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The Food Assistance National Input-Output Multiplier (FANIOM) Model and Stimulus Effects of SNAP

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Abstract

USDA's Economic Research Service uses the Food Assistance National Input-Output Multiplier (FANIOM) model to represent and measure linkages between USDA's domestic food assistance programs, agriculture, and the U.S. economy. This report describes the data sources and the underlying assumptions and structure of the FANIOM model and illustrates its use to estimate the multiplier effects from benefits issued under the Supplemental Nutrition Assistance Program (SNAP, formerly the Food Stamp Program). During an economic downturn, an increase in SNAP benefits provides a fiscal stimulus to the economy through a multiplier process. The report also examines the different types of multipliers for different economic variables that are estimated by input-output multiplier and macroeconomic models and considers alternative estimates of the jobs impact. FANIOM's GDP multiplier of 1.79 for SNAP benefits is comparable with multipliers from some macroeconomic models.

Keywords: Automatic Stabilizer, fiscal stimulus, multipliers, jobs impact, Input-Output Multiplier Model, Social Accounting Matrix (SAM) multiplier model, Supplemental Nutrition Assistance Program (SNAP), Food Stamp Program.

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Contents

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Summary

USDA's Economic Research Service uses the Food Assistance National Input-Output Multiplier (FANIOM) model to represent and measure linkages between USDA's domestic food assistance programs, agriculture, and the U.S. economy. This report describes the data sources and the underlying assumptions and structure of the FANIOM model and illustrates its use to estimate the multiplier effects from benefits issued under the Supplemental Nutrition Assistance Program (SNAP, formerly the Food Stamp Program).

What Is the Issue?

An increase in SNAP benefits provides a fiscal stimulus to the economy during an economic downturn. When resources are underemployed, the increase in SNAP benefits starts a multiplier process in which inter-industry transactions and induced consumption effects lead to an economic impact that is greater than the initial stimulus. An input-output multiplier (IOM) model, such as FANIOM, tracks and measures this multiplier process.

IOM and macroeconomic models have been used for assessing the multiplier effects from government expenditures authorized under the American Recovery and Reinvestment Act of 2009 (ARRA), a Federal response to the recession that began in 2008. There is potential for confusion and misinterpretation of reported multiplier effects from different models. This report clarifies differences in model assumptions and multipliers. It examines the different types of multipliers for different economic variables that are estimated by IOM and macroeconomic models, and considers alternative estimates of the jobs impact.

What Did the Study Find?

FANIOM provides a framework for calculating different types of multipliers for different variables at the national level. Multipliers are calculated for production, GDP, and employment, and they are adjusted to domestic market effects by netting out the share of new demand met by imports. A type I multiplier includes the direct and indirect effects from a fiscal stimulus, while a type II multiplier also includes the induced effects from the labor income and the type III multiplier also includes the induced effects from capital income.

The type III GDP multiplier is the appropriate multiplier for assessing the impact of government expenditures on economic activity (GDP and production) during an economic downturn. The type I employment multiplier (with import adjustment) is the appropriate multiplier for assessing the jobs impact from government expenditures. The jobs impacts from the FANIOM model for the type II and type III multipliers are consistent with other input-output multiplier models, but higher than estimates from macroeconomic models and from empirical analysis of data on the quarter-to-quarter change in employment relative to a change in GDP.

The FANIOM analysis of SNAP benefits as a fiscal stimulus finds that:

- An increase of $1 billion in SNAP expenditures is estimated to increase economic activity (GDP) by $1.79 billion. In other words, every $5 in new SNAP benefits generates as much as $9 of economic activity. This multiplier estimate replaces a similar but older estimate of $1.84 billion reported in Hanson and Golan (2002).
- The jobs impact estimates from FANIOM range from 8,900 to 17,900 full-time-equivalent jobs plus self-employed for a $1-billion increase in SNAP benefits. The preferred jobs impact estimates are the 8,900 full-time equivalent jobs plus self-employed or the 9,800 full-time and part-time jobs plus self-employed from $1 billion of SNAP benefits (type I multiplier).
- Imports reduce the impact of the multiplier effects on the domestic economy by about 12 percent.

How Was the Study Conducted?

At the core of the FANIOM model are data from the U.S. Bureau of Economic Analysis (BEA), Benchmark Input-Output Accounts for 2002. Data from BEA National Income and Product Accounts are used to specify the induced effects from household income (labor and capital). Employment data from the U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, and U.S. Department of Agriculture are used in estimating the jobs impact. The GAMS software was used to calculate the FANIOM multipliers.

Introduction

USDA's Economic Research Service uses the Food Assistance National Input-Output Multiplier (FANIOM) model to represent and measure linkages between USDA's domestic food assistance programs, agriculture, and the U.S. economy. This report describes the data sources and the underlying assumptions and structure of the FANIOM model and illustrates its use to estimate the multiplier effects from benefits issued under the Supplemental Nutrition Assistance Program (SNAP, formerly the Food Stamp Program). The report also examines the different types of multipliers for different economic variables that are estimated by input-output multiplier (IOM) and macroeconomic models and considers alternative estimates of the jobs impact.

An increase in SNAP benefits provides a fiscal stimulus to the economy during an economic downturn. When resources are underemployed, the increase in SNAP benefits starts a multiplier process in which inter-industry transactions and induced consumption effects lead to an economic impact that is greater than the initial stimulus. An IOM model, such as FANIOM, tracks and measures this multiplier process.

IOM and macroeconomic models have been used for assessing the multiplier effects from government expenditures authorized under the American Recovery and Reinvestment Act of 2009 (ARRA), a Federal response to the 2008 recession. There is potential for confusion and misinterpretation of reported multiplier effects from different models. Confusion can occur in regard to different types of multipliers and multipliers for different economic variables. Furthermore, different assumptions underlying IOM models and macroeconomic models can lead to multiplier effects that can be equivalent or widely different. The comparison and interpretation of model results can be difficult. This report clarifies these differences in model assumptions and multipliers.

Chapter 2 describes the FANIOM model and how it can be used to analyze the multiplier effects from an increase in SNAP benefits (government expenditure). Chapter 3 describes the different economic variables for which multipliers are calculated, describes the different types of multipliers, and calculates them for SNAP benefits. Chapter 4 compares the multiplier effects from an IOM model with those from several macroeconomic models and discusses some issues in reconciling the jobs impact estimates between these two types of models. Chapter 5 describes the conditions associated with an economic downturn that enable government expenditures to work as a fiscal stimulus, and examines the limitations in using an IOM model for analyzing the multiplier effects from government expenditures as a fiscal stimulus.

An Input-Output Multiplier (IOM) Model

Different economic models can be used for multiplier analysis of government expenditures (see box, "Historical Digression on the Roots of Multiplier Models"). While this report emphasizes the use of an IOM model, it extends the model to be equivalent to a social accounting matrix (SAM) multiplier model and compares the multiplier effects from an IOM model with those from macroeconomic models.

Food Assistance National Input-Output Multiplier (FANIOM) Model

USDA-ERS developed the Food Assistance National Input-Output Multiplier (FANIOM) model to assess the economywide and sector effects of U.S. domestic food assistance programs. While the FANIOM model described in this report is tailored to analyze the multiplier effects of SNAP benefits at the national level, it can also be used to analyze the effects of other exogenous changes at the national level.[1]

[1]Hanson and Oliveira (2009) used the model to examine the impact of WIC on agriculture, Hanson (2003) used an earlier version of the model to examine the impact of the school meal programs on agriculture, and Hanson and Golan (2002) used an earlier version of the model to assess the multiplier effects of food stamps.

The FANIOM model is based on two primary sources of data: 2002 Benchmark Input-Output Accounts and National Income and Product Accounts (NIPA). The U.S. Bureau of Economic Analysis (BEA) provides both sets of data. Annual NIPA data are used in the model to specify the income flows from industry to households and from households to consumer expenditures, which involve specification of various tax and savings rates that are not included in the input-output accounts. Merging NIPA data with the input-output accounts creates a Social Accounting Matrix (SAM) and allows the IOM model to calculate the induced effects and estimate the equivalent of a SAM multiplier. Calculation of the induced effects is discussed in context of the multiplier types.

The FANIOM model also involves data on employment (or jobs) by industry. Various measures of employment are included in the model's database. These include the number of full-time plus part-time jobs (FTPT-jobs), full-time equivalent jobs (FTE-jobs), production workers (prod-jobs), and self-employed (self-employed). (See appendix 1 for details about the sources of employment data.) Combinations of these employment measures can be used. For analysis related to agriculture, it is important to include the self-employed since they make up a large share of the total labor force in the industry and they can adjust their hours of work on the farm. The jobs impact measures in this report are the FTE-jobs plus self-employed, and the FTPT-jobs plus self-employed.

The Benchmark Input-Output Accounts used by the FANIOM model are annual data prepared at 5-year intervals, based on data from the Economic Census (Stewart et al., 2007). The most recent benchmark account is for 2002, with 426 industries producing 428 commodities (or goods and services), with many industries and commodities defined at the 6-digit NAICS (*North American Industry Classification System)* level. The number of commodities closely corresponds to the number of industries (groups of firms that produce similar commodities). The term "sector" is sometimes used as a proxy for commodities and industries, and the term "goods and

Historical Digression on the Roots of Multiplier Models

The description and derivation of the multiplier as an economic process has its roots in the development of several economic models. First, in response to the Great Depression (1929-1933), Kahn (1931) and Keynes (1936) developed the aggregate/macroeconomic multiplier to explain how government interventions during a recession can stimulate the economy. An extensive early literature discussing the aggregate multiplier process includes Samuelson's (1940) "Theory of Pump-Priming" and Machlup's (1939) discussion of its temporal dimension. Following the Great Depression, measurement of national income and the effect of fiscal policy on it were of keen interest (Clark, 1938; Samuelson, 1942; Hansen, 1951).

An aggregate multiplier process is embedded in a macroeconomic forecasting model to some extent, depending on the underlying assumptions about agent behavior and market adjustment to disequilibrium between supply and demand. The first macro-econometric models were Keynesian and were influenced by this early literature on income determination and the multiplier process. These models were used to analyze fiscal stimulus packages during the 1960s. During the 1970s, they continued to be used but were criticized for the treatment of market adjustment processes and the bounded rationality of the agents in the model. In response, new generations of macro-econometric models arose where agents are forward looking, and markets adjust quickly and fully to disequilibrium despite potential market imperfections (Diebold, 1998; Mankiw, 2006; Woodford, 2009). Under the new paradigms, the multiplier effects from fiscal policy are dampened if not negated. The recession that started in 2008 has brought back an interest in multiplier effects from a fiscal stimulus.

A second model of the multiplier process is based on the input-output accounts developed by Leontief (1936, 1986). An input-output multiplier model includes the direct and indirect effects of a change in demand on industry production. It can also include the induced effects from the additional expenditures generated by the increased income to households. Moore (1955) and Moore and Petersen (1955) are two early applications of input-output multiplier analysis, looking at the impact of a change in industry demand on a regional economy. Miernyk (1965) published what has become a classic on input-output analysis that introduced the terminology of Type I and Type II multipliers, and which treats the induced effects of the input-output multiplier as equivalent to the aggregate multiplier. Miller and Blair (1985) published a classic textbook on input-output nalysis, which discusses the different types of multipliers, as does Hewings (1985).

