12-1-2008

Modeling the Economic Impacts of Large Deployments on Local Communities

Aaron L. Gregory

MODELING THE ECONOMIC IMPACTS OF LARGE DEPLOYMENTS ON LOCAL COMMUNITIES

THESIS

Aaron L. Gregory, Captain, USAF

AFIT/GCA/ENV/08-D01

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States Government.

AFIT/GCA/ENV/08-D01

MODELING THE ECONOMIC IMPACTS OF LARGE DEPLOYMENTS ON LOCAL COMMUNITIES

THESIS

Presented to the Faculty

Department of Systems Engineering and Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Cost Analysis

Aaron L. Gregory, BS

Captain, USAF

December 2008

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

AFIT/GCA/ENV/08-D01

MODELING THE ECONOMIC IMPACTS OF LARGE DEPLOYMENTS ON LOCAL COMMUNITIES

Aaron L. Gregory, BS

Captain, USAF

Approved:

____//signed//______________ _21 Nov 08_
Jeffrey S. Smith (Chairman) Date

AFIT/GCA/ENV/08-D01

Abstract

The Global War on Terrorism has required the large scale deployment of active-duty troops to support operations in Afghanistan and Iraq. This thesis presents an economic analysis of the impacts these deployments have had on local communities as measured by changes in local retail sales. County level data from Colorado, Kansas, North Carolina, and Tennessee were combined with open source deployment information to construct panel models. Panel model analysis is a form of regression that combines cross-sectional and time-series dimensions. Seasonality and general economic conditions were also incorporated into the model. The goal of this research is to provide an empirical model to community leaders and federal agencies that addresses the potential effects of continued deployments. The results of this research have demonstrated that the deployment of brigade size units decrease the level of retail sales in a county by 0.3 percent, which leads to losses in local governmental revenue.

AFIT/GCA/ENV/08-D01

To my wife and kids, you are my inspiration.

Acknowledgments

First and foremost I thank our Heavenly Father who has sustained me through the grace of His son and my Savior. I would also like to express my great appreciation to my wife and eternal companion. Not only has she supported me in this consuming endeavor but has managed to do so gracefully and with great poise. My terrific kids also deserve great big hugs for their sacrifice of "daddy-time" during these past several months.

This entire effort never would have occurred had I not been guided by advisors like Lt Col Jeffrey Smith and Dr. Michael Hicks, and mentors like Lt Col Michael Greiner and Dr. Bill Stockman. Each has provided critical guidance on this incredible journey.

Finally, I would like to thank my classmates for challenging me to succeed and then helping each other to do it.

Aaron L. Gregory

Table of Contents

List of Tables

Page

MODELING THE ECONOMIC IMPACTS OF LARGE DEPLOYMENTS ON LOCAL COMMUNITIES

I. Introduction

In support of the Global War on Terrorism (GWOT), our active duty military force has been called on to deploy in large numbers to locations throughout the world. These deployments have lasted from one month to over a year and a half. The likelihood that troops might be called upon to deploy in large numbers for extended periods of time is the subject of considerable concern to the local business owners, policy makers, and the public. Specifically, local business owners may be concerned about the potential loss of revenue that might result from the extended departure of troops that normally purchase from retail establishments in the community. In addition, policy makers must decide, if and how, to assist the community to overcome the potentially negative effects of troop deployments on the local communities.

In this introduction, I provide background information on trends in troop deployments during GWOT, discuss how troop deployments could impact local economies, and discuss proposals that seek to overcome potentially negative economic impacts.

Background

The events of September 11, 2001, and the ensuing GWOT (which include Operations Noble Eagle, Enduring Freedom, and Iraqi Freedom) led to large mobilizations of active duty military personnel. Although the US military establishment has a long history of sending troops into conflicts the world over, from the Philippines at the end of the 19th century to Sierra Leone at the end of the 20th century, the current conflicts in Iraq and Afghanistan have increased the frequency and duration of deployments. Army combat units regularly deploy for a year or more. Because of the variability of the troops actually being at home station, private businesses and public municipalities have to plan for the impacts of troop rotations (Loughran et al, 2006).

Potential Impact on Local Economies

At the risk of overstating the obvious, military installations and their troops have tremendous economic impacts on the surrounding communities. Military installations typically employ a large number of civilians from the surrounding communities, which contributes to the availability of employment for the local communities. Additionally, the troops and their families shop in the local communities, which drives employment outside the military installation as well.

A dramatic expression of the impact of military deployments on a local community and its economy occurred 5 October 2007. Ronald "Bo" Ward owned a barbershop outside gate 1 of Fort Campbell, near Clarksville, Tennessee. During the division's first deployment to Iraq in 2004, General Petraeus sent Mr. Ward a postcard thanking him for keeping his shop open during the deployment and "giving haircuts to children of our families." The troop deployments from the fort, however, have so adversely impacted his business that he sought commercial rezoning approval for his home in Clarksville. The rezoning would have allowed him to provide haircutting services in his home, which he had hoped would offset the lack of clients at his shop near the fort. When the city council voted down his request, Mr. Ward stood up in the council chambers and said, "Y'all have put me under…I'm out of here." He then drew a handgun, placed it in his mouth, and shot himself (Austin, 2007).

While anecdotal, the story of Bo's Barbershop is no less compelling in its testimony to the impact that a military installation has on the local community. Researchers have been trying for years to understand how the presence of a military installation affects local economies. The RAND Corporation published a series of studies focused on the effects of the defense drawdown that occurred in the 1990s. One of the studies specifically tried to identify the effects base closings had on small companies in California (Dardia et al, 1996). The study concluded that communities suffered from base closings, but the extent to which they suffered depended on the degree of integration between the base and community and the characteristics of the members from both the base and the local community. Poppert and Herzog (2003) improved on the early studies, which examined base closures by examining the entire duration of the closure process (which was typically six years), focusing on county level effects. They found that direct personnel gains and losses at military installations have an indirect effect on employment rates in the local economy using panel data at the county level.

In contrast to the studies examining base closures, Angrist and Johnson (2000) studied the data from the Gulf War to analyze the effects of a large-scale deployment on spousal employment rates for the families left behind. They found that the employment rates for wives of deployed male troops went down, but the employment rate for husbands of deployed female troops was unchanged. These findings suggest that large-scale deployments can affect employment rates, but the study did not address the effects on retail sales, which is another important indicator of the health of a local economy. More recently, Hill (2005) provided an estimate for an area newspaper, on the employment impacts of a deployment of troops from Fort Stewart, GA. He found that the deployment of 15,000 troops would lead to 7,590 indirect jobs being lost in the local economy, however he did not consider the effects on retail sales.

Potential for Mitigation

In the wake of base closures during the 1990's, the Office of Economic Adjustment (OEA) under the Secretary of Defense was given the responsibility of facilitating the conversion and reutilization of installation assets. OEA has provided over $231 million in grants to the various base closure locations. Additionally the Economic Development Administration, Department of Labor, and Federal Aviation Administration have provided over $816 million in cash grants to these communities (Poppert and Herzog, 2003).

Much of the assistance to communities affected by base closures is in the form of releasing installation assets to the local government and the private sector. The conversion of assets becomes an infusion of infrastructure for community growth. Cash grants are also provided. In the case of mitigating potential impacts of deployments on local economies, these grants along with other forms of assistance, such as loosening zoning restrictions, may provide an opportunity for local governments to offset the potentially negative effects (Poppert and Herzog, 2003).

Study Objective

While much research has been done to examine the affects of deployments on local jobs and immediate family members, a problem that has not been addressed by previous research is the economic effects that local communities can expect as the troops leave *en masse* for a year or more, with only 18 months at home before redeploying. Accordingly, the purpose of this study is to estimate a model that can forecast the economic effects of military deployments on the local economies surrounding military installations. The model would improve on previous studies by including a lagged time component and by addressing the economic impact on retail sales. Substantial practical value would accompany such a model because the US military is likely to continue rotating large numbers of troops from various bases located in the continental United States in support of major overseas operations. The model would also help local leaders plan for the future with a better understanding of the economic impacts that troop deployments have on their economies.

Scope

This research looks specifically at Army installations because of the relatively large number of troops that normally deploy in one mobilization, as compared to the other services. The availability of county level retail sales also played a limiting factor in my research. Colorado, Kansas, North Carolina, and Tennessee were the only states that provided county level monthly retail sales estimates and had significant Army installations; therefore, Fort Carson, Fort Riley, Fort Bragg, and Fort Campbell will be the installations of focus for this study. This study used national economic data from the Bureau of Economic Analysis, retail sales data from state revenue departments, and open-source deployment information from Defense Department press releases and GlobalSecurity.org will be examined. Reliable deployment information was another limiting factor that limits the years of this study to 2001 through 2005.

II. Literature Review

Impacts of Military Installations on Local Communities

There is little question that US military installations exert an economic influence on local communities. In order to maintain normal operations, military installations purchase goods and services from local vendors. Military installations, of posts as that are known in the Army, also provide income to the military and civilian personnel that work at the installations and live in the communities. Military installations may host a variety of visitors, including units from other installations, for the purpose of training. Additionally military retirees are attracted to communities that are located near military bases.

Schunk (2004) points out that the economic impact of military installations is not limited to the direct purchasing of goods and services for the operations and maintenance of the installations. Economic multiplier effects occur once the initial funds are injected into local economies. Only by including the multiplier effects can the true significance of military base operations to local economies be measured. In the state of South Carolina he estimated the total impact to be $7.3 billion in annual sales and 142,000 jobs that are either directly or indirectly supported by the military presence. Table 1 summarizes the various bases in South Carolina and their economic impacts according to Schunk's study.

