The Local Labor Market Spillover Effects of Military Personnel Contractions

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Abstract

This paper estimates the local spillover effects of military personnel on private sector employment in county level labor markets. I exploit a policy experiment in the United States when, between 1988 and 2000, the size of the military was cut by about 30 percent. The bulk of the cuts took place in counties that in 1987 hosted major military installations. To account for the significant heterogeneity in the trends of private sector employment growth both between and among counties with and without major military installations, I propose a two step identification strategy. First, I match each county with major military installations to a weighted average of counties without major military installations. The weights are constructed in such a way that the pre-treatment differences in the private sector employment trajectories between a county with major military installations and the weighted average of its comparing counties are minimized. Second, to address the potential endogeneity in the magnitude of the cuts in military personnel, I construct an instrumental variable which is the predicted size of the cuts based on the historical military presence in each county and the contemporaneous nationwide cuts. I find that reducing military personnel by one individual led to a reduction of 0.4 private sector jobs in the same year and 1.2 private sector jobs cumulatively.

1 Introduction

Economic activities in a local economy rely on each other. Businesses benefit from being geographically close to each other via demand spillovers, input-output linkages, and agglomeration effects.[1] Despite the fact that previous economic studies largely agree on the existence of local spillover effects and show that they are positive (e.g., Bartik, 1990; Moretti, 2010), it is empirically difficult to estimate the size of these effects and decide on the mechanism by which the spillovers occur. The difficulty of carrying out controlled experiments and the scarcity of plausible natural experiments where only some local businesses or industries are exogenously shocked leaves the question still in debate.

In this paper I estimate the local spillover effects of shocks to employment in one sector of local labor markets, the U.S. military, to the local private sector labor market. I exploit the large contractions in military personnel between 1988 and 2000, when the size of the military personnel declined by about 30%. These large military personnel contractions provide a good natural laboratory for studying local spillover effects for several reasons. First, although military personnel only account for less than one percent of the total population nationwide, most military employees are concentrated in or around major military installations. Thus the impacts are substantial for counties that are homes to major military installations, while other counties are essentially not affected. Second, while there are studies that estimate local multipliers using shocks to other industries, changes in military personnel are less likely to be confounded with other shocks. Last , the nature of military employment is such that certain kinds of local spillover effects to private sector employment are unlikely to exist. As a result, I argue that the local spillover effects found in this paper mainly arise through demand channels, and thus I am able to estimate the importance of a particular mechanism by which local spillovers occur.

I propose a two step identification strategy given the nature of the policy experiment. Counties hosting major military installations in 1987, where the effects of military personnel contractions were expected to take place, were on average bigger, denser, richer and experiencing higher growth rate in private sector employment. As military installations are distributed across the country in all types of geographic

[1] Demand spillover is a mechanism by which workers in some businesses generate demand for goods and services produced by other businesses. The input-output linkage is a mechanism by which the final products of some businesses are inputs or intermediate goods for other local businesses. Agglomeration effects are channels by which the presence of other firms in the same or closely related industries promotes productivity, through facilitating cheaper access to intermediate goods, sharing of a larger pool of specific labor, and the exchange of ideas (Marshall, 1890).

conditions and local economic features, there is also substantial heterogeneity among counties where major malitary installations are located. One challenge for identification is thus to find appropriate groups of counties for comparison. I match each county with major military installations to a weighted average of those without major military installations, such that the pre-treatment differences in the private sector employment trajectories are minimized. Furthermore, the size of the cut might be correlated with unobservable factors that also affect private sector employment. I construct an instrumental variable for the magnitude of the military personnel contractions based on a county's historical military presence and contemporaneous nationwide cuts. I bootstrap the two steps jointly to get statistical inference.

I estimate that there are sizable local spillover effects. Cutting military personnel by one individual causes a decline of about 0.4 jobs in the private sector in the same county in the same year. I estimate that cumulatively across the 13 period, cutting military personnel by one individual reduces about 1.2 jobs in the local labor market with most of the effect concentrated in the first few years after the cut. I show that the effects are mainly driven by military personnel's demand for local goods and services.

The rest of the paper is organized as follows. Section 2 briefly introduces the related literature. Section 3 describes the historical background of the military personnel contractions since the late 1980s. Section 4 introduces the identification strategy. Section 5 introduces the data and construction of the samples used in this paper. Section 6 presents the results. Section 7 briefly discusses the mechanisms of the effects and compares my findings with other existing studies. Section 8 concludes.

2 Related Literature

This study is related to a few strands of literature. Many researches have studied demand shocks and local labor market dynamics. The seminal work by Blanchard and Katz (1992) shows that states in the US vary greatly in output per capita and unemployment rate. A state economy hit by a shock takes long time to recover. Autor et al. (2013) study the effects of rising China's export on local economies. They construct for each Commuting Zone an index for the similarity of industrial structure compared with the exporting industries in China. They find that increasing competition from China increases the unemployment rate and lowers the income growth in Commuting Zones that face larger competition from China. Recent studies point out that low mobility rates among displaced workers contributes to the prolonged distress of local economies (e.g., Notowidigdo, 2013). But previous studies have reached very different estimates. Black, McKinnish and Sanders (2005) study the effects of booms and busts of the coal mining industry on coal rich counties in the Appalachian region. They find that for each job lost in the mining industry, about 0.3 jobs were lost in the non-tradable sector, while there is no significant impact on the tradable sector. Moretti (2010) finds that one job created in the tradable sector created 1.6 additional jobs in the non-tradable sector. He also finds that the local multiplier is significantly larger for skilled workers, each of whom creates 2.6 additional jobs.

This paper also relates to studies on local fiscal multipliers, which is revived recently due to the large government spending during the Great Recession. Many papers study the local employment effects of the American Recovery and Reinvestment Act of 2009 (See for example, Feyer and Sacerdote 2012, Shoag 2012, Chowdorow-Reich et. al. 2012, Suarex Serrato and Wingender 2012). These papers in general find that the cost of a new full time job is between 28,000 and 34,000, implying a sizable local multiplier over 2.[2] These studies also find different magnitudes of the multiplier depending on the channel the stimulating money is spent.

There is a small strand of literature that estimate the impacts of variations in military spending on local economies. Nakamura and Steinsson (2013) estimate a local multiplier at the state level using variations in military procurement to states. This paper mainly focuses on local labor markets. State will be a too big to be defined as local labor markets, while the measurement of military procurement is imprecise at the county or MSA level. Hooker and Knetter (1998), Herzog and Poppert (2004) find a small effect of military base closures and the consequent military personnel cuts on local private sector employment and income. Using firm-level data in California, Krizan (1998) finds a small negative effect on firm births near the closing major

[2] The multiplier is calculated by Okun's law. For transfer programs such as the ARRA, it is hard to convert to employment on employment measures. The local fiscal multiplier is often larger than the national fiscal multiplier since the local economies cannot raise interest rate, thus a large fiscal stimulus attracts workers from other places as well. See Nakamura and Steisson 2012, Delong and Summers 2012.

military installations. These papers do not include the period of large military cuts. They also do not address the possible endogeneity of military personnel cuts.

3 Background

3.1 Distribution of military personnel in the United States

The vast majority of military personnel in the United States were located in some 500 major military installations across the United States in 1987.[3] Top graph in Figure 3 shows counties that had at least one major military installations. Counties marked in red are those hosting major military installations in 1987. There are 383 counties in 1987 that hosted 536 major military installations. A few military installations are clustered in the San Francisco Bay area, San Diego area, Seattle area, and Washington, DC area. Most of the military installations are spread across the United States. The bottom map color codes the military to civilian population ratio for each county in 1988. Darker color represents higher military to population ratio. An cursory eyeball test shows that counties with high military to population ratio are often those with major military installations. States like Washington, Colorado, Oklahoma, Illinois, Kentucky, South Carolina and Maryland have the largest military to population ratio, while states in the Northeast and north Midwest has the smallest presence of military personnel. The top graph in Figure 4 shows that in 1990, there were 1.5 million military personnel in the 383 counties with major military installations, accounting for about 90% military personnel in the United States. This ratio remained the same in year 2000, although the total number of military personnel had been cut substantially during the period. The bottom graph in Figure 4 shows that the military to population ratio is much higher in counties with major military installations (2.61% in 1990). Counties without major military installations have essentially no military presence (0.11% in 1990).

Most of the military installations had existed for decades, if not for centuries. The location choices of military installations were mainly based on national defense considerations and served the purpose of military operations. For example, essen-

[3] A major military installation is defined as those listed as major installations in the 1989 Base Structure Report.

tially all the naval bases are located on seaports or on lakeshores, since large bodies of water are essential for Navy operations. There are many military installations in the greater Washington, DC area to protect the nation's capital. Cost saving considerations are also elements for the location choices of major military installations. Military installations that require large plots of land are often located in places with low land prices, many of them in midwestern and southern states like Kentucky, Arizona, and Indiana. Air Force bases are often located outside large cities for the balance of land price and national defense considerations. Although there are many economic and non-economic considerations for the location choices of military installations, industrial composition is not one of them. There are two aspects of this argument. On the one hand, a military installation does not located in a place simply precisely because that the place has an industrial structure or demographic composition that serves the production of military operations or generate demand for military services. On the other hand, although there are local businesses that rely at least partly on the existence of nearby military installations, major items that the military purchases are most likely not provided by firms that are located nearby.[4] Most of the existing major military installations by the end of the 1980s had a history at least dates back to WWII, their presence was predetermined for the counties they resided.

