

Senior Project
Department of Economics



**“Does Money Matter: A Study on the
Marginal Effects on Incumbent and
Challenger Campaign Expenditures”**

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Abstract

Politics and money goes hand-in-hand in America. Every election, one of the most talked about issues is how much money each candidate is raising; however, is the amount of money a candidate raises a good indication of the margin of the vote he will receive? This paper uses a translog ordinary least squares technique to calculate the marginal effects of campaign expenditures for both incumbents and challengers. It will replicate a similar study conducted by Dennis Coates (1998) while adding unemployment as an additional variable to the model, as well as determining if Republican and Democrat incumbents can be pooled together in the data set (as Coates did). The overall conclusions are that the marginal effects of campaign expenditures are relatively small, unemployment is not statistically significant to the model, the marginal effects of a candidate's expenditures depends on the political party of the incumbent, and that Coates' research was not robust in that the marginal effects for Republican and Democrat incumbents takes a different sign.

I. Introduction

The amount of money spent on political races is increasing every year. Between the 1998 and 2008, there was an over 4 billion dollar increase in the amount of money that was spent on elections. This amounted to an over 325 percent increase in campaign expenditures. Moreover, in the 2008 election alone, 5.2 billion dollars was spent on U.S. federal elections (Open Secretes). To put this in perspective, United States political candidates spent about the same amount during the 2008 election cycle as the entire GDP of Kosovo. Thus, the amount of money that is spent on American politics is not small by any stretch of the imagination. With this in mind, one of the questions that economists frequently ponder is how effective these campaign expenditures are in increasing the percentage of the vote won by the candidate that is spending the money. Previous literature on this topic shows that challengers generally have a higher marginal benefit for each dollar spent than incumbents, even though incumbents generally spend more on an election, and have a higher reelection rate (Jacobson 1978). This paper will determine what the marginal effects of campaign expenditures are for both incumbents and challengers by replicating Coates' (1998) translog model of campaign expenditures. Furthermore, it will add unemployment as a variable to the Coates' model, as well as determine if the model that Coates studied can use pooled data (pooling incumbents that are both Republicans and Democrats) or if the research would be better by separating incumbents by political party.

II. Review of Literature

The affect of campaign expenditures on election results is a hotly debated issue in economic and political science literature. However, this literature is inconclusive on how campaign expenditures by congressional candidates affect the race's outcome. Jacobson (1978) was one of the first individuals to study this topic. His researched involved a 2SLS technique

because he believed that several of the endogenous terms in a traditional OLS were correlated with the error. Using this technique, he concluded that spending by challengers has a much greater outcome on election results than spending by incumbents. This theme of the challenger spending having a larger effect than incumbent spending is echoed in Palda and Palda (2006) where they studied legislative elections in the French Parliament. They found that for each additional Franc that was spent by the incumbent, he received an increase in the percentage of the vote by 1.01 percentage points while challengers received a marginal effect of twice that.

These two studies seem to raise question to the theory that a candidate's expenditures represents a production function in which the percentage of the vote (output) is modeled as a function of campaign expenditures (input). The goal of the candidate is to maximize his utility (which is represented by earning the largest portion of the vote possible). If this is true, and candidates do increase their votes by increasing campaign expenditures, then they would follow an output expansion path and receive a higher output (vote share). Levitt (1994) criticized the above works for their use of cross-sectional data analysis. By using cross sectional analysis, he argues, the research suffers from two problems: the inability to adequately measure candidate quality and omitted variable bias related to district specific unobserved heterogeneity. He overcomes this problem by using panel data and restricting his analysis to races in which the challenger and incumbent have previously faced each other. In fact, he shows that once district-specific and quality controls are in place, the results for incumbents and challengers are about equal. However, he concludes that campaign expenditures do not significantly affect election results. He finds that for every additional 100,000 dollars spent by the incumbent, he receives less than 0.33 percent more votes. He further finds that the challenger's marginal effects are only slightly higher, but not significantly different.

Stratmann (2006) has found similar results as Palda and Palda (2006) in that challengers benefit more from campaign expenditures than incumbents. He found that when campaign limits are enacted on state assembly races, races become more competitive. In fact, when a state switches from no campaign limits to placing limits on all sources of candidate contributions, the incumbency advantage decreases by six percent. This result suggests that challengers benefit most from campaign expenditures and that restricting the amount of expenditures that can be made will increase the ability of the challenger to win. Finally, Fair (2007) focuses more on predicting the winner of a U.S. House election and not campaign expenditures; but, does find that economic variables matter when determining vote share.

