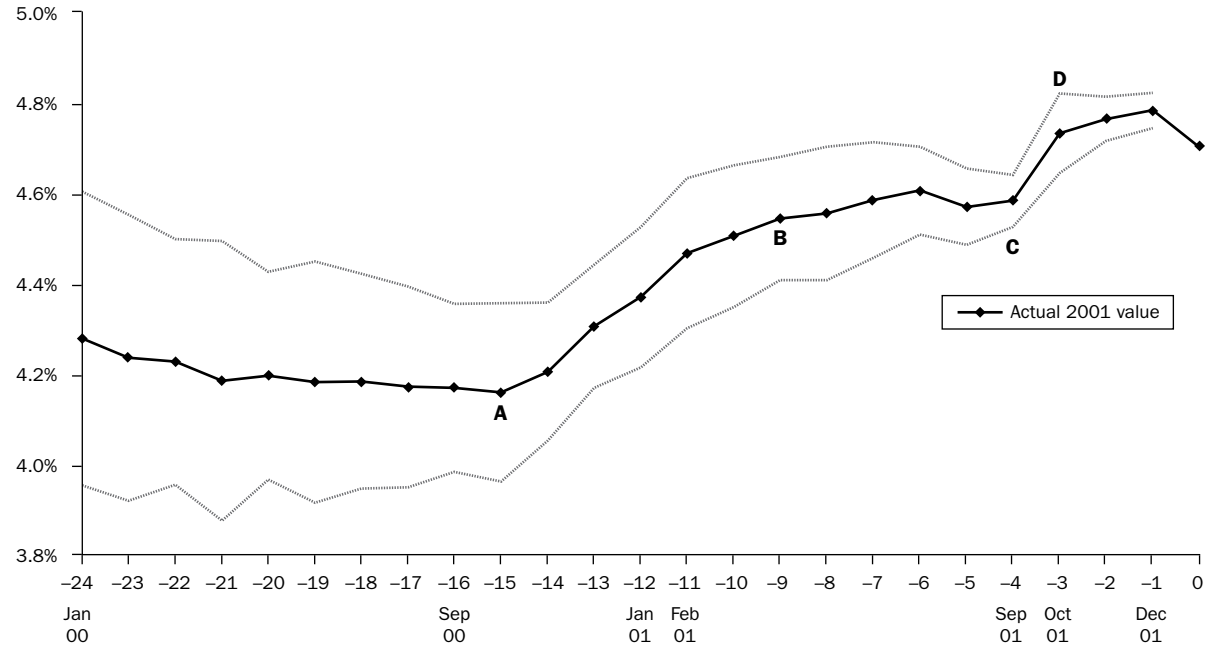
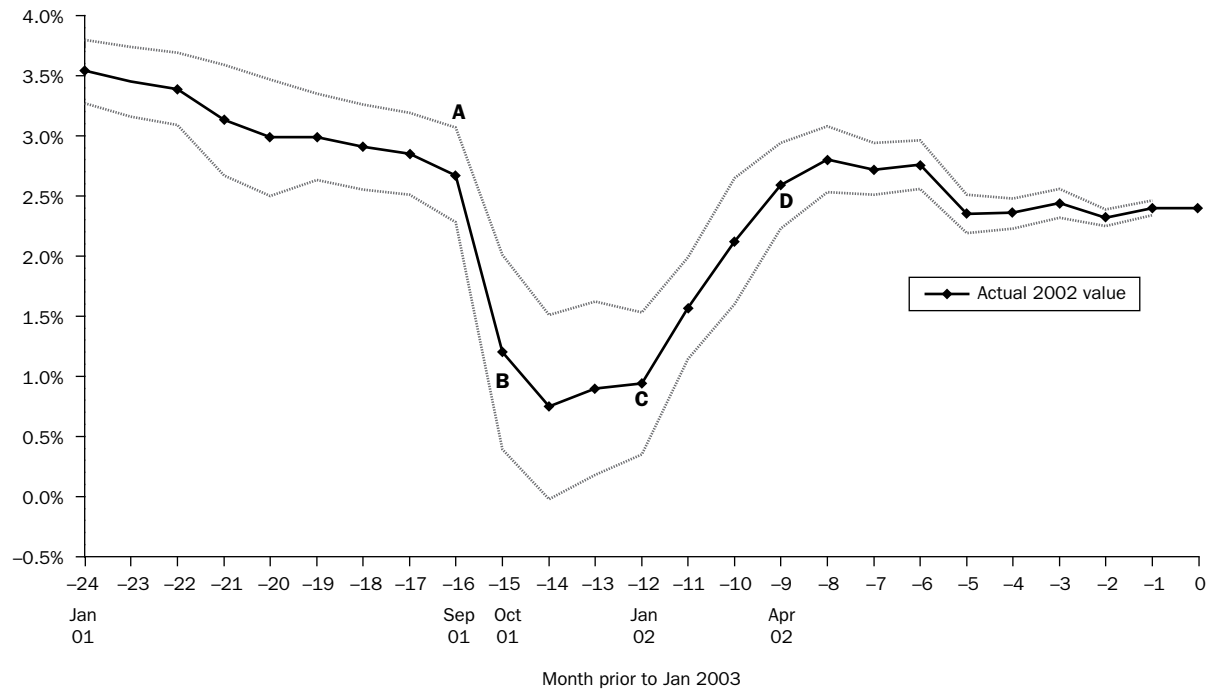