Table 1 Summary of South Carolina Military Installations

Branch of Service	Installation	Direct Employment
Army	Fort Jackson	19,000
Air Force	Charleston AFB	6,942
Air Force	Shaw AFB	5,400
Air National Guard	McEntire ANGS	1,799
Marines	Marine Corps Air Station	5,125
Marines	Marine Corps Recruit Depot	2,705
Navy	Beaufort Naval Hospital	1,120
Navy	Charleston Naval Weapons Station	11,673

Source: Schunk, 2004

Researchers address the direct contribution of a military installation to the local economy by measuring wages earned by installation employees, support contracts executed by local businesses, and other direct money transfers to the community. Economic multipliers are then used to measure the indirect portion of the installation's contribution. These multipliers estimate "the effect that an increase or decrease in a specific economic activity has on the economy at large through its effects on demand for supplies and/or through its effect on incomes" (Dardia et al, 1996). Innes et al. (1994) pointed out that the size of the community where a base is located determines the appropriate size of the multiplier. They reason that for smaller communities, the military installations receive fewer goods and services from local suppliers. Through their research on the California base closings during the 1990's, Innes et al. (1994) found that between 1.2 and 1.4 is an appropriate range for an economic multiplier. They also pointed out that many of the previous studies with multipliers as high as 3.0 tended to be less professional and dubious (Innes et al, 1994).

Dardia et al. (1996) took into consideration the direct and indirect effects of three California base closures in the early 1990's. They specified certain base and community characteristics that might impact local economic effects in order to improve on previous base closure economic impact estimates. The base characteristics they looked at were number of military personnel living off base, ratio of military to civilian personnel, number of base workers who are military spouses, number of spouses working in the community, number of base workers who are retired military, and alternate uses for facilities. The community characteristics they looked at were percentage of population accounted for by base, percentage of school enrollment from military children, number of retired military in community, proximity to urban area, general growth prospects, and political unity. George AFB, Fort Ord, and Castle AFB closures were studied, and the researchers concluded that the degree to which a community suffers due to a base closure depended on the extent to which the base and community were integrated (Dardia et al, 1996).

The study by Dardia et al. of base closures looked at closures as simple events that took place rather than a process that actually took up to six years to complete. Poppert and Herzog (2003) improved on previous studies by including a time component in their models, which examined base closures over the duration of the process. Panel models were used to estimate the indirect employment effects from changes in personnel levels at bases that were in the process of closing and a control group of bases that were not on the list for closure. The amount of land made available each year of the base closure process was used as an independent variable, which acted as a measure of capital infusion by the federal government to the local economies. Direct personnel losses on bases not listed for closure had a more negative impact on local employment then bases targeted for closure, but the positive employment impacts at bases listed for closure did not start until two years after the base closure announcement. The findings were in part attributed to the reutilization of land made available the base closure proceedings. Though the study by Dardia et al. does not estimate the impacts of temporary troop reductions due to deployments, it does measure the impacts on local communities of decrease military personnel and demonstrates a potential method of estimating the economic impacts of large military deployments from communities (Dardia et al, 1996).

Angrist and Johnson (2000) used data collected from the first Gulf War to analyze the economic effects of large-scale deployments on local communities. The data comes from the 1992 Survey of Officers and Enlisted Personnel that was performed between May and October 1992. They estimated spousal employment rates using ordinary least squares (OLS). The employment rate of wives of deployed male soldiers tended to decrease, but the employment rate of husbands of deployed female soldiers stayed the same (Angrist and Johnson, 2000).

Background on Installations

Fort Carson

At 138,523 acres, Fort Carson is located in El Paso County, Colorado and stretches south along Interstate 25 into Pueblo and Fremont counties. The installation houses the 3rd Armored Cavalry Regiment (3rd ACR), the 3rd Brigade, 4th Infantry Division (3rd Brigade 4th ID), and the 10th Special Forces Group, in addition to normal base operations and other tenant organizations. The 3rd ACR is the largest tactical unit with over 4,700 troops, followed by the 3rd Brigade, 4th ID with close to 4,000 troops. The 10th Special Forces Group is a much smaller unit with around 1,100 troops (GlobalSecurity.org, 2007).

Colorado Springs, located on the north side of Fort Carson, is the closest city to the installation. According to the 2000 Census, over 360,000 people live in the metropolitan area. In addition to Fort Carson, Schriever AFB, Peterson AFB and the Air Force Academy are located around Colorado Springs. Although these other installations deploy troops in support of GWOT, their numbers are minuscule when compared with those sent from Fort Carson (US Census, 2008).

Fort Riley

Fort Riley was initially established in 1853 to protect settlers coming down the Kansas River on their way West and became the cavalry headquarters for the Army. The installation was used as a launching pad for cavalry operations throughout the West as more and more Americans began settling "Indian Territory." Today the installation is situated on 100,707 acres in Riley and Geary counties in Kansas.

The 1st Brigade, 1st Infantry Division (1st Brigade 1st ID) and the 3rd Brigade, 1st Armored Division (3rd Brigade 1st AD) call Fort Riley home. They are considered round out brigades by their divisions because the two brigades are required for the European based divisions to arrive at full strength (GlobalSecurity.org, 2007). More than 12,000 soldiers reside at Fort Riley and over 8,000 civilians work on the installation (Fort Riley, 2008). Fort Riley is located between Manhattan and Junction City Kansas. According to the 2000 Census, Manhattan had a population of 44,831, while Junction City had a population of 18,886 (US Census, 2008). Fort Leavenworth also resides in Kansas, but does not deploy troops in sufficient quantities to enter the scope of this study.

Fort Bragg

Just west of Fayetteville, North Carolina on 160,700 acres sits Fort Bragg. The installation boasts the largest Army installation (by population) in the world. Almost 10 percent of the Army's active duty force resides here (GlobalSecurity.org, 2007). The installation is home to the 82ndAirborne Division as well as the headquarters XVIII Airborne Corps. Approximately 43,000 military and 8,000 civilian personnel work at the installation, which extends from Cumberland to Hoke counties. Fayetteville has a population of only 121,015 according to 2000 census data (US Census, 2008).

Fort Campbell

Fort Campbell lies on the border between Kentucky and Tennessee. Although two thirds of the 105,000 acres of the fort are actually in Tennessee, the post office is located in Kentucky giving the installation a Kentucky domicile (Fort Campbell, 2008). The 101st Airborne Division is based at Fort Campbell. Approximately 23,000 soldiers and 4,000 civilians work at the post. The post covers portions of four counties, Montgomery and Stewart counties in Tennessee, and Trigg and Christian counties in Kentucky (GlobalSecurity.org, 2007). Clarksville, the nearest city, has a population of only 103,000 according to 2000 census data (US Census, 2008).

Military Deployments

The deployments associated with the ongoing GWOT operations represent the largest mobilization of military power since the Vietnam War. The DOD, especially the Army, has sustained high-tempo operations for more than five consecutive years. Below, Table 2 summarizes the deployment actions from the four installations selected for the current study. This table only summarizes brigade size deployments that took place from 2001 through mid 2005. Deployment information after August 2005 was not available at the time of this study, so the timeline is truncated at that point. Additional deployments from these installations may have occurred during this timeframe, but such deployments would have been smaller in size. More detailed information on the composition of deployments was considered too sensitive to current operations by the Army for release in this study.

Table 2. Summary of Deployments

Installation	Unit	Location	Time Period
Fort Carson	3rd Brigade, 4th ID	Kuwait/Iraq	Mar 2003 – Mar 2004
	3rd Armored Cavalry Regiment	Kuwait/Iraq	Feb 2003 – Mar 2004
		Iraq	Mar 2005 – Aug 2005
Fort Riley	3rd Brigade, 1st Armored	Kuwait/Iraq	Feb 2003 – Apr 2004
		Iraq	Jan 2005 – Aug 2005
	1st Brigade, 1st ID	Iraq	Aug 2003 – Aug 2003
Fort Bragg	1st Brigade, 82nd Airborne	Iraq	Jan 2004 – May 2004
		Afghanistan	Apr 2005 – Aug 2005
	2nd Brigade, 82nd Airborne	Kuwait/Iraq	Feb 2003 – Jan 2004
	3rd Brigade, 82nd Airborne	Afghanistan	Jul 2002 – May 2003
		Iraq	Sep 2003 – Jan 2004
Fort Campbell	1st Brigade, 101st Airborne	Kuwait/Iraq	Feb 2003 – Mar 2004
	2nd Brigade, 101st Airborne	Kuwait/Iraq	Feb 2003 – Mar 2004
	3rd Brigade, 101st Airborne	Afghanistan	Jan 2002 – Jul 2002
		Kuwait/Iraq	Feb 2003 – Mar 2004

Summary

This chapter reviewed the findings of previous research on local economic effects from military installations. While much of the focus from previous research has been in response to BRAC initiatives, more recently researchers have attempted to address the effects from large military deployments. Additionally, this chapter provided an overview of the installations selected for the current study and a summary of the deployments in which units from those installations participated. The next chapter will describe the variables and methodology used in this thesis.

III. Methodology

This chapter describes the method of analysis used to estimate the economic impacts of large deployments on local communities. Historical data were collected to build a panel model for each state. Each variable represents monthly county level data. This cross-sectional data spans from January 2001 to August 2005. The time period includes both months of deployments and months without deployments for each installation.

Spatial Component

According to Beck (2005) an OLS model using geographic information may be misspecified if spatial autocorrelation is not taken into account. Spatial autocorrelation demonstrates correlation within variables across space. When looking at county level retail data, the potential for autocorrelation of retail sales among neighboring counties may exist. Getis (2007) points out that spatial autocorrelation refer to dependence between spatial units (i.e. counties) with regard to a single variable (i.e. retail sales). The null hypothesis is that no spatial autocorrelation exists or spatial randomness. The alternative hypotheses of spatial autocorrelation are positive spatial autocorrelation (neighbors are similar and like values cluster) or negative spatial autocorrelation (neighbors are dissimilar and checkerboard pattern of like values).

