DYNAMICS OF MACROECONOMIC SHOCKS ON FOOD ASSISTACE PROGRAMS IN THE UNITED STATES

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ABSTRACT

Monthly national U.S. data for the period 1997-2012 associated with macroeconomic shocks and participation in food assistance programs were used to model dynamics using polynomial distributed lags and vector autoregression approaches. Contemporaneous causal flows of macroeconomic shocks and participation in food assistance programs were modeled using directed acyclic graphs. With a more accurate set of predictions associated with participation rates in food assistance programs based on macroeconomic drivers or shocks, policy makers will be in better position to assess program costs and to minimize errors in the budgetary process.

Key Words: Supplemental nutrition assistance program, SNAP, causality, directed acyclic graphs, macroeconomic shocks, distributed lags, vector-autoregression

JEL Classification: E66, C18, I18

INTRODUCTION

The United States Department of Agriculture (USDA) administers various food and nutrition assistance programs that provide children and low-income people access to food, a healthful diet, and nutrition education. Approximately one in four Americans participate in the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the National School Lunch Program (NSLP) (FNS, 2011a). These programs serve as an economic safety net buffering the effects of low income and lack-of-asset households and protecting target populations against income losses and unexpected expenses. Judging from the dramatic rise in caseloads of these programs, in recent times, the role as a safety net has certainly expanded and may have changed during and after the recent U.S. economic recession. Therefore for policy makers, it is vital to have an up-to-date understanding on the plethora of macroeconomic variables (or shocks) in affecting eligibility and participation in food assistance programs.

Over the past few years, notable changes are evident in the unemployment rate; the level and volatility of disposable personal income; the number of divorces or separations (sociological stress); the number of housing starts; the value of homes and the value of homes versus the value of mortgages; the level of oil prices and other commodity prices; the number of personal bankruptcies; the personal savings rate; stress in financial markets; and the debt-to-income ratio. To illustrate, currently the unemployment rate is in the range of 8 to 9 percent, up from 4 to 5 percent just several years ago. At present, the number of housing starts, a leading economic indicator, is at a historically low level dating back to 1960. Roughly one of four

households is underwater, that is, the value of their home is less than the amount owed on their mortgage. Since 2007, U.S. home prices have dropped nearly 30 percent. Currently, oil prices are at slightly more than $100 per barrel, well above historic norms except for the period from March 2008 to September 2008. Over the past decade, household financial obligations, not counting home mortgages, as a percent of disposable personal income is in the range of 16.5 to 19 percent. Further, while the personal savings rate is on the rise since 2005, it is below the levels of the 1960s, 1970s, and early 1980s.

Moreover, the U.S. economy has recently experienced financial stress, that is, interruption to the normal functioning of financial markets (Hakkio and Keeton, 2009). Increases in financial stress ultimately lead businesses and households to cut back on their spending, which results in a decline in economic activity.

The Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program) is the oldest food and nutrition assistance program of the federal government targeting low-income Americans. The number of participants in the SNAP declined through the 1990s. This decline was attributed to the Personal Responsibility and Work Opportunities Reconciliation Act of 1996 (PRWORA) as well as falling unemployment levels. In subsequent years, participation in the SNAP increased from about 17.2 million to 26 million people per month in 2006. It reached all-time high of 29 million people per month in year 2008. The current economic slowdown coupled with rising unemployment levels are blamed for this rise in SNAP participation (FNS, 2011a).

Macroeconomic shocks are economic, financial, and sociological stressors. At times, these macroeconomic shocks lead to declines in economic activity. Consequently, during these instances, the number of participants in USDA food assistance programs is likely to rise. Leete and Bania (2010) investigated the relationship between income shocks and food insufficiency for U.S. households. Using data from the Survey of Income and Program Participation (SIPP) of U.S. households, they found that both the level of income and negative income shocks affected the probability of food insufficiency, while positive income shocks did not.

In the United States, welfare reform enacted in 1996 limited cash assistance as an entitlement, imposed increased work requirements on recipients of cash assistance, eliminated eligibility of the SNAP for some populations, and limited SNAP benefit levels for others. Ziliak et al. (2003), Currie and Grogger (2001), and Kornfeld (2002) documented that these changes were driven in part by macroeconomic conditions as well as by changes in policies associated with welfare reform.

In addition, several researchers have explored aspects of the relationship between income variability and food-related programs or outcomes. Blundell and Pistaferri (2003) found a negative relationship between income variability and food expenditures using data from the Panel Study of Income Dynamics (PSID) for the years 1978-1992. Newman (2006) examined the implications of income volatility for participation in the National School Lunch Program (NSLP), and Farrell et al. (2003) considered the implications of income volatility for participation in the SNAP. Using data over the period 1994-1997 from the SIPP and the Survey of Program

Dynamics, Ribar and Hamrick (2003) found that assets, indicative of the ability of households to borrow and to save, were important to weathering bouts of poverty without experiencing food insufficiency.

