Causal Effects of Uncertainty:
Evidence from Military Base Realignment and Closures

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Abstract

Uncertain times are often bad times, and separating uncertainty shocks from large negative level shocks is difficult. We use the Base Realignment and Closure (BRAC) process in the United States in 2005 to investigate this issue, where the level shock may be positive, negative, or neutral, and is finalized only after a well defined period of significant uncertainty. When combined with an even greater period of time before the level shock is implemented, we can clearly separate first-moment from second-moment shocks. When using attention to BRAC as an instrument, we find that the effect of uncertainty on employment and the labor force is small but significant, with a 1% decrease in response to a one standard deviation increase in uncertainty. While similar, the peak effect is smaller and comes after a shorter lag than the effect found in the existing literature that relies on dynamic models that fall short of making causal claims.

JEL Classification: E32, E62

Keywords: base realignment and closure, causal impact, uncertainty, employment, labor force

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1 Introduction

Uncertainty is an important source of macroeconomic volatility, and has often been modeled as second-moment shocks (Bloom, 2009; Gourio, 2012; Leduc and Liu, 2016; Basu and Bundick, 2017; Fernández-Villaverde and Guerrón-Quintana, 2020; Dietrich et al., 2022). However, crashes in levels of production or demand tend to occur in uncertain times, and uncertainty shocks can cause recessions. This endogeneity makes separating second-moment shocks from first-moment (level) shocks difficult in practice, which in turn makes isolating the impact of a pure second-moment uncertainty shock challenging.

This paper contributes to the uncertainty literature by leveraging a natural experiment involving domestic US military base closures, which neatly isolates any possible first-moment shocks from the uncertainty shock. Our approach also addresses concerns with reverse causality, as the decisions are made primarily on the basis of national defense considerations, and are not endogenous to local economic conditions. We use an empirical framework that treats the attention paid to military base closures in an area with military employment during a round of national base closures as an instrument for the impact an uncertainty shock has on the local economy. The uncertainty period treatment effect is caused by the initial proposal of military base closures and personnel changes, after a strictly internal process at the US Department of Defense (DoD). This proposal is then followed by several months of public debate and revision before the final changes are announced, generating substantial uncertainty in locations with military bases.

This process, known as Base Realignment and Closure (BRAC), is employed by the DoD to either close or "realign" (move soldiers and civilian employees out of or into existing locations) domestic military bases. The closing of military bases has long been a controversial topic, as the loss of jobs – both first-order jobs on a base itself, and second-order jobs in the community that rely on the base and its personnel – raises the concern of constituent communities and their representatives. While both politicians and the military recognized the need to change the military force structure after the end of the Cold War, no politician wanted cuts to happen in their district (Sorenson, 1998). The BRAC process was designed to insulate these decisions from lobbying, political pressure, and conflict between the executive and legislative branches, keeping the focus on military effectiveness and cost efficiency (Mann, 2019). Despite a relatively stream-lined process from a military perspective, however, the affected communities face significant uncertainty about their futures. The BRAC process affects many thousands of jobs, and can result in both net job gains or net job losses. BRAC would often close entire facilities completely. Bases could be listed in the initial proposal and then removed entirely by the end, or appear minimally affected in the initial stages only to face extensive losses in the final results. We discuss BRAC in more detail in Section 2.

Decisions regarding military bases are generally independent of state or local policy, and bases close to state borders may directly affect the economy in more than one state. To address this, we examine the impacts of uncertainty at the metropolitan level. Using a panel of more than 400 metro areas that have non-zero military employment, we find that the average metro during the uncertainty surrounding a BRAC round experiences a small but statistically significant drop in both the employment level and the labor force, an effect that peaks in the 2-5 months after the BRAC round starts. This occurs many months, and often multiple years, before the changes themselves are implemented by the military. The timing and magnitude of these impacts are generally earlier and slightly smaller than what is found in previous research on uncertainty relying on time series dynamics rather than causal analysis, which we discuss later in this paper.

To briefly summarize, our identification strategy rests on four facts:

1. Recommendations are made primarily based on military readiness and military cost savings, and not the affected local economy;
2. The impact of recommendations can be quite large, and may be positive or negative for the affected community;
3. A substantial window of uncertainty exists during which communities and their officials lobby to save jobs at their bases, or gain even more, with occasional success; and
4. The actual change in jobs (the first-moment level effect) happens far removed - often years - from the second-moment uncertainty effect.

Our paper builds on a few recent studies that explore the causal impact of uncertainty shocks. Ludvigson et al. (2021) propose a novel structural VAR identification strategy to isolate exogenous uncertainty shocks. Baker et al. (2024) use natural disasters, terrorist attacks, and political shocks as instruments for first- and second-moment shocks, identified using stock returns and volatility. Coibion et al. (2024) and Kumar et al. (2023) employ randomized information treatments that provide different types of information about the first and/or second moments of future economic growth to generate exogenous changes in households' and firms' perceived macroeconomic uncertainty.

Our paper also contributes to recent studies that examine the impact of uncertainty at disaggregated levels, such as state and sectoral levels (Shoag and Veuger, 2016; Choi et al., 2018; Mumtaz et al., 2018; Baker et al., 2022; Choi et al., 2024). We extend this literature by analyzing the effects of uncertainty on local labor markets at the level of Metropolitan and Micropolitan Statistical Areas (collectively referred to as Core Based Statistical Areas, or CBSAs). CBSAs are an ideal unit of disaggregation for our study, as they capture economic linkages between cities and their surrounding areas where most commuters live. This is discussed in more detail in Section 4.1. Furthermore, we add to this literature by exploring its effects on migration and labor force. The literature has generally focused on the unemployment rate, the employment level, investment, and output. We show that in cases where heightened uncertainty is not resolved for an extended period, workers may make different decisions about labor force participation or migration.

2 The Base Realignment and Closure Process

This section begins with background information on the BRAC process, then elaborates on the steps involved, and concludes with a discussion of the reasons for focusing on the 2005 round.

Historically, the President had wide latitude to close bases with little input from Congress. However, the US military used to be relatively small in peacetime, only seeing large military expenditures during wartime. Military bases also used to be fairly crude, and so their simple structures were often abandoned when no longer necessary or just given back to local communities. After the Korean War, the United States military was no longer effectively demobilized after the end of hostilities. Security needs during the Cold War gave rise to a large standing army in peacetime for the first time in US history. Congress had good reason to suspect that political opposition to the policies of the Johnson and Nixon administrations lead to retaliation from the executive in the form of base closures. As the Vietnam War wound down in the early 1970s, Defense Secretary McNamara unsentimentally closed many bases, and Congress had enough (Sorenson, 2006).