The Social Accounting Matrix (SAM) multiplier is a third model of the multiplier process. A SAM expands upon the input-output accounts by fully integrating a nation's National Income and Product Accounts with the input-output accounts, which involves accounting for taxes and savings and other inter-institutional income flows. Early development of the SAM multiplier is found in the work of Pyatt and Round (1979) and Defourny and Thorbecke (1984), and recent summaries in Pyatt (2001) and Robinson (2006). IMPLAN (2010) provides a data-software package that applies a SAM-type multiplier similar to one developed in this report. Holland and Wyeth (1993) discuss moving from an input-output type II to a SAM-type II multiplier.

services" is used interchangeably with the term "commodities." (For more information about the structure and content of the input-output accounts, see box, "Commodity and Income Flows in the Input-Output Accounts.")

Annual input-output accounts through 2008 have been prepared by the U.S. Bureau of Economic Analysis (2010a). They reduce the detailed farm and food processing sectors of the benchmark accounts to one sector each, which limits their usefulness for studying the economic impacts on food and farm sectors. Therefore, the FANIOM model makes use of less recent 2002 data to achieve the industrial detail for studying the effect of Federal food assistance programs.

The U.S. Bureau of Labor Statistics (2009b) has developed annual input-output accounts through 2008 based on the 2002 benchmark accounts. The accounts are used to project the employment requirements for 202 industries 10 years into the future.[2] For analysis related to farm and food issues, this set of accounts disaggregates food processing reasonably well (though less than the benchmark accounts), but it only disaggregates agriculture into crop and livestock sectors. Methods exist to disaggregate more recent but more aggregated input-output accounts using older but more disaggregated accounts (Jackson and Comer, 1993). Future work may pursue this data development to clarify whether the new data base is worthwhile in the sense of more accurate impact estimates that are significantly different at the national level. Using such a method to create a more recent disaggregated input-output account would add to the cost of developing and updating the model.

[2]These accounts include a "domestic employment requirement table" to estimate the jobs impact for a change in final demand, such as exports or personal consumption expenditures, which this report compares to FANIOM estimates.

More recent detailed input-output accounts and models for multiplier analysis have been developed for 2008 by the Minnesota IMPLAN Group, Inc. (2010, noted subsequently as IMPLAN) and by the U.S. Bureau of Economic Analysis (2010b, noted subsequently as RIMS II) for 2007/08 using various procedures and data to update the 2002 benchmark input-output accounts. Both IMPLAN and RIMS II are designed to be used at the State or county level, so multipliers may be more strongly affected by the year of data as businesses come and go from a region. Use of IMPLAN and RIMS II entail a monetary cost. With IMPLAN, a user purchases the data and software to conduct the multiplier analysis independently. With RIMS II, a user purchases specific multipliers. Though the analysis in this report could be done with IMPLAN, USDA-ERS has chosen to develop a national IOM model that is easy to maintain (low cost), does not require significant data updating, can be easily used for other types of multiplier analysis at the national level, and can serve as a teaching tool.

FANIOM, like other IOM models, is a system of linear simultaneous equations. Model parameters are specified as average coefficients from annual data for 2002. Derivation of the multipliers is an exercise of comparative statics; given an exogenous change, the model determines the new levels of economic activity consistent with that change. The process by which the economy adjusts to the new equilibrium level of economic activity is not modeled (see box, "Timeframe for Multiplier Process to Work"). The comparative static solution to an IOM model is traditionally found by matrix inversion of the system of linear simultaneous equations (Miller and Blair, 1985). Rather than using matrix inversion to calculate multipliers, the FANIOM model is solved as a system of simultaneous equations using

Commodity and Income Flows in the Input-Output Accounts

The input-output accounts describe the flow of commodities from the industries that produce them to the industries that use them as inputs in production and to final demand. The inter-industry commodity flows are an essential part of the multiplier process. They are the basis from which an increase in production from an exogenous change in demand for a commodity gets passed on to other industries as demand for inputs. Final demand consists of a number of components: personal consumption expenditures (PCE), government purchases, private fixed investment as business equipment and structures and as residential construction, inventory change, and exports to the rest of the world. Imports are treated as a negative component of final demand since they are purchased as intermediate inputs by domestic industries and by the other components of final demand (except exports). All users of a commodity, be it industry or final demand, purchase the same share of the domestically produced commodity and imports of that commodity. The import share by commodity has an impact on the multiplier effects. A greater import share results in a smaller multiplier effect on domestic production.

Corresponding to the commodity flows from industry to industry but in the opposite direction are the income payments for the purchase of the commodities, which are the intermediate cost of production. To fully specify the cost of production by industry, the input-output accounts also include industry payments to factors of production in the form of employee compensation (labor income) and operating surplus (capital income). Labor income is a gross measure of labor income to hired workers that includes the employer and employee contributions for social insurance (social security and Medicare). Capital income is one value for each industry in the input-output accounts, but in NIPA it includes interest payments, dividends, rent, proprietors' income, retained earnings, profit tax, and depreciation. For consistency with including the self-employed as part of the employment measure, proprietors' income is reallocated from capital income to labor income. Appendix 2 discusses how proprietors' income is reallocated. Interest, dividends, and rent are treated as the capital income that households receive as a return to ownership of financial assets and property. Excise and sales taxes plus import tariffs less subsidies to industry are treated as an additional component of factor payments to derive industry value added as the sum of factor payments. Government revenue from these taxes will increase as expenditures on commodities increase. Due to issues about the treatment of excise and sales taxes in the input-output accounts, estimating the increase in government revenue generated from these taxes in the multiplier process is unreliable.

Another feature of the input-output accounts is that all commodity purchases, as intermediate or final demand, are recorded in the accounts at producer prices. But the purchase of a commodity may also involve retail trade, wholesale trade, and transportation margins for the service industries that deliver the commodity from the producer to the purchaser. The trade and transportation margins by commodity are maintained separately in the accounts, and can be used to calculate commodity expenditures in purchaser prices. In deriving the multiplier effects for a change in consumer expenditures it is important to specify the change in expenditures for commodities in purchaser prices (value at the retail outlet) and convert that into a change in expenditures for commodities in producer prices (value at the factory gate), plus a change in the expenditures on trade and transportation services.

Timeframe for Multiplier Process To Work

The multiplier effects on economic activity occur over time. There is no definitive analysis about how long it takes for the full multiplier effects to occur. Still, it is possible to provide some guidance on the timeframe for the economic effects from the multiplier process to occur. The initial increase in expenditures by SNAP recipients has a direct effect on the economic activity of the producers of the goods and services purchased, retail establishments, and the wholesale and transportation systems. These effects will occur quickly, particularly for SNAP benefits as recipients spend them during the month that they receive them. The producer of the goods and services may not respond as quickly to the direct effect by increasing production if inventories are plentiful. Consequently, the short-term effectiveness of a fiscal stimulus will depend on inventory levels. If inventories are low, the producer will increase production during the current or next month following the expenditures and will order new inputs. The new input orders will stimulate production by the industries that make them, generating the next round of the multiplier process and the first round of indirect effects. The new input orders are likely to occur during the same quarter as the initial expenditure.

Also occurring during this first quarter in response to the direct effects and initial indirect effects is an increase in labor income for the directly affected industries and their input suppliers. A first round of induced effects on economic activity is generated from the additional labor income. These occur as households receive their paychecks, which will happen during the first quarter. Less clear is when the induced effects from capital income occur, but they are more likely to occur later than the induced effects from labor income, as households receive capital income less quickly and less often than wages.

The direct effects and initial rounds of indirect and induced effects will arguably occur quickly and most probably during the first quarter of the initial expenditures. The subsequent rounds of indirect and induced effects take place sequentially over time. Though empirical evidence does not exist, to put some bounds on the timeframe it seems reasonable to argue that each round of effects will take an additional quarter. Thus, within a year, four rounds of indirect and induced effects will likely occur. So what percent of the multiplier process is accounted for by the direct effects and four rounds of indirect and induced effects? One response to this question is from the input-output method of taking a power series approximation to the inverse of the (I-A) matrix (Miller and Blair, 1985, pp. 22-24; Hewings, 1985, p. 14). Each round of induced economic effects from the multiplier process is equivalent to adding an additional term in the power series. A feature of a power series is that the impact of each additional term is reduced exponentially. "In many applications it has been found that after about 7 rounds of indirect effects the impact is insignificantly different from zero. So, it is possible to capture most of the effects associated with a given final demand by using the first few terms in the power series." By four rounds in the first year, it is reasonable to claim that 75 percent of the multiplier effects will have been accounted for.

an optimizing algorithm in the GAMS software (Brooke et al., 1992). For a linear IOM model, the solution will be robust to the solution method, be it matrix inversion or optimization. A benefit of using GAMS is that the IOM model is specified as a system of algebraic equations, which is a flexible means of developing modifications to a traditional IOM model, particularly related to the induced effects. Other authors have preferred to use alternative matrix decompositions to achieve the same end (Pyatt and Round, 1979). Appendix 3 provides a technical description of the FANIOM model.

FANIOM is a partial-equilibrium, static model of the U.S. economy. By its nature, the model is unable to capture all economywide impacts of any program, such as opportunity costs of the government expenditures or the implications of the revenue sources. The report does discuss how macroeconomic models have addressed stimuli programs and their potential implications on future interest rates, inflation, and household expectations and behavior.