We will extend the literature in several ways. First, the extant literature places emphasis primarily on the level of income or the volatility of income as the key macroeconomic variable in affecting food insufficiency as well as participation in the SNAP and the NSLP. We intend to center attention on additional macroeconomic variables besides income on the number of participants in various food and nutrition programs.

The broad objective is to determine how macroeconomic shocks affect the number of participants in various food and nutrition assistance programs. Specifically, we wish to identify and to assess the key macroeconomic factors linked to participation in food assistance programs. To accomplish this objective, we will rely on the use of structural/econometric models and vector autoregression models as well as the development of graphical causal structures (directed acyclic graphs) to shed light on interrelationships among various macroeconomic variables and participation in SNAP.

DATA AND METHODOLOGY

Monthly national data associated with macroeconomic shocks and with participation in food assistance programs will be used over the period from 1997 through 2012. This time frame also includes behavior before and after the recent recession. The set of macroeconomic variables (shocks) include: (1) the unemployment rate; (2) the debt-to- income ratio; (3) the number of housing starts; (4) the Kansas City Financial Stress Index; (5) the St. Louis Financial Stress Index; (6) the S&P Case-Shiller home price index; (7) oil prices; (8) the number of personal bankruptcies; (9) the personal saving rate; and (10) the Conference Board Leading Economic Index. To account for the participation in USDA food assistance programs, we use the number of participants (monthly national and state-level) in the SNAP program.

Details on Data Pertaining to Selected Macroeconomic Variables

The Kansas City Financial Stress Index (KCFSI) is a monthly composite index of 11 variables reflecting stress in the U.S. financial system, compiled by the Kansas City Federal Reserve Bank. These variables fall into two broad categories: average yield spreads and behavior of asset prices. The index is calculated using a principal components procedure (Hakkio and Keeton, 2009). This series is available monthly back to January 1990. A positive value of the KCFSI indicates that financial stress is above the long-run average, while a negative value signifies that financial stress is below the long-run average.

The St. Louis Financial Stress Index (STLFSI) is similar to the construction of the KCFSI. This index is a monthly composite index of 18 variables which deal broadly with interest rates (e.g. federal

funds rate, 2-year Treasury, 10-year Treasury, and 30-year Treasury), yield spreads (e.g. 10-year Treasury minus 3-month Treasury, 3-month commercial paper minus 3-month Treasury bill, and corporate Baa-rated bond minus 10-year Treasury), and other financial indicators (e.g. Chicago Board Options Exchange Market Volatility Index, Merrill Lynch Bond Market Volatility Index and J.P. Morgan Emerging Markets Bond Index). Each of the 18 components of the STFSI captures some aspect of financial stress. This series is available weekly back to January 1994.

The Conference Board Leading Economic Index (LEI) is a composite of ten variables which historically have turned downward before a recession and upward before an expansion. The ten variables which comprise this index are: (1) average weekly hours, manufacturing; (2) initial weekly claims for unemployment insurance; (3) manufacturers' new orders of consumer goods and materials; (4) manufacturers' new orders of non-defense capital goods; (5) building permits for new private housing units; (6) the difference (spread) between interest rates of 10-year U.S. Treasury notes and the federal funds rate; (7) the inflation-adjusted measure of the money supply as represented by M2; (8) the Institute for Supply Management (ISM) index of new orders; (9) the S&P 500 stock price index; and (10) the University of Michigan Consumer Sentiment Index, which deals with consumer expectations about the economy.

To accomplish our objective, the delineation of the dynamic effects of macroeconomic shocks on the number of participants in USDA food assistance programs, various quantitative modeling approaches are used. Initially, we use structural or econometric models to identify key macroeconomic influences on the number of participants in the SNAP program. Models are

developed for the United States and for each of the 50 states. To capture dynamics, distributed lags formulations of the aforementioned macroeconomic variables are entertained in order to determine short-run impacts and cumulative impacts of these shocks on participation in food assistance programs. As well, we plan to calculate the average length of time associated with a change in any macroeconomic shock on participation in various programs. We use of polynomial distributed lags (Almon lags) in this endeavor (Almon, 1965; Griliches, 1967; Nerlove, 1972; Greene, 2008). Finally, we provide measures of forecast accuracy associated with the national and state models of participation in food assistance programs. This assessment is done based on absolute error, squared error, or absolute percent error, both within sample and out-of-sample (Pindyck and Rubinfeld, 1998).

Importantly, to check on the robustness of the econometric models, we use a vector autogression (VAR) approach as well. Similar to the econometric approach, we develop VAR models for the United States and for each state. Assessments of changes in macroeconomic shocks then can be done using impulse response functions. Forecasts of participation in the SNAP sample and out-of-sample, are made based on the VAR approach. Subsequently, comparisons are made between the use of the econometric models and the VAR models.