Congressional legislation blocked the president's ability to unilaterally close bases in 1977 for ten years (10 US Code §2687). Since then there have been five BRAC rounds, beginning in 1988 and followed by rounds in 1991, 1993, 1995, and 2005. When arguing (unsuccessfully) for a new BRAC round in 2018, the Department of Defense (2020) stated that the five previous BRAC rounds had resulted in estimated annual military cost savings of $12 billion, underscoring the economic significance of the process.

One of the key innovations to the BRAC process in 1991 and later was the introduction of an independent commission, whose recommendations came months after the initial recommendations from the DoD, and had to be accepted or rejected in their entirety. The goals of the BRAC commission are laid out in the statute that initiates the process. According to the proposal (Cheney et al., 1991), the process gives "priority consideration" to military value. This emphasis helps separate the BRAC process from local economic conditions – a point we will elaborate on in Section 3.

We focus on the 2005 round for several reasons. The 1988 through 1995 rounds were primarily about a reduction in forces following the end of the Cold War, and so there was a significant expectation of general cuts across bases on net. The 1988 round had no public uncertainty period between proposed closures and final results, while the 1990s rounds were all authorized at once and occurred with only a single year between them, making the closures and realignments much more likely to be anticipated, and thus not a clear cause of uncertainty with a discrete start and end. Sorenson (1998) offers further evidence that the 1990s rounds involved a lot of anticipation ahead of time, stating that 1995 was expected to be a round with many cuts, as previous cuts from 1991 and 1993 were "behind schedule."

The 2005 round was different, as it was far removed from previous rounds, and was primarily about a reorientation of military priorities in the context of the War on Terror during a time of rising military expenditures. While some areas experienced cuts, many saw significant gains, and there was no expectation of large negative average changes at any given base. This contrasts with most uncertainty shocks - such as financial crises or natural disasters - which typically involve concurrent negative first-moment effects. In this case, we can focus on the pure second-moment effect due to the temporal lag in implementation and net-zero expectation. We can also control for any potential anticipation of first-moment shocks at the CBSA level, effectively analyzing the impact in the context of a mean-preserving spread. Moreover, the 2005 round was the only BRAC round to affect all 50 states and Washington DC, and data availability and quality is higher in 2005 compared to the rounds in the 1990s, due to its more recent implementation and improved record-keeping.

The principal steps of the BRAC process are as follows:

1. DoD force structure report;
2. Government Accountability Office (GAO) certification of the DoD figures;
3. Establishment of the BRAC commission and appointment of its members by the president, with Senate confirmation;
4. Publicly-proposed closures and realignments from DoD;
5. BRAC commission deliberations, including public hearings and town hall meetings, public feedback and comments, on-site reviews of military installations and public sharing of data;
6. BRAC commission final recommendations to the president;
7. Presidential approval, or return to BRAC commission;
8. Congressional rejection within 45 days, else automatic approval;
9. DoD implementation.

Steps three through six above took approximately four months in 2005.[1] The first two steps can take multiple years as the DoD goes over internal records. Presidential approval has historically taken less than two weeks, and as little as one day. Both presidential approval, and step eight, congressional expiration, are generally regarded as formalities that, historically, do not change the final results[2]. Step nine, implementation, is required to begin within two years of congressional expiration and be completed within six.

[1]The DoD proposal was published May 13, the BRAC Report September 8th, with Presidential Approval on September 15th, and the Congress's ability to overturn expiring October 23rd.

[2]This is an intentional part of the design of the BRAC process, to minimize political interference.

3 BRAC is an Uncertainty Shock

We define the BRAC uncertainty period as the time between the Department of Defense's announcement of the initial proposal and the BRAC Commission's final recommendation to the President – that is, from May 13, 2005, to September 8, 2005.

To identify BRAC as an uncertainty shock, we need to establish four key points: (1) BRAC involves uncertainty, (2) it is exogenous to local economic conditions, (3) it constitutes a shock, and (4) it is distinct from a first-moment (level) shock. We now address each of these points in turn.

BRAC involves uncertainty

BRAC recommendations can have positive, negative, or neutral outcomes, and these outcomes shift significantly over the course of the process. In 2005, 13% of the 471 CBSAs in our sample were projected to have employment gains in the initial DoD report, while 23% were projected to have losses. Of those, 21% of them experienced changes in direct military employment outcomes in the time between the initial DoD report and the final BRAC report. These changes during the uncertainty period could involve thousands of jobs, and were almost evenly split between gains and losses, as shown in Table 1. Spending on the BRAC process also had a wide range of outcomes, with more than 10% experiencing gains and more than 30% losses over these four months. In total for the CBSAs in our sample, 36,540 jobs were gained relative to the original DoD report in May, while 26,701 jobs were lost.

Table 1: Share of CBSAs with Changes Between DoD Proposal and BRAC Report

	Direct Employment	Spending
Major gain (greater than 25%)	6.8%	6.4%
Minor gain (0 to 25%)	2.1%	4.3%
No change	79.0%	55.3%
Minor loss (-25% to 0)	5.6%	12.8%
Major loss (less than -25%)	6.5%	21.3%

The final decision on a given base is unknown until the end, making the process inherently uncertain. This uncertainty is heightened by the four-month-long period of public deliberation, during which communities actively lobby to protect their local bases and the associated jobs. According to the final report from the BRAC commission, they “conducted 20 regional hearings to obtain public input and 20 deliberative hearings for input on, or discussion of, policy issues... Commissioners participated in hundreds of meetings with public officials and received well over 200,000 pieces of mail... the Commission’s web site registered over 25 million hits.” The evolving nature of the recommendations and the very public political and procedural dynamics involved contributed to a widespread perception of uncertainty throughout the BRAC process.