Counties with major military installations are not a random sample of counties in the United States. They are larger and have higher population densities. The 383 counties with major military installations accounted for about 12% of the total county-level jurisdictions in the United States, but they accounted for about 50% of its total population in 1988. On average, these counties were also growing at a faster pace in private sector employment in the decade prior to the start of the large cuts in military personnel in 1988. Figure 1 shows the trajectories of the private sector employment index. The index is the level of private sector employment relative of the county to its 1980 level. The blue solid line shows the average trajectory of the indices for counties with major military installations as of 1988. The red solid line shows the

[4] The relationship between Air Force bases and aircraft manufacturers is a good example for this argument. Air Force bases are spread across the United States, while the aircraft used by the Air Force are mostly manufacturered in a few industrial centers. Same is true for other weapons and military supplies. One exception might be the Naval bases shipyards, where the shipyards are often located near major Naval bases.

average trajectory of the indices for counties without major military installations. Counties with major military installations were growing at a much greater speed during that period than those without major military installations. Between 1980 and 1987, private employment in counties with major military installations on average grew by 22%, while that in counties without major military installations grew only 11%. However, the average figures mask important heterogeneity in growth rates within each type of counties. The blue dashed lines show the 25-75 span of the indices of counties with major military installations. The red dashed lines show the 25-75 span of the indices of counties without major military installations. The bottom quartile of counties with major military installations on average grew much more slowly than the average county without major military installations. The top quartile of counties without major military installations on average grew much more rapidly than the average county with major military installations.

3.2 Military personnel contractions, 1988 - 2000

The size of the military as measured by the number of men and women in uniform in the United States has been declining since the end of WWII. This trend was paused in the 1980s when the military underwent significant expansion under the Reagan Administration. The expansion was mainly concentrated in military procurement for development of new weapons,[5] the size of military personnel did not experience a comparable expansion, the but declining trend was reversed. Another reason for the pause of the declining trend in military personnel is the political gridlock in deciding which military installations to cut. Members of Congress from jurisdictions that host military installations objected to cuts in the military presence in their jurisdictions. Since the late 1970s, proposed cuts for every single military base must be passed in Congress, strong political objections made any cuts essentially impossible.

The international geopolitical situations changed dramatically in the late 1980s. In June 1987, President Reagan addressed at the Brandenburg Gate in Berlin, calling for "tear down this wall". The near end of the Cold War urged for a matching reduction in military capacity in the United States. On the other hand, the fiscal situation for the federal government after large tax cuts and increasing spending

[5] For example, the Strategic Defense Initiative (SDI) to use ground-based and space-based systems to protect the United States from attack by strategic nuclear ballistic missiles.

during the Reagan Administration also made the cuts necessary. In 1988, the Base Re-Alignment and Closure (BRAC) Act was passed. An independent commission with members jointly nominated by the President and Congress became responsible for choosing military installations to be re-aligned or permanently closed. Military values and cost-saving considerations were the main criteria for choosing which installations to be reduced or closed. This law insulated individual Congress members from the political penalties of potential shutdowns of military installations in their jurisdictions. With the BRAC rounds in 1988, 1991, 1993 and 1995, the size of the military personnel dropped by over 30% between 1988 and 2000. The declining trend stopped in 2001 after the 9-11 terrorist attacks. Although there was another round of BRAC in 2005, the size of active duty military personnel has been pretty much stable at around 1 million. Figure 2 shows the trajectory of active duty military personnel between 1975 and 2010 and marks the major events related to the changes in size of military personnel.

The cuts in military personnel during the period between 1988 and 200 were largely across-the-board. Of course, the most cuts were concentrated in counties with military installations, especially those that experienced large closures or re-alignments. However, as is shown in Figure 4, the percent declines in military personnel were similar in counties with major military installations and those without. Between 1990 and 2000, military personnel in counties with major military installations dropped from 1.47 million to 1.05 million, a 28.5% decline, military personnel in counties without major military installations dropped from 0.15 to 0.1 million, a 33% decline. The size of the shock due to cuts in military personnel is larger in counties with major military installations, the military to civilian population dropped from 2.61% in 1988 to 1.68% in 2000. The size of the shock is negligible in counties without major military installations, which had barely budged from 0.11% of the population in 1988 to 0.08% of the population in 2000. Therefore, we would expect that our results are mainly identified from counties hosting major military installations as of 1988.

Despite that the cuts in military personnel during that period were largely across-the-board, the potential impact on local economy was an explicit consideration for the geographic distribution of cuts in military installations and military personnel.

For example, in the process of deciding which installations to be closed or realigned, the BRAC Commission received many complaints from local communities citing the potential substantial harm to their local economies. There are indeed cases where large closures or realignments of military installations proposed by the DoD were rejected by the BRAC Commission for possible substantial economic consequences. For example, Naval Submarine Base New London in Connecticut was listed to be closed in the initial proposal by the DoD in 2005, but the BRAC Commission found that "the argument of overall economic impact compelling" (BRAC 2005 Report to the President), and partly for that reason, the Commission decided to take it off from the BRAC list. Besides, even the considerations seemingly unrelated with local labor market conditions, such as cost saving considerations and and military values, can be confounded with the outcome of interest. For example, good labor market conditions in a local economy drives up local prices. Other things equal, closing military installations located in these areas would accrue to sizable savings. Increasing population in economic booming areas would also affect the operations of the military installations nearby, thus the military value of such a base may be reduced. For all these reasons, I will propose an instrumental variable for the changes in military personnel.

4 Identification Strategy

4.1 A two-step identification strategy

Given the distribution of military personnel in the United States and the nature of the substantial contractions during the period between 1988 and 2000 as introduced in the previous section, the challenges for identification are twofold. First, since the military personnel are concentrated in a small group of counties with major military installations, the effects of military personnel contractions are likely to be concentrated in these counties. Second, among counties with major military installations, the magnitudes of the cuts differ across counties and are potentially endogenous. As a result, I propose a two step identification strategy. In the first step, I construct a weighted average of a group of counties without military installations as the comparison for each county with military installations. The weights are constructed in such a way that the pre-treatment trend of the outcome variable is minimized for the county with major military installations and its comparison. In the second step, I evaluate the effects of military personnel contractions on local private sector employment by restricting the comparisons within the grouped counties with weights. I address the issue of endogenous magnitude of the cuts by proposing a shift-share instrumental variable.

4.2 Comparison groups for counties with major military installations

As is shown in Figure 1, counties with major military installations had an average private sector employment trajectory between 1980 and 1987 which is much higher than that of counties without major military installations. In cases where the potentially treated sample are inherently different from the comparison group, and the size of the comparison group is much larger than that of the potentially treated sample, existing studies often pick intuitive comparing units from the larger comparison group for the treated sample. For example, in order to study the effects of the large increase of Cuban immigrant workers in Miami, FL due to the Mariel Boatlift event in 1980 on the local labor market, Card (1990) picks four comparing cities, Atlanta, Los Angeles, Houston, and Tampa-St. Petersburg, which the author argues that exhibited similar employment growth rates as Miami. In studying of the spillover effects of the mining sector, Black, McKinnish and Sanders (2005) compares counties with large coal reserve with those without in the same state. In order to evaluate the effects of large government investment through Tennessee Valley Authority (TVA), Kline and Moretti (2013) compare counties within the TVA region to those just lie outside of the region. A key assumption of these approaches is that the intuitive selection of the comparison units are indeed good proxy for the counterfactual outcomes of the treated units had there been no such treatment. Other studies use statistical methods to let the data speak to the selection of best comparing units. For example, Evans and Lien (2005) select metropolitan areas that jointly have similar pre-treatment characteristics with the Pittsburgh metropolitan area using a simple statistical model.

The studies cited earlier either have only one treated unit or have a group of mostly homogeneous treated units. They select a group of arguably homogeneous comparing units from the larger potential comparing pool that are similar on average would suffice for the comparison. Figure 1 shows that there is substantial variation in the outcome of interest within the potentially treated units. Therefore, selecting a group of comparing units that have a similar pre-treatment mean trajectory as that of the treated units does not guarantee that the selected comparing group is a good one for each of the treated unit. In similar cases where the treated units exhibit substantial heterogeneity, existing studies have also proposed intuitive approaches as well as more data-driven approaches. In studying the impact of winning a large manufacturing firm on the productivity of incumbent firms , Greenstone, Hornbeck, and Moretti (2010) use the runners-up counties in the bid to attract each large manufacturing firm as intuitive comparing groups for the winning counties. In general, researchers have used matching estimators to identify the average treatment effect where each treated unit is matched with one or a few comparing units that share similar observable characteristics. Unfortunately, existing matching estimators in simple forms work only with binary treatment variables, and have difficulties in estimating standard errors (Abadie and Imbens, 2006, 2008)

The baseline specification in this paper adopts a generalized matching approach which relates each county with major military installations to a weighted average of counties with no major military installations. The weights are constructed in such a way that the county with military installations and the weighted average of counties with no major military installations have the most similar characteristics prior to the start of treatment in 1988. Specifically, for each county b with major military installations, select a vector of α_{b_j}'s for all potential comparing counties $j \in J$ such that:

$$\alpha_{b_j} = argmin \sum_{t \in T} ||\mathbf{X}_{bt} - \sum_{j=1}^{J} \alpha_{b_j} \mathbf{X}_{b_j t}||, \tag{1}$$

$|| \cdot ||$ is a distance measure. $\alpha_{b_j} \in [0, 1]$ and $\sum_{j=1}^{J} \alpha_{b_j} = 1$. Thus the weights are all well-behaved. $T = [1981, 1987]$. $\mathbf{X}_{.t} = (y_{.0}, \mathbf{Z}_{.t})$ is a vector of covariates to be matched on. $y_{.0}$ is the average private sector employment index between 1981 and 1987, standardized at 1 in 1980 for each county. $\mathbf{Z}_{.t}$ is a vector of pre-determined covariates prior to the treatment that predict future private sector employment growth. Variables relating to the military are excluded from $\mathbf{Z}_{.t}$. This approach is similar to the way the counterfactual is constructed in the synthetic control method developed by Abadie, Diamond, and Hainmueller (2010).

$\mathbf{Z}_{.t}$ is a vector of covariates that predict the trajectory of the private sector employment between 1988 and 2000. The literature lacks a systematic documentation of the key determinants of long-run private sector employment trajectory. Following the growth literature, I use the Bayesian Model Averaging (see Doppelhofer, Miller and Sala-i-Martin, 2004 for an application) method to decide which variables best predict 1988-2000 private sector employment growth. That is, I estimate the following regression with different combinations of variables

$$\frac{Emp_{i2000} - Emp_{i1988}}{Pop_{i1980}} = \tilde{\mathbf{Z}}_{\mathbf{it}} \cdot \beta + \varepsilon_i.$$

$\tilde{\mathbf{Z}}_{.t}$ includes a wide range of variables available that may explain the long-run growth of private sector employment. The prior probability of including each variable in the sample is 1/2. I include a variable in $\mathbf{Z}_{.t}$ if the posterior probability of being included in the regression above is higher than 1/2. Table 1 shows the posterior probabilities of a sample of variables. I include in $\mathbf{Z}_{.t}$ those marked in bold, which all have posterior inclusion probability close to 1.