Structural Econometric Models with Polynomial Distributed Lag Formulations

The structural specification for this analysis may be expressed as:

(1) $$p_{it} = f\left(MS_{1t}, MS_{2t}, \ldots, MS_{jt}\right) + \epsilon_{it}$$

where p_{it} denotes participation rate in the ith food assistance program in time period t, and MS_{jt} refers to the jth macroeconomic shock in time period t. The key in this analysis is the focus on the distributed lag structure for the respective macroeconomic variables in order to capture carryover effects. We use a polynomial distributed lag structure on the macroeconomic shocks with and without endpoint constraints. We examined polynomial degrees of order 2 and 3 and lag lengths up to 12 periods. The selection of the appropriate distributed lag model for the participation in the SNAP, the WIC, and the NSLP will be made based on Akaike, Schwarz, or Hannan-Quinn information criteria.

Vector Autoregression (VAR)

The general (non-panel) VAR can be represented as follows:

(2) $X_t = \sum_{k=1}^{K} \Gamma_k X_{t-k} + \epsilon_t$ for $t = 1,2,\ldots,T$,

where *X* corresponds to a vector of macroeconomic variables and the number of participants in each of the USDA food assistance programs, X_{t-k} is a vector of *k* lags of each of variables under consideration, Γ_k is a matrix of parameters, and ϵ_t is a vector of orthogonal innovations, i.e. $E(\epsilon_t) = 0$ and $corr(\epsilon_t | X_t, X_{t-k}) = 0$.

The Panel Vector Autoregression (P-VAR)

The P-VAR model is described as:

(3) $X_{st} = \sum_{k=1}^{K} \Gamma_{ks} X_{st-k} + \beta u_s + \epsilon_{st}$ for $t = 1,2,\ldots,T$, and $s = 1,2,\ldots,S$,

where *X* corresponds to a vector of macroeconomic variables and the number of participants in each of the USDA food assistance programs, X_{st-k} is a vector of k lags of each of variables

under consideration, Γ_{ks} is a matrix of parameters, β is an identity matrix, u_s is a vector of state level fixed effects and ϵ_{st} is a vector of orthogonal random innovations, i.e. $E(\epsilon_{st}) = 0$ and $cor(\epsilon_{st}|X_{st}, X_{st-k}, u_s) = 0$.

Once the VAR and P-VAR models are developed, we will perform innovation accounting to obtain the moving-average representation for either the general VAR or the panel VAR. Here the vector $\mathbf{X}_t$ can be written as a function of the infinite sum of past innovations as follows:

(4) $$X_t = \sum_{i=0}^{\infty} H_k \epsilon_{t-k},$$

where H_k is a mxm matrix of moving average parameters which map current and historical innovations at lag *k* into the current position of the vector X_t. The key to performing this operation is the identification of contemporaneous causal flows among innovations. Bernanke (1986) used subjective information to accomplish such identification. We use the graph theoretical information following Swanson and Granger (1997) and Bessler and Akleman (1998). The moving-average representation can be presented in three alternative forms to enlighten us on dynamic patterns of response to macroeconomic shocks: (1) the use of impulse response functions (how does each series respond, over time to a one-time-only shock in each series of the VAR?); (2) the use of forecast error variance decompositions (what percentage of the uncertainty (variance) at forecast horizon *h* is explained by current or earlier shocks in each series of the VAR?); and (3) the use of historical decomposition of each series (how does information emanating in each series contribute to the historical pattern in each series?). These three forms of presentation of the moving-average representation are standard offerings and are programmed in commercial software packages and have been applied in several studies (Bessler, 1984; Dharmasena and Bessler, 2004; Capps, Bessler, and Williams, 2012).

To clarify the identification of the aforementioned contemporaneous causal flows, we modeled causal structures (directed acyclic graphs) among the innovations from each macroeconomic variable. Information on the numbers of participants in the SNAP, the WIC Program and various Child Nutrition Programs is modeled as dependent on the shocks emanating from the macroeconomic variables considered. The PC-Algorithm found in association with the TETRAD project (at Carnegie Mellon University, Sprites, Glymour and Scheines, 2000), is applied to achieve such identification. Applications of these algorithms have become prevalent in recent years following Swanson and Granger (1997) and Bessler and Akleman (1998).

Given the number of macroeconomic variables under consideration, degrees-of-freedom and collinearity issues are certain to arise in the estimation of the respective econometric and VAR models. To mitigate these issues, we plan to include a single macroeconomic variable in the econometric, VAR and P-VAR specifications. Consequently, the number of econometric, VAR and P-VAR models to be estimated will rest on the number of macroeconomic variables to be considered. In this way, we are able to isolate and discern the impacts and forecast ability of each macroeconomic shock on the number of participants in the SNAP, the WIC Program, and the NSLP. For emphasis, national level and state level models of participation in key food assistance programs is provided, along with an assessment of forecast performance.

Preliminary Results and Anticipated Outcomes

This study is useful for government policy makers in designing or redesigning economic safety net programs adjusting for macroeconomic shocks. Causality structures of macroeconomic variables and participation in food assistance programs will show how the variables are interrelated in a complex system. With a more accurate set of predictions associated with participation rates in food assistance programs based on macroeconomic drivers or shocks, policy makers will be in better position to assess program costs and to minimize errors in the budgetary process.

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