BRAC is exogenous to local economic conditions

BRAC decisions are largely exogenous to local economic conditions, based on the criteria established in the statutes that govern the process. Specifically, the criteria for closing or realigning a base are outlined as follows, in order of priority:

Military Value

1. Current and future mission requirements
2. Availability and condition of land
3. Accommodation of future mobilization and contingencies
4. Cost and manpower

Return on Investment

5. Extent and timing of potential costs and savings

Impacts

6. Economic impact on communities
7. Ability of communities to support operations and personnel
8. Environmental impact

The criteria prioritize military value and return on investment, with economic impact on local communities appearing only as the sixth consideration, well after strategic and cost-based factors. The primacy of military goals in the selection process was explicitly stated in the BRAC report (2005): “The Army used the BRAC Selection Criteria during its analyses and ensured that military value (Criteria 1-4) was the primary consideration in making its BRAC 2005 recommendations." Every base affected by the BRAC process is given a section in the final report, with a subsection labeled "Community Concerns," followed by "Commission Findings," which provides further insight into the primacy of military needs over economic impacts.[3]

BRAC constitutes a shock

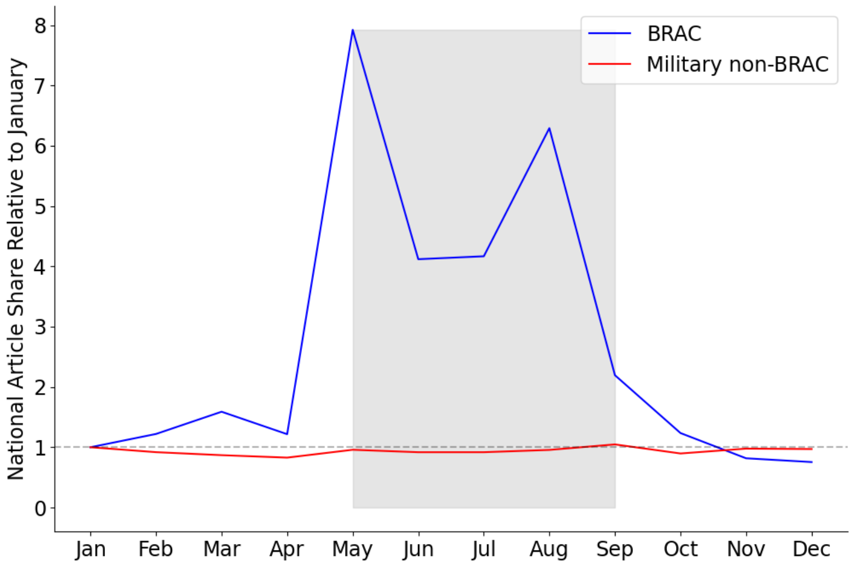
One potential concern is that the BRAC process may either go unnoticed by the public – thus generating little uncertainty – or, conversely, become a constant topic of discussion, making the uncertainty period of our natural experiment ill-defined.

To account for this issue, we construct a measure of community attention paid to BRAC during the uncertainty period based on the frequency of newspaper coverage. We use the database of U.S. newspapers from Access World News, a well-established source in the macroeconomic uncertainty literature (Baker et al. 2016, Baker et al. 2022). Specifically, we search the archive for articles that mention *((base and realignment and closure) or brac) and (military or army or navy or marines or "air force")*, and then divide those article counts by the total article counts for that month and place.

Figure 1 illustrates the "surprise" nature of BRAC, as national aggregate discussion of BRAC in the news remained relatively flat in the first four months of the year before jumping by a factor of 8 in May, the month the DoD released its initial proposals, then remaining elevated throughout the BRAC period. The partial drop in September can be explained by the fact that the BRAC process was resolved in the first two weeks of that month, and that some informal results began trickling out at the end of August, as the BRAC commission wrapped up public hearings. To ensure we are capturing attention to BRAC specifically – and not to other concurrent military issues – we also show that discussion of non-BRAC military terms remains flat throughout the year.

[3]For example, the "Community Concerns" section for Fort Gillem, Georgia, noted severe local economic challenges, including high unemployment and low income. The "Commission Findings" acknowledged flaws in DoD's impact analysis, citing job losses and the base's proximity to a HUBZone. Despite urging mitigation efforts, the Commission proceeded with closure, resulting in 1,081 job losses. Years later, the site remained under EPA Superfund negotiations.

Figure 1: National Share of Articles Discussing BRAC and Military Terms in 2005



Notes: The share of U.S. articles in the AWN database from 2005. The BRAC search terms are: *((base and realignment and closure) or brac) and (military or army or navy or marines or "air force")*. The Military non-BRAC terms are: *(military or army or navy or marines or "air force") not ("base realignment and closure" or brac)*. Both are divided by the total articles in that month, then normalized to 1 in January. The shaded area represents the BRAC uncertainty period between May and September, inclusive, beginning with the proposals from the DoD and ending with the BRAC report.

To further investigate the unpredictability of BRAC outcomes, we also approach this as a classification problem, considering whether a given CBSA will experience any direct employment changes due to BRAC. We run a logit regression for the 1991, 1993, and 1995 rounds. The estimates from these rounds are then applied to the 2005 BRAC round to generate the predicted results. We compare the predicted results for 2005 to the actual outcomes from that year. This yields a "true negative" rate of 49.5% and a "true positive" rate of 9.8%, resulting in an overall prediction accuracy of only 59.3%. Notably, the model exhibits a high "false negative" rate of 39.2%, meaning that in nearly 40% of cases where a CBSA was actually affected by BRAC-related employment changes, the model incorrectly predicted no impact.[4]

BRAC is distinct from a first-moment shock

BRAC represents a second-moment, or uncertainty, shock rather than a first-moment level shock. The key feature that distinguishes BRAC from a traditional first-moment shock is the multi-year delay between the decision and the actual implementation of base closures. Although the economic consequences of BRAC can be significant, implementation typically begins in the fiscal year after the BRAC decision and continues for up to six years. This temporal lag is essential for identifying the effects of uncertainty separate from immediate economic impacts.

Summary of the Identification Strategy

To summarize, the BRAC process constitutes a well-defined uncertainty shock. First, its outcomes are highly uncertain: base realignment and closure recommendations can be positive, negative, or neutral for a given locality, and they are both perceived by the public as changeable throughout the process, and do in fact change for many CBSAs. Following a months-long period of deliberation and lobbying, communities are left uncertain about the final outcome until the BRAC Commission submits its recommendations. Second, BRAC decisions are exogenous to local economic conditions, driven primarily by military value and cost-effectiveness, with local economic impact ranking low in the decision criteria. Third, BRAC is a genuine shock rather than a predictable event. Analysis of U.S. newspaper coverage shows a sharp spike in attention only after the Department of Defense announces its initial proposal, with little coverage beforehand, suggesting that the process was largely unanticipated by the public. Finally, BRAC is distinct from a first-moment (level) shock. Implementation of closures and realignments is delayed by several years, separating the announcement from its economic consequences.