Once we have the optimal weights α_{b_j} from solving Equation 1, denote the synthetic outcome for each county b with major military installations as $y_{bt}^{synth} = \sum \alpha_{b_j} y_{jt}$. Notice since α_{b_j} does not change over time, we can construct y_{bt}^{synth} for $t \geq 1988$ as the counterfactual of y_{bt} if there are no military cuts. Figure 5 uses San Diego as an example. The table above shows the weights α_{b_j}. There are 9 counties from the larger comparing pool with non-zero weights. The sum of weights from these counties is equal to 1. Pinellas County, FL which includes the City of St. Petersburg, Oakland County, MI which includes the City of Pontiac, and Santa Fe county, NM collectively contribute 0.7 out of a total weight of 1. The graph below shows the private sector employment trajectories for San Diego County y_{bt} (blue line) and its synthetic control y_{bt}^{synth} (red line) from 1981 to 2000. y_{bt} and y_{bt}^{synth} track each other between 1981 and 1987 and diverge afterwards. San Diego has slightly better private sector growth record at the beginning but started to trend below that of its synthetic control since 1992. The gray line shows the military personnel to 1980 population ratio for San Diego. The trajectory of military personnel in San Diego is similar to that of the national trend. Cuts in military personnel in San Diego started in 1990 and was reversed in 1998. Between 1990 and 1998, about 45 thousand military personnel were cut in San Diego, accounting for about 2% of its 1980 population. The trajectory of private sector employment for San Diego follows the changes in military personnel, while the trajectory of private sector employment for the synthetic San Diego has been growing smoothly.

It is essential to the baseline specification that the weights are constructed such that the weighted average of the characteristics of the comparing group is very similar to those of the county with major military installations they match on. The example of San Diego shows that this re-weighting method does a good job in matching the key outcome of interest in the period prior to the treatment. One way to systematically check the goodness of fit is to examine the differences between y_{bt}^{synth} and y_{bt} in the pre-treatment period for counties with major military installations. The top left graph in Figure 6 shows the average trajectories of private sector employment indices for counties with major military installations and their synthetic controls, as well as their 25-75 spans between 1981 and 1987. The graph shows that the actual and synthetic private sector employment trajectories track each other very nicely. The top right graph calculates the margin of error of the comparing group $(y_{bt}^{synth} - y_{bt})/y_{bt}$ for each county with major military installations. The mean of the margin of error is literally zero. The 95% confidence interval is pretty much bounded between (-0.15,0.15).

Yet another way to check the goodness of fit for years beyond 1988 is to do a placebo test. I randomly choose half of the counties from the large pool of comparing counties and assign them as "treated" and assign the rest as "untreated". For each county b' in the "treated" group, I apply the same synthetic control approach to construct a comparing group from counties in the "untreated" group J'. I then construct the synthetic control of the private sector employment $y_{b't}^{synth} = \sum \alpha_{b'_{j'}} y_{j't}$. I plot the average of $y_{b't}$ and $y_{b't}^{synth}$ as well as the 25 to 75 span in the graph in the second row of Figure 6. The trajectories of private sector employment indices for the placebo treated and their synthetic controls tracks closely with each other for all years between 1980 and 2000.

4.3 Estimating the local labor market spillover effects

I estimate the following variations of equations using weighted least squared estimation:

$$\frac{Emp_{igt} - Emp_{igt-1}}{Pop_{ig1980}} = \sum_{k=-K}^{K} \beta_k \cdot \frac{Mil_{igt-k} - Mil_{igt-k-1}}{Pop_{ig1980}} + \Omega + \varepsilon_{igt} \qquad (2)$$

where Emp_{it} is the level of private sector employment in county i in year t, Pop_{i1980} is the civilian population in county i in 1980. The dependent variable measures one year change in private sector employment per initial civilian population. Mil_{it} is the number of military personnel in county i in year t. Both Emp_{it} and Mil_{it} are taken from the BEA Regional Economic Accounts.[6] The key explanatory variable measures changes in military personnel per initial civilian population. $k \in [-K, K]$. These terms takes into account of potential effects of future or past cuts. The coefficient β_k thus has the intuitive interpretation as the number of private sector jobs lost due to cutting military personnel by one. g denotes comparing groups of counties defined earlier. Weights are used in all variations of the model. Weights $\alpha_i = 1$ for counties with major military installations, weights for counties with no major military installations are from the matching procedure introduced earlier. Ω is the fixed effects. When $\Omega = \tau_t$ the model controls for year fixed effects. The model is identified by variations in changes in military personnel per capita within the same year. Since the weights are used, weighted average of the counties with major military installations and the weighted average of all comparing counties have the same initial conditions prior to the sample period. When $\Omega = \lambda_{gt}$, I control for group-year fixed effects. I am restricting the model to be identified by the variations in changes in military personnel within the same group of counties in a same year. Controlling for group fixed effects restricts the comparison to be made between a

[6] The military personnel in the BEA data are compiled from the annual DoD report “Distribution of Personnel”. The BEA data include both active duty military personnel and military reserve that are meeting regular training.

county with major military installations and its most comparable counterfactuals, it thus improves the precision of the estimation. Notice that a county without major military installations can appear in the regression multiple times if it is chosen with positive weights for multiple counties with major military installations, but each of these observations will have a different λ_{gt} and potentially different weights.[7]

Changes in military personnel per capita might be correlated with the idiosyncratic shocks to the local economy. Although the DoD states that the decision of military cuts and base closures are predominantly based on national defense and cost-saving considerations, evidence abound that local governments and communities usually object to any military cuts in their local economies. The objection is likely to be stronger in a jurisdiction where the local economy is experiencing a negative idiosyncratic shock. The DoD is also likely to avoid potential negative impacts on the local economy by cutting less in places that are likely to be severely affected. Thus the OLS estimates are likely to underestimate the true effects of military personnel contractions. I propose an instrumental variable for changes in military personnel per capita as the predicted cuts based on the historical military to population ratio and the contemporaneous changes in national military personnel, that is:

$$(\frac{Mil_{it} - Mil_{it-1}}{Pop_{i1980}})^{IV} = \frac{\hat{M}il_{i1980}}{Pop_{i1980}} \cdot (\ln(NtlMil_t) - \ln(NtlMil_{t-1})),$$

where $NtlMil_t$ is the national total of military personnel in year t. $(\ln(NtlMil_t) - \ln(NtlMil_{t-1})$ is the national change in military personnel in the current year. $\hat{M}il_{i1980}/Pop_{i1980}$ is the military to civilian population ratio in county i in year 1980. Since 1980 the total number of military personnel stayed largely stable for the most part during the Reagan Administration. Mil_{it} can be measured with error.[8] The measurement errors in the BEA data are likely to be correlated over years. For example, the DoD report is a snapshot of the distribution of military personnel on a particular date of the year, which do not necessarily reflect the overall distribution

[7] The pool of potential comparing counties are large. Therefore, each county in the potential comparing pool has relatively small chance of being assigned with positive weights in the comparing group for any of counties with major military installations. The county in the comparison group that has the largest total weights of about 6.

[8] In the BEA data, numbers of active duty military personnel in each county are reported by each department of the military. Numbers of military reserve meeting regular training are only available at the state level. The state level military reserve personnel are allocated to each county proportional to the county population.

throughout the year, and the error structure will be the same in different years. To address this concern, $\hat{Mil}_{i1980}$ is taken from Census 1980. Mil_{it} and $\hat{Mil}_{it}$ thus are taken from two sources and the measurement errors are unlikely to be correlated. $NtlMil_t$ is aggregated from the BEA data and is thus independent of the idiosyncratic measurement error at the county level.

Statistical inferences are conducted from bootstrapping.[9] In each repetition b, I redraw with replacement counties with major military installations. I separately redraw counties with and without major military installations. Both pseudo samples have the same number of counties as in the original samples. I then repeat the re-weighting procedure and find a new vector of weights for each county with major military installations.[10] I re-estimate Equation 2 and obtain $\hat{\beta}_b$. Finally, I align all B re-estimates of $\hat{\beta}$ and test whether the 95% confidence interval includes the null hypothesis.

4.4 Cumulative effects

We are interested in the total effects of cutting the military personnel by 1 on the number of private sector jobs in the local economy. Ideally, we can increase the size of K in Equation 2 to include changes in military personnel many years before and after. However, since the contractions in military personnel are often persistent and smooth, increasing the dynamic aspect of the panel makes the model increasingly susceptible to multi-colinearity and estimation becomes increasingly unstable as K increases. I propose a simple alternative approach to get around this issue. I estimate the long-difference model between 1988 and 2000:

$$\frac{Emp_{i2000} - Emp_{i1988}}{Pop_{i1980}} = \beta \cdot \frac{Mil_{i2000} - Mil_{i1988}}{Pop_{i1980}} + \lambda_g + \varepsilon_{ig}, \tag{3}$$

where λ_g is group dummies where each group g is defined as earlier. The change in per capita military personnel for county i between 1988 and 2000 is instrumented by the predicted change based on initial military to population ratio in the county in 1980 and the national change in military personnel during the same period:

[9] 250 repetitions. Abadie and Imbens (2008) suggest that, unlike the simple matching estimator, bootstrap is likely to work in this case since there is no restriction on the number of comparing units to be matched on.

[10] Counties that appear multiple times in the pseudo sample are assigned with different IDs.

$$(\frac{Mil_{i2000} - Mil_{i1988}}{Pop_{i1980}})^{IV} = \frac{\hat{Mil}_{i1980}}{Pop_{i1980}} \cdot (\ln(NtlMil_{2000}) - \ln(NtlMil_{1988})),$$

I estimate the model using two stage least squares estimator. Weights α_i as defined earlier are used.

