This document provides an overview of how we can simulate the effects of SNAP policies and business cycles over time. The document is broken into two parts. The first is how to calculate the change in the SNAP caseload due to policies versus the economy. The second is how to get standard errors for the estimates of the percent due to these various factors.

1. **How to Estimate the Percent Due to Various Factors**

The data extend from January 1990 to December 2016. Similar to Ziliak et al. (2000) we simulate how much of the change in SNAP caseloads over time is due to changes in unemployment/business cycle factors versus how much is due to SNAP reform policies. The challenge is that SNAP caseloads from previous periods feed into SNAP caseloads in the current period, so the effects of any changes in economic conditions or reform in the past accumulate into the present.

If we want to know the percentage due to SNAP reform and we chose time t\* for our start period (say July 2000 for instance), then we can form predicted SNAP caseloads according to the following equation based on equation (2) of our paper:



is the predicted SNAP caseloads for state *s* in time *t* net of the contribution of the SNAP policies. is a vector of 24 lagged values of . is the vector of policies as it is in time *t\*,* which we hold fixed while we build up the variables. is the vector including the EITC variable and the control for TANF implementation along with lagged values. is the vector of unemployment rates, as it is in time t including lagged values.

is built iteratively time period by time period. In the first time period, is formed by taking the actual level of in the time period and subtracting off for the first time period, thus netting out the contribution of the SNAP policies from predicted caseload.For time t*\*+2,* the first lag of will be in time *t\*+1.* The rest of the lags for the 23 preceding periods will simply be equal to the value of for that period. For month *m\*+3*, the first two lags of will be the predicted values from time *t\*+1* and *t\*+2* and the rest will be equal to the value of for that period the 22 preceding periods. And so on.

We can continue to build up the will simply be equal to the value of for that period variable up until our end date, let’s call it time *T*. This provides the predicted caseloads if everything except for SNAP policy changes. We can compare this to the predicted changes if everything changes as it does in the data. In order to do this, we can follow the same procedure except we will fix all

We form the percent due to policy changes for state *s* by forming

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Where is the predicted first difference in the log SNAP caseload per capita based on our model when all variables are allowed to evolve as they do in our data set. We use predicted caseloads, rather than the actual first difference in log caseloads, because the actual caseloads contain factors unobserved to us that play a further role in actual caseload changes. We repeat the exercise for unemployment and seasonal fluctuations. We also average this over all of the states to get an average percent explained, and average over a subset of the states to get an effect among states that implement certain policies.

1. **How to Get Standard Errors**

One issue in calculating the percent due to policy changes or economic factors is that the parameters in the model used to form the predicted SNAP total are all estimated with some amount of estimation error. Since this is the case, we should have some sort of standard errors accompanying our estimates of the percent due to the various factors. One way to get standard errors is to take lots of random draws of the parameters from the distribution of the estimators.

The parameter estimates are . Let be the estimated asymptotic variance-covariance matrix of the estimators. We can get using the method described in Driscoll and Kraay (1998). Asymptotically, the estimators should be distributed normally. Since is a consistent estimate of the mean of the distribution and is a consistent estimate of the variance-covariance matrix. We can then take draws of the parameters from the multivariate normal distribution with the point estimates as the mean and as the covariance matrix of the multivariate normal distribution. We take 100 draws.

Within each of the 100 draws, we calculate the percent change in the SNAP caseloads due to policy changes and the percent due to economic factors, while subbing in the randomly drawn parameter values into the equation to form . We then calculate the standard deviation of the percent change over the 100 reps to get a standard error for the percentage changes.