With all the ambiguity in the literature as to the true effects of campaign expenditures on incumbents and challengers, it seems that one researcher has done the best job to explain the confusion on this issue. Coates (1998) outlines campaign expenditures and election results as a translog model, which gives him the ability to test how candidate expenditures interact with different candidate and district specific variables. This model gives him an advantage over all other models in that he is able to account for the effects by incumbents, challengers, district specific variables, and how they interact with each other in creating a model that can be used to calculate the marginal effects of campaign expenditures. He then calculates the marginal effects of incumbent and challenger expenditures by finding the first derivative of his empirical model with respect to expenditures. By doing this, his research helps explain why the previous work on this topic is inconclusive and that results vary from study to study due to their inability to capture the interaction of incumbent and challenger spending with the above-mentioned variables. In his analysis, he looks at running a campaign as a production function in which increasing vote share increases a candidate's utility. He finds that the effect of the challenger and incumbent

expenditure depends on the interaction between these variables and other exogenous variables.. Overall, he concludes that incumbents face a negative marginal effect for addition campaign expenditures while challengers face a positive marginal effect.

This paper will continue to bring the discussion on this topic forward by determining the marginal effects of incumbent and challenger campaign expenditures. It will use Coates' (1998) model to study the 2008 congressional election. Attempting to increase the predictability of Coates' model, this paper will also use the economic variable of state unemployment to test and see if the unemployment rate matters when determining the marginal effects of campaign expenditures. As mentioned above, Fair concludes that economic variables are significant when determining candidate vote share, and this paper will test to see if his conclusion holds in the Coates model. Finally, this study will test to see if Coates acted properly in pooling the data. Coates runs his model by pooling incumbents of both major parties into one regression. This research will separate incumbents from both major parties to test the robustness of Coates' model.

III. Theoretical Model

The model this research uses to analyze campaign expenditures and incumbent vote share is Coates' (1998) interpretation of a Cobb-Douglas Production Function. The dependent variable is the incumbent's percentage of the vote (output), with independent variables (inputs) consisting of challenger expenditure, incumbent expenditure, and a vector of additional exogenous variables:

$$Vote_{incumbent} = e^A + Expenditure_{incumbent}^B + Expenditure_{challenger}^C$$

Where:

$$A = X + W + Z$$

$$B = X + W + \ln(I) + \ln(C)$$

$$C = X + Z + \ln(I) + \ln(C)$$

In this model, X represents a vector of district specific variables, W represents variables related to the incumbent, and Z represents variables related to the challenger (see Table 1 for a list of variables and whether they are categorized as X, W, Z). The production function hypothesis, as mentioned earlier, is that as a candidate increases his expenditures his output (the percentage of the vote he receives) will increase.

Figure 1

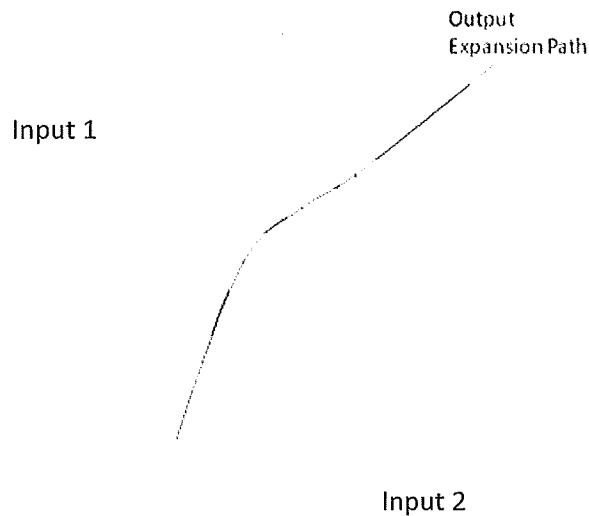


Figure 1 represents this exact scenario where an incumbent increases his expenditures, and also increases the percentage of the vote he receives. The black line above that describes this occurrence is the output expansion path. This path indicates how, as the incumbent increases his