Equation 3 is a rough accumulation of the effects of changes in military personnel over the 13-year period. For some counties, the cuts might be concentrated in the earlier years of the period, so the accumulative effects capture for potentially most of the unfolding effects of the cuts and probably capture some long run effects. For other counties, the cuts might be concentrated in the later years of the period, so the effects may not have been fully realized. However, as I will show below, the effects of the cuts usually realize within a few years. Therefore, estimating the long difference equation is likely to be a good approximation of the cumulative effects.

5 Data and Sample

This paper uses multiple sources of publicly available data. The main source of data at the county level comes from the Bureau of Economic Analysis (BEA) Regional Economic Accounts. The BEA data put together county level economic and labor market outcome variables from the Census Bureau, Bureau of Labor Statistics, and other government agencies. The data include employment and income by 2-digit sectors for each county from 1969 to 2011. Most importantly, the BEA data include military as a sector, which they compile from from the DoD annual reports. So county level military employment and their compensation are directly from the BEA data. Data on major military installations and distribution of military personnel are corroborated with two other annual DoD publications: Base Structure Report and Distribution of Personnel. County military personnel from the BEA data are compiled from data provided by DoD, which are based on a DoD database that also generates the Base Structure Report and the Distribution of Personnel Report. The Base Structure Reports have the name, location (ZIP code), personnel, and main function of major military installations. The Distribution of Personnel reports have the name and number of military personnel and DoD civilian employment in major cities and major military installations. Number of military personnel in a county in 1990 and 2000 can also be obtained from publicly available census tract tabulations for 1980, 1990 and 2000 censuses by aggregating military personnel in census tracts (where county FIPS code can be recovered). The county military personnel from the Censuses are from self-reported occupations from in-house surveys. Since they are collected in different ways, the measurement errors in the numbers from the two data sources are unlikely to be correlated.

Federal civilian employment are also from the BEA regional economic account. Primary military procurements are from DoD publication Form DD350 Individual Contracting Action Report from 1966 to 2000. DD350 records the amount, main product or service, year month of delivery, name of the primary contractor, and the county of the primary contractor for each primary contractor for each procurement greater than 25,000 dollars (50,000 since 1990). I aggregate procurement to the county-year level. I use the geographic distribution of military installations from National Transit Database (NTD) as well as annual publication of Base Structure Report to create a GIS map with military installations. I then decide which counties have major military installations by overlaying the GIS map with military installations and the GIS map with counties.

I drop counties with civilian population less than 5000 in 1980. I construct a balanced panel of the remaining 2812 counties (and county equivalents) between 1970 and 2010. There are 383 counties with major military installations in 1987. The main regression sample includes years between 1988 and 2000, although I use information in years before. I also use years between 2001 and 2010 in robustness checks.

6 Results

6.1 Baseline results

Table 2 shows the results of estimating variations of Equation 2 using both OLS and 2SLS estimators. Column 1 and Column 2 use a sample of 2,812 counties and treat each county with equal weights. Column 1 estimates the model using OLS and Column 2 estimates the model using 2SLS using the shift-share instrument introduced in Section 4. The OLS estimate suggests that reducing military personnel by 1 is associated with 0.2 fewer jobs in the private sector in the contemporaneous year. The 2SLS estimate shows that reducing military personnel by 1 reduces 0.4 jobs in the private sector in the current year. The 2SLS estimate is larger than the OLS estimate, suggesting that the DoD has avoided large cuts in local economies with unobservable negative shocks. Columns 3 through 5 use the re-weighted sample as discussed in Section 4.1. Weights constructed based on the synthetic control are used throughout. Column 3 uses OLS while Column 4 and Column 5 use 2SLS. Since the weights used here are constructed, we use bootstrap for inference and report the 95% confidence intervals for the bootstrapped estimates. In Column 3, county group dummies fully interacted with year dummies are included in the regression. The estimated coefficient is 0.13 and is statistically significant at 5% level. Column 4 uses 2SLS estimator and controls for only year fixed effects. That is, in Column 4, the weighted average of *all* counties with major military installations and the weighted average of *all* counties without major military installations have the matched up county characteristics and private sector employment trajectories prior to large military cuts. Column 5 uses 2SLS estimator and controls for the fully interacted dummies of county group dummies and year dummies. Thus the comparison is restricted within a county group in the same year. Since counties with major military installations all have weight 1, *each* county with major military installations are matched up with the county-specific weighted average of counties without major military installations in terms of county characteristics and private sector employment trajectories prior to large military cuts. Column 4 and Column 5 yield surprisingly similar results. Reducing military personnel by 1 reduces about

0.7 private sector jobs in the same county in the same year. Both estimates are statistically significant at 5% level. The first stages are strong, with F statistics well above the rule-of-thumb threshold of 10. (Stock and Yogo, 2005). I use Column 5 of Table 2 as the preferred specification.

Table 2 shows the contemporaneous effect of cuts in military personnel on local private sector employment. The total effect of the cut may take years to fully realize. An interesting parameter would be the accumulative number of private sector jobs lost over the years due to reducing military personnel by one. One way to estimate the accumulative effect is to include future and past changes in military personnel, that is, increasing in K in Equation 2. Columns 1 replicates the baseline result. Column 2 includes changes in military personnel one year prior and one year after. Column 2 further includes changes in military personnel two years prior and two years after. 95% confidence intervals of the estimated coefficients from bootstrap are reported in the brackets. The coefficient on the contemporaneous change in military personnel gets gradually smaller as we include more leads and lags, which implies that the changes in military personnel are positively serially correlated. The effect is overestimated when there is no leads and lags included. The effect of cutting military personnel by one reduces contemporaneous private sector employment by 0.437 in Column 2 and 0.441 in Column 3. Both estimates are statistically significant at 5% level. The point estimators for changes in previous years are in general positive but is much smaller in magnitude, and is not statistically significant. The point estimators for changes in future years are even smaller in magnitude and sometimes with the wrong sign. They are never statistically significant. The first stage regressions are very strong. The first stage Kleinbergen-Paap F statistics are well above the rule-of-thumb levels throughout the levels. The Angrist-Pischke F-statistics for whether a particular endogenous variable is identified are also large. In theory, more leads and lags can be included in the regression to take full accounts of the effect of military personnel cuts took place in the past and in the future. However, adding more leads and lag terns makes the estimation increasingly unstable as colinearity increasingly becomes an issue. Therefore, I estimate the long difference model in Equation 3. The results are reported in Column 4 of Table 3. Over the period between 1988 and 2000, cutting military personnel by one in a county reduces about 1.2 private sector employment over the 13 year period. The coefficient is 10% significant based on bootstrapped confidence intervals. The first stage is relatively weak with the F statistics of around 8.

6.2 A test for the goodness-of-fit and model specification

If the re-weighting exercise balances all the observables that may affect the outcome variable and the model is well specified, the residuals from the baseline specification should not be correlated with any year dummy or a dummy indicating whether the county has major military installations. To propose two tests to see whether this is the case. First, I calculate the residual from the baseline specification,

$$\hat{\varepsilon}_{igt} = \frac{Emp_{igt} - Emp_{igt-1}}{Pop_{ig1980}} - \sum_{k=-K}^{K} \hat{\beta}_k \cdot \frac{Mil_{igt-k} - Mil_{igt-k-1}}{Pop_{ig1980}} - \hat{\lambda}_{gt}.$$

The error terms should not be systematically different for counties with major military installations and those without major military installations, collectively and in each year. To test this, I run the following regressions:

$$\hat{\varepsilon}_{igt} = \gamma_1 \cdot Hasbase_i + v_{igt},$$

and

$$\hat{\varepsilon}_{igt} = \sum_{t=1988}^{2000} \gamma_{2t} \cdot Hasbase_i \cdot \tau_t + \mu_{igt}.$$

$Hasbase_i$ is equal to 1 if county i hosts major military installations. τ_t is equal to 1 in year t. Weights α_i constructed earlier are used. We test $H_0 : \gamma_1 = 0$ (Test 1) and $H2_0 : \gamma_{2,1988} = ... = \gamma_{2,2000} = 0$ (Test 2). The F-test for $H_0 : \gamma_1 = 0$ has an $p-$value of 0.29. The joint F-test for $H_0 : \gamma_{2,1988} = ... = \gamma_{2,2000} = 0$ has $p-$value of 0.016.

Alternatively, we can run the difference between the outcome variable for a county with major military installations and its synthetic controls against years. Define the variables as follows:

$$(\frac{Emp_{igt} - Emp_{igt-1}}{Pop_{ig1980}})^{synth} = \sum_j \alpha_j \cdot \frac{Emp_{jgt} - Emp_{jgt-1}}{Pop_{jg1980}}$$

$$(\frac{Mil_{igt} - Mil_{igt-1}}{Pop_{ig1980}})^{synth} = \sum_j \alpha_j \cdot \frac{Mil_{jgt} - Mil_{jgt-1}}{Pop_{jg1980}}$$

$$y_{igt} = \frac{Emp_{igt} - Emp_{igt-1}}{Pop_{ig1980}} - (\frac{Emp_{igt} - Emp_{igt-1}}{Pop_{ig1980}})^{synth}$$

$$x_{igt} = \frac{Mil_{igt} - Mil_{igt-1}}{Pop_{ig1980}} - (\frac{Mil_{igt} - Mil_{igt-1}}{Pop_{ig1980}})^{synth}$$

We run the following regression focusing on the sample counties with major military installations using 2SLS:

$$y_{igt} = \sum_k \beta_k x_{igt-k} + \gamma_{3t}\tau_t + \varepsilon_{igt},$$

where τ_t is the year dummy which takes value 1 in year t. $k \in [-2, 2]$ as in the baseline specification. We test whether γ_{3t} is equal to zero individually and jointly (Test 3).

The results of these tests are reported in Table 4. Whether a county with base or not is not correlated with the residual from the baseline regression. Counties with major military installations and those without are also not statistically different from each other for most years during the sample period. However, the joint F-test is significant at 5% level. An alternative joint-test for year fixed effects in Column 4 show that the year dummies are significant at 1% level, although most of them are statistically insignificant individually.