Figure 4.
***Consensus Economics* Poll Forecast: Real GDP Growth in 2002**



incorporated into the forecast, which subsequently grew slightly to converge to the actual 2001 unemployment rate value of 4.79%.[29]

Impact of 9/11 on 2002 Macroeconomic Outcomes

Forecasts for macroeconomic outcomes in 2002 began to be collected in January 2001. Figure 4 above gives the evolution of the forecast for real GDP growth in 2002, and figure 5 for the unemployment rate in 2002. The real GDP growth forecast fell from 3.5% to 2.7% over the first nine months of 2001. The 9/11 attack produced an immediate dramatic revision in this forecast from 2.7% to 1.2%, and the forecast was further revised downward in November by –0.75%. This pessimistic outlook was sustained through January 2002, but the forecast was then revised upward so that by May 2002, it had regained its level prior to the 9/11 attack. The actual value for 2002 of 2.4% is remarkably close to the forecasted value of 2.7% immediately prior to the 9/11 attack. It is tempting to ascribe the recovery in the forecast to mitigation responses of the private and public sectors that were not fully anticipated in the immediate aftermath of the attack.[30] However, it may also be true that forecasts in late 2001 were subject to significant error, and/or that forecasters were anticipating negative shocks such as subsequent attacks that did not materialize. Deeper research is required that can identify the separate impacts on forecast revisions of model error, unanticipated mitigation, and unrealized events. However, this preliminary analysis does suggest an upper bound on the magnitude of a short-run resiliency effect at the macroeconomic level of roughly 1.5% of GDP.[31]

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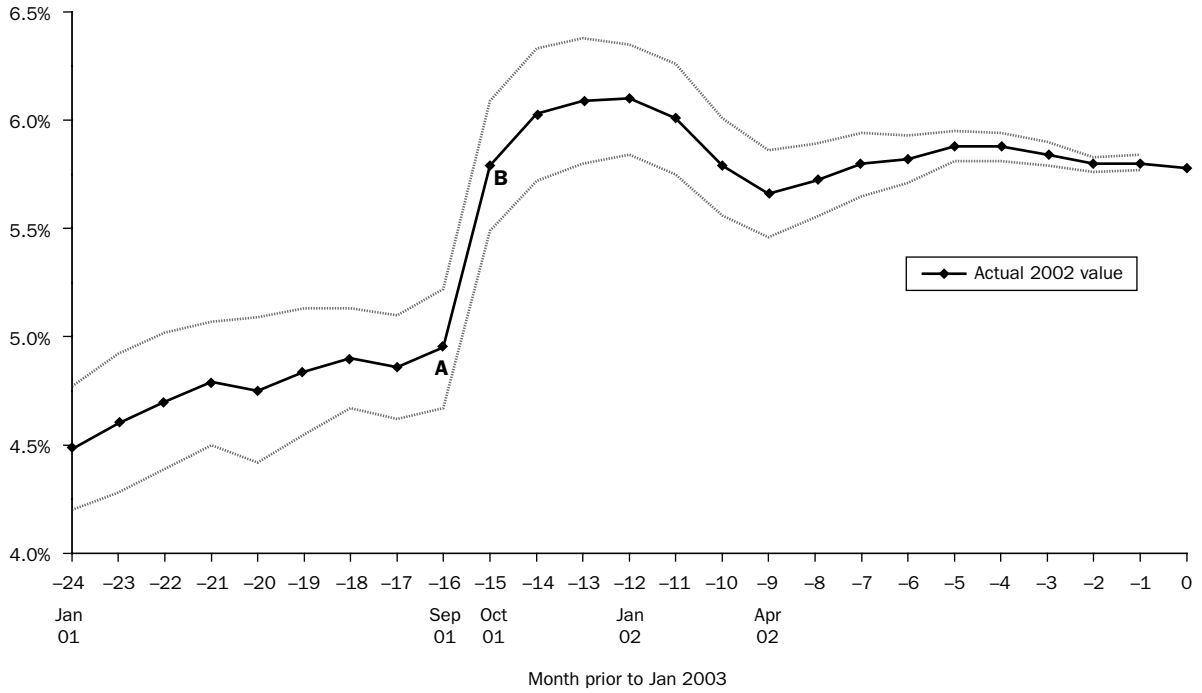
[29] The initial value for the official unemployment rate in 2001 was 4.79%. The Bureau of Labor Statistics subsequently revised labor force statistics, and the official 2001 value is now 4.73%. Forecasters were presumably targeting the initial BLS value.