inputs¹, he also increases his percentage of the votes. The inputs candidates use stem from their campaign expenditures, and as campaign expenditures increase, the candidate is able to operate on a new isoquant. These isoquants represent a higher percentage of the vote (output) a candidate is able to receive as he increases inputs. Thus, this theoretical model of a production function leads one to hypothesize that an increase in campaign expenditures, with all other things equal, results in an increase in the percentage of the vote. This notion has been challenged, empirically, by much of the literature described in section two of this study. Coates (1998) himself challenges this by showing that the marginal effects of addition spending by an incumbent is negative. Much of the previous research has not been able to explain why an incumbent and a challenger may have witnessed different levels of marginal productivity for having the same expenditures. Coates does this through his translog model by controlling for the variations in the variables that make up equations X, W, and Z above. By doing this, he is able to show that campaign expenditures are determined by a variety of variables that must be accounted for. However, the theoretical model does not give an economic explanation for why the marginal effects of campaign expenditures would be negative.

The theoretic model also gives a prediction for what the values of the main independent variables will be. One would expect that, since the incumbent's percentage of the vote is the dependent variable, an incumbent's expenditure would positively influence the dependent variable. Moreover, it is expected that the challenger's expenditure will negatively affect the incumbent's vote share. The unemployment rate is expected to carry a negative sign, as an increase in unemployment would result in a decrease in the incumbent's percentage of the vote. Voter's would be more likely to punish incumbents for the high unemployment rate, rather than

¹ Input 1 and 2 can be any input, or vector of inputs, that are used in congressional campaigns such as television advertisements, phone banks, yard signs, campaign staff, etc.

challengers. Furthermore, it is also expected to be significant to the model, as Fair (2007) cites that economic variables do influence a candidate's vote share. Remember that unemployment was not a variable that was used in Coates' model, and this study will test to see if Fair's conclusion holds that unemployment is significant in calculating vote share. Other variables, such as home ownership rates and population demographics are not as easy to predict how they will affect the model, but it seems reasonable to assume that the higher the median age of a district, the more home owners in the district, and the higher the home value of the district, the larger the incumbent's vote share would be (as these types of people would generally be happier with consistency, and remaining at status-quo). Finally, variables such as whether the incumbent is male, the percent of black constituents, and the Democrat's percentage of the vote in 2006 are impossible to predict how they will affect the incumbent.

Furthermore, it is important to discuss in this section the implications of pooling the data, as Coates did in his model. If the data is pooled, the marginal effects may be biased because several independent variables in the model may act differently depending on whether the Republican or Democrat is the incumbent. For example, the variable that tracks the Democrats previous percentage of the vote would act positively for Democrat incumbents and negatively for Republican incumbents. Thus, the net affect that would be observed would be zero. This same affect could be occurring in other variables in the model, and this may have been overlooked by Coates' pooled model because Democrat and Republican incumbents generally have a very different constituent base. This affect will be analyzed by determining the marginal effects of incumbents and challengers for the pooled model, and also the models that separate Republican and Democrat incumbents, as well as an F-test.

IV. Data

Data for this study is taken from two main sources: the Federal Elections Commission's online publication and the United State's Census Bureau's American Community Survey. Table 1 shows the descriptive statistics for each variable used, as well where they fit in the theoretical model (X, W or X). The election data are based on the 2008 general election. The dependent variable is the incumbent's percentage of the vote, while the remaining variables listed in Table 1 are independent variables used to describe the dependent variable. It is also important to note that some observations have been eliminated for the purpose of this study. This research will only analyze races in which there was an incumbent and a challenger competing. Contested races in which there is no incumbent have been thrown out, because this study focuses on the marginal effects of incumbents and challenger, a race with no incumbent would mean there are two challengers, and could skew the results. Moreover, all races in which there was only one candidate have been eliminated due to the small amounts of money that are needed to win this race and the fact that the single candidate receives 100 percent of the vote, thus biasing the results one way or another. Furthermore, all third party candidates have also been eliminated. Finally, this study will only look at races in which there was a Republican and a Democrat candidate. Third party candidates occur infrequently, and generally receive less than three or five percent of the vote. They do not raise as much money as major party candidates, and can skew the results because of that. Thus, the final number of observations this paper will study is 297(district-level elections) observations.