Exogenous Shock to an IOM Model From Government Expenditures

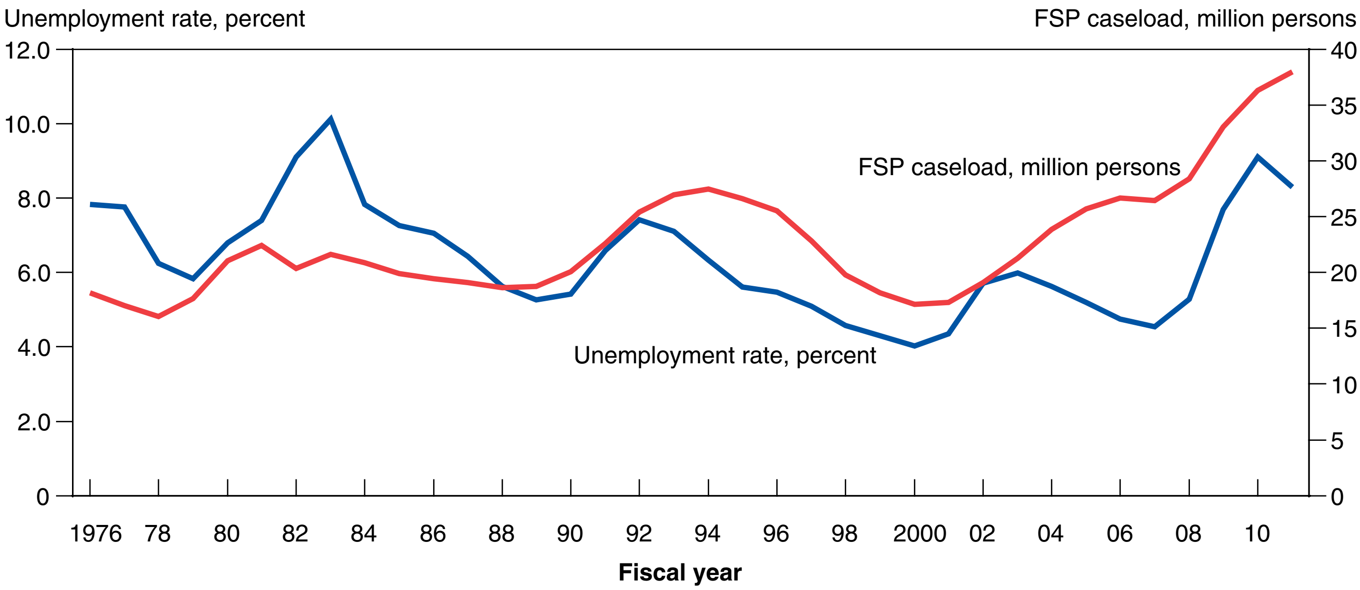
Translating government expenditures as a fiscal stimulus into an exogenous shock to the IOM model is a critical step in using an IOM model to estimate the multiplier effects. How to do this is specific to the type of expenditure or the type of project/program that is funded. For instance, investment into infrastructure is an increase in government demand for construction activity; extension of unemployment insurance benefits is a transfer to households; and general aid to States can be used in many ways such as funding education, primarily teacher salaries.

When government expenditures go directly to households as transfers, wages, or tax rebates, there is the issue of how much is spent, how much is saved (or used to pay off debt), and how much is taxed. The higher a household's income, the more likely some of it will be saved and taxed, which reduces the multiplier effects from the expenditures. This is a reason to carefully translate government expenditures into an exogenous change in final demand.

This report focuses on government expenditures as SNAP benefits to low-income households. SNAP is the Nation's largest domestic nutrition assistance program for low-income Americans. In fiscal year (FY) 2009, the program served 33.7 million Americans in an average month and issued $50.4 billion of SNAP benefits over the year, including $4.3 billion from ARRA legislation. As a means-tested entitlement program, SNAP automatically responds to changing economic conditions, providing assistance to more households during an economic downturn or recession and to fewer households during an economic expansion (figs. 1 and 2). While SNAP is an automatic fiscal stimulus, SNAP can also serve as a discretionary fiscal stimulus, meaning that Congress can change the program in any given year as economic conditions warrant. For example, as part of the government economic stimulus package of 2009 (ARRA), Congress temporarily increased the maximum benefit amounts to recipients by 13.6 percent (of 2009 levels). Increasing benefits to SNAP recipients provides a sudden stimulus because SNAP recipients spend the benefits quickly and fully. An

Figure 1

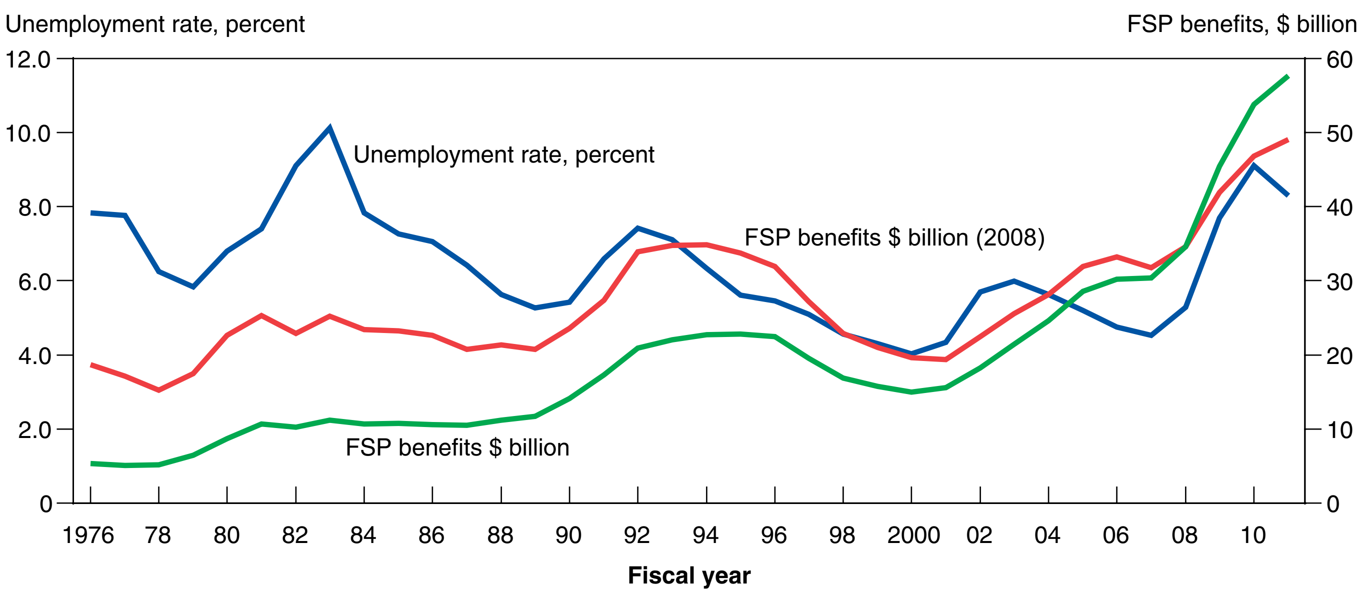
Annual SNAP caseload and unemployment rate, 1976-2008, with CBO projections for 2009-11



Source: U.S. Department of Agriculture, Food and Nutrition Service; U.S. Bureau of Labor Statistics, Current Population Survey; and Congressional Budget Office.

Figure 2

Annual SNAP benefits and unemployment rate, 1976-2008, with CBO projections for 2009-11



Source: U.S. Department of Agriculture, Food and Nutrition Service; U.S. Bureau of Labor Statistics, Current Population Survey; and Congressional Budget Office.

estimate of the expected increase in SNAP benefits in response to the 2008 recession—based on Congressional Budget Office (CBO) projections—is presented in the box, "SNAP Response to the 2008 Recession."

SNAP recipients use the benefits quickly and fully, with no effect on the savings or taxes of the recipients. The issue is in translating the increase in benefits into a change in consumer expenditures on goods and services. As stipulated by program rules, recipients spend all the benefits on food at home,

SNAP Response to the 2008 Recession

Congressional Budget Office (CBO 2009a,b,d) estimates for the expected increase in SNAP benefits due to the recession that started in January 2008 are presented in the table below. The benefit amounts are reported in "current" dollars (not adjusted for inflation) for the year that the benefits are issued. There are two components: (1) the additional benefits from an increase in caseloads and (2) the additional benefits from a 13.6-percent increase in the maximum benefit amount from the American Recovery and Reinvestment Act of 2009 (ARRA). The combined increase in benefits issued range from a high of $15.4 billion in 2009 and $14.7 billion in 2010 to a low of $4.2 billion in 2008 and 2012 (excluding 2013 when the average monthly caseload is expected to fall).

As part of the 2009 fiscal stimulus package, ARRA included a 13.6-percent increase in the SNAP maximum benefit amounts based on the June 2008 Thrifty Food Plan cost for a four-person reference family. The maximum benefit is the amount of SNAP benefits received by recipients who have no "net income" (calculated as a family's gross income less deductions). The maximum benefit varies by household size (and whether a family resides in Alaska or Hawaii). For example, the maximum benefit for a 4-person household (in the 48 States and DC) increases by $80 from $588 to $668 in 2009 as a result of the ARRA. With legislation passed in February 2009, States were able to implement the adjustment to households' benefits starting in April 2009 (USDA-FNS, 2009). ARRA stipulated that the "adjusted" maximum benefit amounts remain in effect until the June cost of the Thrifty Food Plan (TFP), which rises with food price inflation, exceeds this adjusted maximum benefit amount. The cost of the June TFP is the usual basis for setting the SNAP maximum benefits for an upcoming fiscal year.

According to CBO (2009d) cost projections for ARRA, the additional SNAP benefits issued during FY 2009 are estimated to be $4.812 billion. The estimate is for one-half of the fiscal year (April through September), reflecting the timing of when the additional benefits are issued. For FY 2010, the additional benefits are estimated at $6.1 billion, decreasing to $4.4 billion for FY 2011, $3.1 billion for FY 2012, $1.6 billion in FY 2013, and zero thereafter. The estimated additional benefits from the ARRA get smaller as the benefits with the adjusted maximum benefit is compared to the benefits that would be issued without passage of ARRA, given expected food price inflation.

Estimated additional SNAP benefits issued following the 2008 recession, 2008-13

	2008	2009	2010	2011	2012	2013	Sum
				$ billion			
Estimated additional SNAP benefits	4.238	15.417	14.660	8.194	4.273	1.639	48.421
From caseload increase	4.238	10.605	8.602	3.832	1.158	0.000	28.435
From SNAP benefit adjustment	0.000	4.812	6.058	4.362	3.115	1.639	19.986

Source: CBO (2009a,b,d) cost estimates.

but empirical research finds that recipients shift some cash income that was being spent on food into nonfood expenditures upon receiving the benefits. Consequently, food expenditures increase by only a percentage of the total increase in benefits, while nonfood expenditures increase by the remaining amount.

This report assumes that food expenditures increase by 26 percent of the increase in SNAP benefits. Fraker (1990) and Fox et al. (2004) reviewed a number of studies that estimated the effects of SNAP benefits on food expenditures by households and the shifting of cash into nonfood expenditures. Estimates ranged from 0.17 to 0.47, indicating that a $1 increase in SNAP benefits would lead to additional food expenditures of between $0.17 and $0.47. Estimates based on data after 1977 changes in the SNAP purchase requirement range from 0.23 to 0.35. Levedahl (1995) estimates a marginal propensity to consume food from SNAP benefits of 0.26, while Kramer-LeBlanc et al. (1997) estimate a value of 0.35, and Breunig and Dasgupta (2005) estimate a value of 0.30. These estimates are considered more relevant to current program circumstances.

The increase in food-at-home expenditures is distributed among specific food items using average food expenditure shares from the personal consumption expenditure (PCE) data in the input-output accounts. Similarly, nonfood expenditures are distributed among the nonfood goods and services in the PCE data according to average shares of nonfood expenditures. The average expenditure shares are calculated in purchaser prices, at retail, and then converted to expenditures for goods and services at producer prices and for trade and transportation services. These average shares for food and nonfood expenditures are used to approximate what should be marginal expenditure shares for an increase in expenditures from a change in SNAP benefits. This use of average shares as marginal shares is typical of an IOM model but could be a source of model misspecification. Households' average use of income may differ from how they spend an increase in income. Marginal expenditure shares specified from econometrically estimated income elasticities could be used to modify the FANIOM model. This would be a useful extension of the model.