[30] Mitigation responses at the local/regional level would include, for example, the ability of NYC-based businesses to continue operating by shifting location or quickly recovering productive capacities (see Chernick 2004.) At the national level, mitigation responses could include a further easing of monetary policy in late 2001, an easing of fiscal policy, and large incentives to purchase automobiles offered to consumers after 9/11.

[31] Some actions that mitigated impacts in 2002 may not have affected longer-run economic outcomes positively. For example, the easing of monetary policy may have contributed to intensification of the housing market bubble and resulting crash and recession of 2008–2009.

Figure 5.
***Consensus Economics* Poll Forecast: Unemployment Rate in 2002**



The impact of the 9/11 attack on the forecasted 2002 unemployment rate is intriguing. Figure 5 above shows that immediately after the attack, the forecast was revised from 4.95% to 5.79%, a rise of 0.84% that is consistent with the large decrease in the 2002 real GDP forecast.[32] Unlike forecasted growth, however, the unemployment forecast was never revised back down to its pre-9/11 level, and the immediate 9/11-related revision was permanently incorporated into the forecast. The recovery from the 2001 recession has often been described as a "jobless recovery."[33] These forecast dynamics suggest that forecasters apparently first anticipated a jobless recovery in early 2002, as they revised their growth forecasts up but maintained a high unemployment rate forecast.

Forecasting Uncertainty and the 9/11 Attack

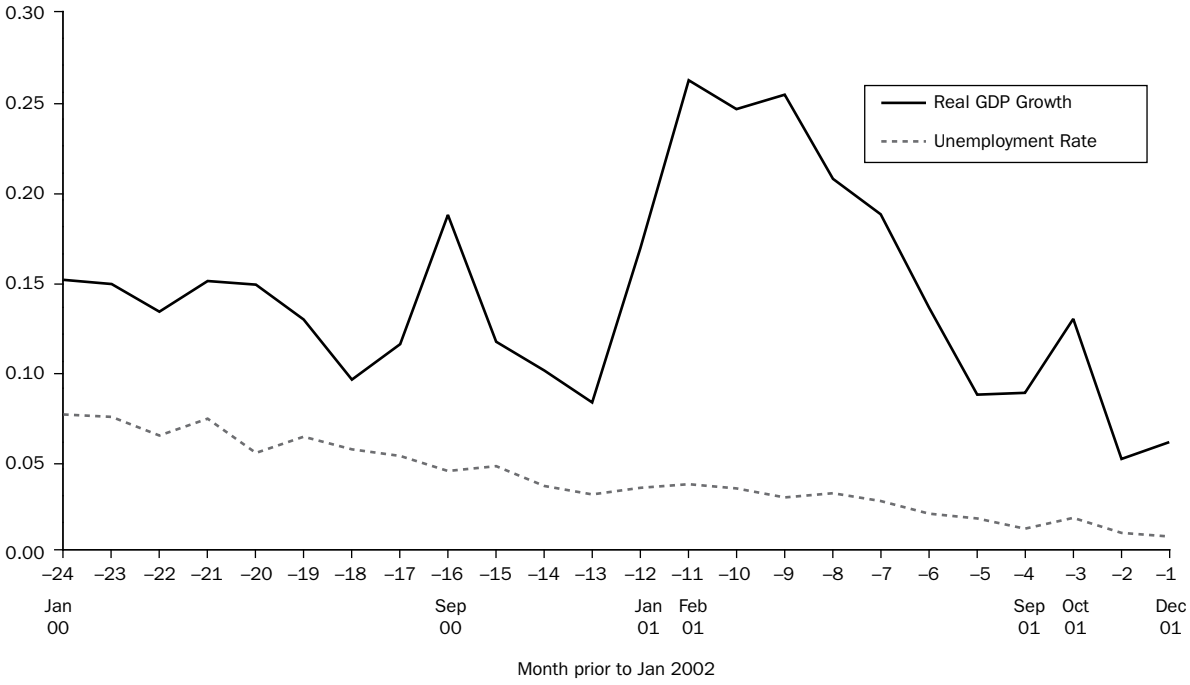
It is important to consider not only the consensus poll forecast, but the level of uncertainty evident in individual forecasts as measured by dispersion of these forecasts around the mean. Forecasters may have been highly uncertain about how the 9/11 attack would impact outcomes in 2001 and 2002, with some believing that the attack would have little impact but others anticipating a sizable impact. Such an increase in uncertainty would be reflected in an increased dispersion of forecasts around the average level.