[4] See the Online Appendix for the details on the model specification.

4 Data

4.1 Geographic Level of Analysis

All analysis is performed at the level of Metropolitan or Micropolitan Statistical Areas (collectively referred to as Core Based Statistical Areas, or CBSAs). Each CBSA is a city core plus its surrounding areas. These are an ideal level of disaggregation for this study, since they emphasize economic and social linkages between cities and their surrounding areas. State level analysis would either neglect important economic interactions that cross state lines (as in the New York-Newark-Jersey City, NY-NJ-PA CBSA, or the Memphis, TN-MS-AR CBSA), or questionably assume interactions between very different economic areas in the state (as in the Chicago–Naperville–Elgin, IL–IN–WI CBSA, and parts of southern Illinois). The nature of CBSAs as units of economic connectedness also implicitly controls for spillover effects in our analysis. While it may be justifiable to consider spillover effects – particularly between two CBSAs within the same state where state-level policy actions could be influenced by the BRAC in the long term – the assumption of no spillover effects is reasonable over the short time horizons we are studying.

4.2 Sources

The data on the BRAC round, including both proposed and final base closures and realignments, came from the 1991, 1993, 1995, and 2005 Department of Defense reports to the BRAC commission, and the BRAC commission reports to the president. Military share of employment in a given CBSA came from the Bureau of Economic Analysis (BEA) regional data.

The CBSA-level employment, labor force, and unemployment rate variables are part of the Bureau of Labor and Statistics (BLS) Local Area Unemployment Statistics series. This employment data is constructed by the BLS based on the Current Population Survey, American Community Survey, annual population estimates, and state unemployment insurance data, then seasonally-adjusted. Controls for the impacts of Hurricane Katrina on Gulf-coast states are collected from the Federal Emergency Management Agency (FEMA) Individual and Household Programs, total claims paid data.

The news-based measure of attention to BRAC is constructed by searching the Access World News (AWN) database as described in Section 3. Our uncertainty measure is constructed similarly, by searching AWN for the terms *(economic or economy or economies) and (uncertain or uncertainty or uncertainties)*. In all news-based measures, the results for each time period and CBSA are divided by the total articles for that time and place, then normalized to have a unit standard deviation.

4.3 CBSA Coverage and Military Base Distribution

Our analysis covers 471 CBSAs across all 50 states and Washington DC. This represents 49.5% of all of the CBSAs in the United States in 2005, with our primary constraint being data availability, particularly in the AWN database. All of the CBSAs in our sample have non-zero military employment, with a mean of 1.53% and median of 0.61%. This is very close to the average of all CBSAs in the US (1.44% mean and 0.61% median). The full distribution of our sample is in Figure A1. The scope of the 2005 BRAC round is illustrated in Figure 2, which shows the bases listed in the May 2005 DoD report distributed across the country. Of the CBSAs in our sample, 167 (35.5%) are home to at least one military base that is listed in the DoD report.

5 Estimating the Causal Impact of Uncertainty

This section begins by detailing our analytical framework. We then assess the strength of our instrumental variable before presenting results on how uncertainty affects the labor market at the CBSA level.

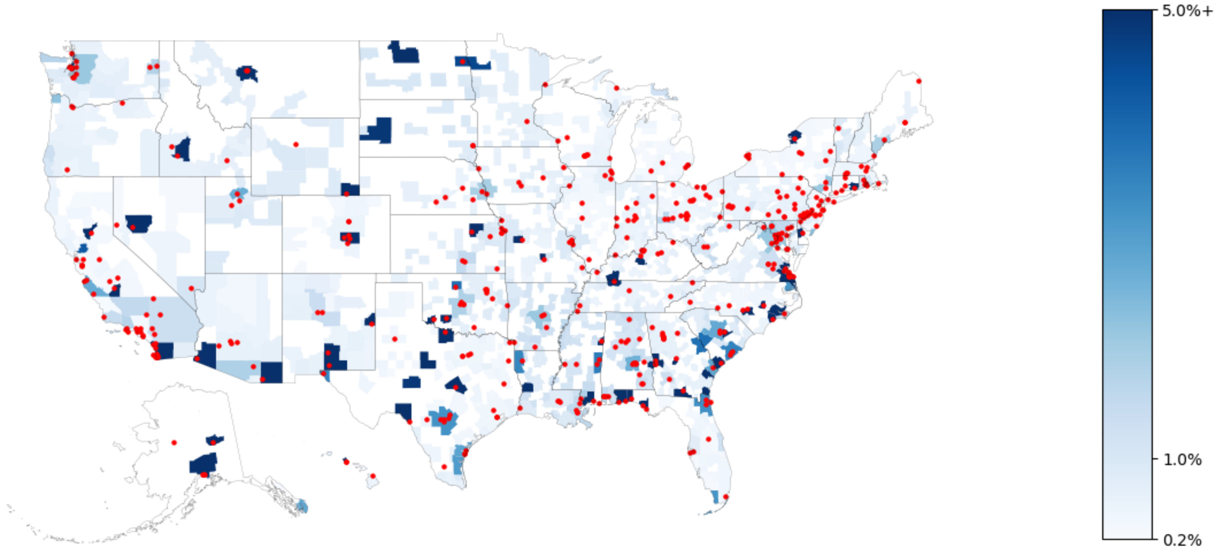
5.1 Analytical Framework

We aim to estimate the impact of uncertainty on changes in local labor market from the month before BRAC began to the current month. Specifically, we estimate the following OLS regression:

$$Y_{jt} = \alpha_j + \beta_1 U_{jt} + \beta_2 D_{jt} + \beta_3 F_{jt} + \epsilon_{jt} \quad (1)$$

The dependent variable, Y_{jt}, is the change in either the logarithm of employment level, the

Figure 2: CBSA Military Share of Employment and BRAC Military Base Locations



Notes: Coloration represents the percent of military employment in a given CBSA in 2005, with no color meaning zero military employment, and dark blue meaning 5% or more, with an average slightly over 1%. About 5.4% of CBSAs have 5% or more military employment, which we clip to 5% here in order to focus on the majority of the distribution. Each red dot is the (approximate) location of a military base that was in the May 2005 Department of Defense report.

logarithm of labor force level or the unemployment rate in CBSA j at time t from the month before BRAC began ($t = 0$): $Y_{jt} = \text{outcome}_{jt} - \text{outcome}_{j0}$. We use the inverse hyperbolic sine transformation in place of the logarithmic transformation, as it closely approximates log results while accommodating both zero and negative values.