Multiplier Effects from an Input-Output Multiplier (IOM) Model

There are a number of different types of multipliers that can be derived from an IOM model and each type can be calculated for a number of economic variables. This chapter clarifies the differences among these multipliers by describing what they are and how they are calculated. Using the FANIOM model, these multipliers are calculated for SNAP benefits.

Multipliers for Three Economic Variables: Production, GDP, and Employment

A "multiplier" is a ratio between changes in two economic variables. A multiplier expresses the change in one economic variable that is endogenous—i.e., determined within the framework of the model—as result of a change in a second economic variable that is exogenous—i.e., determined outside of the model. This study considers three endogenous variables of economic activity: production, gross domestic product (GDP or value added), and employment (jobs).[3]

[3]Multipliers for other endogenous economic variables such as household income can be calculated. This report focuses on these three variables since they are most commonly discussed in context of the 2008 recession.

Production is a measure of economic activity that corresponds to the cash receipts or revenue from the sale of goods and services. It is a gross measure of economic activity in that it includes inter-industry transactions. Relative to the value of production, GDP is net of inter-industry expenses, or the purchase of inputs from other industries. An IOM model embraces both measures of economic activity since the input-output accounts include inter-industry transactions. Macroeconomic models focus on GDP to measure economic activity. Comparing multipliers from these two modeling approaches can be confusing if it is unclear whether a production or GDP multiplier is being reported. It is important to make the distinction clear since the production multiplier is close to twice the magnitude of the GDP multiplier. Following Miernyk (1965), the U.S. Bureau of Economic Analysis uses the term "total requirements" as the direct plus indirect production activity generated by a change in final demand (Horowitz and Planting, 2006). This report makes the distinction between these two multipliers by referring to a production multiplier and a GDP multiplier.

The FANIOM model is specified with data for 2002. Most applications will pertain to events in a more recent year. That is, the exogenous shock will be in dollar value for the more recent year. To the extent that the structure of the IOM model remains the same over time as specified by the data underlying the model, the production and GDP multipliers from 2002 will be applicable to the dollar value of the exogenous change in a more recent year. The assumption of an unchanging structure is unlikely to be fully true, but, practically, the change in an IOM model structure over 5 to 10 years is minimal. To demonstrate, a Type I production multiplier (as described below) has been calculated from three benchmark input-output accounts for 1992, 1997, and 2002 for an exogenous change in household expenditures from $1 billion of SNAP benefits. The multipliers ranged from 1.84 for 1992 (Hanson and Golan, 2002) to 1.92 for 1997 (unpublished), with an intermediate value of 1.88 for 2002 (in this report). Similarly, Stern (1975) estimated a multiplier for an exogenous change in final demand from a set of government transfers to households using the 1972 benchmark input-output accounts and found a value of 1.87. The evidence suggests that production and GDP multipliers based on 2002 data will work reasonably well for an application that pertains to economic activity in 2008 through 2012.

The employment multiplier (jobs impact) is a demand for labor by industry to carry out the new production activity. The new demand can be met by employing new workers, having existing employees work more hours, or not laying off existing employees and/or not reducing hours of work. These are the created and saved jobs. The model cannot distinguish among the means by which the jobs impact occurs; it provides a general estimate of the demand for additional labor.

Calculation of employment multipliers starts with data on average industry jobs-production ratios for each employment measure. The IOM model estimates the change in production by industry from the multiplier process. The change in industry jobs is estimated for each industry as the product of the industry jobs-production ratio and the change in industry production.

The employment multiplier is calculated by the model as the number of jobs per billion dollars of SNAP benefits (or other form of government expenditures) in 2002 dollars, the year of the data for model specification. But it is preferable to report the jobs impact in terms of the year for which the study is being conducted, such as 2008. Unlike the production or GDP multipliers, the magnitude of the employment multiplier is sensitive to the number of years between the year for which the model is specified (2002) and the year in which the results are reported (2008). Adjusting the employment multiplier to a more recent year depends on the rate of inflation and labor productivity.

Labor productivity tends to increase over time so the amount of labor necessary to produce a given amount of output tends to fall. To adjust for labor productivity, the employment-output ratios of 2002 are reduced by a labor productivity adjustment factor of 0.873 using the U.S. Bureau of Labor Statistics (2009a) major sector productivity index (output per hour) for the business sector. Given an increase in the price of commodities, the dollar value for a quantity of output in a more recent year is larger than the dollar value in an earlier year. To reflect this change in the dollar value of a quantity of output, the employment-output ratios (number of jobs per unit of output) are reduced by an inflation adjustment factor of 0.868 using the implicit price deflator for the labor productivity measure (U.S. Bureau of Labor Statistics, 2009a). Combined, these two adjustments result in an overall employment adjustment factor of 0.758 that reduces the employment impact per billion dollars of output in 2002 dollars to an employment impact per billion dollars of output in 2008 dollars.[4]

[4]The 0.758 employment adjustment factor is very close to a value of 0.754 derived from the BLS (2009b) Employment Requirement Table, for 2002 and 2008, for an exogenous change in personal consumption expenditures.

Types of Multipliers

The multiplier effects depend on more than simply which pair of endogenous and exogenous variables is considered. For any given pair, there are several "types" of multipliers that depend on how other variables in the model are treated—specifically, which variables are held constant or unchanging in the calculation of a multiplier and which variables are allowed to vary (Miernyk, 1965; Hewings, 1985; Miller and Blair, 1985). This study distinguishes three types of multipliers (type I, II, and III), which have their roots in alternative methods of analyzing the multiplier process (see box, "Historical Digression on the Roots of Multiplier Models," on page 3). A further distinction is whether the multipliers are adjusted to domestic economic effects by netting out the share of goods and services that are imported into the U.S. market (import adjustment). Each type of multiplier is calculated for the three endogenous variables of economic activity considered in this study.

A type I multiplier consists of two components: the "direct" and "indirect" effects due to an exogenous change in final demand. For an increase in SNAP benefits, the direct effects are the share of expenditures made by SNAP recipients that go to domestic producers. Given the structure of the input-output accounts, the direct effects are distributed among the producers of the goods and services being purchased, the retailer, and the wholesale and transportation systems. These industries increase production to supply the domestic share of the new demand for goods and services. An increase in imports completes the direct effects, but these are not a fiscal stimulus to the domestic economy. Imports are a leakage in the multiplier process for the domestic economy, but they do provide a stimulus to the rest of the world. The direct effects from SNAP benefits tend to occur completely in the month of receipt, a quick and full response to the fiscal stimulus by the government.

The indirect effects are the inter-industry demand for inputs to production that arise in response to the direct effects from the new demand for goods and services. An IOM model hinges on the input-output accounts that record the inter-industry use of goods and services in the production of other goods and services. It is this set of complex interactions among industries that provides the basis for calculating the indirect effects for the type I multiplier. The indirect economic activities are distributed over time, with some occurring sooner than others. Most indirect effects will occur within the year, for they involve the refilling of inputs used in producing the goods and services purchased by food stamp recipients. For instance, the baker who sells more loaves of bread will order more flour from the miller, who will process more wheat to fill the order. All stages of the new production activity incur new demand for such basic inputs as energy and labor, as well as the need for transportation services. Given the heightened demand for food with SNAP benefits, a significant share of the new demand for inputs into food processing is for farm products.

A type II multiplier expands the type I multiplier with the induced effects from labor income (net of taxes and savings). The jobs created or saved through the direct and indirect effects of the type I multiplier process have a corresponding increase in labor income to households. The households that receive the income spend some of it, devote some to income tax, and put some into savings. The portion of labor income that is spent on goods and services further stimulates the economy. The first round of induced effects from labor income leads to additional induced and indirect effects, which compound the multiplier process.

To account for the induced effects of the type II multiplier, first calculate the additional number of jobs created or saved. The jobs impact is calculated using the industry jobs-production ratio and the change in production. The number of FTE-jobs plus self-employed is the employment measure used in calculating the jobs impact for this report.

Second, calculate the labor income corresponding to the change in employment. Labor income includes proprietors' income as a return to self-employed labor, which is included in the jobs impact. A typical method to calculate the change in labor income is to multiply the ratio of labor income to industry production by the change in industry production from the type 1 multiplier process, just as the jobs impact is calculated. This approach is consistent with using industry labor income to calculate an average wage for industry employment (FTE-jobs plus self-employed) and multiplying this wage by the change in industry employment (FTE-jobs plus self-employed).

Finally, to complete the calculations of the induced effects for the type II multiplier, calculate the portion of additional labor income received by households that is spent on goods and services. Using *National Income and Product Accounts* (NIPA) data for 2002, subtract social insurance taxes (11 percent) to arrive at net labor income to households, then subtract income taxes (12 percent) and the portion of earned income that is saved (2.5 percent). The remaining labor income is spent on goods and services. The amount spent is distributed among the goods and services consumed by households in proportion to the personal consumption expenditures in the input-output accounts.

A type III multiplier expands the type II multiplier by including the induced effects from the capital income households receive, net of taxes and savings. In addition to the labor income (which includes proprietors' income), households also receive income from the ownership of capital and property in the form of dividends, interest, and rent. These sources of capital income are components of industry gross operating surplus in the input-output accounts. NIPA data for 2002 are used to estimate that households receive 47 percent of industry capital income (net of proprietors' income), with the remainder consisting of other forms of capital income that do not go to households, such as retained earnings, depreciation, and profit tax.

The capital income received by households and spent on goods and services is calculated in a manner similar to the treatment of labor income. The capital income received by households from the multiplier process is calculated by multiplying the change in industry production by the historical average ratio of industry capital income received by households to industry production. The portion of capital income received by households that is spent on goods and services is net of household income tax and savings. The same income tax rate and savings rates are used for both sources of income (capital and labor). Including the induced effects from capital income in an IOM model makes the type III multiplier equivalent to a SAM multiplier.

It is important to adjust the multipliers for the share of goods and services that are imported so that the multipliers are for the domestic U.S. economy only. Imports will fulfill a share of the new demand for commodities that arise from the exogenous change and the multiplier process. It is assumed that the share of new demand fulfilled by imports equals the import share of domestic commodity demand in the benchmark input-output accounts. The accounts assume that all users (industries and households) of a specific commodity purchase the same ratio of imports to domestic supplies, though the ratio varies by commodity. Throughout this report, multipliers will include this import adjustment unless noted otherwise.