6.3 Robustness checks

6.3.1 Confounding factors

This paper estimates the effects of the cuts in military personnel on local private sector employment. The size of military personnel is a proxy for the military spending on the military operations in the local economy where the military personnel are stationed. The assumption for the identification is that the cuts in military personnel are not confounded with other shock that also have effects on the private sector employment. Except for a small recession in the early 1990s, the economy was persistently growing throughout the period between 1988 and 2000. Therefore, the military cuts are unlikely to be correlated with other shocks during that period.[11] Military spending as a whole was under substantial decline and there are multiple dimensions in military spending.[12] Changes in different types of military spending is likely to be correlated. Among all the categories of military spending, military procurement is not realized through military operations via military personnel. If the geographic distributions of military personnel and military procurement are correlated, then the estimated effects of military personnel will be biased. I collect the primary contract awards accrued to the county-year level from the DoD annual publication "Military Prime Contract Files".[13] The cross-sectional correlation between county military personnel and primary procurement awarded to firms located in the county is only 0.12, while the correlation between one-year change in military personnel and one-year change in primary procurement to the county is essentially zero (0.0004).

Besides military personnel, the DoD also hires a large number of civilian workers. These people also generates demand for local goods and services. Notice that increases in civilian workers hired by the DoD are results of increases in military personnel and military operations. So controlling for DoD civilian employment changes leaves the interpretation of the coefficient associated with military personnel changes slightly differents. Unlike military personnel, DoD civilian workers are more likely to stay in the local market when the military operations are cut and are likely to re-enter the local labor market. The effects of military personnel will be biased if we don't take into account of these workers. For this reason, I control for the changes in federal civilian workers in the county.

I instrument changes in per capita federal civilian employment using a shift-share instrument based on the county's initial federal civilian employment and contemporaneous changes in national total federal civilian employment. Similarly, I instrument

[11] The federal government budget was in surplus for the first time since 1969 during the Clinton Administration. The surplus was achieved by tax increase and cuts in government spending. Cuts in military spending accounted for over a half of the total cuts.

[12] For example, The military budget in 2010 was 683.7 billion dollars. 40% of the military budget was spent on maintenance and operations. Spending on military personnel, which mainly consists of compensations to the military, consisted of 22%. Military procurement accounted for about 20% of the the total military spending. Research, Development, Testing and Evaluation accounted for about 12%. Military construction and family housing accounted for the rest.

[13] DoD Form DD 350. Accessed from the National Archives and Records Administration (NARA).

changes in per capita military procurement primary contract award using an instrument that is based on the county's initial per capita military procurement primary contract award and contemporaneous changes in national total military procurement primary contract awards. Specifically,

$$(\frac{FedCiv_{it} - FedCiv_{it-1}}{Pop_{i1980}})^{IV} = \frac{FedCiv_{i1980}}{Pop_{i1980}} \cdot (\ln(NtlFedCiv_t) - \ln(NtlFedCiv_{t-1}))$$

$$(\frac{PCA_{it} - PCA_{it-1}}{Pop_{i1980}})^{IV} = \frac{PCA_{i1980}}{Pop_{i1980}} \cdot (\ln(PCA_t) - \ln(PCA_{t-1}))$$

The results are reported in Table 5. Only the effect of the contemporaneous changes in military personnel, military procurement per capita, and civilian employment are included. But the results are similar as leads and lags are included. Column 1 replicates the baseline results. Column 2 includes contemporaneous changes in per capita federal civilian employment. Column 3 includes contemporaneous changes in per capita DoD primary contract awards. Column 4 includes contemporaneous changes of both federal civilian employment and per capita primary contract awards. The estimated effects of military personnel cuts are essentially not changed and are all statistically significant at 5% level. Declines in federal civilian employment and changes in per capita military procurement have negative effects on changes of private sector employment, the effects are both marginally significant.

6.3.2 Expanding sample period

Cuts in military personnel were concentrated during the period between 1988 and 2000. The declining trend stopped in 2001 as a result of the 9-11 terrorist attack. There was another round of BRAC in 2005, but as noted by then Secretary of Defense Donald Rumsfeld, the DoD took it as an opportunity to reshuffle the distribution of the military instead of large cuts in military capacity. Despite smaller variation, I expand the sample to years between 1988 and 2010. I show that the same results hold in Table 6.

6.3.3 Effects by sectors

Table 7 shows the effects of military personnel contractions on private sector employment by broad industry categories: manufacturing, construction, retail and service. Industries whose outputs mainly serve the local area are likely to be affected more than those whose outputs have a nationwide or global market. This intuition is confirmed. Cuts in military personnel reduced private sector employment have negative and statistically significant effects on private sector employment in all industries, but the effect is largest in the retail and the service industries. Cutting military personnel by one reduces 0.17 private jobs in the service sector, and 0.09 private jobs in the manufacturing sector.

6.3.4 Alternative specification

The baseline specification estimates the effect of cuts in military personnel on local private sector employment by comparing a county with sizable cuts in military personnel with others that does not have cuts in military personnel but with otherwise similar characteristics. Here I propose an alternative specification with county fixed effects, hence the model is identified using the changes in military personnel and changes in private sector growth relative to the average changes in both of each county during the sample period. Specifically, I estimate the following equation:

$$\frac{Emp_{it} - Emp_{it-1}}{Pop_{i1980}} = \sum_{k=-K}^{K} \beta_k \cdot \frac{Mil_{it-k} - Mil_{it-k-1}}{Pop_{i1980}} + \lambda_i + \varepsilon_{it} \tag{4}$$

λ_i is the county dummy. I use all 2,812 counties to estimate this model. Changes in military personnel is instrumented with the shift-share predictor defined earlier. The results are shown in Table 8. The results are surprisingly similar with those in the baseline specification, despite the two specifications use two very different sources of variations.

7 Mechanism and Comparisons with Other Findings

The literature recognizes several channels through which a business affects others in the same local market. First, a new business raises employment and income in the local economy, thus increases demand for local goods and services. This is in general called demand spillovers. Secondly, a business hires from local labor market, which may have direct supply side effects to other businesses in the local economy. Third, a business may attract more businesses to the local economy due to input or output linkages. Fourth, clustering of firms in the same industry generates agglomeration effects where firms learn from each other and thus promote productivity. Last but least, labor mobility plays a large role in the spillover effects of a local business. When a local economy gains a new business, workers move in from other places, when a local economy loses a business, displaced workers move out to other places. The relatively low mobility of displaced workers partly explains why the economic recovery is often slow when a local business shuts down.

The specialties of the military determine that the spillover effects of contractions of military personnel studied here help to isolate certain channels of the effect. We argue that the estimated effects of military personnel on local private sector employment in this paper can be largely regarded as the demand generated by the military personnel and military operations that require inputs from local goods and services. Other channels for local spillover effects are likely to be muted in the setting of military as a special industry. Goods and services produced by the military are in most cases not input of other businesses. Locations of the military installations are not chosen to be close to its inputs, either. Over the long history of the presence of a military installation, other businesses that provide goods and services to it may cluster around the military installation. I have shown that including primary contracts from DoD procurements awarded to local businesses does not change the effects of military personnel. Thus the clustering of military-related businesses near the military installations is not a serious concern for the estimation of the effect. The input/output linkages are likely to be non-essential, too. The military hires men and women in uniform, who are in general less connected with the local labor market. Military installations often also hire civilian workers, who are more likely to be from the local labor market. But as is shown earlier, controlling for changes in federal civilian employment in the county does not change the estimated effects of military personnel either. Military is a monopoly in its own special "industry", thus the channel through the agglomeration effects is also likely closed.[14] Another advantage of

[14]Military spending is often seen as one of the government initiatives that contribute to technological changes.

studying the military personnel is that unlike most of the other industries, the "displaced workers" in the military have close to perfect mobility. Re-deployed military personnel are obliged to move to their new posts. A discharged military worker is paid by the government to travel to the place where the last paycheck was issued before he or she joined the military. In most of the cases, the discharged military personnel leave the local economy where they serve.

Although previous studies on local multipliers differ in the specific industries and contexts they focus on, identifying the effects from one or many different channels, it is still useful to make comparisons between the magnitude of the effect found in this paper and those in the existing literature. If the effects are similar despite all the specialties of the military, we may argue that demand spillovers are likely to be an important channel through which the local spillover effects take place. Besides using the measure which indicates number of additional jobs created in the local economy by creating one job in a specific business or industry, many existing papers have measured the spillover effects by the additional dollar of output in the local economy due to one dollar input (often from the government) in a local business, or by price per additional job. In order to make comparisons, I convert my employment-on-employment measure into dollar-on-dollar measure and dollars-per-job measure.[15]Table 9 compares the results found in this paper with some existing studies on the similar topic. Despite many differences, the results found in this paper are largely similar to many of these existing papers.

8 Conclusions

This paper studies the effect of the large contractions in military personnel between 1988 and 2000 on county level private sector employment. Exploiting the regional distribution of military personnel and the exogenous components of the cuts for each county, I propose a two step identification strategy to establish the causal effects of military personnel contractions on local private sector employment.

These effects are likely to be generated by military procurement instead of military operations, where most of the military personnel are involved (Draca, 2012).

[15]Specifically, I use changes in compensations in dollar values to the military personnel and the total wage income to private sector employment in dollars.

Despite the fact that the military is a relatively closed entity to the local economy, the effects estimated in this paper are substantial. Cutting military personnel by one reduces about 0.4 job in the private sector in the same county in the contemporaneous year, and 1.2 private sector jobs cumulatively. The negative effects are concentrated in a few years following the cut. There is no evidence that counties recover to the employment levels had there been no military cuts. Among all sectors, the service sector and the retail sector are the most seriously affected. The effect is robust to the inclusion of possible confounding factors and the use of alternative specifications. The results found in this paper suggest that the demand spillover is an important channel through which local businesses affect one another. The magnitude of the effect found in this paper is largely comparable with existing studies that use different sources of variations in different sets of circumstances, which suggests that local demand spillovers is the main channel for local spillover effects.