Our primary variable of interest, U_{jt}, captures cumulative economic uncertainty in CBSA j at time t, up to the conclusion of the BRAC round at month $t = 5$. After this point, the same value is carried forward. Specifically, U_{jt} is defined as

$$U_{jt} = \begin{cases} \frac{\sum_{i=1}^{t} \text{econ\_unc\_articles}_{ji}}{\sum_{i=1}^{t} \text{all\_articles}_{ji}} & \text{if } t \leq 5 \\ \frac{\sum_{i=1}^{5} \text{econ\_unc\_articles}_{ji}}{\sum_{i=1}^{5} \text{all\_articles}_{ji}} & \text{if } t > 5 \end{cases}$$

For ease of interpretation, we normalize U_{jt} to have a unit standard deviation. This construction allows us to isolate the effect of uncertainty specifically generated during the BRAC process, excluding any uncertainty arising in the post-BRAC period.

The control variable, D_{jt}, captures the direct impact of BRAC in CBSA j. Since no actual level changes due to BRAC occur within our time frame, D_{jt} serves to control for anticipation effects. For all $t \leq 5$ (i.e., before the BRAC round concludes), the direct effect is measured as the log of the projected employment changes reported in the May 2005 DoD report. For all $t > 5$ (i.e., after the conclusion of the round in September), it is measured as the log of the employment effects based in the final BRAC Commission outcomes. In particular,

$$D_{jt} = \begin{cases} \text{DoD\_proposed}_j & \text{if } t \leq 5 \\ \text{BRAC\_final}_j & \text{if } t > 5 \end{cases}$$

Finally, F_{jt} is the log of total FEMA claims in Gulf Coast states from September onward ($t \geq 5$), included to control for the effects of Hurricane Katrina:[5]

$$F_{jt} = \begin{cases} 0 & \text{if } t < 5 \\ \text{katrina\_claims}_j & \text{if } t \geq 5 \end{cases}$$

For each of the three dependent variables, equation (1) is estimated 12 times for each $t \in [1...12]$, resulting in a total of 36 regressions. However, these regressions may be biased due to potential endogeneity of the economic uncertainty variable, that is, $\text{corr}(U_{jt}, \epsilon_{jt}) \neq 0$.

To address these biases, we propose instrumenting economic uncertainty using attention paid to the BRAC process. This instrument also allows different CBSAs to experience heterogeneous levels of uncertainty in response to BRAC. Specifically, our first-stage regression is:

$$U_{jt} = \alpha_j + \gamma_1 B_{jt} + \gamma_2 D_{jt} + \gamma_3 F_{jt} + \delta_{jt} \tag{2}$$

where B_{jt} is the news-based measure of the number of articles referencing BRAC during the

[5]Hurricane Katrina was identified in the Gulf of Mexico on August 23rd and made landfall on August 29th, 2005. Including the FEMA control in the entire month of August does not materially change the estimate for that month.

process, as described in Section 3, and the other variables are as defined in equation (1). The variable B_{jt} captures cumulative attention in CBSA j at time t, up to the conclusion of the BRAC round at month $t = 5$. After this point, the same value is carried forward. Specifically, B_{jt} is constructed as:

$$B_{jt} = \begin{cases} \frac{\sum_{i=1}^{t} \text{brac\_articles}_{ji}}{\sum_{i=1}^{t} \text{all\_articles}_{ji}} & \text{if } t \leq 5 \\ \frac{\sum_{i=1}^{5} \text{brac\_articles}_{ji}}{\sum_{i=1}^{5} \text{all\_articles}_{ji}} & \text{if } t > 5 \end{cases}$$

We then proceed with the second-stage regression:

$$Y_{jt} = \alpha_j + \beta_1 \hat{U}_{jt} + \beta_2 D_{jt} + \beta_3 F_{jt} + e_{jt} \tag{3}$$

where $\hat{U}_{jt}$ is the predicted values from equation (2). The instrumental variable – attention paid to BRAC – does not directly affect the economic outcome, thereby satisfying the exogeneity condition. Equation (3) provides unbiased estimates, conditional on B_{jt} being a strong instrument, a condition we test and demonstrate in the following section.

5.2 Attention to the BRAC is a Strong Instrumental Variable

The commonly accepted metric for instrument strength is the F-statistic from the first-stage regression in equation (2). In our exactly-identified model with one endogenous variable and one instrument, the first-stage F-statistic is equivalent to the square of the t-statistic on the instrument. For the five months of the BRAC process, the F-statistics are 14.7, 30.6, 23.3, 20.0, and 18.4, respectively. After month 5, when the BRAC process concludes, we no longer update the news-based measures and thus obtain a constant F-statistic of 19.4 for the post-BRAC period. All our first-stage F-statistics exceed the rule-of-thumb threshold of 10, as proposed by Staiger and Stock (1997).

Aside from directly testing the strength of instruments, we also use estimation methods that are robust to weak instrumental variables. Moreira (2009) and McElroy and Sheng (2025) argue that, in the case of a single instrument, confidence intervals from Anderson and Rubin (1949) are efficient regardless of whether instruments are strong or weak. We calculate Anderson–Rubin confidence intervals and show them alongside OLS intervals in Figure 3. In nearly all cases, they are shifted further away from zero than standard OLS confidence intervals.

5.3 Results

Figure 3 presents the impacts of the 2005 BRAC uncertainty shock on local labor markets based on the two-stage least squares (2SLS) regression in equation (3). Table 2 contains the detailed 2SLS estimates, compared to those from the OLS regression in equation (1). Instrumenting economic uncertainty with attention to BRAC, we find that a CBSA with one standard deviation higher economic uncertainty experiences a peak drop of about 0.1 log points in the employment level; see Panel (a). This is similar in magnitude to the peak employment effect found in Baker et al. (2022), where a standard-deviation shock to uncertainty leads to a peak drop in employment of 0.13 log points in a panel VAR framework.