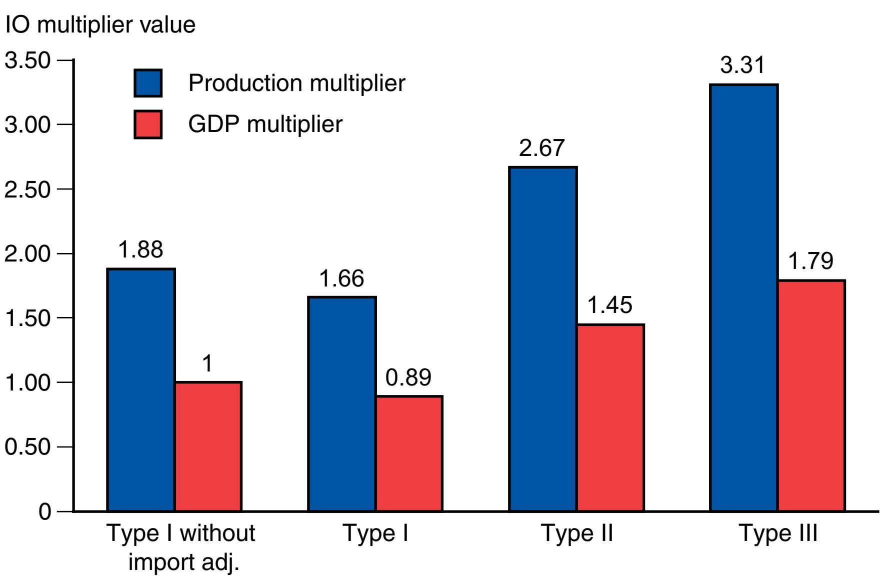
Multiplier Estimates

Figure 3 compares the production and GDP multipliers from $1 billion of SNAP benefits for the different types of multipliers. The type I multiplier without import adjustment is a starting point for comparing the relative impact of additional multiplier components. The type I GDP multiplier without import adjustment is 1.0, such that a $1-billion change in final demand generates an equivalent change in GDP, while the type I production multiplier without the import adjustment is 1.88. The GDP multiplier is 53 percent of the production multiplier, reflecting an average 55.6 percent ratio of GDP to production in the 2002 benchmark input-output accounts. This relationship between GDP and production multipliers holds for each type of multiplier. The 1.88 production multiplier using the 2002 benchmark input-output accounts is similar to the value of 1.84 reported in Hanson and Golan (2002) using the 1992 benchmark input-output accounts. Including the import adjustment with the type I multipliers (second pair of columns in figure 3) lowers both the production and GDP multipliers by 12 percent. The GDP multiplier is less than one, since some of the new demand for goods and services is met by imports and the income (GDP or factor returns) generated from the production of those imports goes to foreign producers.

The type II multiplier adds the induced effects from labor income to the type I multiplier. In figure 3, the type II multipliers include the import adjustment. The production multiplier is 2.67, and the GDP type II multiplier is 1.45. The induced effects from labor income increase the multiplier effects from the fiscal stimulus by 62 percent. The type III multipliers add the induced effects

Figure 3

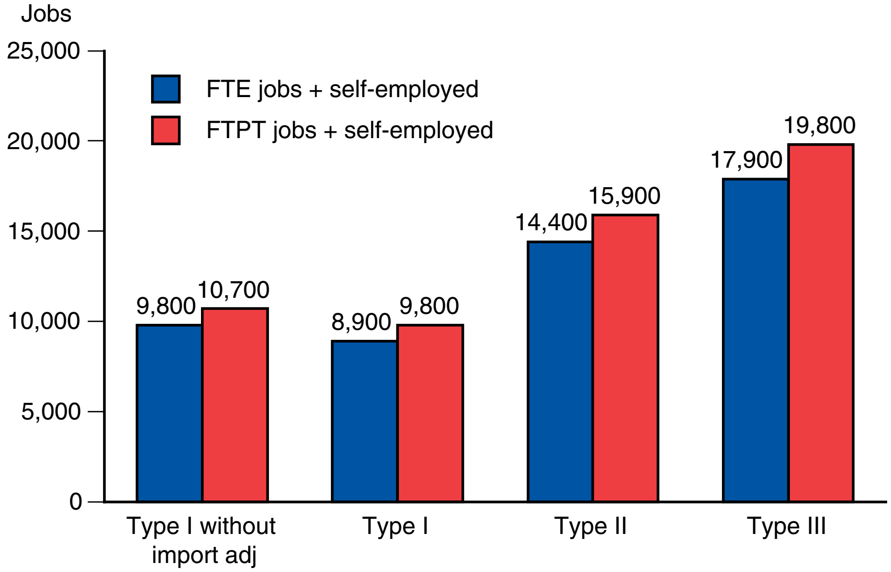
Production and GDP multipliers from a $1-billion increase in SNAP benefits



Source: ERS calculations from input-output multiplier model.

Figure 4

Jobs generated per $1 billion (2008 dollars) of SNAP benefits



Source: ERS calculations from input-output multiplier model.

of capital income to the type II multipliers. The type III multipliers are 3.31 for production and 1.79 for GDP, a 24- percent increase relative to the type II multipliers.

Figure 4 compares the jobs impact (employment multipliers) per $1 billion of SNAP benefits for the type I, II, and III multipliers. The jobs impact is calculated in two ways, as FTE-jobs plus self-employed and as FTPT-jobs plus self-employed. These jobs impacts use average employment-to-output ratios by industry and the change to industry production in their calculation. The $1 billion of SNAP benefits generates a jobs impact of 9,800 FTE-jobs plus self-employed from the direct and indirect effects of a type I multiplier without import adjustment. The import adjustment reduces the jobs impact by 10 percent to 8,900 FTE-jobs plus self-employed. Adding the induced effects from labor income (type II multiplier) increases the employment effects to 14,400 FTE-jobs plus self-employed, a 62-percent increase over the type I multiplier. Adding the induced effects for capital income (type III multiplier) increases the jobs impact by another 24 percent to 17,900 FTE-jobs plus self-employed. The jobs impact as FTPT-jobs plus self-employed is about 10 percent larger than the FTE-jobs plus self-employed for each type of multiplier.

Table 1 summarizes the multiplier effects on production, GDP, and jobs for three types of multipliers and two employment measures. Different types of multipliers are used for different situations (see box, “What Type of Multiplier To Use”). Of particular importance for analyzing the fiscal stimulus from government expenditures is the type III GDP multiplier. The value of 1.79 is comparable with the GDP multipliers generated by several macroeconomic models.

What Type of Multiplier To Use?

Both the U.S. Department of Agriculture and U.S. Department of Commerce use type I multipliers for the analysis of export impacts on the U.S. economy (Schluter and Edmondson, 1994; Davis, 1996; Edmondson, 2008; and Tschetter, 2010). The type I multiplier with import adjustment is suited to determine the number of jobs associated with the production activities underlying U.S. exports. Tschetter (2010)—using the employment requirements table prepared by the U.S. Bureau of Labor Statistics (2009b)—estimated that 6,076 jobs (FTPT-jobs plus self-employed) were generated per $1 billion of U.S. exports in 2008, given the composition of exports that year. The same employment requirements table can be used with PCE (Personal Consumption Expenditures) data on household expenditures to find that, on average, 9,645 FTPT-jobs plus self-employed were generated per $1 billion of household expenditures in 2008. This number of jobs compares well with the jobs impact with the type I multiplier (with import adjustment) reported in table 1 (9,800 FTPT-jobs plus self-employed) that is calculated by the FANIOM model for a similar scenario.

The type II multiplier, with the induced effects from labor income, is typically used for regional analysis of the economic impact from an exogenous change in economic activity such as a military base closure (U.S. GAO, 2005) or a production plant moving into or out of a region (U.S. Federal Reserve Bank of Dallas, 2004). Both IMPLAN (2010) and RIMS II (U.S. Bureau of Economic Analysis, 2010) are IOM models designed for this type of analysis. A common feature of these applications is the long-term change in economic activity for a region. The induced effects from labor income are relevant since the exogenous change will affect the employment opportunity in the region and hence the earnings spent in the region. For a type II multiplier, IMPLAN estimates a jobs impact of about 17,000 FTPT-jobs plus self-employed for $1 billion of household expenditures in 2008, slightly higher than the 15,900 FTPT-jobs plus self-employed from the FANIOM model.

Traditionally the induced effects from capital income have not been included in an IOM model. However, including the induced effects from capital income makes the type III multiplier in an IOM model equivalent to a SAM multiplier and comparable with a macroeconomic multiplier. Sullivan et al. (2004) provide an example of using a SAM multiplier, while Zandi (2008a) provides an example of a GDP multiplier from a macroeconomic model.

A jobs impact measured as the number of FTE-jobs plus self-employed and calculated using an industry average jobs-to-GDP (or production) ratio times the change in GDP (or production) is appropriate for assessing the jobs impact from a new business starting or old business closing since this will affect all jobs in that business. Such a jobs impact is also appropriate for calculating the number of jobs it takes to support the level of exports or household expenditures in a particular year. But this method of estimating the jobs impact may not be appropriate for a change in exports or household expenditures. How employment changes in response to a change in GDP (or production) may be less than what would be calculated using an average jobs-to-GDP (or production) ratio.

Table 1
Production, GDP, and job multipliers from a $1-billion increase in SNAP benefits

	Production	GDP	FTE-jobs	FTPT-jobs
Type I without import adjustment	1.88	1.00	9,800	10,700
Type I	1.66	0.89	8,900	9,800
Type II	2.67	1.45	14,400	15,900
Type III	3.31	1.79	17,900	19,800

Source: ERS calculations.

Distribution of Multiplier Effects Among Industries

SNAP benefits increase household food expenditures and allow recipients to shift some cash income from the purchase of food to the purchase of other goods and services. The new demand for food and nonfood goods and services, along with inter-industry linkages, has an impact on production, GDP, and employment for a number of industries, including agriculture, food processing, retail stores, wholesale-transportation, energy, and various other manufacturing and service industries. The induced effects on household expenditures from labor and capital income compound the multiplier effect across industries, while the import share reduces the impact on domestic producers.

The shift of cash income from food to nonfood expenditures as households receive more SNAP benefits has a significant impact on how the multiplier effects are distributed over industries. Even though recipients spend all SNAP benefits on food, the receipt of SNAP benefits allows them to shift some of their previous cash expenditures on food to alternative uses. As a consensus estimate from the literature, this report assumes that, on average over all SNAP recipients, every dollar of SNAP benefits generates an additional 26 cents of food expenditures, with the rest spent on nonfood goods and services. Expenditures on food and nonfood goods and services are assumed to be in proportion to average expenditure shares in the personal consumption expenditures of the 2002 Benchmark Input-Output Accounts.

Consider the case of a $1-billion increase in retail food expenditures where the type I multiplier (without import adjustment) is used to estimate the impact of the food expenditures on agriculture. Out of the $1 billion in food expenditures, 26.2 percent goes to retailers, 11.7 percent goes to the wholesale-transportation system, 56.5 percent goes to food processors, and 5.6 percent goes directly to agriculture. Some foods such as fresh fruits and vegetables, tree nuts, and eggs bypass the processing industries and go directly from the farm through the wholesale-transportation system into retail outlets. Food processors purchase the bulk of agricultural commodities for processing into the foods we eat.[5] Another source of indirect effects of food expenditures on agriculture is the use of agricultural commodities in the production of other agricultural commodities, such as feed grains for animal and dairy production. Given the direct and indirect effects, the $1 billion of retail food expenditures generates $267 million of agricultural production,

[5]The processing of agricultural commodities into the foods that we eat involves a complex network of industries. One set of industries purchases agricultural commodities and processes them into basic food products, such as flour from wheat, while another set of industries uses the basic foods to make more highly processed foods such as bread and the many prepared foods that we eat.