This study has strong policy implications. State and local governments spend billions of dollars every year trying to attract new businesses or retaining existing businesses.[16] A sizable local spillover effect is often used as the justification for these subsidies. The findings in this paper is especially relevant for the local effects of government spending and government employment. The budget sequestration of 2013. Local communities, especially those that rely heavily on federal spending, have expressed concerns over its economic impacts. My estimates show that between 1988 and 2000, an annual cut of 24 billion dollars in compensation to military personnel reduced 320 thousand jobs in the current year.[17]

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[16]New York Times (Dec. 1, 2012) estimates that state and local governments spend more than 80 billion dollars in tax credit alone in order to attract or retain local businesses. Link http://www.nytimes.com/2012/12/02/us/how-local-taxpayers-bankroll-corporations.html

[17]The Congressional Budget Office estimates that the 42 billion dollar cuts in federal government spending in 2013 is expected to cost 750 thousand jobs. The estimated effect is similar to what is found in this paper.

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Table 1: Selecting relevant predictors using Bayesian Model Averaging

	Coef.	Std. Err.	Post. Prob.
1987 population	-3.23e-08	1.06e-08	1
1980 urban rate	-.0535581	.0122544	1
1987 per capita income	-3.19e-06	1.50e-06	1
1980-1987 per capita income growth	-.1773312	.0325313	1
1980-1987 private employment growth	.7084568	.0209568	1
1988-2000 predicted employment growth (Bartik)	-68.44739	28.08406	1
1987 population density	-4.40e-06	2.33e-06	0.85
1990 percent white	.0004828	.0042705	0.03
1990 percent black	-.0009273	.0058569	0.04
1980-1990 change in percent white	.0012833	.0117545	0.03
1980-1990 change in percent black	-.0000115	.0005918	0.02
1990 percent of population 25+ with college degrees	1.296398	.273045	1
1990 serious crimes known to police per 100k population	-1.294899	.2751076	1
1980 crimes known to police per 100k population	6.26e-06	1.49e-06	1
1987 share of employment in the mining sector	-39.27434	15.90061	0.96
1987 share of employment in the manufacturing sector	-19.55629	7.848434	0.95
1987 share of employment in the whole sale sector	-5.025373	1.886796	0.98
1987 share of employment in the service sector	15.97564	6.725159	0.99
1987 share of employment in the non-military public sector	-4.023329	1.325048	1
1987 share of employment in the construction sector	6.127794	2.467267	0.91
1987 share of employment in the transportation sector	5.614417	2.474775	0.99
1987 share of employment in the retail sector	omitted		
1987 share of employment in the finance and insurance sector	omitted		
1986 physicians per 100k population	-.0000189	.0000357	0.26

Table 2: Baseline Results

	(1)	(2)	(3)	(4)	(5)
	All counties		Re-weighted sample		
	OLS	2SLS	OLS	2SLS	2SLS
$\Delta Mil_{it}/Emp_{i1980}$	0.227***	0.404**	0.131**	0.661**	0.666**
cluster-robust s.e.	(0.041)	(0.170)			
bootstrapped 95% C.I.			[0.11,0.29]	[0.11,1.68]	[0.12,1.70]
Year FE	X	X		X	
County Group× Year FE			X		X
Weights			X	X	X
First Stage F-stat		29.00		26.59	86.93
Hausman test	$H_0:$ (1) = (2)		$H_0:$ (3) = (5)		
	$p = 0.20$		$p = 0.03$		

Note: The dependent variable is $(Emp_{it} - Emp_{it-1})/Pop_{i1980}$. In Column 1 and Column 2, there are 36,556 observations from 2,812 counties. In Columns 2 through 5, there are 66,625 observations from 1,838 counties, including 383 counties with major military installations in 1988, and 1,455 counties without. See the text for details of constructing county groups and weights. Standard errors are in parentheses, clustered at the county level. Bootstrapped confidence intervals are in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Kleinbergen-Paap first stage F-statistics are reported for specifications using 2SLS. p-values for Hausman tests are from bootstrapped results.

Table 3: Cumulative Effects

	(1)	(2)	(3)	(4)
$(Mil_{i2000} - Mil_{i1988})/Emp_{i1980}$				1.175
bootstrapped 95% C.I.				[-0.09,4.06]
bootstrapped 90% C.I.				[0.21,2.59]
$\Delta Mil_{it}/Emp_{i1980}$				
Two years later			-0.126	
bootstrapped 95% C.I.			[-0.39,0.77]	
Angrist-Pischke F stats			{47.269}	
One year later		0.196	0.079	
bootstrapped 95% C.I.		[-0.02,1.16]	[-0.16,0.62]	
Angrist-Pischke F stats		{85.206}	{88.241}	
This year	0.666	0.437	0.441	
bootstrapped 95% C.I.	[0.12,1.70]	[0.12,1.19]	[0.08,1.10]	
Angrist-Pischke F stats		{126.446}	{125.851}	
One year before		0.304	0.238	
bootstrapped 95% C.I.		[-0.16,0.85]	[-0.35,0.83]	
Angrist-Pischke F stats		{164.385}	{128.644}	
Two years before			0.239	
bootstrapped 95% C.I.			[-0.26,0.64]	
Angrist-Pischke F stats			{105.870}	
County Group× Year FE	X	X	X	
County Group FE				X
Predicted emp growth 88-00				X
Kleinbergen-Paap First Stage F-stat	86.925	559.158	725.569	7.766

Note: The dependent variable is $(Emp_{it} - Emp_{it-1})/Pop_{i1980}$. In Columns 1-3, there are 66,625 observations from 1,838 counties, including 383 counties with major military installations in 1988, and 1,455 counties without. There are 5,544 observations in Column 4. Weights constructed earlier are included in the sample. Standard errors are in parentheses, clustered at the county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Angrist-Pischke partial F-statistics are in curly brackets. Bootstrapped confidence intervals are in brackets.

Table 4: Joint Tests of Year Fixed Effects

	(1)	(2)	(3)	(4)
	$\Delta \bar{Emp}_{it}$	γ_1	γ_{2t}	γ_{3t}
	$\times 0.001$	$\times 0.001$	$\times 0.001$	$\times 0.001$
WithBase	12.296	-0.234		
	(16.047)	(0.221)		
1988	11.683		0.690*	1.560**
	(12.786)		(0.361)*	(0.741)
1989	8.352		0.521	1.003
	(14.644)		(0.301)	(0.639)
1990	1.257		-0.138	-0.766
	(15.704)		(0.405)	(0.815)
1991	8.352		0.136	0.050
	(14.644)		(0.390)	(0.792)
1992	5.435		-0.504	-1.301*
	(12.005)		(0.341)	(0.698)
1993	12.466		-1.079**	-2.351**
	(16.589)		(0.436)	(0.916)
1994	16.039		-1.464***	-3.169***
	(15.602)		(0.418)	(0.872)
1995	16.523		-0.474	-1.398*
	(14.171)		(0.384)	(0.816)
1996	13.572		-0.373	-1.145
	(15.210)		(0.402)	(0.831)
1997	15.512		0.124	-0.130
	(15.190)		(0.393)	(0.822)
1998	15.808		-0.294	-0.917
	(19.347)		(0.561)	(1.158)
1999	13.097		-0.005	-0.127
	(18.457)		(0.469)	(0.947)
2000	13.954		-0.186	-0.392
	(15.379)		(0.361)	(0.720)
N		66625	66625	4979
N of counties		1838	383	383
$p-$value for H_0		0.290	0.016	0.006

Note: Standard errors in parentheses, clustered at the county level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5: Confounding Factors

	(1)	(2)	(3)	(4)
$\Delta Mil_{it}/Emp_{i1980}$	0.666	0.623	0.688	0.629
bootstrapped 95% C.I.	[0.12,1.70]	[0.07,1.56]	[0.14,1.79]	[0.08,1.67]
Angrist-Pischke F stats	{86.925}	{91.943}	{83.596}	{93.412}
$\Delta FedCiv_{it}/Emp_{i1980}$		0.236		0.329
bootstrapped 95% C.I.		[-0.55,1.34]		[-0.60,1.33]
Angrist-Pischke F stats		{78.028}		{75.296}
$\Delta PCA_{it}/Pop_{i1980}$			0.044	0.046
bootstrapped 95% C.I.			[-0.02,0.14]	[-0.02,0.15]
Angrist-Pischke F stats			{44.451}	{43.773}
County Group× Year FE	X	X	X	X
First Stage F-stat	86.925	2918.682	915.650	546.427

Note: The dependent variable is $(Emp_{it} - Emp_{it-1})/Pop_{i1980}$. Only the contemporaneous changes in military personnel, federal civilian employment, and primary contract awards per capita are used in the regression. There are 66,625 observations from 1,838 counties, including 383 counties with major military installations in 1988, and 1,455 counties without. Weights constructed are used in the sample. Standard errors are in parentheses, clustered at the county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Angrist-Pischke partial F-statistics are in brackets. Bootstrapped standard errors are pending.

Table 6: Effects of Military Personnel on Private Employment,1988-2010

	(1)	(2)	(3)
$\Delta Mil_{it}/Emp_{i1980}$			
Two years later			-0.294
bootstrapped 95% C.I.			[-0.64,0.24]
One year later		0.006	-0.035
bootstrapped 95% C.I.		[-0.26,0.84]	[-0.33,0.68]
This year	0.661	0.450	0.437
bootstrapped 95% C.I.	[0.16,1.65]	[0.12,1.26]	[0.13,1.27]
One year before		0.458	0.397
bootstrapped 95% C.I.		[0.02,1.01]	[0.05,0.98]
Two years before			0.269
bootstrapped 95% C.I.			[-0.29,0.70]
County Group× Year FE	X	X	X
First Stage F-stat	92.449	1103.495	489.324

Note: 2SLS estimates used. The dependent variable is $(Emp_{it} - Emp_{it-1})/Pop_{i1980}$. There are 117,875 observations from 1,838 counties, including 383 counties with major military installations in 1988, and 1,455 counties without. Weights constructed are included in the sample. Standard errors are in parentheses, clustered at the county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. 95% confidence intervals from bootstrapping are in brackets.