Figures 1 and 3 graph the one-standard-deviation bounds for the growth and unemployment rate forecasts respectively. As would be expected, these bounds narrow over time, reflecting convergence in individual forecaster projections as more information becomes known and uncertainty falls. There is no obvious widening of these bounds immediately after the 9/11 attack. A lack of increased dispersion in individual forecasts is confirmed by other evidence. For the growth forecast, 15 individual forecasters

[32] Regression estimates that are not presented here show that real GDP growth and unemployment forecasts are closely related to each other in an Okun's Law specification (see Knotek (2007) for a thorough discussion of the Okun's Law relationship.) The change in the unemployment rate forecast that took place in October 2001 is very consistent with the change in the growth forecast based on the Okun's Law relationship. The finding of a strong Okun's Law relationship between these two forecast series suggests that some forecasters were using Okun's Law to derive an unemployment forecast from a growth forecast, or using a macroeconometric model that had Okun's Law embedded in it as a structural equation.

[33] See Groshen et al (2004) for an analysis of the "jobless recovery."

Figure 6.
Coefficient of Variation for 2001 Forecasts



reported values in both September and October 2001, and their revisions are tightly clustered around the mean value of –0.5%.[34] In the case of unemployment, the revisions of 15 forecasters reporting projections for both months are tightly clustered around a mean value of 0.13.[35] Figure 6 graphs the coefficients of variation (standard deviation divided by mean) of individual forecast values at different months in 2001. For the growth forecast, this statistic did rise slightly after the 9/11 attack, but to a level that was less than those when the forecast was being revised significantly in the first half of 2001. For the unemployment forecast, there was also a slight rise after the 9/11 attack, but this rise was very slight. Taken together, the evidence suggests that forecasters shared a rather high degree of certainty on the magnitude of the impact of the 9/11 attack on growth and unemployment in 2001.