$87 million of agricultural GDP or value added, and close to 3,000 agricultural jobs (FTE-jobs plus self-employed).

Using the type I multiplier model adjusted for imports, the impact of $1 billion in food expenditures on domestic agricultural production, GDP, and employment is reduced by about 16 percent. The $73.4-million increase in agricultural GDP with the import adjustment is distributed between livestock (44 percent) and crop production (56 percent). The GDP impact on livestock is distributed among dairy (14.2 percent), poultry (7.8 percent), and cattle plus other animals (22 percent). The GDP impact on crops is distributed among grains (12.4 percent), fruits and vegetables (30.8 percent), and other crops (12.8 percent).

Now consider a $1-billion increase in SNAP benefits, which will increase retail food expenditures by $260 million (26 percent) and expenditures on nonfood goods and services by $740 million due to the shift of cash income from food to nonfood. Using the type I multiplier with import adjustment, agriculture receives $68 million in cash receipts from the sales of agricultural commodities (production). The additional sales lead to $23.5 million of agricultural value added or GDP, and close to 765 agricultural jobs (FTE-jobs plus self-employed). The increase in agricultural GDP is distributed between livestock (38 percent) and crop production (62 percent). The GDP impact on livestock is distributed among dairy (11.4 percent), poultry (6.1 percent), and cattle plus other animals (20.8 percent). The GDP impact on crops is distributed among grains (11.3 percent), fruits and vegetables (23.2 percent), and other crops (27.2 percent).

Finally, consider the case of a $1-billion increase in SNAP benefits with the type III multiplier with import adjustment. Given the direct, indirect, and induced effects from labor and capital income, the $1 billion of SNAP benefits generates $92.6 million of agricultural production, $32.3 million of agricultural GDP or value added, and close to 1,000 agricultural jobs (FTE-jobs plus self-employed).[6] The increase in agricultural GDP is distributed between livestock (38 percent) and crop production (62 percent). The GDP impact on livestock is distributed among dairy (11.4 percent), poultry (6.0 percent), and cattle plus other animals (20.6 percent). The GDP impact on crops is distributed among grains (11.4 percent), fruits and vegetables (22.3 percent), and other crops (28.3 percent). Most of the increase in GDP goes to the service industries (67.4 percent), while agriculture receives 1.8 percent; food processors, 2.8 percent; energy sectors, 3.2 percent; nonfood manufacturing, 7.6 percent; retail trade, 9.8 percent; and wholesale-transportation, 7.4 percent.

[6]With the type II multiplier (including import adjustment), the $1 billion of SNAP benefits generates $83.1 million of agricultural production, $28.9 million of agricultural GDP, and 938 agricultural jobs (FTE-jobs plus self-employed). The distribution of these impacts among agricultural sectors is identical to the distribution for the type III multiplier.

Comparing and Reconciling Multipliers With Macroeconomic and IOM Models

This section first compares the multiplier effects from an IOM model with those from several macro-economic models. It then discusses how to reconcile the jobs impact from an IOM model with those derived using the method recommended by the U.S. Executive Office of the President, Council of Economic Advisors (2009; CEA in subsequent citations).

Comparison of Multipliers from Alternative Macroeconomic Models

There is considerable debate on the appropriate macroeconomic model for analyzing the multiplier effects from a countercyclical fiscal policy. The effect of fiscal policy on real economic activity (real GDP) is sensitive to model assumptions regarding household behavior (myopic vs. forward-looking), market adjustment to disturbances, and monetary policy. Several studies present multipliers from alternative macroeconomic models that have contributed to the debate on expected multiplier effects of government expenditures funded by the ARRA during the 2008 recession.

Romer and Bernstein (2009) estimate GDP multipliers for an increase in government purchases and a decrease in taxes using the Federal Reserve FRB/US model and a model from a leading private forecaster. They assume an accommodative monetary policy in which "the federal funds rate remains constant rather than increasing in response to the fiscal expansion, on the grounds that the funds rate is likely to be at or near its lower bound of zero for the foreseeable future" (p. 12). Their analysis finds that an increase in government purchases results in a GDP multiplier of 1.56, and a tax cut results in a multiplier of 1. They state that these multipliers "represent a consensus among economists and professional forecasters" (p. 3).

Zandi (2008b) used a macroeconomic model to analyze the GDP multiplier from various spending and tax proposals considered for the 2009 stimulus package. The model is specified so monetary policy is accommodating, and government borrowing has little or no crowding out effects (Zandi, 2008a; 2009). Simulations of the model result in GDP multipliers of 1.73 for SNAP benefits, 1.63 for unemployment insurance benefits, 1.38 for general aid to States, and 1.59 for infrastructure spending. A weighted average of these GDP multipliers is 1.50 using weights from CBO (2009a) budget estimates for ARRA expenditures. The weighted-average multiplier for government expenditures is close to the Romer and Bernstein GDP multiplier of 1.56 for government purchases, and Zandi's GDP multiplier of 1.73 for SNAP benefits corresponds to the 1.79 GDP multiplier (type III) from the FANIOM model.

Though these two studies dominated discussions among Congress and the Obama Administration about the expected impact of ARRA expenditures, other analyses illustrate the range of GDP multiplier effects generated by macroeconomic models (see table 2 and appendix of CBO, 2010). For instance, Cogan et al. (2009) contend that the GDP multiplier is less than 1 while Hall (2009) suggests that it can rise to 1.72. Hall's analysis illustrates how interest rates near the zero bound allow a fiscal stimulus to occur without crowding out private sector investment. Cogan's analysis illustrates that multiplier effects are significantly reduced by model assumptions that households are forward-looking with perfect foresight and that unemployment as a labor market adjustment problem does not exist.

Reconciling FANIOM Jobs Impact Estimates with CEA Estimates

Romer and Bernstein (2009) is the basis for the Council of Economic Advisors (CEA)-recommended method for estimating the jobs impact from government expenditures funded through the American Recovery and Reinvestment Act of 2009 (CEA, 2009).

There are four steps in the CEA method to estimate the jobs impact from government expenditures:

1. Start with a GDP multiplier of 1.56 for all types of government expenditures, including spending on goods and services, transfers to States, and transfer payments to households. The multiplier is derived from simulation experiments with several macroeconomic models.
2. Assume that a 1-percent increase in GDP will increase employment by 1 million jobs. CEA states that this is a "conservative rule of thumb" that allows for higher productivity as a means by which GDP rises in response to a fiscal stimulus (Romer and Bernstein, 2009, p. 3).
3. Calculate that a $100-billion increase in government spending creates 1,085,355 job-years. Derive the jobs impact by applying a 1.56 GDP multiplier to the $100-billion increase in spending to get a $156 billion increase in GDP, which is about 1.085355 percent of GDP in 2008 ($14,373 billion, prior to revisions). At 1 million jobs per 1-percent increase in GDP, the 1.085355-percent increase in GDP results in the 1,085,355 jobs from a $100 billion increase in spending.
4. Divide the $100-billion increase in government spending by the 1,085,355 jobs to get the CEA rule of thumb that a $92,136 increase in government spending creates 1 job.

The CEA-estimated jobs impact, based on macroeconomic analysis, is less than the jobs impact from the FANIOM model based on input-output analysis. By the CEA method, $1 billion of SNAP benefits generates 10,854 jobs (divide 1,085,355 jobs by $100 billion). With the FANIOM type III multiplier, the jobs impact from $1 billion of SNAP benefits is 17,900 FTE-jobs plus self-employed (table 1). The jobs impact from the FANIOM model is 65 percent larger than the CEA jobs impact. It is not clear what job measure CEA uses (FTE-jobs or FTPT-jobs) and whether it includes the self-employed, but the more comprehensive jobs measure is the FTE-jobs plus self-employed. The FANIOM type II jobs impact is 33 percent (FTE jobs) larger than the CEA estimate, while the type I jobs impact is 18 percent

(FTE jobs) smaller than the CEA jobs impact estimate. The type III multiplier is most similar to the multiplier process in a macroeconomic model where consumption depends on income derived from all sources, labor, and capital. The difference in the jobs impact from these two types of models is significant enough that it needs some explanation and discussion as to how the estimates might be reconciled.

The difference in the jobs impact estimates is from differences in (1) the magnitude of the GDP multiplier and (2) the jobs-to-GDP (production) ratio. First, the 1.79 type III GDP multiplier is 15 percent more than the CEA 1.56 multiplier. The CEA multiplier was derived for government expenditures in general, whereas the FANIOM multiplier is for SNAP benefits, which are likely to be larger since SNAP recipients tend to spend all the benefits quickly. Multiplier estimates for other types of government expenditures from Zandi (2008a) support a larger multiplier for SNAP. Increasing the CEA multiplier from 1.56 to 1.79 would increase the CEA jobs impact to 12,500 jobs per $1 billion of SNAP benefits, a 15-percent increase. This reduces the gap between jobs-impact estimates from 65 percent to 43 percent. Differences in household saving and tax rates between models could also contribute to the difference in multipliers, but these are difficult to check without detailed information about the macroeconomic model (which is not readily available). Features of a macroeconomic model that do not affect an IOM model could also reduce the GDP multiplier effects relative to the IOM multipliers. These offsets include price and interest rate effects. But, given the assumptions about underemployed resources and accommodating monetary policy to hold interest rates low, the multipliers from Zandi and Romer/Bernstein are unlikely to be reduced by the offsets.

A second reason for the difference in estimated jobs impact is that the change in number of jobs corresponding to a change in GDP is smaller in the CEA analysis than with the FANIOM model.[7] The CEA analysis starts with the assumption that 1 million jobs are generated from a 1-percent increase in GDP. The FANIOM type III multiplier results in 1.44 million more jobs (FTE-jobs plus self-employed) from a 1-percent increase in GDP, a 44-percent larger jobs impact. Though CEA does not document how they arrived at 1 million jobs per 1-percent increase in GDP, empirical analysis of the historical relationship between changes in the number of jobs relative to a change in GDP undoubtedly underlies this assumed value. CBO (2009c, 2009d) reports a similar ratio between changes in GDP and jobs. They use an empirical estimate of "Okun's Law" (Knotek, 2007) to calculate a change in the unemployment rate given a macro forecast on GDP, and then derive a change to employment from the change in the unemployment rate.