The study of spatial autocorrelation exhibits the following advantages:

- Tests for model misspecification
- Determines strength of spatial effects on any variable in the model
- Allows for tests on spatial heterogeneity

Testing for spatial autocorrelation is not simply an extension of the Durbin-Watson (DW) statistic, which uses residuals from regression to test for temporal autocorrelation. Equation (1) defines how the DW is calculated using the residuals $e_{i,t}$ and $e_{i,t-1}$ of panel regression. The expected result of this equation if no autocorrelation were present would be close to 2.0. Unlike temporal autocorrelation, which is a one-way time dimension, spatial autocorrelation is multidirectional in nature. Additionally, a variety of units may be used to measure the spatial effects such as distance, neighbors, and economic links (Getis, 2007). Equation 2 defines the Moran's I, which is the most commonly used test of spatial autocorrelation. In practice, Moran's I values greater than 2.3 or less than -2.3 indicate spatial autocorrelation, and a value of 0.0 represents no spatial autocorrelation (Anselin, 1999). For a more in depth review of spatial statistics and modeling, see Bao (2008).

$$DW_{i,t} = \frac{\sum_{i=1}^{N} \sum_{t=2}^{T} \left(e_{i,t} - e_{i,t-1}\right)^2}{\sum_{i=1}^{N} \sum_{t=2}^{T} e_{i,t}^2} \tag{1}$$

$$I = \frac{N}{\sum_i \sum_t w_{i,t}} \frac{\sum_i \sum_t w_{i,t} (X_i - \bar{X})(X_t - \bar{X})}{\sum_i (X_i - \bar{X})^2} \tag{2}$$

Panel Model Regression

The data for this study has been organized into cross-sectional time-series data, which provide two kinds of information. First, the cross-sectional data provide information on the differences between each of the observations. In this study, the observations of retail sales, GDP growth and deployments are made for each county within the state. Second, the time-series data reflect changes in the county level observations over time.

To meet the primary goal of this study, the testing and analysis is conducted using a panel model that predicts the growth in retail sales. Panel data describe a dataset where multiple variables are observed at more than one time period. This type of data can also be described as longitudinal data or cross-sectional time-series data (Wooldridge, 2006). Using panel data in a regression model gives the researcher more informative data, more variability, less collinearity, and more degrees of freedom, all of which provides for a better model (Baltagi, 2005).

In panel data analysis, the composite error term contains both an idiosyncratic error and unobserved effects. The idiosyncratic error is similar to the errors in time series regression models that vary by time. The unobserved effects are unobserved variables in the error term that do not vary by time. When dealing with unobserved effects in panel data, two methods of estimation exist. First, the fixed effects method works by eliminating the unobserved effect through transformation. The average for each explanatory variable for county i is subtract from the variable for each county i at each time period t resulting in time-demeaned data, which eliminates the unobserved effect previously mentioned. Fixed effects modeling is preferred when the unobserved effects are thought to be correlated with one or more of the explanatory variables. Second, the random effects method, which does not eliminate the unobserved effects, may be used when the unobserved effect is expected to be uncorrelated with all the explanatory variables. If unobserved effects are uncorrelated with all explanatory variables, then the coefficients can be consistently estimated by using a single cross-section, but using a single cross-section disregards much of the useful data in other time periods. Pooled OLS could also provide consistent coefficient estimates, but the standard errors would ignore the serial correlation in the composite error term. Random effects modeling uses generalized least squares and subtracts only a fraction of the average of each variable, which does not remove the unobserved effects (Wooldridge, 2006). For my analysis, I use the fixed effects model, which allows for the possibility of correlation between unobserved effects and other explanatory variables.

The panel model specification proposed in this research is that retail sales, are a function of military deployment, general economic health, and a lag variable. Dummy variables for the months of the year were also included in the model to account for seasonal effects in retail sales.

$$Sales = F\{\alpha + \beta_0 MilitaryDeployments + \beta_1 GDPGrowth + \beta_2 Lag + \varepsilon_{i,t}\} \quad \textbf{(3)}$$

The natural log of retail sales allows the model results to be reported in approximate percentage change in retail sales rather than the nominal change in retail sales. Percentage change in retail sales standardizes the reporting across counties whether the counties retail sales are typically in the millions of dollars or the thousands of dollars per month.

The panel model notation is:

$$Log(y_{i,t}) = x_{i,t}\beta + \varepsilon_{i,t} \qquad (4)$$

where i = {military installation}

t = time

β = Vector of coefficients

x_{it} = Vector of regressors

ε = Error term

α = Constant

y_{it} = County Level Retail Sales

Different diagnostic tests were conducted to ensure each model has statistical significance. This model could form the basis for business plans and government policies in areas that are potentially affected by military deployments. The implications of such policies will be discussed in chapters four and five.

GDP Deflator

The retail sales data gathered from the various states is reported in current year dollars. In order to compare the data across years it was converted to 2000 base year dollars using the GDP deflator published by the Bureau of Economic Analysis (BEA, 2008).

Measured Variables

Retail Sales

Retail sales represent the level of consumer spending in the local economy surrounding each of the military installations. The departments of revenue for Tennessee, North Carolina, Kansas and Colorado provide county level retail sales information by month. Tennessee has 95 counties, North Carolina has 100 counties, Kansas has 105 counties, and Colorado has 64 counties.

GDP Growth

GDP growth measures the overall health of the economy in terms of economic activity. This variable accounts for potential bias from general economic conditions in the nation as a whole. State level GDP growth could also be used as an indicator of the state economic health. Both state GDP and national GDP showed to be statistically significant when the models were ran independently, but national GDP revealed larger impacts on retail sales. The Bureau of Economic Analysis has provided annual GDP growth estimates for all years being analyzed. In order to remove the effects of inflation from the estimate, all models in this research used real GDP growth.

Deployment Action

The DOD has been publicly releasing brigade size troop deployments since 2001 and GlobalSecurity.org has tabulated these deployments through August 2005, providing information on were each brigade has been deployed and for what period of time. National security concerns prevent more detailed information on actual deployments. Brigade size or larger troop deployments are accounted for in the model by using a dummy variable for the months in which a deployment took place. A brigade typically consists of approximately 3,000 to 5,000 troops.

Time Lag

The final variable that is included in this study is time lag. The lag indicates that a period of time passes before the effects of a deployment appears in the data. This accounts for the time between when a deployment takes place and when the effects actually appear in the community. The time lag was calculated by minimizing Akaike information criterion for various time lag lengths.

Other Considerations

County population growth was also a consideration in forming a model of estimation, but it failed to be statistically significant in any of the models created for this research effort. Although employment has been used in the past for some of the other studies into the economic impacts of military installations, it was not used in this thesis because retail sales provide a different perspective on the effects of military installations on local communities. Additionally, retail sales impact employment.

Summary

This chapter has reviewed the method of analysis used to create models to determine the economic impacts of large deployments on local communities. The data was arranged into a panel for each state under consideration, and fixed effects estimation was performed. This chapter also detailed the variables included in the models. The next chapter discusses the results from each model and analyses those results.

IV. Analysis and Results

In this chapter, the previously specified data is analyzed, and the results are described. Statistical tests were also performed to verify the model specification.

Statistical Tests

Spatial Autocorrelation

The first step is to test for spatial autocorrelation because the models deal with geographical data (Anselin, 2006). I used the Moran I test at the 95 percent confidence level to test whether spatial autocorrelation was present in the counties surrounding to the military installations. A spatial weights matrix was created for each state based on the "queen" format of contiguous borders between counties (Anselin, 2003). The null hypothesis in a Moran I test is that no spatial autocorrelation is present, which is indicated by Moran I = 0.0. The alternative hypotheses are that either positive spatial autocorrelation exists, indicated by Moran I > 2.3 with a p-value < 0.05, or negative spatial autocorrelation exists, indicated by Moran I < -2.3 with a p-value < 0.05. No significant spatial autocorrelation was found in any of the counties surrounding the military installations in question. As a result neither a spatial lag nor a spatial error specification was used in the models (Anselin, 2003). For a more detailed look at the results of the Moran I test see Appendix A.

Stationarity

The next diagnostic to perform is a test of the stationarity for the dependent variable. Using the Fisher test for panel unit root, which is similar to the Augmented Dicky Fuller for time series, (Wooldridge, 2006) the dependent variables in each state appear stationary based on the test results. For a more detailed look at the results of the Fisher test for panel unit root see Appendix B.

Fixed or Random Effects

I used the Hausman test to decide whether to use Fixed or Random Effects Models. The null hypothesis in a Hausman test is that the coefficients estimated by either Fixed or Random Effects models are the same. If the null hypothesis holds true, then the random effects model can be used. The result of Hausman testing on all models was a p-value of 0.000, which does not allow me to use random effects modeling.

Normality

In order to test the normality of the error terms, I performed the Shapiro-Wilk W test. The null hypothesis for this test is that the distribution is normal. If the p-value is greater than 0.05, then the null hypothesis has not been rejected. The data from all four states were tested, and I was only able to reject the null hypothesis in Kansas. The failure of normality only becomes a problem, however, when conducting hypothesis testing. The results of the models developed in this study are not affected by this finding.

Homoskedasticity

When performing regression analysis, the variance of unobserved errors is assumed to be constant which is the homoskedasticity assumption. Heteroskedasticity in regression models results in spurious estimations. The White estimator was used to create robust standard errors to ensure homogeneity of variance or homoskedasticity.

Panel Model Results

For each of the four states, various models were constructed to provide insight into how the deployments affect local communities. Models were also run that included data from all four states.

Colorado

Retail sales in Colorado ranged from a low of $264,000 to a high of $2,260,000,000 with a mean of $129,000,000. The national GDP growth rate ranged from 0.75% to 3.64% with a mean of 2.26%.

Table 3. Colorado Descriptive Statistics

	Mean	Std Dev	Min	Max
Monthly Retail Sales (000's)	129,000	283,000	264	2,260,000
Log (Sales)	16.8217	1.9642	12.4871	21.5383
Annual GDP Growth Rate	0.0226	0.1047	0.0075	0.0364
Number of Units Deployed	0.6250	0.8360	0	2

Note: 3528 Observations

Table 4 presents the results of the models used in my analysis in Colorado. The first model estimates the effects on retail sales by how many units are deployed at a time. This model indicates that as the number of units deployed increases, monthly retail sales will decrease by 1.3 percent.

In order to determine if one unit had more of an impact than the other, I ran a model with variables for both the 3rd Brigade 4th ID and the 3rd ACR. The model resulted in both units being statistically significant. The 3rd Brigade 4th ID has a negative coefficient of 4.3 percent. The 3rd ACR has a positive coefficient of 1.7 percent. When I remove the 3rd ACR from the model, the 3rd Brigade 4th ID coefficient changes to negative 3.1 percent. When I remove the 3rd Brigade 4th ID from the model, the 3rd ACR coefficient changes to negative 1.1 percent. The results of these model specifications indicate colinearity between the deployments of the two units. The data show that both units deployed during the same month 61 percent of the time during the period of investigations for this study.