Furthermore, our estimates indicate that the peak effect on employment occurs about five months after the beginning of the BRAC period, which is notably sooner than the peak response of 11–14 months found in Baker et al. (2022). Some of these differences between our results and those from the VAR analysis are undoubtedly due to the characteristics of the specific natural experiment we are using, rather than a more general shock to uncertainty.

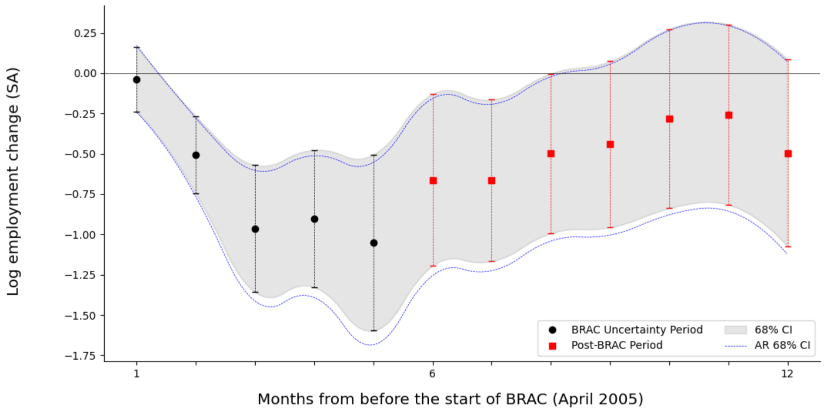
Additionally, the previous news-based measure focuses on policy-related uncertainty, while we focus on more general economic uncertainty for two reasons. On one hand, excluding policy-specific search terms broadens the number of articles we capture, which is particularly important for disaggregated geographies like CBSAs. On the other hand, we have no reason to exclude economic uncertainty that is not explicitly related to policy.

Turning to the impact on the unemployment rate in Panel (b), we do not observe any significant results. This finding contrasts with most studies that document large and persistent unemployment effects in response to uncertainty shocks.

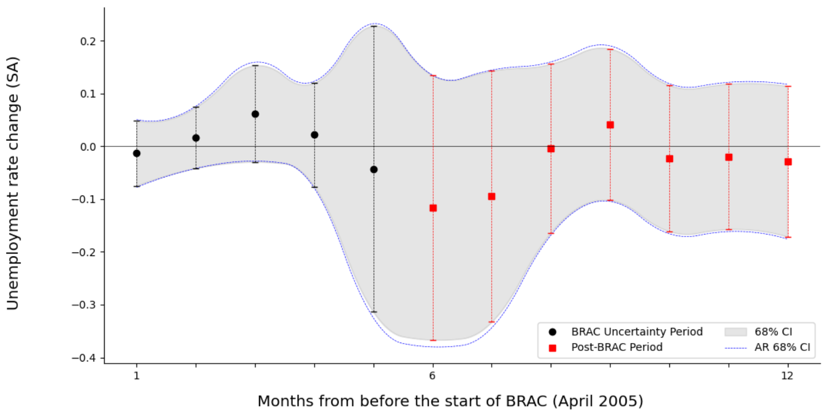
To explore this further, we examine the labor force response, given that the unemployment rate is a function of both the employment level – which we observe similar results for – and the labor

Figure 3: Impacts of 2005 BRAC Uncertainty Shock on Local Labor Market

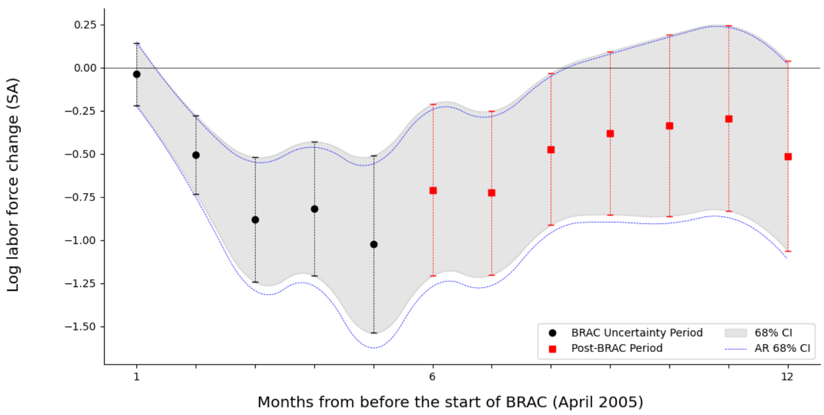
(a) 100 * Log Employment Change, Seasonally Adjusted (SA)



(b) Unemployment Rate Change, Seasonally Adjusted (SA)



(c) 100 * Log Labor Force Change, Seasonally Adjusted (SA)



force. To our knowledge, the previous literature has not directly explored the labor force response to uncertainty. However, Baker et al. (2022) finds a peak *unemployment rate* response that, while significant, is about 21% smaller than the peak *employment level* response using state-level data. While the authors do not address this directly, it can be explained by a same-direction response in the labor force of smaller magnitude than the response in employment. Given our focus on the CBSA level, we are able to examine labor market dynamics between CBSAs that may be overlooked in studies using more aggregated data.

Our results show an almost identical negative response in the labor force (Panel (c)) to an uncertainty shock as we observe in employment, with the loss peaking at about 0.1 log points in month five. This suggests that the lack of a response in the unemployment rate may be explained by some combination of people moving away from affected CBSAs during the BRAC process, or, more likely, locals ceasing to search for new work, or potential newcomers deciding to move elsewhere due to heightened uncertainty. Unfortunately, we cannot delve into the details of this process, as county-to-county migration flows are estimated by the Census based on American Community Survey data, which is not available at frequencies that align with the natural experiment we are analyzing. Nonetheless, these findings strongly support the case for exploring the labor force as an outcome in future research on uncertainty.

The direct BRAC effects, which we use to account for anticipation given the information available at the time, are not significant at any time horizon. The FEMA claims, which enter the equations only from September onward, are highly significant. In our sample, 22 CBSAs had FEMA claims. Due to the magnitude of the damage caused by Hurricane Katrina, we also re-run the regression with these CBSAs dropped from the sample and find that this does not meaningfully change the sign, magnitude, or significance of any of our results relative to using the full control sample.