V. Results

The empirical model that is used is a Trans Log Ordinary Least Squares technique that is found by taking the semi-log of the theoretical equation described above.

$$Vote_{incumbent} = (A)\ln E + (B)\ln Expenditure_{inc} + (C)\ln Expenditure_{chal}$$

This provides for a model in which each variable is interacted with the incumbent's expenditure, challenger's expenditure, or both. The results for the pooled model can be found in Table 2 below. In this model, only four variables were found to be statistically significant, with unemployment not being one of the significant variables. It did, however, carry the correct sign in becoming negative when it was interacted with the log of the incumbent's expenditure. The overall r-square value was .52, meaning the model represented 52 percent of the variation in the incumbent's percentage of the vote.

Conversely, Table 3 and 4 represent the results of the model when it is not pooled. Remember, Coates only analyzes the pooled data, and does not separate it by the incumbent's political party. Table 3 represents the results when the incumbent is a Democrat. This model seems to improve the number of significant values by witnessing 5 significant variables; however, the unemployment rate remains insignificant, but does again carry the correct sign when interacted with the incumbent's expenditure. The overall r-square value does drop a bit, to .52 in this model. Moreover, the model that represents when the incumbent is a Republican seems to be the best model that was run in this research. It contains 11 significant variables with

an r-square value of .62; however, it still does not see unemployment as being statistically significant. Thus, in all three models, it seems that unemployment is not statistically significant and does not add to the model that Coates used in his research. However, unemployment is not the only factor this study is focused on.

Once the regression results were calculated, the marginal effect of campaign expenditures was then determined. These marginal effects were calculated by using the parameter estimates found in each model, the overall mean of each variable, and then finding the first derivative of each equation with respect to challenger and incumbent expenditure separately. Table 5 shows the results that are found when calculating these marginal effects. In the pooled model, this study concurs with the results that were found by Coates in his work. In his work, Coates found the marginal effects for incumbents to be negative, at $-.321$ and for challengers to be $-.013$. This research finds a similar result in that they remain negative for both the incumbent and the challenger (however the results of this study are somewhat smaller in value than those calculated by Coates). Moreover, these results would further concur with Coates' analysis that incumbents have negative marginal effects while challengers have positive marginal effects for each additional dollar spent. However, when the data is not pooled, the robustness of his findings is questionable. As Table 5 further describes, when the data is separated for incumbents and challengers that are Republicans and Democrats, the reader can see a different result than what Coates had found. For an incumbent that is a Democrat, the marginal effect of that incumbent is negative while the challenger's marginal effect also remains negative (as the pooled model suggests). Conversely, for a Republican incumbent the marginal effects seem to be positive for both the incumbent and challenger. This shows that there is a difference in the marginal effects depending on whether the incumbent is a Democrat or a Republican. This clearly shows that

Coates' model was not robust. Further investigation of whether or not Republican and Democrat incumbents should be pooled was conducted by using a F-test. The correlating F-value that goes with this model is 2.5, which relates to a P-value of .00041. This P-value shows that the null hypothesis (the hypothesis that the model can be pooled) is to be rejected and concludes that model cannot be pooled. Thus, by not pooling the data, the robustness of Coates' model is called into question because there is a positive marginal effect for a Republican incumbent and a negative marginal effect for Democrat incumbent.

Furthermore, these marginal effects also tell a story similar to what Levitt (1994) discussed in his research about the subject. In that study, Levitt argued that the effects of campaign expenditures are somewhat small for the amount of money that is spent on elections. To put these marginal effects into perspective, look at a race in which the incumbent is a Republican, and both the incumbent and the challenger spend the mean level of expenditures (\$1,478,303 for the incumbent and \$562,083 for the challenger). The incumbent will see a 2.2 percentage point increase in the percent of the vote he receives; while, the challenger's spending will result in a 1.9 percentage point decrease in the incumbent's percentage of the vote. The net effect, with both candidates spending the mean level of expenditures on the campaign, is an increase in the vote share of the incumbent by .3 percentage points (when the incumbent is a Republican). This practical example shows that Levitt was correct in his assessment that the marginal effects of additional campaign expenditures are quite small, and that campaign expenditures by both candidates does not seem to matter much in an election.