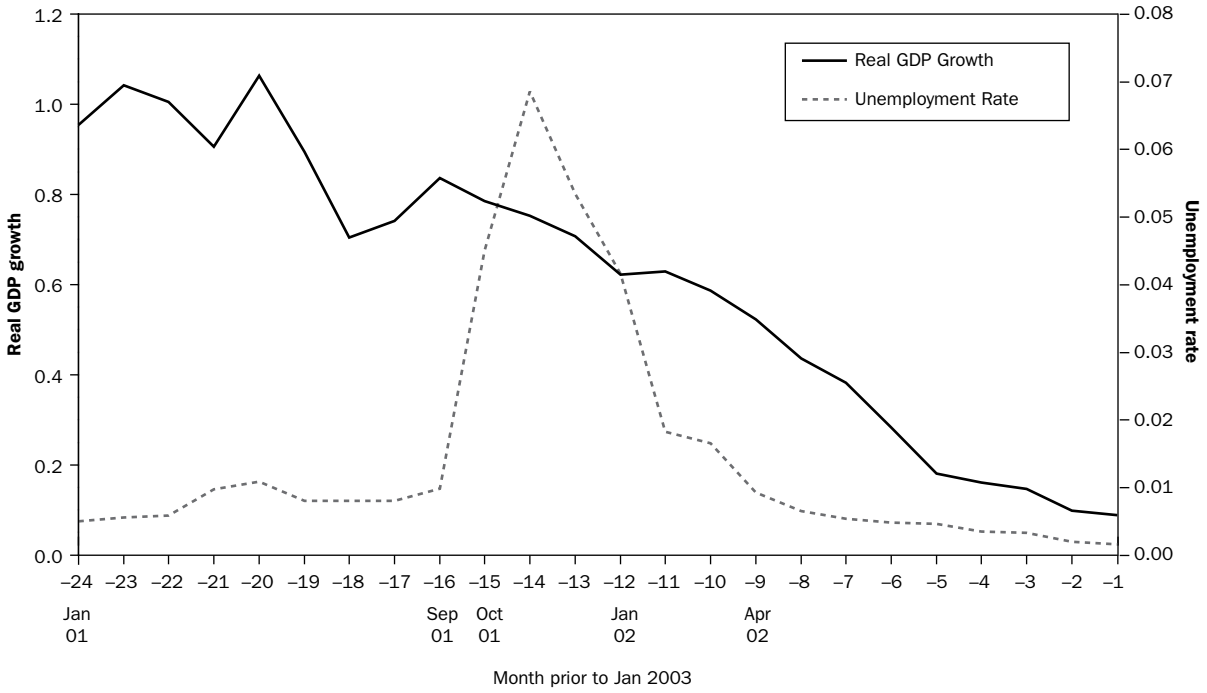
Figures 4 and 5 graph the one-standard-deviation bounds for the 2002 growth and unemployment forecasts, and figure 7 graphs the coefficients of variation (note that figure 7 has two y-axes.) Dispersion in the growth forecast did increase dramatically immediately after the 9/11 attack and stayed at a high level through January 2002, after which it fell to more normal levels. Forecasters had an unusually wide range of beliefs on the potential impact of the 9/11 attack on 2002 growth. Interestingly, in the case of unemployment, there was no significant increase in the dispersion of individual forecasts after the 9/11 attack.

Econometric Analysis of Forecast Revisions

Using forecast revisions to identify the macroeconomic impacts of the 9/11 attack is based on the two key assumptions that these revisions were not transitory but permanent, and that the revision was due entirely to the 9/11 attack rather than other news or developments happening at the same time. The permanent nature of the revisions to the 2001 forecasts and the 2002 unemployment forecast are apparent in figures 1, 3, and 5, and the transitory nature of the revision to the 2002 growth forecast is also obvious in figure 4. However, it is not entirely clear that the revisions to the 2001 forecasts

[34] Five forecasters revised their projection by –0.4%, four by –0.5%, four by –0.6%, one by –0.7%, and one by –0.8%.
[35] Three forecasters did not revise their projections, five revised by 0.1%, six by 0.2%, and one by 0.3%.

Figure 7.
Coefficient of Variation for 2002 Forecasts



were due solely to the 9/11 attack, particularly as a recession was also impacting the economy, and news related to the recession may have affected forecasts after September 10, 2001. Figures 1 and 3 do suggest that most of the recession-related revision appeared to have taken place during October 2000–February 2001, and the Survey of Professional Forecasters pool stated explicitly that the 9/11 attack alone caused them to revise their growth forecast downward by 0.5%. It nonetheless cannot be ruled out *a priori* that some part of the jump-shift revision that took place after the 9/11 attack was associated with a recession-related revision process.

To better control for any recession-related revision, and to also evaluate the impacts on forecast revision of other major terrorist events and war outbreaks, I regress monthly forecast revisions during October 1989 to October 2008 to a set of explanatory variables that includes dummy variables for the 9/11 attack, the outbreak of the Gulf War in August 1990, the bombing attack on the World Trade Center in February 1993, the Oklahoma City bombing in April 1995, and the invasion of Iraq in March 2003, dummies for months in the forecasting horizon, and dummies for months in the forecasting horizon in growth-downturn years. Month dummies control for the pattern of forecast revision over the course of a typical year.[36] Month-downturn dummies control for the possibility that forecasts are revised in a different manner during years in which growth is revised significantly downward over the course of the forecasting horizon. Growth downturn years include 1990, 1991, 1992, 2001, 2002, 2007, and 2008.[37] If forecasts are typically revised downwards in October, or in Octobers of downturn years, these dummy variables will capture that and purge the coefficient on the 9/11 dummy of the typical revision pattern. Forecast revisions are the forecast of the current month minus the forecast of the previous month. Dummy variables for war and terrorist events take on a value of 1 in the month that they occur and 0 for all other months.