Table 7: Effects by Sector

	(1) Manufacturing	(2) Construction	(3) Retail	(4) Service
$\Delta(Mil/Emp)_{it}$	0.087*	0.089***	0.127***	0.168***
	(0.051)	(0.037)	(0.045)	(0.074)
First Stage F-Stat	67.61	46.65	62.02	64.83
Emp per 100 pop	6.7	3.0	9.0	14.5

Note: 2SLS estimates in all columns. Standard errors are in parentheses, clustered at the county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Military Cuts and Private Employment, Fixed Effects Model

	(1)	(2)	(3)
$\Delta(Mil/Emp)_{it}$			
Two years later			0.105
			(0.236)
			{14.644}
One year later		0.249	0.205*
		(0.174)	(0.123)
		{47.965}	{33.615}
This year	0.310***	0.323**	0.369*
	(0.103)	(0.155)	(0.220)
	{42.453}	{14.644}	{25.986}
One year before		0.197	0.197
		(0.204)	(0.175)
		{48.389}	{50.137}
Two years before			0.057
			(0.159)
			{13.900}
County FE	X	X	X
Year FE	X	X	X
Kleinbergen-Paap F-stat	42.453	1.850	0.788

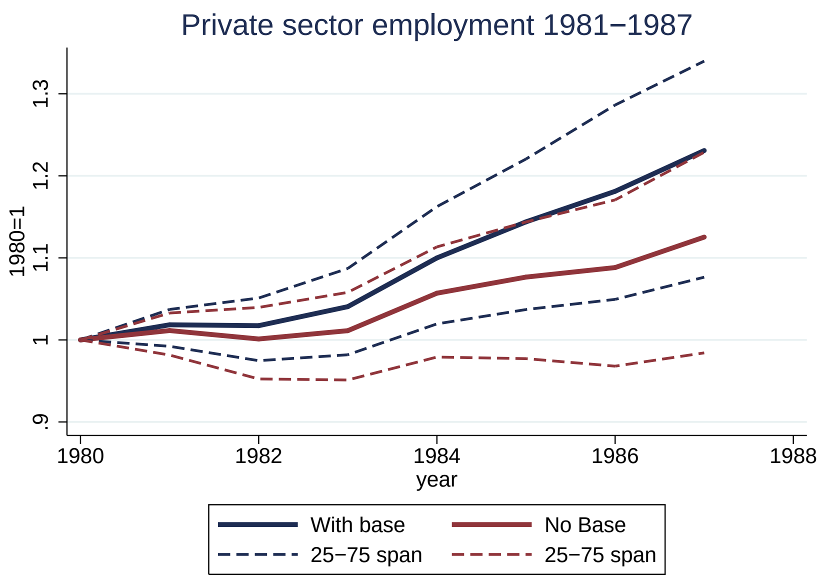
Note: The dependent variable is $(Emp_{it} - Emp_{it-1})/Pop_{i1980}$. 2SLS estimates used in all specifications. There are 36,556 observations from 2,812 counties in the sample. These are all the counties that had a population greater than 5,000 in 1980. Standard errors are in parentheses, clustered at the county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Kleinbergen-Paap first stage F-statistics are reported for 2SLS regressions. Angrist-Pischke partial F-statistics are in brackets

Table 9: Comparison with Existing Studies

Study	**years**	**emp-emp**	**dollar(10k)-emp**	**dollar-dollar**	**Sector**
This study	1	1.6	0.24	1.6	military personnel
This study	12	2.2	0.33	1.72	military personnel
Black et al. (2005)	4	1.35			coal mining
Moretti (2010)	10	2.6			tradable sector
Poppert & Herzog (2004)	1	1.04-1.4			military personnel
Chowdorow-Reich et al (2012)	2		0.33	1.88	ARRA, hhd income
Nakamura & Steinsson (2013)	2			1.5	military procurement

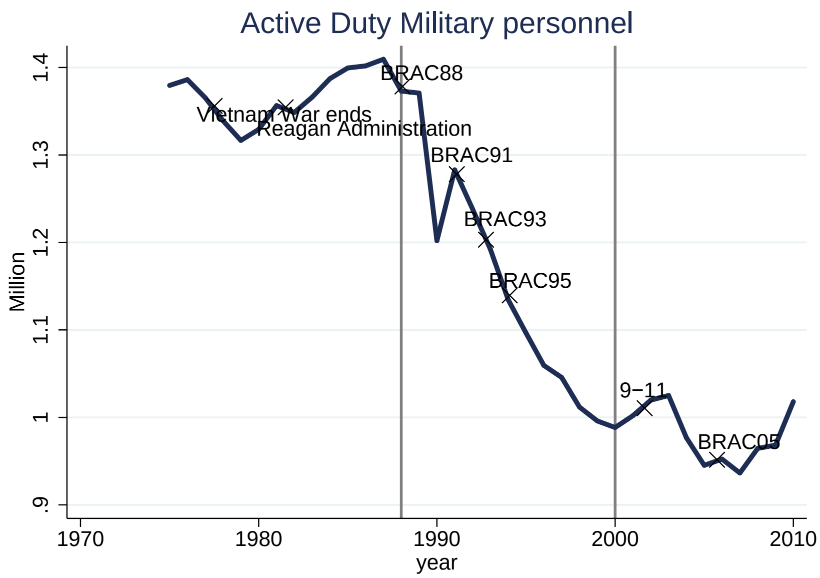
Note: The column titled “years” indicates the number of years the effect is evaluated. The column titled “emp-emp” reports the increase of total number of jobs as a result of increase one job in the sector under shock. The column titled “dollar (10k)-emp” shows the total number of jobs created per 10 thousand dollars increase in the sector under shock. For this study, we measure the shocks in dollars using the compensation to the military personnel. The column titled “dollar-dollar” shows the total dollars gained in the local economy as a result of one dollar increase in the sector under shock. In this paper, we use labor compensation to measure the shock in dollars.

Figure 1: Private Sector Employment 1980-1987 by County Type



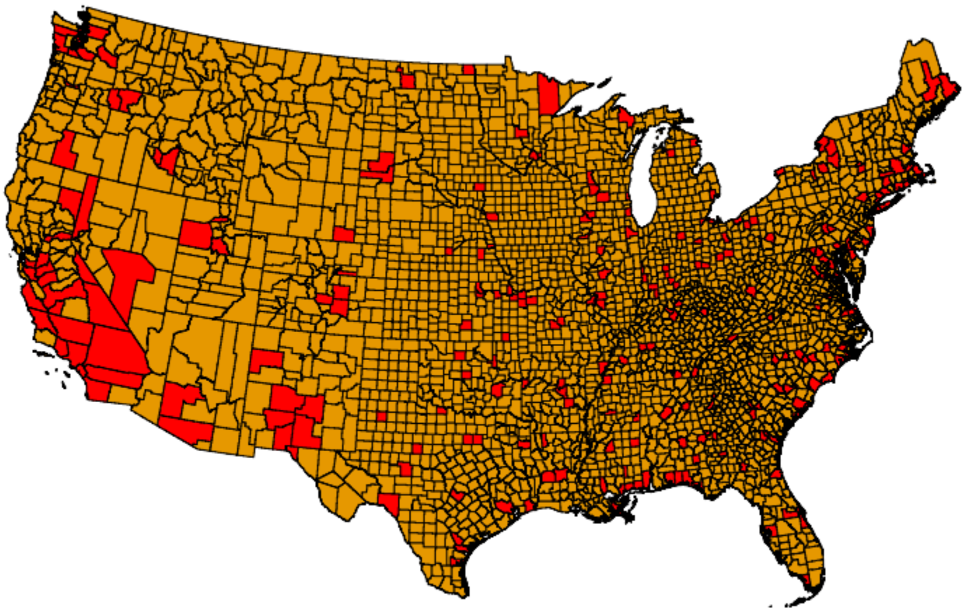
Note: Private sector employment level in 1980 for each county is standardized to 1. An index for private sector employment level is constructed as a ratio of private sector employment level in each year between 1981 and 1987 relative to that in 1980. The blue solid line shows the average trajectory of the indices for counties with major military installations as of 1988. The blue dashed lines show the 25-75 span of the indices of these counties. The red solid line shows the average trajectory of the indices for counties without major military installations. The red dashed lines show the 25-75 span of the indices of these counties.

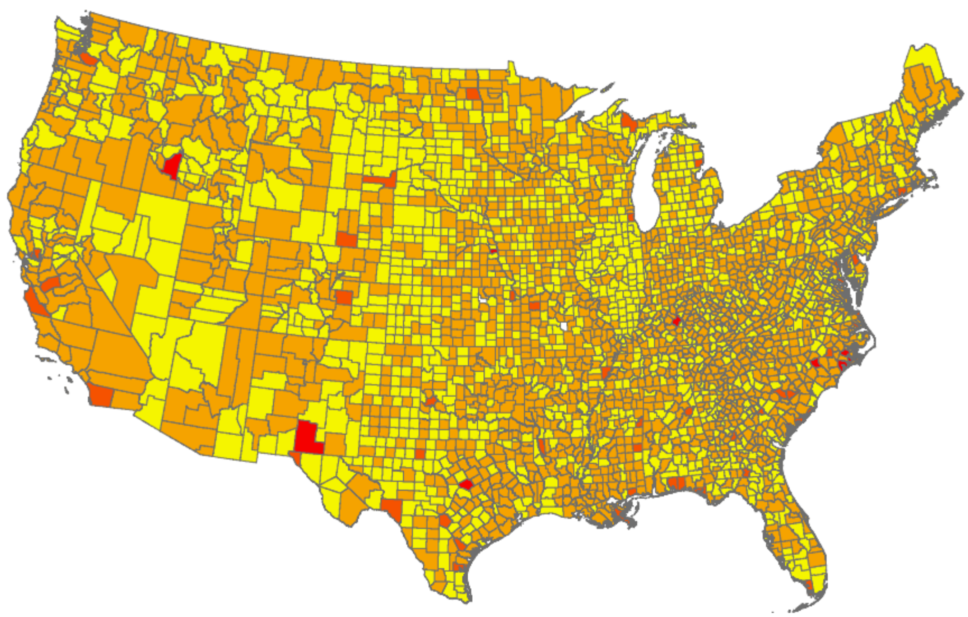
Figure 2: Military Personnel 1975-2010



Source: Active Duty Military Personnel Strengths by Regional Area and by Country. Department of Defense (309A), 1975-2010.