While we are cautious in drawing strong conclusions about the persistence of the employment and labor force effects over time, our post-BRAC periods exhibit a pattern broadly consistent with impulse response functions in the VAR literature – showing a gradual return to baseline following the peak. Although the second-stage regression results for this period are not statistically significant, this may reflect limited statistical power rather than an absence of underlying effects, particularly given that we do not include the purely endogenous uncertainty that arises after the BRAC natural experiment ends.

6 Conclusion

In this paper, we adopt a novel approach to examining uncertainty by utilizing an exogenous natural experiment to isolate the effects of second-moment uncertainty shocks from any potentially confounding first-moment effects. The BRAC process serves as an ideal means of achieving this identification by separating level effects – often by several years – from uncertainty effects, which allows us to examine the process across hundreds of locations. After accounting for the direct effect of changes in BRAC spending levels, we observe a significant negative effect on both employment and labor force participation. Additionally, the scalability of the process, based on a continuous treatment variable that exhibits a clear relationship with the expected impact of the shock, further enhances our analysis. The average CBSA with military employment experienced a 1.05 percent decline in employment as a result of the BRAC process. Compared to employment declines during earlier recessions, this BRAC effect is slightly larger than that of the 1990-91 recession, in terms of nonfarm employment, and about seven-eighths as large as the decline in the 2001 recession (Singleton, 1993; CBO, 2005).[6]

The effect is even larger when we compare our estimates to the level of military employment. In 2005, military employment accounted for 1.2% of total nonfarm employment.[7] While this BRAC shock affected the entire economy, it was equivalent to eliminating seven out of eight military jobs in a CBSA in 2005 – remarkably large relative to the original source of the shock. In the case of other uncertainty shocks, the source of the disturbance is rarely identified as cleanly, which limits the ability to trace how the initial uncertainty propagates through the economy. Future

[6]Our effect peaks around 5-6 months after the impulse, while the 1990-91 and 2001 recessions both lasted 8 months.

[7]Military employment is from BEA, Series B4280C0A173NBEA. Total nonfarm employment is from the BLS, Current Population Survey.

work examining similar episodes with well-identified uncertainty shocks could further isolate these effects, particularly if their impacts on the labor force can also be measured.

Although the validity of the treatment effect relies, to some extent, on the assumption that policymakers involved in a BRAC round prioritize non-economic factors over local economic considerations, the results provide a clear recommendation for future BRAC processes. If the process of uncertain deliberation itself poses harm to potentially affected economies, *regardless of the eventual outcome*, then this should be carefully weighed against the benefits of lengthy and public discussions prior to implementation. Furthermore, our findings indicate that the depth and breadth of base closures and realignments do not significantly influence the uncertainty effect on the local economy. This suggests that fewer but larger BRAC rounds would be preferable to more frequent and smaller rounds, and that shorter, more efficient public deliberation periods should be favored over a more prolonged process. Reducing uncertainty in this way could help mitigate some of the negative effects associated with the BRAC process.

References

Theodore W Anderson and Herman Rubin. Estimation of the parameters of a single equation in a complete system of stochastic equations. *The Annals of mathematical statistics*, 20(1):46–63, 1949.

Scott R Baker, Nicholas Bloom, and Steven J Davis. Measuring economic policy uncertainty. *Quarterly Journal of Economics*, 131(4):1593–1636, 2016.

Scott R Baker, Steven J Davis, and Jeffrey A Levy. State-level economic policy uncertainty. *Journal of Monetary Economics*, 132:81–99, 2022.

Scott R Baker, Nicholas Bloom, and Stephen J Terry. Using disasters to estimate the impact of uncertainty. *Review of Economic Studies*, 91(2):720–747, 2024.

Susanto Basu and Brent Bundick. Uncertainty shocks in a model of effective demand. *Econometrica*, 85(3):937–958, 2017.

Nicholas Bloom. The impact of uncertainty shocks. *Econometrica*, 77(3):623–685, 2009.

CBO. Employment during the 2001-2003 recovery. *Congressional Budget Office Background Paper*, 2005.

Dick Cheney et al. Base realignment and closure report. Technical report, Department of Defense, 1991.

Sangyup Choi, Davide Furceri, Yi Huang, and Prakash Loungani. Aggregate uncertainty and sectoral productivity growth: The role of credit constraints. *Journal of International Money and Finance*, 88:314–330, 2018.

Sangyup Choi, Davide Furceri, and Seung Yong Yoo. Heterogeneity in the effects of uncertainty shocks on labor market dynamics and extensive vs. intensive margins of adjustment. *Journal of Economic Dynamics and Control*, 162(104859), 2024.

Olivier Coibion, Dimitris Georgarakos, Yuriy Gorodnichenko, Geoff Kenny, and Michael Weber. The effect of macroeconomic uncertainty on household spending. *American Economic Review*, 114(3):645–677, 2024.

Department of Defense. Base realignment and closure, fiscal year 2020 budget estimates. Technical report, 2020.

Alexander M Dietrich, Keith Kuester, Gernot J Müller, and Raphael Schoenle. News and uncertainty about COVID-19: Survey evidence and short-run economic impact. *Journal of Monetary Economics*, 129:S35–S51, 2022.

Jesús Fernández-Villaverde and Pablo A Guerrón-Quintana. Uncertainty shocks and business cycle research. *Review of Economic Dynamics*, 37:S118–S146, 2020.

Francois Gourio. Disaster risk and business cycles. *American Economic Review*, 102(6):2734–2766, 2012.

Saten Kumar, Yuriy Gorodnichenko, and Olivier Coibion. The effect of macroeconomic uncertainty on firm decisions. *Econometrica*, 91(4):1297–1332, 2023.

Sylvain Leduc and Zheng Liu. Uncertainty shocks are aggregate demand shocks. *Journal of Monetary Economics*, 82:20–35, 2016.

Sydney Ludvigson, Sai Ma, and Serena Ng. Uncertainty and business cycles: Exogenous impulse or endogenous response? *American Economic Journal: Macroeconomics*, 13(4):369–410, 2021.

Christopher T. Mann. Base closure and realignment (BRAC): Background and issues for congress. Technical report, Congressional Research Service, 2019.

Tucker S. McElroy and Xuguang Simon Sheng. An instrumental variables approach to testing forecast efficiency. *Forthcoming in Journal of Applied Econometrics*, 2025.