[36] Isiklar and Lahiri (2007) describe the pattern of revisions in CE GDP growth forecast data for 18 developed countries (including the U.S.) and show the bulk of revision to growth forecasts takes place from December of the previous year to March of the current year.

[37] The criterion used to determine growth-downturn years is if the final forecasted value for real GDP growth was 80% or less than the initial forecasted value. All years except 1992 and 2002 are part of NBER-dated recessions. Econometric results are robust to the inclusion or exclusion of 1992 and 2002 as growth downturn years.

Results are presented for specifications that use the actual and absolute values of the monthly forecast revisions. For actual values, coefficients on the month and month-downturn dummies will tend to be statistically insignificant, because the influences of negative and positive revisions across the sample period will cancel each other out. However, if revisions in October of the current year tended to be either negative or positive and significant, the coefficient on the 9/11 dummy will be purged of this. For absolute values, coefficients on the month and month-downturn dummies are capturing whether significant revision takes place in a month regardless of whether revisions are positive or negative. It is important to note that coefficients on the 9/11 and Gulf War dummies will be positive in the absolute-value regressions, but they are capturing negative impacts nonetheless.[38]

Table 1 gives regression results for revisions to real GDP growth forecasts. As expected, the constant terms in the actual-value regressions (A) and (B) are insignificantly different from zero, but they are positive and significant in the absolute-value regressions (C) and (D). The coefficient on the dummy variable capturing the immediate impact of 9/11 on forecasted growth for 2001 is statistically significant at the 1% level across regression specifications. It does change from –0.54% to –0.43% if month-downturn dummies are included, because forecasted growth is usually revised downward in downturn years.[39] The impact is also somewhat lower at –0.39–0.44% in the absolute-value regressions. The estimated impact of 9/11 on growth in 2002 is robust across all specifications. The Gulf War had a statistically significant negative impact on growth forecasts for both 1990 (from –0.37–0.48%) and 1991 (roughly –1.0%.) Interestingly, the two largest downward revisions of forecasted real GDP growth in this forecast dataset were associated with the impact of 9/11 and the outbreak of the Gulf War on growth in the following year (2002 and 1991 respectively). In contrast, the bombing of the World Trade Center in 1993, the Oklahoma City bombing, and the invasion of Iraq in 2003 had no significant impacts on growth forecasts.

Table 1.
Forecast Revision Regressions: Real GDP Growth

	A	B	C	D
Dependent variable	**Actual values**	**Actual values**	**Absolute values**	**Absolute values**
Constant	–0.01 (–0.29)	–0.01 (–0.30)	**0.14** (5.97)	**0.14** (5.95)
9/11: 2001	**–0.54** (–3.37)	**–0.43** (–2.66)	**0.44** (4.16)	**0.39** (3.53)
9/11: 2002	**–1.44** (–9.06)	**–1.37** (–8.37)	**1.39** (13.22)	**1.36** (12.14)
Gulf War: 1990	**–0.48** (–3.04)	**–0.46** (–2.85)	**0.37** (3.51)	**0.38** (3.44)
Gulf War: 1991	**–1.07** (–6.72)	**–1.00** (–6.11)	**0.97** (9.17)	**0.97** (8.73)
WTC bombing: 1993	0.14 (0.87)	0.10 (0.63)	0.04 (0.40)	0.05 (0.50)
WTC bombing: 1994	–0.03 (–0.16)	–0.04 (–0.24)	–0.03 (–0.25)	–0.02 (–0.16)
Oklahoma City bombing: 1995	–0.21 (–1.35)	–0.23 (–1.45)	–0.07 (–0.64)	–0.09 (–0.80)
Oklahoma City bombing: 1996	0.11 (0.71)	0.09 (0.60)	0.06 (0.57)	0.07 (0.61)
Iraq invasion: 2003	–0.21 (–1.30)	–0.22 (–1.41)	–0.02 (–0.22)	0.01 (0.09)
Iraq invasion: 2004	–0.02 (–0.11)	–0.04 (–0.24)	–0.02 (–0.21)	–0.01 (–0.09)
Month dummies included	Yes	Yes	Yes	Yes
–October of current year	0.01 (0.17)	0.06 (1.13)	–0.04 (–1.18)	–0.06* (–1.66)
Month–downturn dummies included	No	Yes	No	Yes
–October of current year	–	*–0.16* (–2.14)	–	0.07 (1.36)
# of obs	425	425	425	425
R^2adj	0.27	0.32	0.46	0.46
Durbin-Watson	1.23	1.37	1.63	1.67

Estimated using OLS. T statistics in parentheses. Statistical significance at the 1% level denoted by **bold,** at the 5% level by *italic,* and at the 10% level by *.