To approximate the ratio of change in the number of jobs to a 1-percent change in GDP, figure 5 displays the quarter-to-quarter change in the number of employees (BLS, Current Employment Statistics, nonfarm payroll employees in thousands) as a ratio to the percent change in real GDP from 1979 to 2009. An average of these ratios is one estimate of the change in jobs as a ratio to the change in GDP. For the first quarter of 1979 (1979-1) through 2009-1, the average ratio is 710,000 jobs per 1-percent change in GDP.[8] If the quarters 2000-3 to 2003-2 are excluded, the average ratio becomes 851,000 jobs per 1-percent change in GDP. The 2000-3 to 2003-2 time period includes the 2001 recession and a period of unusually slow job

[7]IOM models use an average jobs-to-production ratio to calculate the jobs impact from a production multiplier. The IOM model also calculates the change in GDP so it is possible to calculate a ratio of the change in jobs to a change in GDP. A difference in the employment measure for the number of jobs could contribute to the difference in the jobs impact, but it is not clear since the CEA does not define how employment is measured. The difference is likely to be 10 percent or less.

[8]Extreme values for three quarters are excluded (1990-3, 2007-1, and 2007-4). The employment measure does not include agricultural labor and self-employed, so it undercounts the change somewhat.

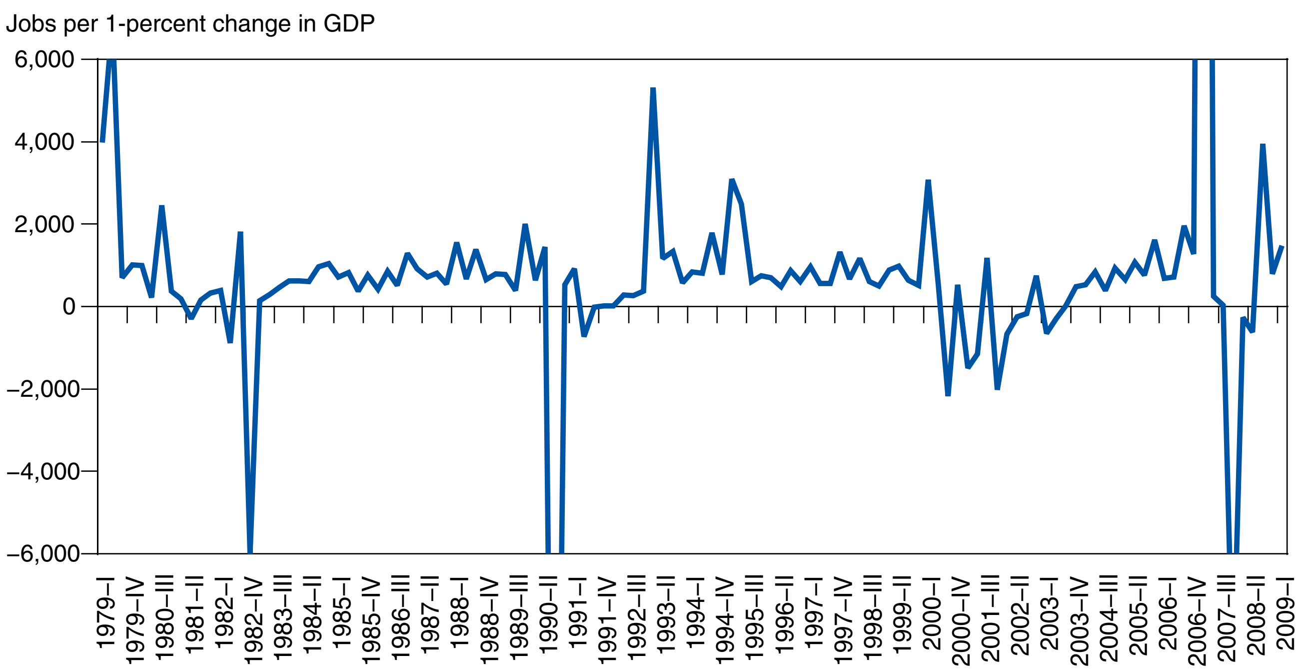
recovery following the recession (Groshen and Potter, 2003). Over a shorter and more recent timeframe of 1992-1 to 2009-1, the average ratio is 973,000 jobs per 1-percent change in GDP when excluding the 2000-3 to 2003-2 period, or 703,000 jobs when including it.

An analysis of quarterly data suggests that the historical relationship between change in jobs and change in GDP is comparable to or somewhat less than 1 million jobs per 1-percent change in GDP. This supports the CEA jobs impact relative to the larger jobs impact with the type III multiplier from the FANIOM model. The empirical analysis calls into question the use of an average jobs-to-production ratio to calculate the jobs impact from a change in production, as conducted in the FANIOM and other IOM models. One explanation for a smaller jobs impact is that an increase in production activity by existing businesses will increase the number of production-workers only since nonproduction workers such as managers and support staff like accountants are already working and will not be affected by the increased production activity (see appendix 1 for a definition of production-workers). This is a different situation than a new business hiring all types of new workers, and can explain how a change in jobs to a change in GDP (production) is smaller than an average jobs-to-GDP (production) ratio.[9]

Exploratory analysis with the FANIOM model modifies the jobs impact estimate by allowing only production workers plus the self-employed to respond, which leads to smaller induced effects from earnings by a smaller number of new workers, and smaller type II and III multipliers. The increase in production workers is calculated, as with other employment measures, by multiplying the change in industry production by the industry ratio of production workers plus self-employed to production. The increase in labor

[9]Tschetter (2010) uses an average jobs-to-production ratio to calculate the number of jobs that support U.S. exports and distinguishes the estimate from what would be the number of jobs associated with a change in exports.

Figure 5
Quarterly change in employment per 1-percent change in real GDP, 1979-2009



Source: ERS calculations from BEA-NIPA data on GDP and BLS data on CES employment.

Table 2
Economic effects from the estimated increase in SNAP benefits for 2009

	FANIOM FTE jobs + self-employment impact		FANIOM Prod-jobs + self-employment impact		CEA	
	GDP, $ bil	*# jobs*	*GDP, $ bil*	*# jobs*	*GDP, $ bil*	*# jobs*
From $1 billion of SNAP benefits	1.79	17,900	1.34	12,500	1.56	10,854
From total increase in SNAP benefits	27.642	275,958	20.658	192,708	24.050	167,332
From caseload increase	19.014	189,823	14.210	132,558	16.543	115,103
From maximum benefit adjustment	8.628	86,135	6.448	60,150	7.507	52,229

Source: ERS calculations.

income is calculated by multiplying the increase in production workers plus self-employed by an average industry wage, which is set by dividing total industry labor income (including proprietors' income) by total industry employment (FTE-jobs plus self-employed).

The type II production and GDP multipliers are 2.36 and 1.12 when only production workers plus self-employed adjust, down from 2.67 and 1.45 when all jobs adjust (see table 1, FTE plus self-employed). The type III production and GDP multipliers are 2.84 and 1.34 respectively, down from 3.31 and 1.79 when all jobs adjust. For the type II multiplier, the jobs impact is 10,400 production workers plus self-employed per $1-billion increase in SNAP benefits, while the jobs impact for the type III multiplier is 12,500 production workers plus self-employed per $1 billion of SNAP benefits. This jobs impact is only 15 percent larger than the CEA jobs impact estimate of 10,854 jobs per $1 billion of government expenditures, while the jobs impact from the type II multiplier is essentially equal. But now the type III GDP multiplier is about 15 percent less than the CEA multiplier (table 2).

Table 2 summarizes the estimated GDP and jobs impacts for $1 billion of SNAP benefits and for the CBO (2009a,b,d)-estimated increase in SNAP benefits in 2009 (see table in box, "SNAP Response to the 2008 Recession"). The total increase in SNAP benefits is derived both from the increase in caseloads and from the 13.6-percent increase in the maximum benefit amount. The first two columns in table 2 are the GDP and jobs impact from the FANIOM model with the type III multiplier and full jobs adjustment. The fifth and sixth columns are the GDP and jobs impact using the CEA method. Relative to the CEA method, the type III multiplier from the FANIOM model has a 15 percent larger GDP multiplier and a 65 percent larger jobs impact. The third and fourth columns are the GDP and jobs impact from the FANIOM model when only production workers plus self-employed adjust. In this case the jobs impact from the FANIOM model is 15 percent greater than the CEA jobs impact, but consistent with a CEA jobs impact if the GDP multiplier were 15 percent larger (increased from 1.56 to 1.79). From the perspective of consistent results, the GDP multiplier from the FANIOM model falls to 1.34 when only production workers plus self-employed adjust.

Limitations of an IOM Model

The underlying assumptions of an IOM model impose limitations on using the model to analyze the economic effects from a fiscal stimulus. Limitations include those due to the IOM model's linear structure and use of average coefficients. Also, an IOM model does not allow for price effects, interest rate effects, or several other economic adjustments that could arise in response to a fiscal stimulus and reduce the multiplier effects relative to those from an IOM model. These economic adjustments to a fiscal stimulus are designed into macroeconomic models. Depending on economic circumstances and specification of these adjustments in a macroeconomic model, these models can result in multipliers that are as large as the GDP type III multiplier from an IOM model (offsetting factors have little to no effect on the multiplier), or they can result in multipliers that are zero because economic adjustments fully offset the multiplier effects from an IOM model.

Linear Structure of the IOM Model and Fixed Prices

The linear structure of an IOM model results in the same multiplier for any magnitude of exogenous change to a specific component of final demand. So, for instance, the linear structure of the model allows the 1.79 type III GDP multiplier calculated from a $1-billion change in SNAP benefits to be used to estimate the GDP impact from a change in SNAP benefits of any magnitude. Of course, this cannot be true for all magnitudes of change in SNAP benefits, for at some magnitude of change the underlying assumptions of the model will be violated. For instance, an IOM model assumes that the exogenous change in demand affects the demand and supply of goods and services, and not prices. For this to occur, the resources for increasing production—namely labor and production capacity— must be available. If resource constraints exist, then the increase in demand will cause prices to increase, reducing the multiplier effects on production, GDP, and employment.

Key economic conditions of an economic downturn include high unemployment, low utilization of production capacity, and low inventory levels. Under these conditions, an increased demand for goods and services from government expenditures will stimulate production rather than simply causing pressure on prices or a rundown of inventories. They are the economic conditions for which an IOM model is appropriate for calculating the multiplier effects of government expenditures. Excess capacity and high unemployment during the 2008 recession suggest that the economy can absorb the new demand from the fiscal stimulus package with little or no price effects. Inventory reduction since mid-2008 suggests that new demand for goods will stimulate new production activity.

Use of Average Coefficients From Base-Year Data

The parameters of the linear IOM model are calibrated with data from the input-output accounts, NIPA, and employment measures. The coefficients are average values from data in a base year, but they are used to determine the change to an endogenous variable in response to a change in the exogenous variable, which is a marginal change. Ideally, marginal coefficients should be used in the model, but in most cases either the average coefficient is a good approximation to a marginal coefficient or there is not enough information to reliably estimate a marginal coefficient. Still, there are situations where the distinction between an average and marginal coefficient is important and it may be preferable to replace an average coefficient in the model with a marginal coefficient. An example is the use of average jobs-to-production ratios in estimating the jobs impact from an increase in economic activity (production or GDP). When an IOM model is used to assess the jobs impact from a business startup, the business can be expected to hire an industry average number of jobs per unit of production. If a business is already in operation and receiving additional orders, a marginal jobs coefficient may be more appropriate. It may not be necessary to hire as many new workers as are used on average, since occupations such as managers and support staff may not take on additional work. One way to approximate a marginal jobs coefficient is to allow an expansion of production workers only as production increases.