VI. Conclusions

Overall, this paper aimed at achieving three main goals: to determine if unemployment mattered in calculating the marginal effects of a candidate's campaign expenditures, to determine the marginal effects of a candidate's campaign expenditures, and to determine if the data can be pooled (as Coates had done in his research). As the results have shown, in all three separate regressions (the pooled data, the Democrat incumbent, and the Republican incumbent) unemployment was not statistically significant. It carried the right sign throughout every model, but did not seem to statistically add anything further to the model as Fair had suggested it would when predicting vote share. Furthermore, this research showed, through calculating marginal effects for a model that pooled the data but also for models that separated incumbents by political party, that a Democrat incumbent sees a negative marginal effect while a Republican incumbent sees a positive marginal effect. The sign of the Democrat incumbents marginal effect seems to fall in line with Coates' research, but there does not seem to be any economic reason that the theoretical model used in this study can come up with as to why the marginal effects of a Democrat incumbent would be negative. It seems that a game theory model may be able to describe this occurrence. Due to the scope of this study, game theory was not able to be included, but future studies would benefit from including it as a way to describe this negative marginal effect for Democrat incumbents. Moreover, this research has also shown that when the model is not pooled, the marginal effects of Democrat and Republican incumbent's campaign expenditures are different. Due to these findings, it can be concluded that Coates' research is not robust in that he found an overall negative marginal effect for the data set that pooled Republican and Democrat incumbents together. Further investigation by an F-test has led this study to conclude that the data should not be pooled when analyzing this topic. It seems that in order to

calculate the effects of additional campaign expenditures, the political party of the incumbent must be considered when pooling data. Overall, though, the marginal effects of campaign expenditures are relatively small, as Levitt had suggested in his research. This idea of campaign expenditures not significantly influencing elections may lead way to an idea that candidates are not rational actors. This phenomenon further implies that future studies should examine this topic with a game theory model in order to better explain the potential irrational decisions that candidates make by spending large amounts of money on their congressional races.

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Table 1: Independent Variables Descriptive Statistics²

Variable	Mean	Std. Deviation	Equation
Midwest	.256	.437	X
South	.360	.480	X
West	.212	.410	X
Unemployment	5.81	1.10	X
District Median Age	36.94	3.251	X
Percentage of Black Constituents	.106	.121	X
Percentage of Home Owners	.691	.088	X
District Home Value	232200.67	146486.83	X
Democrat Vote 2006	.443	.228	X
Male Incumbent	.828	.378	W
Incumbent Expenditure	1478303.35	929881.09	
Challenger Expenditure	562083.23	959793.98	

Table 2: Pooled Model Results

Name of Variable	Non Interacted Parameter	Interaction Log Incumbent Exp.	Interaction Log Challenger Exp.
Intercept	115.75 (<.001) ***	-	-
Midwest	-31.26 (.05) **	4.96 (.04) **	-.96 (.21)
South	-16.97 (.25)	2.85 (.21)	-.93 (.20)
West	.46 (.98)	-.37 (.89)	-.02 (.98)
Unemployment	6.19 (.19)	-1.16 (.11)	.31 (.16)
Incumbent Male	8.69 (.53)	-1.43 (.46)	-
Log Incumbent Exp.	-	-.99 (.11)	.28 (.43)
Log Challenger Exp.	-	.24 (.43)	-.24 (.01) ***
District Median Age	-2.29 (.15)	.39 (.12)	-.08 (.36)
Home Value	-0.00004 (.30)	.000007 (.31)	.0000006 (.77)
Percent Home Owner	-28.78 (.69)	2.32 (.83)	-.13 (.97)
Democrat Vote 2006	10.10 (.65)	-.55 (.87)	-1.73 (.14)
Percent Black Constituents	61.60 (.13)	-8.29 (.83)	1.16 (.52)

Confidence at *10 percent, ** 5 percent, *** 1 percent level

P-values represented in parenthesis

Adjusted R-square: .537

² The equation column represents the variable each descriptive statistic takes in the theoretical model