I structured one more model to capture the effect of both units, using a single dummy variable, being deployed at the same time. The result of this model is a 3.2 percent decrease in monthly retail sales, which is more than the impact from two units being deployed at one time in the first model. This reinforces the finding that the 3rd Brigade 4th ID does have more of an impact on the local community than the 3rd ACR. All the models display the strong seasonal trend in retail sales, which is expected. The high R-squared values indicate a high degree of explanatory power by these models.

Table 4. Effect of Large Deployments on Local Communities in Colorado

Independent Variables	(1)	(2)	(3)	(4)	(5)
Number of Units Deployed	-0.013***				
_3rd4thID		-0.043***	-0.031***		
_3rdACR		0.017*		-0.011*	
Both Units					-0.032***
GDP Growth	1.822***	1.560***	1.759***	1.694***	1.841***
lnSales (t – 1)	0.438***	0.434***	0.435***	0.442***	0.435***
February	0.140***	0.131***	0.136***	0.141***	0.136***
March	0.388***	0.380***	0.385***	0.387***	0.385***
April	0.108***	0.100**	0.104**	0.109***	0.104**
May	0.255***	0.246***	0.250***	0.256***	0.251***
June	0.508***	0.500***	0.504***	0.509***	0.504***
July	0.306***	0.299***	0.302***	0.306***	0.303***
August	0.330***	0.327***	0.327***	0.330***	0.327***
September	0.404***	0.410***	0.408***	0.401***	0.400***
October	0.149***	0.155***	0.153***	0.145***	0.145***
November	0.111***	0.108***	0.109***	0.111***	0.110***
December	0.610***	0.607***	0.608***	0.611***	0.609***
_Constant	9.154***	9.228***	9.210***	8.098***	9.206***
Within R^2	0.4501	0.4515	0.4511	0.4491	0.4511
Between R^2	1.0000	1.0000	1.0000	1.000	1.0000
Overall R^2	0.9751	0.9746	0.9747	0.9754	0.9747
AIC	-1205.041	-1138.691	-1210.024	-1197.006	-1209.001

Note: * statistically significant at 90%. **statistically significant at 95%. ***statistically significant at 99%.

Kansas

Retail sales in Kansas ranged from a low of $371,000 to a high of $818,000,000 with a mean of $23,100,000. The national GDP growth rate ranged from 0.75% to 3.64% with a mean of 2.26%.

Table 5. Kansas Descriptive Statistics

	Mean	Std Dev	Min	Max
Monthly Retail Sales (000's)	23,100	80,4000	371	818,000
Log (Sales)	15.4829	1.4392	12.8246	20.5228
Annual GDP Growth Rate	0.0226	0.1047	0.0075	0.0364
Number of Units Deployed	0.5179	0.5343	0	2

Note: 5880 Observations

Table 6 presents the results of the models used in my analysis in Kansas. Once again the first model estimates the effects on retail sales by how many units are deployed. Monthly retail sales are estimated by this model to decrease by 0.9 percent for each additional unit deployed. Again, I ran a model with variables for both the 3rd Brigade 1st AD and the 1st Brigade 1st ID. The model resulted in both units being statistically significant with the 3rd Brigade 1st AD having a negative 1.3 percent impact and the 1st Brigade 1st ID having a positive 0.7 percent impact. Further examination of the data revealed that the 1st Brigade 1st ID did not participate, within the scope of this study, in any deployments longer than two months. The effectual difference between the two units then is not surprising because returning troops have an opportunity to spend locally upon return with the additional money they received from the temporary duty assignment (TDY), but are not gone for such a long period of time as to significantly affect normal spending patterns.

I structured one more model to capture the effect of both units being deployed at the same time. Although the model results in a 1.9 percent increase in monthly retail sales, this finding can be considered spurious. By examining the data, only one month was found to have both units deployed, which undermines the models validity. As shown in previous models a strong seasonal trend is demonstrated in the models for Kansas, which is expected. All the models have high R-squared values indicating a high degree of explanatory power; however, only the first two provide results that can be considered reliable for the purposes of this analysis.

Table 6. Effect of Large Deployments on Local Communities in Kansas

Independent Variables	(1)	(2)	(3)	(4)	(5)
Number of Units Deployed	-0.009***				
_3rd1stAD		-0.013***	-0.013***		
_1st1stID		0.007**		0.008*	
Both Units					0.019***
GDP Growth	1.030***	1.114***	1.100***	0.943***	0.918***
lnSales (t – 1)	0.357***	0.351***	0.352***	0.360***	0.360***
February	0.055***	0.049***	0.051***	0.053***	0.054***
March	0.268***	0.262***	0.264***	0.266***	0.268***
April	0.127***	0.126***	0.126***	0.129***	0.128***
May	0.195***	0.192***	0.193***	0.199***	0.199***
June	0.263***	0.261***	0.261***	0.267***	0.267***
July	0.152***	0.150***	0.150***	0.155***	0.155***
August	0.183***	0.177***	0.179***	0.183***	0.180***
September	0.221***	0.220***	0.220***	0.223***	0.223***
October	0.134***	0.133***	0.133***	0.135***	0.135***
November	0.135***	0.133***	0.133***	0.139***	0.139***
December	0.356***	0.353***	0.354***	0.360***	0.360***
_Constant	9.768***	9.857***	9.838***	9.710***	9.707***
Within R^2	0.5406	0.5417	0.5394	0.5394	0.5396
Between R^2	1.0000	1.0000	1.0000	1.0000	1.0000
Overall R^2	0.9843	0.9837	0.9847	0.9847	0.9847
AIC	-10534.72	-10552.69	-10543.2	-10519.97	-10522.5

Note: * statistically significant at 90%. **statistically significant at 95%. ***statistically significant at 99%.

North Carolina

Retail sales in North Carolina ranged from a low of $986,000 to a high of $1,750,000,000 with a mean of $89,000,000. The national GDP growth rate ranged from 0.75% to 3.64% with a mean of 2.26%.

Table 7. North Carolina Descriptive Statistics

	Mean	Std Dev	Min	Max
Monthly Retail Sales (000's)	89,000	183,000	986	1,750,000
Log (Sales)	17.3550	1.3677	13.8001	21.2854
Annual GDP Growth Rate	0.0226	0.1047	0.0075	0.0364
Number of Units Deployed	0.8213	0.7586	0	3

Note: 5600 Observations

Table 8 presents the results of the models used in my analysis in North Carolina. As with previous the states, the first model estimates the effects on retail sales by how many units are deployed. The result of this model is that as the number of units deployed increases, monthly retail sales will decrease by 1.2 percent.

I also ran a model with variables for each unit. The model resulted in all units being statistically significant. The 1st Brigade 82nd Airborne has a negative coefficient of 9.8 percent. The 2nd Brigade 82nd Airborne has positive coefficient of 0.5 percent. The 3rd Brigade 82nd Airborne has negative coefficient of 1.1 percent. When only the 1st Brigade is modeled, the coefficient is negative 9.6 percent. When only the 2nd Brigade is modeled, the coefficient is positive 1.6 percent. When only the 3rd Brigade is modeled, the coefficient is negative 0.5 percent but not statistically significant. Further examination of the data revealed that the 2nd Brigade 82nd Airborne departed on the eve of the other units return home. The effectual difference between the units then is not surprising because the returning troops offset the potentially negative impact of the 2nd Brigade 82nd Airborne departure.

I structured one more model to capture the effect of all units being deployed at the same time. I found the variable for the deployment of all units not statistically significant in this model.

Table 8. Effect of Large Deployments on Local Communities in North Carolina

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Units Deployed	-0.012***					
_1st82nd		-0.098***	-0.096***			
_2nd82nd		0.005***		0.016***		
_3rd82nd		-0.011***			0.005	
All Units						-0.007
GDP Growth	1.256***	2.616***	2.768***	0.877***	1.101***	1.061***
lnSales (t – 1)	0.555***	0.550***	0.552***	0.562***	0.562***	0.560***
February	-0.168***	-0.170***	-0.164***	-0.169***	-0.164***	-0.168***
March	-0.104***	-0.103***	-0.099***	-0.099***	-0.098***	-0.101***
April	0.081***	0.100***	0.104***	0.084***	0.086***	0.083***
May	-0.084***	-0.065***	-0.061***	-0.082***	-0.081***	-0.084***
June	0.006	0.008	0.014	0.012	0.016	0.011
July	-0.072***	-0.070***	-0.064***	-0.065***	-0.063***	-0.067***
August	-0.095***	-0.093***	-0.087***	-0.088***	-0.086***	-0.090***
September	-0.013	-0.028**	-0.024**	-0.010	-0.008	-0.011
October	-0.030***	-0.044***	-0.040***	-0.027***	-0.024***	-0.027***
November	-0.108***	-0.122***	-0.119***	-0.105***	-0.103***	-0.106***
December	-0.044***	-0.063***	-0.057***	-0.047***	-0.041***	-0.044***
_Constant	7.761***	7.827***	7.771***	7.621***	7.625***	7.651***
Within R^2	0.3704	0.3966	0.3960	0.3695	0.3684	0.3683
Between R^2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Overall R^2	0.9850	0.9850	0.9850	0.9852	0.9852	0.9851
AIC	-5750.259	-5983.094	-5964.149	-5940.933	-5930.405	-5930.108

Note: * statistically significant at 90%. **statistically significant at 95%. ***statistically significant at 99%.

Although the months of June and September were not statistically significant, seasonality is still present in the models for North Carolina. All the models explain have high R-squared values indicating a high degree of explanatory power.

Tennessee

Retail sales in Tennessee ranged from a low of $606,000 to a high of $1,190,000,000 with a mean of $58,000,000. The national GDP growth rate ranged from 0.75% to 3.64% with a mean of 2.26%.

Table 9. Tennessee Descriptive Statistics

	Mean	Std Dev	Min	Max
Monthly Retail Sales (000's)	58,000	141,000	606	1,190,000
Log (Sales)	16.7136	1.4113	13.3151	20.8991
Annual GDP Growth Rate	0.0226	0.1047	0.0075	0.0364
Number of Units Deployed	0.8929	1.2633	0	3

Note: 5320 Observations

Table 10 presents the results of the six models used in my analysis. The first model estimates the effects on retail sales by how many units are deployed. The result of this model is that as the number of units deployed increases, monthly retail sales will decrease by 1.5 percent.