Marcelo J Moreira. Tests with correct size when instruments can be arbitrarily weak. *Journal of Econometrics*, 152(2):131–140, 2009.

Haroon Mumtaz, Laura Sunder-Plassmann, and Angeliki Theophilopoulou. The state-level impact of uncertainty shocks. *Journal of Money, Credit and Banking*, 50(8):1879–1899, 2018.

Daniel Shoag and Stan Veuger. Uncertainty and the geography of the great recession. *Journal of Monetary Economics*, 84:84–93, 2016.

Christopher J Singleton. Industry employment and the 1990-91 recession. *Monthly Lab. Rev.*, 116: 15, 1993.

David S. Sorenson. *Shutting down the Cold War: The politics of military base closure*. St. Martin's Press, 1998.

David S. Sorenson. *Military base closure: a reference handbook*. Greenwood Publishing Group, 2006.

Douglass Staiger and James H. Stock. Instrumental variables regression with weak instruments. *Econometrica*, 65(3):557–586, 1997.

Tables and Figures

Table 2: Effects of Economic Uncertainty in CBSAs From the 2005 Base Realignment and Closure

Dependent Variable	Equation	Months Since the Beginning of BRAC Round											
		BRAC Uncertainty Period					Post-BRAC Period						
		1	2	3	4	5	6	7	8	9	10	11	12
employment	OLS	0.06*	0.07	0.02	0.01	0.10	0.13	0.12	0.11	0.15	0.16	0.16	0.09
		(0.04)	*(0.06)*	*(0.07)*	*(0.08)*	*(0.09)*	*(0.10)*	*(0.09)*	*(0.10)*	*(0.10)*	*(0.11)*	*(0.11)*	*(0.11)*
labor_force	OLS	-0.07**	0.05	-0.01	0.04	0.13	0.01	0.12	0.12	0.16*	0.15	0.16	0.08
		(0.03)	*(0.05)*	*(0.07)*	*(0.07)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.08)*	*(0.09)*	*(0.10)*	*(0.11)*	*(0.11)*
unemp_rate	OLS	-0.01	-0.00	-0.02	0.02	-0.02	-0.01	-0.01	-0.01	0.01	0.01	-0.01	-0.02
		(0.01)	*(0.01)*	*(0.02)*	*(0.02)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.03)*	*(0.03)*	*(0.03)*	*(0.03)*	*(0.03)*
employment	2SLS	-0.04	-0.51**	-0.96**	-0.90**	-1.05*	-0.66	-0.67	-0.50	-0.44	-0.28	-0.26	-0.50
		(0.20)	*(0.24)*	*(0.40)*	*(0.43)*	*(0.55)*	*(0.54)*	*(0.50)*	*(0.50)*	*(0.52)*	*(0.56)*	*(0.56)*	*(0.58)*
labor_force	2SLS	-0.04	-0.50**	-0.88**	-0.82**	-1.02**	-0.71	-0.73	-0.47	-0.38	-0.34	-0.29	-0.51
		(0.18)	*(0.23)*	*(0.36)*	*(0.39)*	*(0.52)*	*(0.50)*	*(0.48)*	*(0.44)*	*(0.48)*	*(0.53)*	*(0.54)*	*(0.55)*
unemp_rate	2SLS	-0.01	0.02	0.06	0.02	-0.04	-0.12	-0.10	-0.00	0.04	-0.02	-0.02	-0.03
		(0.06)	*(0.06)*	*(0.09)*	*(0.10)*	*(0.27)*	*(0.25)*	*(0.24)*	*(0.16)*	*(0.14)*	*(0.14)*	*(0.14)*	*(0.14)*
First-Stage F-Stat		14.7	30.6	23.3	20.0	18.4				19.4			
Note:	*p<0.1; **p<0.05; ***p<0.01												

Notes: The results of six different specifications over 12 time periods (72 regressions) are listed above. The first three rows represent the coefficients and standard deviations on the economic uncertainty variable in an OLS regression (equation 1) with three different dependent variables. The second three rows represent the same regressions, but when instrumenting uncertainty with a measure of BRAC mentions in the news (equation 3). The first stage regression is the same for every regression in the post-BRAC period because any uncertainty after the resolution of the BRAC process would no longer be explainable by our instrument. The employment and labor force values are in 100*log changes from the time period before BRAC, while the unemployment rate is in level change and the uncertainty variable is normalized to unit standard deviation.

Online Appendix

Prediction of BRAC Results in 2005

The model trained on data from 1991, 1993, and 1995 rounds is specified as follows:

$$
\begin{aligned}
Y_{jt} = \alpha_j &+ \beta_1 D_{jt} + \beta_2 P_{jt} \\
&+ \beta_3 Unemp_{jt} + \beta_4 Mil_{jt} + \beta_5 Agr_{jt} + \beta_6 Mfg_{jt} \\
&+ \beta_7 Vc_{jt} + \beta_8 Pc_{jt} + \beta_9 Nw_{jt} + \beta_{10} Pd_{jt} + \epsilon_{jt}
\end{aligned} \tag{A1}
$$

The dependent variable Y_{jt} equals 1 if the CBSA j will experience any direct employment changes from the BRAC in year t, and 0 otherwise. The explanatory variables are

- D_{jt} is the log of the proposed employment changes from the DoD at the beginning of the BRAC process;
- P_{jt} is the log of the direct employment results of the BRAC process from the prior round;
- $Unemp_{jt}$ is the seasonally-adjusted unemployment rate before the start of the BRAC round;
- Mil_{jt}, Agr_{jt} and Mfg_{jt} are the military, agricultural and manufacturing share of employment, respectively;
- Vc_{jt} and Pc_{jt} are the violent crime and property crime rates, respectively;
- Nw_{jt} is the non-white share of the population;
- Pd_{jt} is the population density.

The estimates from the 1991, 1993, and 1995 rounds for the intercept a_j and the slope parameters β_1 through β_{10} are applied to the 2005 BRAC round to generate the new $\hat{Y}_{j,2005}$. We then compare the predicted results for 2005 to the actual results from 2005. This yields a "true negative" rate of 49.5% and a "true positive" rate of 9.8%, resulting in an overall prediction accuracy of only 59.3%. Notably, the model exhibits a high "false negative" rate of 39.2%, indicating that a substantial portion of actual positives were incorrectly classified as negatives.

Figure A1: Distribution of CBSA Military Employment