Table 3: Incumbent Democrat Results

Name of Variable	Non Interacted Parameter	Interaction Log Incumbent Exp.	Interaction Log Challenger Exp.
Intercept	120.696 (.037) **	-	-
Midwest	-16.103 (.572)	2.305 (.587)	-0.124 (.901)
South	-36.30 (.138)	6.249 (.090) *	-2.48 (.0259) **
West	-1.34 (.967)	-.185 (.969)	0.425 (.698)
Unemployment	6.596 (.514)	-1.00 (.509)	0.397 (.292)
Incumbent Male	20.159 (.322)	-2.92 (.304)	-
Log Incumbent Exp.	-	-1.79 (.184)	0.859 (.186)
Log Challenger Exp.	-	.859 (.185)	-0.291 (.020) **
District Median Age	-1.78 (.490)	0.331 (.408)	-0.127 (.371)
Home Value	-.00006 (.358)	0.00001 (.332)	-0.000002 (.518)
Percent Home Owner	-76.57 (.573)	9.56 (.658)	1.35 (.848)
Democrat Vote 2006	-20.96 (.617)	8.22 (.205)	-5.06 (.013) **
Percent Black Constituents	38.37 (.539)	-4.71 (.619)	2.45 (.319)

Confidence at *10 percent, ** 5 percent, *** 1 percent level

P-values represented in parenthesis

Adjusted R-square: .525

Table 4: Incumbent Republican Results

Name of Variable	Non Interacted Parameter	Interaction Log Incumbent Exp.	Interaction Log Challenger Exp.
Intercept	120.71 (.001) ***	-	-
Midwest	-55.88 (.016) **	8.467 (.035) **	-0.838 (.607)
South	-15.47 (.446)	2.709 (.462)	-0.453 (.781)
West	-30.60 (.217)	5.058 (.245)	-1.079 (.515)
Unemployment	4.81 (.357)	-0.876 (.284)	0.035 (.892)
Incumbent Male	-6.01 (.745)	0.836 (.744)	-
Log Incumbent Exp.	-	-1.278 (.098) *	0.41 (.420)
Log Challenger Exp.	-	0.41 (.420)	-0.349 (.024) **
District Median Age	-5.46 (.012) **	0.846 (.01) ***	-0.082 (.384)
Home Value	-0.00004 (.318)	0.00000094 (.893)	0.0000058 (.052) **
Percent Home Owner	140.57 (.10) ***	-19.142 (.147)	0.3224 (.942)
Democrat Vote 2006	71.703 (.060) *	0.806 (.05) **	0.806 (.658)
Percent Black Constituents	-9.37 (.944)	-0.146 (.995)	-0.146 (.964)

Confidence at *10 percent, ** 5 percent, *** 1 percent level

P-values represented in parenthesis

Adjusted R-square: .612

Table 5: Marginal Effects³ of Campaign Expenditures by Model in 10,000 U.S. Dollars

Model	Incumbent	Challenger
Pooled	-0.00985	-0.04578
Democrat Incumbent	-0.01515	-0.02071
Republican Incumbent	0.01465	-0.03428

³ It is important to note that the dependent variable is the incumbent's percentage of the vote; thus, a negative number for the challenger means that the challenger sees a positive marginal effect with campaign expenditures. As the challenger increases his expenditure, the incumbent's percentage of the vote decreases.