[38] It is also important to note that a positive coefficient on a month or month-downturn dummy in an absolute-value regression indicates that relatively larger revisions (upwards or downwards) typically take place in that month compared to the base, and a negative coefficient indicates that smaller revisions typically take place.

[39] As shown by the statistically significant negative coefficient on the current-year October month-downturn dummy variable in regression (B).

Table 2.
Forecast Revision Regressions: Unemployment Rate

	A	B	C	D
Dependent variable	**Actual values**	**Actual values**	**Absolute values**	**Absolute values**
Constant	0.01 (0.83)	0.01 (0.89)	**0.06** (6.27)	**0.06** (6.45)
9/11: 2001	*0.15* (2.31)	*0.13* (1.95)	**0.12** (2.73)	*0.11* (2.38)
9/11: 2002	**0.84** (12.63)	**0.82** (12.29)	**0.79** (18.08)	**0.80** (17.65)
Gulf War: 1990	0.05 (0.79)	0.04 (0.56)	0.04 (0.81)	0.03 (0.56)
Gulf War: 1991	**0.51** (7.67)	**0.45** (6.71)	**0.48** (11.10)	**0.45** (9.90)
WTC bombing: 1993	0.01 (0.19)	0.02 (0.25)	–0.03 (–0.73)	–0.03 (–0.61)
WTC bombing: 1994	0.03 (0.07)	0.05 (0.82)	–0.05 (–1.10)	–0.04 (–0.89)
Oklahoma City bombing: 1995	0.11* (1.64)	*0.13* (1.99)	0.05 (1.16)	0.06 (1.39)
Oklahoma City bombing: 1996	0.12* (1.84)	*0.14* (2.15)	0.06 (1.33)	0.07 (1.56)
Iraq invasion: 2003	0.01 (0.22)	0.04 (0.56)	–0.04 (–0.83)	–0.04 (–0.88)
Iraq invasion: 2004	0.03 (0.49)	0.06 (0.89)	–0.06 (–1.37)	–0.05 (–1.23)
Month dummies included	Yes	Yes	Yes	Yes
–October of current year	–0.02 (–0.81)	–0.03 (–1.35)	*–0.03* (–2.19)	*–0.04* (–2.44)
Month–downturn dummies included	No	Yes	No	Yes
–October of current year	–	0.04 (1.29)	–	0.02 (0.95)
# of obs	425	425	425	425
R^2adj	0.36	0.44	0.55	0.57
Durbin-Watson	1.11	1.34	1.64	1.73

Estimated using OLS. T statistics in parentheses. Statistical significance at the 1% level denoted by **bold,** at the 5% level by *italic*, and at the 10% level by *.

Table 2 gives results for unemployment rate forecast revision regressions. The estimated immediate impact of 9/11 on the unemployment forecast for 2001 ranges from 0.11–0.15%, and all coefficients are significant at the 5% level or better. The impact on the 2002 forecast is also robust. The outbreak of the first Gulf War was not associated with a significant impact on the unemployment forecast for 1990, but there was a very significant increase the 1991 forecast. As in the case of real GDP growth, neither the bombing of the World Trade Center in 1993 nor the invasion of Iraq in 2003 was associated with any significant impacts on forecasted unemployment rates. For the actual-value regressions (A) and (B), the Oklahoma City bombing was associated with significant increases in the unemployment rate in both 1995 and 1996, but this result is not robust to the absolute-value specifications (C) and (D), and casual inspection of forecast graphs for the unemployment rate analogous to figures 3 and 5 shows that the increase in the unemployment rate that these coefficients are picking up was part of a smooth adjustment playing out over several months as opposed to a jump-shift adjustment that can be associated with the disaster *per se*.

Macroeconomic Impacts: Summary

The regression results suggest that the immediate impact of the 9/11 attack on the real GDP forecast was between –0.4–0.54%. Because the Survey of Professional Forecasters pool stated that the 9/11 attack in and of itself caused them to lower their forecast by 0.5%, setting the value of this impact at –0.5% is compelling. Although no formal test of revision persistence is carried out here, simple inspection of figure 1 suggests that the immediate post-9/11 revision did not dissipate to any significant degree. I thus conclude that the 9/11 attack in and of itself caused the U.S. economy to lose 0.5% of real GDP growth in 2001.