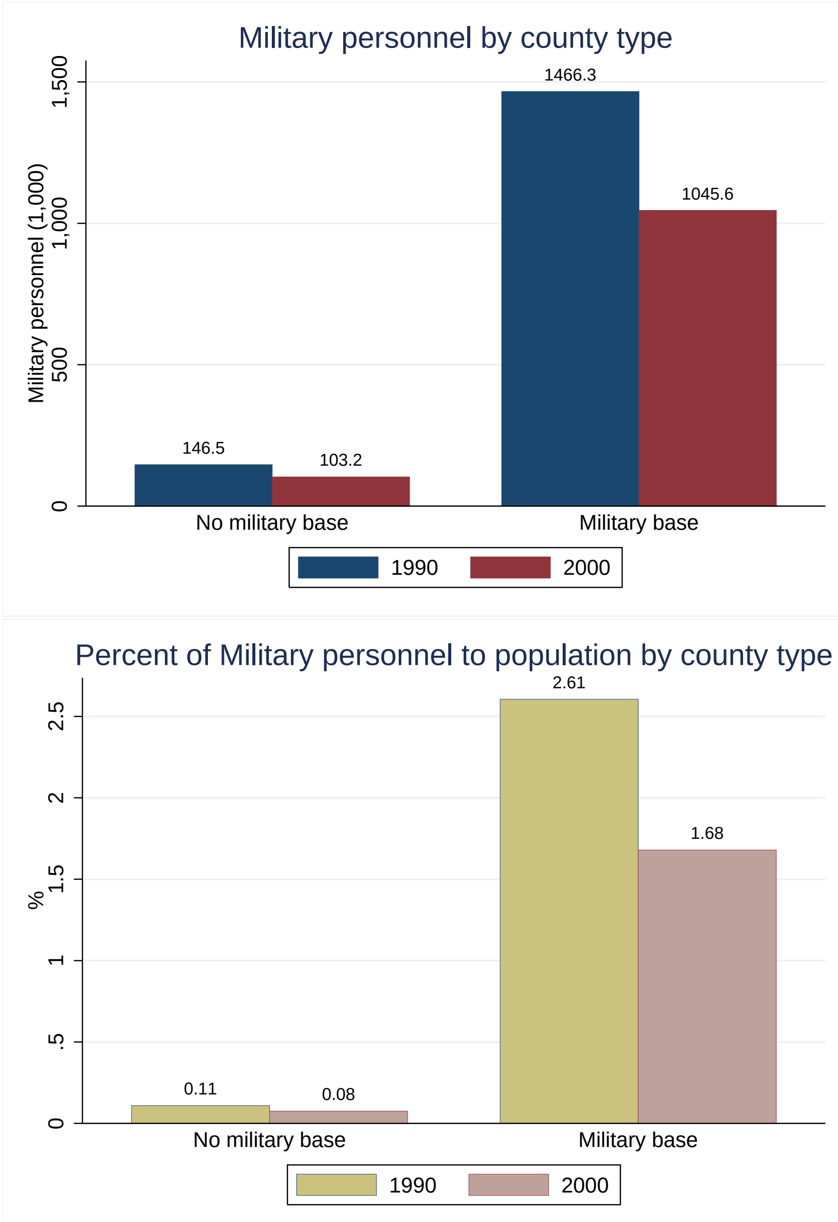
Figure 3: Distributions of Major Military Installations and Military to Population Ratio





Note: The map on the top shows the counties that have at least one major military installation as listed on the 1989 Base Structure Report published by the Department of Defense (reflecting a snapshot as of September 1988). Counties marked in red are those with at least one major military installation in 1988. The map below shows military to population ratio by county. Darker colors represent higher percentages. Alaska and Hawaii are included in the analysis but not shown in the maps.

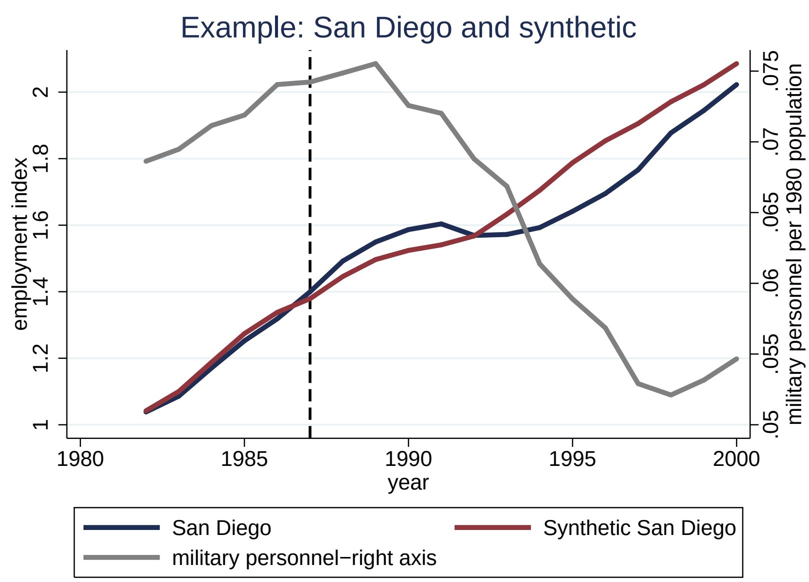
Figure 4: Military Personnel Counts and Changes by Whether Having major military installations



Note: The graph on the top shows the military personnel by counties with major military installations and those without in 1990 and 2000, respectively. The graph below shows the military personnel to population by the two types of counties, in 1990 and 2000, respectively.

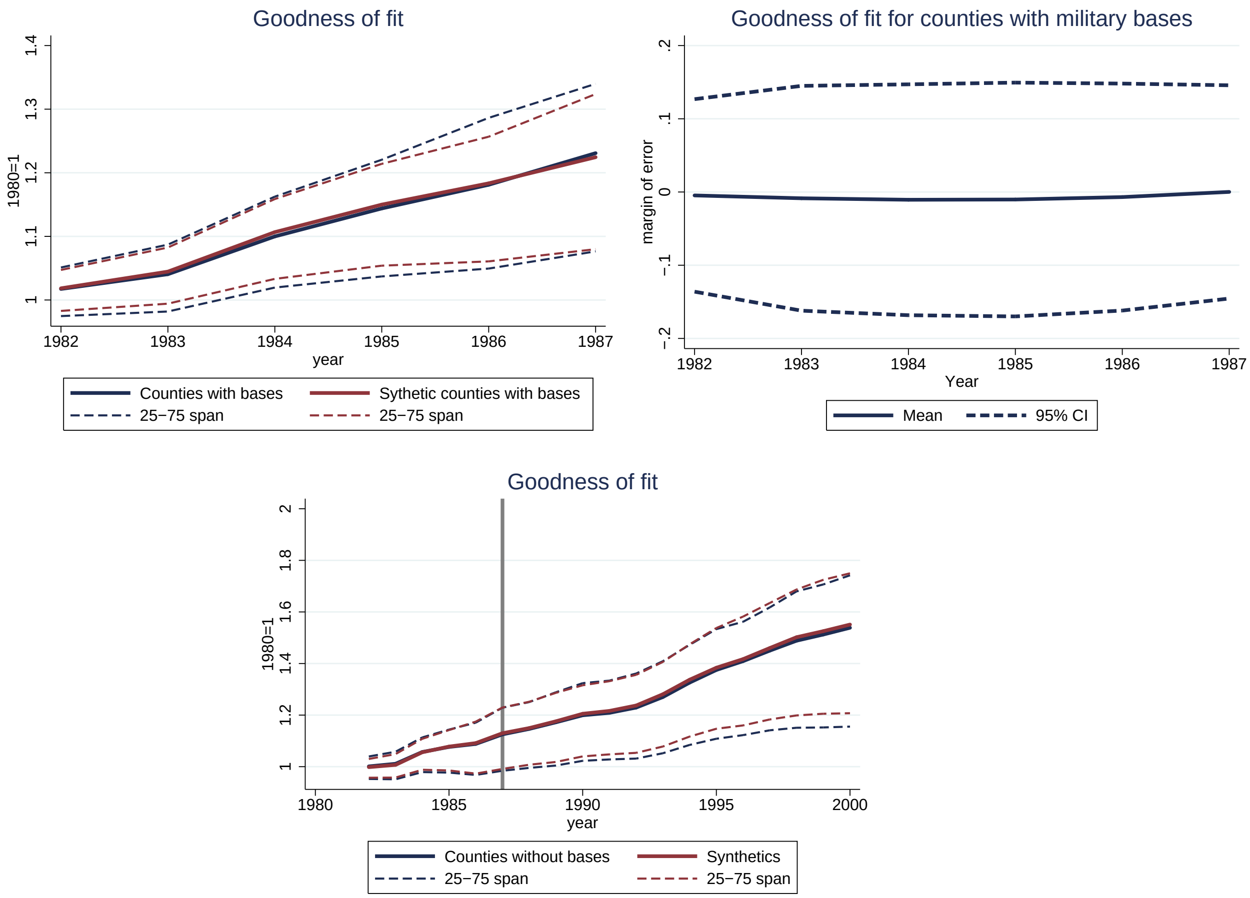
Figure 5: Synthetic Control Example - San Diego

County	City	Weight
Pinellas, FL	St. Pertersburg	0.28
Oakland, MI	Pontiac	0.27
Santa Fe, NM	Santa Fe	0.17
Marion, OR	Salem	0.08
Alachua, FL	Gainesville	0.08
Denton, TX	Denton	0.06
Broward, FL	Fort Lauderdale	0.04
Lee, FL	Fort Myers	0.02
Sonoma, CA	Santa Rosa	0.00



Note: Top table shows the counties and their respective weights that construct the synthetic control for San Diego County, CA. Only counties with positive weights are included. The largest cities in each county are also reported. The bottom graph shows the private sector employment indices for San Diego and synthetic San Diego as well as military personnel to population ratio in San Diego.

Figure 6: Goodness of Fit of the Synthetic Controls



Note: The graphs show the goodness of fit for the matching procedure. The top left graph shows the private sector employment indices for counties with major military installations and their synthetic controls. The top right graph shows the differences between the private sector employment for each county with major military installation and its synthetic control, as well as the 95% confidence interval. The bottom graph shows a placebo test using randomly assigned treatment status among counties without major military installations.