I also ran a model with variables for each unit. The model resulted in all units being statistically significant. The 1st Brigade 101st Airborne Division has a positive coefficient of 4.1 percent. The 2nd Brigade 101st Airborne Division has negative coefficient of 3.7 percent. The 3rd Brigade 101st Airborne Division has negative coefficient of 0.9 percent. When only the 1st Brigade is modeled, the coefficient is negative 0.1 percent but not statistically significant. When only the 2nd Brigade is modeled, the coefficient is negative 0.4 percent. When only the 3rd Brigade is modeled, the coefficient is negative 0.5 percent.

Table 10. Effect of Large Deployments on Local Communities Tennessee

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Number of Units Deployed	-0.015**					
_1st101st		0.041***	-0.001			
_2nd101st		-0.037***		-0.004**		
_3rd1101st		-0.009***			-0.005*	
All Units						-0.007***
GDP Growth	2.414***	2.4443***	2.383***	2.425***	2.425***	2.394***
lnSales (t – 1)	0.435***	0.431***	0.437***	0.435***	0.435***	0.433***
February	0.093***	0.091***	0.092***	0.093***	0.093***	0.092***
March	0.222***	0.221***	0.222***	0.222***	0.222***	0.222***
April	0.156***	0.155***	0.156***	0.156***	0.156***	0.155***
May	0.195***	0.195***	0.195***	0.195***	0.195***	0.195***
June	0.188***	0.187***	0.188***	0.188***	0.188***	0.187***
July	0.176***	0.176***	0.176***	0.176***	0.176***	0.175***
August	0.190***	0.188***	0.190***	0.190***	0.190***	0.188***
September	0.130***	0.128***	0.130***	0.130***	0.130***	0.128***
October	0.179***	0.166***	0.179***	0.179***	0.179***	0.177***
November	0.137***	0.135***	0.137***	0.137***	0.137***	0.135***
December	0.262***	0.259***	0.262***	0.262***	0.262***	0.260***
_Constant	9.235***	9.298***	9.202***	9.226***	9.226***	9.273***
Within R^2	0.5837	0.5865	0.5828	0.5837	0.5845	0.5843
Between R^2	1.0000	1.0000	1.0000	1.000	1.0000	1.0000
Overall R^2	0.9924	0.9922	0.9926	0.9924	0.9923	0.9923
AIC	-13326.29	-13326.29	-13319.69	-13323.99	-13339.94	-13323.99

Note: * statistically significant at 90%. **statistically significant at 95%. ***statistically significant at 99%.

I structured one more model to capture the effect of both units being deployed at the same time. Using a variable to represent both units being deployed at the same time, results in a 0.7 percent decrease in monthly retail sales.

All the models display the strong seasonal trend in retail sales, which is expected. All the models have high R-squared values indicating a high degree of explanatory power.

Overall

Retail sales overall for all four states ranged from a low of $606,000 to a high of $2,260,000,000 with a mean of $70,800,000. The national GDP growth rate ranged from 0.75% to 3.64% with a mean of 2.26%.

Table 11. Overall Descriptive Statistics

	Mean	Std Dev	Min	Max
Monthly Retail Sales (000's)	70,800	180,000	606	2,260,000
Log (Sales)	16.6038	1.6783	12.4871	21.5383
Annual GDP Growth Rate	0.0226	0.1047	0.0075	0.0375
Number of Units Deployed	0.7180	0.8965	0	3

Note: 20,384 Observations

Table 12 presents the results of the four models used in my analysis. All four models estimate the effects on retail sales by how many units are deployed. First, retail sales are estimated using national GDP growth, which acts as a proxy for the health of the national economy. In contrast to the individual state models, county population growth was shown to be statistically significant when applied to the aggregate models. Including this variable did not, however, have a significant influence on the results of these models. The models estimate a small negative impact of 0.3 percent on retail sales from brigade size troop deployments.

Table 12. Effect of Large Deployments on Local Communities Overall

Independent Variables	(1)	(2)	(3)	(4)	(4)
Number of Units Deployed	-0.003***	-0.003***	0.001	0.001*	-0.003***
National GDP Growth	1.737***	1.745***			1.737***
State GDP Growth			0.918***	0.932***	-0.077
County Population Growth		0.003**		0.003**	0.003**
lnSales (t – 1)	0.384***	0.383***	0.394***	0.394***	0.383***
February	0.014	0.013	0.011	0.011	0.013
March	0.159***	0.159***	0.157***	0.157***	0.159***
April	0.111***	0.111***	0.109***	0.109***	0.111***
May	0.125***	0.125***	0.124***	0.124***	0.125***
June	0.212***	0.212***	0.211***	0.211***	0.212***
July	0.126***	0.126***	0.124***	0.124***	0.126***
August	0.133***	0.133***	0.131***	0.131***	0.133***
September	0.164***	0.164***	0.161***	0.161***	0.164***
October	0.103***	0.103***	0.100***	0.100***	0.103***
November	0.063***	0.063***	0.061***	0.061***	0.063***
December	0.259***	0.258***	0.257***	0.257***	0.258***
_Constant	10.074***	10.081***	9.919***	9.927***	10.078***
Within R^2	0.2915	0.2917	0.2849	0.2852	0.2917
Between R^2	1.0000	1.0000	1.0000	1.0000	1.0000
Overall R^2	0.9845	0.9846	0.9853	0.9853	0.9846

Note: * statistically significant at 90%. **statistically significant at 95%. ***statistically significant at 99%.

Retail sales were also estimated using state GDP growth, which acts as a proxy for the economic health of the individual states as compared to the nation as a whole. These models resulted in the number of units deployed having an impact that was not statistically different from zero. When both the state and the national GDP's are included in the model, the coefficients return to the levels seen in the models using only national GDP growth, and the coefficient for state GDP growth does not remain statistically significant. The lack of statistical significance indicates colinearity in the model. The offending variable appears to be the state GDP growth, and the best performing overall model uses national GDP growth.

Summary

Panel model analysis has allowed me to investigate the effects of brigade size deployments on local economies. Across all states involved in this study brigade size deployments have been shown to decrease the level of retail sales in the surrounding counties by 0.3 percent. Table 13 demonstrates the impact of a single soldier's deployment. In dollar terms, the average county with monthly retail sales of $70,800,000 could expect a decline of $212,400 per month in retail sales. On a county level this cannot be considered too small. On average one soldier deployed means $53.10 less will be spent in the local economy, which is easy to believe. The purchasing impact may be from the soldier's portion of a family grocery bill, a few stops at the fast food restaurant for lunch during the month, or any other number of normal purchases that are made throughout the month. These facts are interesting in the face of concerns over the potential impact of troop deployments on local economies. Businesses looking to locate in communities close to military installations should be prepared to face business cycles around that take shape around troop deployments in much the same way they prepare for seasonality. Such businesses and community leaders would likely benefit more by addressing factors that lead to county growth such as those found in Carlino and Mills research (1987) because as shown in table 12, a one percent increase in county population can negate the loss due to deployments.

Local government policy makers and managers also need to be aware of the potential impact on government revenue. As shown in table 13, municipal revenue on average would decrease by $12,638 per month, which equates to $151,656 over a year. That is a significant drop in the budgeting ability of community leaders that may already face tightening budgets.

Table 13. Significance of Analysis

State	County	Ave Monthly Retail Sales	Percent Decline	Dollar Value Decline	Purchasing Impact of a Soldier	Tax Rate	Lost Taxes
Colorado		$129,000,000	0.30%	$387,000	$96.75	2.90%	$11,223
	El Paso	$799,600,000	0.30%	$2,398,800	$599.70	3.90%	$93,553
	Pueblo	$201,200,000	0.30%	$603,600	$150.90	3.90%	$23,540
	Fremont	$36,600,000	0.30%	$109,800	$27.45	4.40%	$4,831
Kansas		$23,100,000	0.30%	$69,300	$17.33	5.30%	$3,673
	Riley	$38,900,000	0.30%	$116,700	$29.18	7.30%	$8,519
	Geary	$18,800,000	0.30%	$56,400	$14.10	6.55%	$3,694
N. Carolina		$89,000,000	0.30%	$267,000	$66.75	4.25%	$11,348
	Cumberland	$249,900,000	0.30%	$749,700	$187.43	6.75%	$50,605
	Hoke	$8,800,000	0.30%	$26,400	$6.60	6.75%	$1,782
Tennessee		$58,000,000	0.30%	$174,000	$43.50	7.00%	$12,180
	Montgomery	$126,400,000	0.30%	$379,200	$94.80	7.00%	$26,544
	Stewart	$4,700,000	0.30%	$14,100	$3.53	7.00%	$987
Ave County		$70,800,000	0.30%	$212,400	$53.10	5.95%	$12,638

V. Conclusions and Recommendations

Chapter Overview

This chapter addresses the overall finding of the research study and provides an assessment of the finding in light of potential policy implications. The previous chapters are tied together to provide emphasis for potential actions to be taken by decision makers. Additionally, suggestions for future research are made in the context of deployment impacts on local economies.

Overall Summary and Implications

Numerous studies have been conducted on the effects of military installations on local communities. Up to this point the studies have focused on the employment rates affected by base closures or on social issues related to deployments. The current research effort has provided evidence that local economies are also impacted by the current operations tempo of our military forces. The cycle of large numbers of troops departing and returning year after year negatively impacts the retail economies.

This report has presented results of an analysis of the impact large deployments on local communities as measured by county level retail sales growth. The effect of deployments of brigade size active-duty units in Colorado results in retail sales shrinking by 1.3 percent for the deployment of one brigade. In Kansas the effect is a 0.9 percent decrease in retail sales. In North Carolina the effect is a 1.2 percent decrease in retail sales. In Tennessee the effect is a 1.5 percent decrease in retail sales. Overall a 0.3 percent decrease in retail sales can be expected in a county that is adjacent to military installations that take part in large scale deployments.