Results also suggest that the 9/11 attack caused an immediate increase in forecasted unemployment of 0.11-0.15%. No evidence on the 9/11 impact on unemployment is available from the Survey of Professional Forecasters. To be conservative, I will set the value of this immediate impact at 0.11%. If it is assumed that the impact was felt entirely in the fourth quarter of 2001, then it is straightforward

Table 3.
U.S. Labor Force Statistics in 2001

(1,000 people)	Q1	Q2	Q3	Q4	Annual Average
Civilian labor force	141,858	141,461	141,700	142,291	141,828
Employment.	135,864	135,130	134,839	134,308	135,035
Unemployment.	5,994	6,331	6,860	7,983	6,792
Not in labor force	69,171	70,072	70,438	70,467	70,037
Unemployment rate:					
Actual	4.23%	4.48%	4.84%	5.61%	4.79%
No-9/11 alternative	4.23%	4.48%	4.84%	5.19%	4.68%
(difference)	0.00%	0.00%	0.00%	0.42%	0.11%
Number of unemployed:					
Actual	5,994	6,331	6,860	7,983	
No-9/11 alternative	5,994	6,331	6,860	7,385	
(difference)	0	0	0	598	

Source: U.S. Bureau of Labor Statistics and author's calculations.

Note: These data are unrevised initial labor force estimates published by BLS.

to calculate using labor force statistics that the 9/11 attack caused 598,000 extra people to become unemployed in the U.S. in 2001. Table 3 documents this calculation.[40]

These impacts were felt in the last quarter of 2001 and are thus very short-run in nature. Forecasters initially anticipated large negative impacts of the 9/11 attack on 2002 outcomes. In the case of growth, this pessimistic revision was transient, but it in the case of unemployment, it proved to be permanent. It is not clear why growth in 2002 was ultimately able to be sustained at the pre-9/11 forecasted level. Resilience is an obvious possibility, but more research is needed in order to discriminate between alternative explanations.[41]

It is also interesting to note that of the three war-related events included in the regression analysis, two of them, the Gulf War and the 9/11 attack, had significant negative impacts on the macroeconomy, but the invasion of Iraq in 2003 did not. An explanation consistent with this finding is that only unanticipated events that have the potential to seriously disrupt world markets and trading activity have an immediate detectable impact on forecasts of economic variables, but the impacts of conflicts whose outbreaks are anticipated well before they occur are incorporated into forecasts smoothly over time. It is also possible that the invasion of Iraq was judged to have smaller prospects to affect economic activity than the other two events.

III. Concluding Remarks and Possibilities for Further Research

Unlike many other disasters, the 9/11 attack had significant negative macroeconomic impacts in the very short run, and it may well have had significant negative consequences in 2002 in the absence of mitigating actions taken by the private and public sectors.

One obvious path for future research is to take advantage of the fact that individual forecast values are available so that this research could be done in a panel-data context. The key findings of the paper are likely to be robust to a panel approach, but it might be possible to gain insights that cannot be obtained through evaluation of consensus forecasts. Another obvious research path is to evaluate forecasts of other macroeconomic variables such as personal consumption expenditures, business

[40] It is tempting to identify particular sectors that were heavily impacted by 9/11, and attribute this unemployment impact to them. The travel and tourism industry (TTI) in particular was disproportionately impacted by 9/11, and the U.S. Bureau of Economic Analysis estimates that total TTI-related employment fell by 226,000 jobs in the fourth quarter of 2001. However, this is only 38% of the estimated 598,000 jobs lost, which emphasizes that the latter is a macroeconomic estimate summarizing developments in the entire economy.

[41] It also cannot be ruled out that growth and employment in 2002 were less than would have prevailed if the 9/11 attack had never taken place.

investment, the current account, and the Federal budget balance in order to better understand why forecasted growth in real GDP changed the way that it did.

Another very promising task for future research is to analyze quarterly forecast data. Although the CE data on annual forecast targets are useful for evaluating the macroeconomic impacts of 9/11, it would be very desirable to analyze forecast data for macroeconomic variables at the quarterly frequency. Davies (2006) has developed a rich framework for identifying shocks to quarterly forecasts, and this approach has excellent potential to shed much more light on the nature of change in forecasts in response to significant events such as the 9/11 attack.

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