Appendix: SAS Programing

```

PROC IMPORT OUT= WORK.Senior
      DATAFILE= "F:\Econ426\Spring2010 Econ 426-Nelson\Joseph Mann
o\Senior Project\manipulated_data1.xls"
      DBMS=EXCEL2000 REPLACE;
      SHEET="Sheet1$";
      GETNAMES=YES;
RUN;

DATA VARIABLE;
SET WORK.SENIOR;
INC_EXP1 = LOG (INC_EXP/1000);
CHAL_EXP1 = LOG (CHAL_EXP/1000);
/* VARIABLES FOR Z- CHALLENGER INTERACTION */
MIDWEST_INT_INCUMBENT = MIDWEST*INC_EXP1;
SOUTH_INT_INCUMBENT = SOUTH*INC_EXP1;
WEST_INT_INCUMBENT = WEST* INC_EXP1;
UNEMPLOYMENT_INT_INCUMBENT = UNEMPLOYMENT* INC_EXP1;
MALE_INT_INCUMBENT = MALE*INC_EXP1;
BLACK_INCUMBENT_INT_INCUMBENT = INC_BLACK * INC_EXP1;
DEMOCRAT_INT_INCUMBENT = INC_DEM* INC_EXP1;
MEDIAN_AGE_INT_INCUMBENT = MEDIAN_AGE* INC_EXP1;
BLACK_PERCENT = BLACK/TOTAL_POP;
BLACK_PERCENT_INT_INCUMBENT = BLACK_PERCENT * INC_EXP1;
MEDIAN_INCOME_IN_INCUMBENT = MEDIAN_IN* INC_EXP1;
HOME_OWNER_PERCENT = HOME_OWNER / TOTAL_POP;
HOME_OWNER_PERCENT_INT_INCUMBENT = HOME_OWNER_PERCENT* INC_EXP1;
HOME_VALUE_INT_INCUMBENT = HOME_VALUE * INC_EXP1;
LAG_DEMOCRAT_VOTE_INT_INCUMBENT = LAG_DEMOCRAT_VOTE*INC_EXP1;
/* VARIABLES FOR Z- CHALLENGER INTERACTION */
MIDWEST_INT_CHALLENGER = MIDWEST*CHAL_EXP1;
SOUTH_INT_CHALLENGER = SOUTH*CHAL_EXP1;
WEST_INT_CHALLENGER = WEST* CHAL_EXP1;
UNEMPLOYMENT_INT_CHALLENGER= UNEMPLOYMENT* CHAL_EXP1;
MALE_INT_CHALLENGER = MALE*CHAL_EXP1;
BLACK_INT_CHALLENGER = INC_BLACK * CHAL_EXP1;
DEMOCRAT_INT_CHALLENGER = INC_DEM* CHAL_EXP1;
MEDIAN_AGE_INT_CHALLENGER = MEDIAN_AGE* CHAL_EXP1;
BLACK_PERCENT_INT_CHALLENGER = BLACK_PERCENT * CHAL_EXP1;
MEDIAN_INCOME_IN_CHALLENGER = MEDIAN_IN* CHAL_EXP1;
HOME_OWNER_INT_CHALLENGER = HOME_OWNER_PERCENT* CHAL_EXP1;
HOME_VALUE_INT_CHALLENGER = HOME_VALUE * CHAL_EXP1;
LAG_DEMOCRAT_VOTE_INT_CHALLENGER = LAG_DEMOCRAT_VOTE *CHAL_EXP1;
INC_EXP_INT_INCUMBENT = INC_EXP1 * INC_EXP1;
CHAL_EXP_INT_INCUMBENT = INC_EXP1 * CHAL_EXP1;
CHAL_EXP_INT_CHALLENGER = CHAL_EXP1 *CHAL_EXP1;

PROC MEANS;
RUN;

/*
DATA ONE;
SET WORK.VARIABLE;
IF INC_DEM=0 THEN DELETE;

```

```
RUN;  
*/  
/*  
DATA TWO;  
SET WORK.VARIABLE;  
IF INC_DEM=1 THEN DELETE;  
RUN;  
*/
```

PROC REG;

```
MODEL INC_PER = MIDWEST SOUTH WEST UNEMPLOYMENT MALE MEDIAN_AGE BLACK_PERCENT  
HOME_OWNER_PERCENT HOME_VALUE LAG_DEMOCRAT_VOTE MIDWEST_INT_INCUMBENT  
SOUTH_INT_INCUMBENT  
WEST_INT_INCUMBENT UNEMPLOYMENT_INT_INCUMBENT MALE_INT_INCUMBENT  
MEDIAN_AGE_INT_INCUMBENT BLACK_PERCENT_INT_INCUMBENT  
HOME_OWNER_PERCENT_INT_INCUMBENT HOME_VALUE_INT_INCUMBENT  
LAG_DEMOCRAT_VOTE_INT_INCUMBENT  
MIDWEST_INT_CHALLENGER SOUTH_INT_CHALLENGER WEST_INT_CHALLENGER  
UNEMPLOYMENT_INT_CHALLENGER MEDIAN_AGE_INT_CHALLENGER  
BLACK_PERCENT_INT_CHALLENGER  
HOME_OWNER_INT_CHALLENGER HOME_VALUE_INT_CHALLENGER  
LAG_DEMOCRAT_VOTE_INT_CHALLENGER  
CHAL_EXP_INT_INCUMBENT CHAL_EXP_INT_CHALLENGER INC_EXP_INT_INCUMBENT;  
RUN;
```

PROC CORR;

```
VAR MEDIAN_IN;  
WITH HOME_VALUE;  
RUN;
```