The effects of large-scale deployments are most significant for the business owners and community leaders that must make decisions affecting the short-term well being of the citizens living there. Retail sales are naturally cyclical, going through ups and downs throughout the year; however, when the cycle is shifted downward, as is the case during deployments, companies find it more difficult to remain profitable. The effects of deployments then combined with generally weak economic conditions nationally further exacerbate the difficulties faced by community leaders.

The results of this research does not suggest that the United States should stop deploying troops; however, other potential actions do exist that would allow businesses to cope with the effects of deployments. The results of this study indicate that a one-month lag exists when the troops deploy and when they return. Additionally, any policy decisions with respect to helping local communities through large-scale deployment actions should be focused on providing flexibility for those affected. The deployments are not permanent, but they do have the potential to last more than a year. These are important findings that policy makers should take into account. First, zoning boards, such as in the case of Bo Ward, may choose to allow short-term changes in zoning ordinances to accommodate business owners for during a deployment. Second, cash grants similar in format to those provided under BRAC could also be extended to communities facing economic downturns due to large-scale deployments. In the long-term, however, focusing on drawing more people to the counties will do more to positively affect local economies than any negative effects from large scale deployments.

Suggestions for Further Research

The potential for future research on this topic is not small. The effect around Army installations is particularly interesting for the current research project because of the shear magnitude of deployment operations currently being undertaken in response to the GWOT. Another aspect that should be investigated in the future is the effects of military redeployment. Soldiers returning home have additional disposable money that will likely be spent in the local economy. An investigation should be made as to how dramatic the spike in consumption is and for how long.

The prolonged and reoccurring deployments may be a recent development for the Army, but the Navy has a much longer history of departing its homeports in large numbers for six month or more. Future researchers may find the spikes and troughs in consumption at Navy ports an interesting study.

Future researchers might also focus on the differences among the various communities that allow some to pass though deployments with a significantly lower impact on retail sales. Case study methodology may be useful to identify which aspects of a community make it more or less resilient to the impacts of large-scale deployments.

Conclusion

As presented in this study, the deployment of brigade size units in support of GWOT negatively impacts local economies. The effects are noticeable after one month of deployment and last throughout the deployment. The impacts are not extreme but might have a compounding effect when other economic factors also occur. This research provides insight to community leaders and federal aid policy makers facing the potential for continuing operations that will require large-scale military deployments.

Appendix A. Moran I Test for Spatial Autocorrelation

The Moran I uses a spatial weights matrix to test for spatial autocorrelation among the counties for each state that I have looked at.

Table 13. Colorado Moran I Test Results

Location	Ii	z	p-value	Location	Ii	z	p-value
ADAMS	21.903	9.607	0.000	LA PLATA	0.423	0.256	0.399
ALAMOSA	0.776	0.436	0.331	LAKE	0.343	0.216	0.415
ARAPAHOE	31.828	13.938	0.000	LARIMER	1.231	0.733	0.232
ARCHULETA	0.785	0.441	0.330	LAS ANIMAS	0.718	0.382	0.351
BACA	0.507	0.361	0.359	LINCOLN	-1.452	-0.510	0.305
BENT	0.858	0.478	0.316	LOGAN	0.501	0.280	0.390
BOULDER	7.788	3.691	0.000	MESA	-0.313	-0.118	0.453
CHAFFEE	0.766	0.404	0.343	MINERAL	0.942	0.521	0.301
CHEYENNE	0.550	0.388	0.349	MOFFAT	0.265	0.235	0.407
CLEAR CREEK	-0.585	-0.257	0.399	MONTEZUMA	0.376	0.275	0.391
CONEJOS	0.898	0.498	0.309	MONTROSE	0.364	0.226	0.410
COSTILLA	0.716	0.442	0.329	MORGAN	-0.471	-0.230	0.409
CROWLEY	-0.493	-0.210	0.417	OTERO	0.518	0.305	0.380
CUSTER	0.413	0.270	0.394	OURAY	0.836	0.467	0.320
DELTA	0.137	0.120	0.452	PARK	-0.538	-0.168	0.433
DENVER	38.973	25.328	0.000	PHILLIPS	0.474	0.339	0.367
DOLORES	0.608	0.380	0.352	PITKIN	0.093	0.089	0.465
DOUGLAS	4.012	1.923	0.027	PROWERS	0.443	0.319	0.375
EAGLE	-0.191	-0.044	0.482	PUEBLO*	-0.175	-0.019	0.492
EL PASO*	-2.452	-1.021	0.154	RIO BLANCO	0.333	0.247	0.402
ELBERT	-2.298	-1.129	0.129	RIO GRANDE	0.823	0.460	0.323
FREMONT*	-0.090	0.010	0.496	ROUTT	0.415	0.240	0.405
GARFIELD	0.054	0.068	0.473	SAGUACHE	1.557	0.664	0.253
GILPIN	-1.481	-0.801	0.211	SAN JUAN	1.004	0.516	0.303
GRAND	-0.394	-0.109	0.457	SAN MIGUEL	0.613	0.384	0.351
GUNNISON	0.750	0.361	0.359	SEDGWICK	0.322	0.280	0.390
HINSDALE	1.212	0.578	0.282	SUMMIT	0.067	0.075	0.470
HUERFANO	0.768	0.405	0.343	TELLER	-1.728	-0.839	0.201
JACKSON	-0.187	-0.090	0.464	WASHINGTON	-1.396	-0.521	0.301
JEFFERSON	28.592	11.213	0.000	WELD	1.748	0.931	0.176
KIOWA	1.074	0.548	0.292	YUMA	0.629	0.393	0.347
KIT CARSON	0.672	0.417	0.338				

Note: * indicates counties contiguous to Fort Carson.

Table 15. Kansas Moran I Test Results

Location	Ii	z	p-value	Location	Ii	z	p-value
Allen	0.272	0.169	0.433	Linn	0.183	0.136	0.446
Anderson	0.306	0.186	0.426	Logan	0.388	0.239	0.405
Atchison	0.145	0.113	0.455	Lyon	-0.104	-0.025	0.490
Barber	0.309	0.210	0.417	Marion	-0.009	0.029	0.488
Barton	-0.071	-0.002	0.499	Marshall	0.057	0.062	0.475
Bourbon	0.119	0.098	0.461	Mcpherson	0.002	0.035	0.486
Brown	0.190	0.150	0.440	Meade	0.194	0.142	0.443
Butler	0.869	0.442	0.329	Miami	-0.694	-0.380	0.352
Chase	0.136	0.108	0.457	Mitchell	0.343	0.215	0.415
Chautauqua	0.059	0.067	0.473	Montgomery	-0.051	-0.002	0.499
Cherokee	0.003	0.021	0.492	Morris	0.236	0.158	0.437
Cheyenne	0.185	0.162	0.436	Morton	0.144	0.151	0.440
Clark	0.209	0.163	0.435	Nemaha	0.140	0.117	0.453
Clay	0.158	0.116	0.454	Neosho	0.092	0.080	0.468
Cloud	0.284	0.184	0.427	Ness	0.333	0.192	0.424
Coffey	0.273	0.170	0.433	Norton	0.335	0.226	0.411
Comanche	0.227	0.194	0.423	Osage	-0.503	-0.240	0.405
Cowley	0.012	0.035	0.486	Osborne	0.435	0.239	0.406
Crawford	-0.045	-0.004	0.498	Ottawa	0.142	0.107	0.457
Decatur	0.348	0.233	0.408	Pawnee	0.321	0.204	0.419
Dickinson	0.071	0.069	0.472	Phillips	0.329	0.222	0.412
Doniphan	0.102	0.112	0.455	Pottawatomie	-0.007	0.027	0.489
Douglas	7.539	3.792	0.000	Pratt	0.152	0.113	0.455
Edwards	0.323	0.205	0.419	Rawlins	0.342	0.229	0.409
Elk	0.142	0.108	0.457	Reno	2.359	1.210	0.113
Ellis	-0.210	-0.062	0.475	Republic	0.182	0.160	0.436
Ellsworth	0.038	0.051	0.480	Rice	-0.003	0.027	0.489
Finney	-0.537	-0.199	0.421	Riley*	-0.211	-0.082	0.467
Ford	-0.136	-0.042	0.483	Rooks	0.427	0.236	0.407
Franklin	-0.572	-0.252	0.401	Rush	0.233	0.156	0.438
Geary*	0.044	0.054	0.478	Russell	0.269	0.168	0.433
Gove	0.545	0.291	0.386	Saline	-0.599	-0.291	0.386
Graham	0.454	0.248	0.402	Scott	0.280	0.182	0.428
Grant	0.232	0.149	0.441	Sedgwick	1.496	0.835	0.202
Gray	0.133	0.106	0.458	Seward	-0.013	0.017	0.493
Greeley	0.312	0.230	0.409	Shawnee	-0.221	-0.088	0.465
Greenwood	0.266	0.166	0.434	Sheridan	0.497	0.281	0.389
Hamilton	0.362	0.241	0.405	Sherman	0.261	0.182	0.428
Harper	0.158	0.142	0.444	Smith	0.335	0.226	0.411
Harvey	-0.001	0.028	0.489	Stafford	0.112	0.091	0.464
Haskell	0.279	0.173	0.431	Stanton	0.360	0.240	0.405
Hodgeman	0.287	0.176	0.430	Stevens	0.260	0.181	0.428
Jackson	-0.269	-0.114	0.455	Sumner	-0.858	-0.476	0.317
Jefferson	-0.570	-0.307	0.379	Thomas	0.356	0.211	0.416
Jewell	0.330	0.222	0.412	Trego	0.402	0.234	0.408
Johnson	13.601	8.028	0.000	Wabaunsee	-0.494	-0.213	0.416
Kearny	0.443	0.243	0.404	Wallace	0.289	0.215	0.415
Kingman	-1.392	-0.718	0.236	Washington	0.171	0.129	0.449
Kiowa	0.322	0.204	0.419	Wichita	0.387	0.227	0.410
Labette	0.039	0.051	0.480	Wilson	0.270	0.168	0.433
Lane	0.234	0.166	0.434	Woodson	0.350	0.219	0.413
Leavenworth	1.003	0.618	0.268	Wyandotte	7.894	7.328	0.000
Lincoln	0.197	0.137	0.446				

Note: * indicates counties contiguous to Fort Riley

Table 16. North Carolina Moran I Test Results

Location	Ii	z	p-value	Location	Ii	z	p-value
Alamance	0.758	0.401	0.344	Johnston	0.496	0.258	0.398
Alexander	-0.212	-0.102	0.459	Jones	0.366	0.223	0.412
Alleghany	0.259	0.198	0.421	Lee	0.091	0.083	0.467
Anson	0.344	0.229	0.409	Lenoir	0.148	0.102	0.459
Ashe	0.315	0.237	0.406	Lincoln	-2.023	-0.961	0.168
Avery	0.490	0.289	0.386	Macon	0.634	0.366	0.357
Beaufort	0.385	0.218	0.414	Madison	-0.215	-0.127	0.450
Bertie	1.026	0.532	0.297	Martin	0.483	0.266	0.395
Bladen	0.020	0.038	0.485	McDowell	0.173	0.114	0.455
Brunswick	-0.062	-0.022	0.491	Mecklenburg	6.806	3.667	0.000
Buncombe	-2.234	-0.984	0.163	Mitchell	0.477	0.348	0.364
Burke	0.116	0.085	0.466	Montgomery	0.277	0.158	0.437
Cabarrus	2.652	1.445	0.074	Moore	0.067	0.064	0.475
Caldwell	0.131	0.094	0.463	Nash	0.781	0.387	0.349
Camden	0.544	0.394	0.347	New Hanover	-0.581	-0.470	0.319
Carteret	0.177	0.130	0.448	Northampton	0.669	0.423	0.336
Caswell	-1.525	-0.788	0.215	Onslow	0.025	0.039	0.484
Catawba	-0.382	-0.157	0.437	Orange	0.014	0.034	0.486
Chatham	-1.799	-0.733	0.232	Pamlico	0.231	0.179	0.429
Cherokee	0.596	0.379	0.352	Pasquotank	0.386	0.286	0.387
Chowan	0.737	0.463	0.322	Pender	0.169	0.109	0.457
Clay	0.289	0.259	0.398	Perquimans	0.539	0.390	0.348
Cleveland	0.000	0.027	0.489	Person	-0.124	-0.050	0.480
Columbus	0.264	0.182	0.428	Pitt	-0.788	-0.326	0.372
Craven	0.055	0.056	0.478	Polk	0.125	0.121	0.452
Cumberland*	-1.366	-0.639	0.261	Randolph	0.037	0.048	0.481
Currituck	0.289	0.259	0.398	Richmond	0.554	0.301	0.382
Dare	0.315	0.237	0.406	Robeson	0.033	0.045	0.482
Davidson	0.829	0.409	0.341	Rockingham	-0.599	-0.293	0.385
Davie	-0.738	-0.368	0.357	Rowan	-0.005	0.027	0.489
Duplin	0.432	0.241	0.405	Rutherford	-0.043	0.008	0.497
Durham	4.190	2.268	0.012	Sampson	0.052	0.056	0.478
Edgecombe	0.119	0.088	0.465	Scotland	0.295	0.200	0.421
Forsyth	4.456	2.059	0.020	Stanly	0.086	0.071	0.472
Franklin	-1.367	-0.590	0.278	Stokes	-1.954	-1.018	0.154
Gaston	3.304	2.287	0.011	Surry	-0.013	0.020	0.492
Gates	0.921	0.519	0.302	Swain	0.768	0.438	0.331
Graham	0.525	0.381	0.352	Transylvania	-0.185	-0.086	0.466
Granville	-1.604	-0.831	0.203	Tyrrell	0.545	0.395	0.347
Greene	-0.015	0.019	0.492	Union	0.454	0.295	0.384
Guilford	4.804	2.217	0.013	Vance	0.255	0.196	0.422
Halifax	0.495	0.258	0.398	Wake	1.042	0.506	0.306
Harnett	-1.139	-0.486	0.313	Warren	0.473	0.280	0.390
Haywood	0.108	0.083	0.467	Washington	0.923	0.521	0.301
Henderson	0.005	0.029	0.488	Watauga	0.209	0.149	0.441
Hertford	0.615	0.391	0.348	Wayne	-0.090	-0.014	0.494
Hoke*	-0.080	-0.016	0.494	Wilkes	0.257	0.144	0.443
Hyde	0.673	0.425	0.335	Wilson	-0.006	0.027	0.489
Iredell	1.889	0.799	0.212	Yadkin	-0.474	-0.203	0.420
Jackson	0.463	0.300	0.382	Yancey	0.042	0.049	0.480

Note: * indicates counties contiguous to Fort Bragg

Table 17. Tennessee Moran I Test Results

Location	Ii	z	p-value	Location	Ii	z	p-value
Anderson	0.119	0.090	0.464	Lauderdale	0.331	0.225	0.411
Bedford	0.050	0.056	0.478	Lawrence	0.198	0.145	0.443
Benton	0.763	0.384	0.350	Lewis	0.447	0.270	0.394
Bledsoe	-0.334	-0.151	0.440	Lincoln	0.345	0.215	0.415
Blount	1.108	0.693	0.244	Loudon	-0.550	-0.268	0.394
Bradley	0.183	0.136	0.446	Macon	0.428	0.260	0.398
Campbell	0.216	0.156	0.438	Madison	-0.978	-0.415	0.339
Cannon	-0.085	-0.017	0.493	Marion	-0.261	-0.131	0.448
Carroll	0.350	0.195	0.423	Marshall	-0.218	-0.076	0.470
Carter	-0.094	-0.031	0.488	Maury	-0.010	0.027	0.489
Cheatham	-1.886	-0.990	0.161	McMinn	0.149	0.105	0.458
Chester	0.223	0.149	0.441	McNairy	0.280	0.216	0.414
Claiborne	0.422	0.280	0.390	Meigs	-0.626	-0.309	0.378
Clay	0.542	0.352	0.363	Monroe	0.066	0.065	0.474
Cocke	-0.015	0.016	0.493	Montgomery	-0.589	-0.289	0.386
Coffee	0.049	0.057	0.477	Moore	0.295	0.203	0.420
Crockett	0.180	0.126	0.450	Morgan	0.307	0.194	0.423
Cumberland	0.263	0.146	0.442	Obion	0.215	0.155	0.439
Davidson	6.959	3.472	0.000	Overton	0.500	0.279	0.390
Decatur	0.670	0.363	0.358	Perry	0.771	0.413	0.340
DeKalb	0.346	0.203	0.420	Pickett	0.532	0.346	0.365
Dickson	0.015	0.039	0.484	Polk	0.070	0.071	0.472
Dyer	0.237	0.157	0.438	Putnam	-0.206	-0.060	0.476
Fayette	-1.890	-1.111	0.133	Rhea	-0.285	-0.125	0.450
Fentress	0.485	0.272	0.393	Roane	-0.219	-0.058	0.477
Franklin	0.312	0.197	0.422	Robertson	-0.897	-0.514	0.304
Gibson	0.156	0.109	0.457	Rutherford	3.939	1.843	0.033
Giles	0.187	0.138	0.445	Scott	0.403	0.246	0.403
Grainger	-0.651	-0.265	0.396	Sequatchie	-0.159	-0.047	0.481
Greene	0.016	0.037	0.485	Sevier	0.533	0.346	0.365
Grundy	0.391	0.240	0.405	Shelby	-3.632	-3.053	0.001
Hamblen	-0.180	-0.068	0.473	Smith	0.415	0.237	0.406
Hamilton	-2.980	-1.442	0.075	Stewart	0.176	0.132	0.448
Hancock	0.356	0.269	0.394	Sullivan	-0.205	-0.098	0.461
Hardeman	0.248	0.163	0.435	Sumner	0.770	0.444	0.328
Hardin	0.443	0.268	0.394	Tipton	-1.244	-0.723	0.235
Hawkins	-0.131	-0.033	0.487	Trousdale	0.160	0.122	0.451
Haywood	0.329	0.194	0.423	Unicoi	-0.078	-0.032	0.487
Henderson	0.207	0.140	0.444	Union	-0.871	-0.442	0.329
Henry	0.362	0.224	0.411	Van Buren	0.519	0.309	0.379
Hickman	0.134	0.098	0.461	Warren	0.409	0.222	0.412
Houston	0.341	0.200	0.421	Washington	-0.086	-0.018	0.493
Humphreys	0.501	0.299	0.382	Wayne	0.561	0.331	0.370
Jackson	0.485	0.290	0.386	Weakley	0.257	0.180	0.428
Jefferson	-0.536	-0.261	0.397	White	0.269	0.174	0.431
Johnson	-0.180	-0.134	0.447	Williamson	3.921	1.835	0.033
Knox	-1.903	-0.784	0.217	Wilson	0.333	0.187	0.426
Lake	0.144	0.140	0.444				

Note: * indicates counties contiguous to Fort Campbell

Appendix B. Fisher Test for Panel Unit Root

The Augmented Dickey Fuller (ADF) test is typically used in time series to determine whether the data is stationary. In the case of panel date the Fisher Test, which is based on the ADF, tests for stationarity. The null hypothesis assumes that all series are non-stationary, and the alternative hypothesis is that at least one of the series in the panel is stationary.

Table 14. Fisher Test Using All Counties

Model	Chi-Squared	Probability>chi-squared
Fort Carson lnSales	2232.7583	0.0000
Fort Riley lnSales	3131.5676	0.0000
Fort Bragg lnSales	1681.4451	0.0000
Fort Campbell lnSales	1996.2081	0.0000

Appendix C. Hausman Specification Test for Fixed vs. Random Effects

Table 15. Colorado Number of Units Deployed

	Coefficients			
	(b)	(B)	(b-B)	sqrt(V_b-V_B)
	Fixed	Random	Difference	S.E.
Number of Units Deployed	-0.0123	0.0048	-0.0171	.
Annual GDP Growth	1.7537	0.4236	1.3301	.
L1.lnSales	0.4438	0.9921	-0.5482	0.0153
February	0.1377	0.3424	-0.2047	.
March	0.3860	0.6139	-0.2279	.
April	0.1042	0.2189	-0.1147	.
May	0.2459	0.4591	-0.2132	.
June	0.5073	0.6865	-0.1792	.
July	0.3046	0.3254	-0.0208	.
August	0.3268	0.3884	-0.0617	.
September	0.4014	0.4750	-0.0735	.
October	0.1446	0.1766	-0.0319	.
November	0.1061	0.2647	-0.1586	.
December	0.6036	0.8359	-0.2323	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(14) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 1290.27

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

Table 20. Kansas Number of Units Deployed

	Coefficients			
	(b)	(B)	(b-B)	sqrt(V_b-V_B)
	Fixed	Random	Difference	S.E.
num_units	-0.0097	0.0016	-0.0113	.
Annual GDP Growth	0.9903	0.4069	0.5834	.
L1.lnSales	0.3584	0.9974	-0.6389	0.0132
February	0.0555	0.2101	-0.1545	.
March	0.2690	0.4609	-0.1919	.
April	0.1277	0.1994	-0.0718	.
May	0.1952	0.3144	-0.1192	.
June	0.2635	0.3541	-0.0906	.
July	0.1517	0.1884	-0.0366	.
August	0.1836	0.2694	-0.0859	.
September	0.2215	0.3072	-0.0858	.
October	0.1342	0.1957	-0.0615	.
November	0.1356	0.2470	-0.1114	.
December	0.3562	0.4820	-0.1258	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(14) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 2332.87

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

Table 21. North Carolina Number of Units Deployed

	Coefficients			
	(b)	(B)	(b-B)	sqrt(V_b-V_B)
	Fixed	Random	Difference	S.E.
num_units	-0.0125	-0.0009	-0.0115	.
Annual GDP Growth	1.2297	-0.3842	1.6138	.
L1.lnSales	0.5551	0.9940	-0.4389	0.0126
February	-0.1678	-0.1947	0.0269	.
March	-0.1044	-0.0687	-0.0357	.
April	0.0820	0.1200	-0.0379	.
May	-0.0839	-0.1241	0.0403	.
June	0.0059	-0.0004	0.0062	.
July	-0.0720	-0.1036	0.0315	.
August	-0.0952	-0.1065	0.0113	.
September	-0.0133	-0.0460	0.0327	.
October	-0.0296	-0.0677	0.0381	.
November	-0.1082	-0.1421	0.0339	.
December	-0.0435	-0.0435	-0.0001	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(14) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 1222.81

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

Table 22. Tennessee Number of Units Deployed

	Coefficients			
	(b)	(B)	(b-B)	sqrt(V_b-V_B)
	Fixed	Random	Difference	S.E.
num_units	-0.0020	0.0016	-0.0036	.
Annual GDP Growth	2.4072	0.1074	2.2998	.
L1.lnSales	0.4361	0.9985	-0.5624	0.0125
February	0.0939	0.2014	-0.1075	.
March	0.2236	0.3304	-0.1069	.
April	0.1566	0.1925	-0.0359	.
May	0.1961	0.2370	-0.0409	.
June	0.1889	0.2098	-0.0209	.
July	0.1768	0.1931	-0.0163	.
August	0.1904	0.2121	-0.0217	.
September	0.1311	0.1489	-0.0178	.
October	0.1805	0.2271	-0.0466	.
November	0.1382	0.1712	-0.0330	.
December	0.2629	0.3130	-0.0502	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(14) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 2015.55

Prob>chi2 = 0.0000

(V_b-V_B is not positive definite)

Appendix D. Shapiro-Wilk W Test for Normality

The null hypothesis for this test is that the data are normally distributed. The Prob>W value listed in the output is the p-value. If the chosen alpha level is 0.05 and the p-value is more than 0.05, then the null hypothesis that the data are normally distributed is rejected.

Table 23. Shaprio-Wilk Test for Normality

Variable	Obs	W	Prob>W
lnSales Colorado	3528	0.97114	0.02886
lnSales Kansas	5040	0.93894	0.06106
lnSales North Carolina	5600	0.99132	0.00868
lnSales Tennessee	5320	0.98344	0.01656

Bibliography

Angrist, Joshua D. and John H. Johnson, IV. "Effects of work-related absences on families: Evidence from the Gulf War," *Industrial &Labor Review,* 54:41-58 (October 2000).

Anselin, Luc, Julie Le Gallo, and Hubert Jayet. "Chapter 18: Spatial Panel Econometrics." Urbana-Champaign IL: Spatial Analysis Laboratory, Department of Geography, University of Illinois, (2004). 4 February 2008 http://www.sal.uiuc.edu/stuff/stuff-sum/pdf/ch18.pdf.

Anselin, Luc and Rosina Moreno. "Properties of tests for spatial error components," *Regional Science and Urban Economics*, 33:595-618 (January 2003).

Anselin, Luc. *Spatial Econometrics*. Richardson, TX: Bruton Center, School of Social Sciences, School of Social Sciences, University of Texas at Dallas, (26 April 1999). 4 February 2008 http://www.csiss.org/learning_resources/content/papers/baltchap.pdf.

Austin, Jason. "Bo Ward Admired as True Patriot," *The Leaf-Chronicle,* (5 October 2007). 24 October 2007 http://www.theleafchronicle.com/apps/pbcs.dll/article?AID=/20071005/NEWS01/710050371/1002

Baltagi, Badi H. *Econometric Analysis of Panel Data* (3rd Edition). West Sussex, England: John Wiley and Sons, Ltd, 2005.

Bao, Shuming. *Literature Review of Spatial Statistics and Models.* Ann Arbor, MI: China Data Center, University of Michigan. 6 February 2008 http://www.umich.edu/~iinet/chinadata/docs/review.pdf.

Beck, Nathaniel, Kristian Skrede Gleditsh, and Kyle Beardsley. "Space is More than Geography: Using Spatial Econometrics in the Study of Political Economy," *Presented at the 2003 Joint Sessions of the European consortium for Political Research, Edinburgh (March-April),* (14 April 2005).

Bureau of Economic Analysis (BEA). *National Economic Accounts.* 17 March 2008. Washington, DC. http://www.bea.gov/national/index.htm

Carlino, Gerald A. and Edwin S. Mills. "The Determinants of County Growth," *Journal of Regional Science,* 27:39-54 (1987).

Dardia, Michael, Kevin F. McCarthy, Jesse Malkin and Georges Vernez. *The Effects of Military Base Closures on Local Communities: A Short-Term Perspective.* Santa Monica, CA: National Defense Research Institute, RAND, (1996).

Fort Riley, Kansas. *Economic Impact Summary.* 12 March 2008 http://www.riley.army.mil/%7Bdyn.file%7D/ee488ac2dde24355bf7c330bf6566181/FY06%20Economic%20Impact%20Summary.pdf.

Fort Campbell, Kentucky. *Facts and Figures.* 7 February 2008 http://www.campbell.army.mil/ima/sites/about/facts.asp

Getis, Arthur. "Reflections on Spatial Autocorrelation," *Regional Science and Urban Economics,* 37:491-496 (2007).

GlobalSecurity.org. *Army Forts and Camps.* 15 November 2007a. http://www.globalsecurity.org/military/facility/fort.htm

Hill, Jeremy R. *Economic Impact – Deployment of Fort Stewart.* Georgia Southern University: Bureau of Business Research & Economic Development, 2 February 2005.

Innes, Judith and others. *Defense Industry Conversion, Base Closure, and the California Economy*, Berkley: Institute of urban and Regional Development, Center for Real Estate and Urban Economics, University of California at Berkeley, November 1994.

Loughran, David S., Jacob Alex Klerman and Bogdon Savych. *The Effest of Reserve Activations and Active-Duty Deployments on Local Employment During the Global War on Terrorism.* Santa Monica, CA: National Security Research Division, RAND, (2006).

Poppert, Patrick E. and Henry W. Herzog. "Force Reduction, Base Closure, and the Indirect Effects of Military Intallations on Local Employment Growth," *Journal of Regional Science,* 43:459-481 (2003).

Schunk, Donald L. "The Economic Impact of South Carolina's Military Bases," *Business and Economic Review*, 51: 14 (October-December 2004).

US Census Bureau. *Population Finder.* 12 March 2008. Washington, DC http://factfinder.census.gov/

Wooldridge, Jeffrey M. *Introductory Econometrics: A Modern Approach* (3rd Edition). Mason, OH: Thompson South-Western, 2006.

Vita

First Lieutenant Aaron L. Gregory graduated from Hastings High School in Hastings, Michigan. He entered undergraduate studies at Brigham Young University in Provo, Utah where he graduated with a Bachelor of Science degree in Management with co-emphasis in Finance and International Business. He was commissioned through the Detachment 855 AFROTC at Brigham Young University.

His first assignment was at Laughlin AFB as a budget analyst and later as chief of mission budgeting. In August 2006, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology, to obtain a Masters of Science in Cost Analysis. Upon graduation he will be assigned to the Air Force Cost Analysis Agency in Crystal City, Virginia.

REPORT DOCUMENTATION PAGE	*Form Approved OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
16-12-2008	Master's Thesis	October 2006 – March 2008

4. TITLE AND SUBTITLE
Modeling the Economic Impacts of Large Deployments on Local Communities

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Gregory, Aaron L., Captain, USAF

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Way, Building 640
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GCA/ENV/08-D01

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Intentionally left blank

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The Global War on Terrorism has required the large scale deployment of active-duty troops to support operations in Afghanistan and Iraq. This thesis presents an economic analysis of the impacts these deployments have had on local communities as measured by changes in local retail sales. County level data from Colorado, Kansas, North Carolina, and Tennessee were combined with open source deployment information to construct panel models. Panel model analysis is a form of regression that combines cross-sectional and time-series dimensions. Seasonality and general economic conditions were also incorporated into the model. The goal of this research is to provide an empirical model to community leaders and federal agencies that addresses the potential effects of continued deployments. The results of this research have demonstrated that the deployment of brigade size units decrease the level of retail sales in a county by 0.3 percent, which leads to losses in local governmental revenue

15. SUBJECT TERMS
Cost Analysis, Military Personnel, Global War on Terrorism, Panel Analysis, Regression Analysis, Regional Planning

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Lt Col Jeffery Smith, USAF/DFEG
U	U	U	UU	62	19b. TELEPHONE NUMBER *(Include area code)* (jeffery.smith@usafa.edu)

Reset

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18