Household consumption coefficients as well as tax and savings rates are other examples where average coefficients could be improved upon with marginal coefficients if available. Average consumption coefficients are the share of total household expenditures spent on each good and service in the personal consumption expenditures data of the input-output accounts. Average tax and savings rates are calculated from NIPA data on how much households save or pay as tax during the year relative to average household income during the year. For an increase in income or SNAP benefits, the change to consumption, savings, and taxes may be more or less than the average. Specification of marginal consumption, tax, and savings rates from empirical studies of household behavior is worth pursuing, but beyond the scope of this report.[10]

[10]A related model extension is to disaggregate households into different types of households, where expenditure patterns and the distribution of labor and capital income from the induced effects may differ by household type.

Budget Deficits, Interest Rate Effects, and Monetary Policy

Government borrowing to finance fiscal stimulus expenditures may compete with private sector borrowing on financial markets. This can put upward pressure on interest rates, which can reduce business investment and interest-sensitive household purchases such as homes and durable goods. This financial market effect from deficit spending is referred to as crowding out, and may partially offset the multiplier effect of the fiscal stimulus. At issue is how much interest rates will rise in response to government borrowing, and how much business investment and household expenditures will fall in response to the rise in interest rates (Blinder and Solow, 1973; IMF, 2002).

The CBO (2005) summarized the literature to find that a “sustained increase in the federal deficit amounting to 1 percent of GDP raises interest rates by roughly 20 to 60 basis points, with the weight of the evidence around 30 basis points,” concluding that, “Overall, the effects of federal deficits on interest rates are small” (p. 4). At the same time, there is a need for a commitment to medium-term fiscal sustainability to accompany any short-term fiscal stimulus (IMF, 2008). If the fiscal stimulus is seen by markets as compromising fiscal sustainability, it can lead to rising real interest rates.

As for the impact of interest rates on investment, empirical evidence suggests that business investment is determined more by expected output growth than by user cost of capital (Chirinko, 1993; 1999). Furthermore, when the economy is in recession, interest rates are low, so an increase in interest rates will not be the most significant factor in the business investment decision. Household demand for housing is highly sensitive to interest rates, and normally it would fall due to higher interest rates. Zandi (2008a) suggests that, during the 2008 recession, the interest rate effect on housing demand was muted given other housing market problems.

Overall, the empirical evidence suggests that crowding out during a recession is not significant. Still, as the government's accumulated debt rises, it can and will eventually raise interest rates. It is important that the government maintain a longrun plan for debt management.

Other features of the economy can eliminate or at least reduce crowding out of investment, as when the Federal Reserve uses an accommodative monetary policy that holds interest rates steady while the government borrows to finance deficit spending. This was done during the 2008 recession. Crowding out is also a non-issue when interest rates are near zero and the excess funds in the financial system are not being used by private businesses. Under this circumstance, government borrowing to finance deficit spending will not cause interest rates to increase enough to affect investment (Blinder, 2006; Krugman, 2005; Feldstein, 2009). Zandi (2009) suggests that Federal borrowing to finance the stimulus will not lead to excessively higher long-term rates while private bond issuance is depressed, as in the 2008 recession.

Household Savings

Government expenditures as a fiscal stimulus during an economic downturn are funded through government borrowing or deficit spending. At some point in the future, the borrowed funds need to be repaid. Higher income households may expect taxes to be raised in the future to reduce the deficit. And some of these households may increase savings and reduce spending when the government is trying to stimulate the economy with deficit spending, which will reduce the multiplier effects from the fiscal stimulus. These households are considered to be forward-looking with rational expectations and make current consumption-savings decisions in the context of permanent income, or the discounted present value of lifetime income. Other households, for reasons such as myopic expectations and liquidity constraints, make current consumption-savings decisions in the context of current disposable income. They do not reduce current consumption in anticipation of higher taxes, which allows the multiplier effects from the fiscal stimulus to occur.

How households form expectations and make consumption and savings decisions are important features of a macroeconomic model and significantly affect the multiplier from a fiscal stimulus (Bernheim, 1989). The bulk of empirical research finds that household consumption is more sensitive to current income than the permanent income hypothesis would imply (Elmendorf and Mankiw, 1999; Blinder, 2006; Gale and Orszag, 2004). Other studies support the notion of forward-looking households that are free of liquidity constraints (Taylor, 2009). Still, most empirical evidence suggests that the effect of deficit spending on savings and consumption will not significantly reduce the multiplier effects.

Conclusion

The Food Assistance National Input-Output Multiplier (FANIOM) model can be used to provide a systematic exploration of the multiplier effects on economic activity from an exogenous change in final demand. Different types of multipliers (types I, II, and III) can be estimated for various economic variables (e.g., production, GDP, and jobs). This allows the modeler to use the multipliers that are appropriate to the issue being addressed and to compare them to ones calculated by other IOM models and macroeconomic models.

SNAP benefits are a fiscal stimulus whose effects on the economy can be measured with the FANIOM model as multiplier effects. For SNAP benefits, the FANIOM GDP Type III multiplier of 1.79 is an appropriate update for the 1.84 multiplier reported in Hanson and Golan (2002), which is often cited as $9.20 (or $9) of economic activity generated from $5 of SNAP benefits. Though the two multipliers are different—one is a type III multiplier for GDP (1.79) and the other is a type I multiplier for production (1.84) —they each express an overall impact on economic activity. The type III GDP multiplier is a comprehensive multiplier that accounts for the direct, indirect, and induced effects from labor and capital income, and is equivalent to a GDP multiplier from macroeconomic models. The Hanson and Golan (2002) multiplier of 1.84 should be replaced with the new FANIOM model result, such that $1.80 of economic activity (GDP) is generated from $1 of SNAP benefits (rounding off). Essentially, the multiplier estimates are the same, but based on an improved model that uses more recent data.

The GDP multiplier of 1.79 is close to that estimated for SNAP benefits by Zandi (2008a) using a macroeconomic model (1.73). Though larger than the 1.56 multiplier estimated by Romer and Bernstein (2009) for government expenditures, the new GDP multiplier is not inconsistent with it when taking into account the multiplier effects from different types of government expenditures. A weighted average of multipliers from Zandi (2008a) is 1.50, where the SNAP multiplier is 1.73 and the multipliers for other types of government expenditures are lower. The GDP multiplier from the FANIOM model reconciles well with the multipliers from these analyses using macroeconomic models.

Jobs impact estimates from the FANIOM model range from 9,000 to 18,000 FTE-jobs plus self-employed per $1 billion of SNAP benefits, with the range varying by type of multiplier. Ideally, the larger jobs impact (17,900 in table 1) would be used in analysis that uses the corresponding 1.79 type III GDP multiplier. This jobs estimate of 17,900 corresponds to 1.44 million jobs per 1-percent change in GDP, but empirical analysis of quarterly GDP and employment data suggests that between 700,000 and 1 million jobs are generated per 1-percent change in GDP. This range is consistent with the findings from several macroeconomic models that have been used to estimate the jobs impact from ARRA expenditures (U.S. EOP, CEA, 2010, p. 26, table 8). Romer and Bernstein (2009) assume 1 million jobs are generated from a 1-percent change in GDP, which amounts to 10,850 jobs per $1 billion of government expenditures given their 1.56 GDP multiplier. The higher jobs impact from an IOM model is an issue that needs to be resolved if the type III multiplier is to be used to assess the jobs impact from ARRA expenditures. Until that issue is resolved, it seems most appropriate to use the jobs impact from the type I multiplier: 9,000 FTE-jobs plus self-employed or 10,000 FTPT-jobs plus self-employed per $1 billion of SNAP benefits. These jobs impact estimates are more consistent with those estimated using the CEA-recommended method.

In an IOM model such as FANIOM, the jobs impact is calculated by multiplying the average jobs-to-production ratio by the change in production that occurs in response to the fiscal stimulus. This method of calculating the jobs impact assumes that new workers are hired for all occupations in a business in proportion to average industry employment. Another possibility is that only additional production-workers are hired as production increases. Additional nonproduction workers such as managers and support staff (e.g., accountants) may not be hired as production increases.

As an experiment, the FANIOM model was modified to allow only production-workers plus self-employed to adjust in response to a fiscal stimulus. In this case, the jobs impact for the type III multiplier is 12,500 jobs for $1 billion of SNAP benefits. This jobs impact estimate is only 15 percent larger than the CEA estimate of 10,850 jobs. Given the smaller jobs impact, the induced effect from labor income is smaller, reducing the type III GDP multiplier to 1.34, which is about 15 percent less than the GDP multiplier of 1.56 estimated by Romer and Bernstein (2009). This experiment shows promise and merits further exploration.

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Appendix 1—Employment Data by Industry

Employment data by industry consist of:

FTPT-jobs: count of hired full-time plus part-time workers;

FTE-jobs: count of hired full-time equivalent workers;

Self-employed: count of proprietors or self-employed;

Prod-jobs: count of production workers as distinct from nonproduction workers.

Data on FTPT-jobs for non-agriculture industries are derived by combining data from the BEA Regional Economic Accounts, State Personal Income and Employment tables with BLS employment projections (based on historical data on industry employment). The BLS employment projections data use the BLS, Current Employment Statistics (CES), while providing more detail for some industries such as construction and government and including a few data adjustments relative to the CES data.[1] The BLS data are used to disaggregate the more aggregated BEA industry employment data. It is possible to use the BLS industry employment data and get similar industry employment numbers for most industries, but BEA makes a few additional data adjustments that improve the count of FTPT-jobs in some industries.[2]

Agriculture includes 10 crop production industries (NAICS 111), four animal production industries (NAICS 112), and an industry of support activities for agriculture and forestry (called agricultural services, NAICS 115). For the two groups of farm industries (crop and animal production), the aggregate count of FTPT-jobs is from the BEA Regional Economic Accounts (870,000 hired workers). This count is similar to the count of 880,500 from USDA-NASS (see Farm Labor publication) and the count of 811,000 from USDA-ERS (see ARMS survey data).[3] The BEA aggregate farm employment count is distributed among the ten crop production sectors and four animal production sectors with data on hired labor from USDA-ERS, ARMS survey.

For the count of FTPT-jobs in the agricultural services industry, data from BLS, Quarterly Census of Employment and Wages for all employees in the private sector are used.[4] The count of FTPT-jobs is 309,000, which is in between the count of 581,000 in the BEA Regional Economic Accounts and the USDA-NASS count of 232,000, and significantly larger than the BLS employment projections count of 97,000. The BLS projections count is smaller since it is derived from the count of workers who report that agricultural services is their primary occupation in the Current Population Survey—it is likely that some of these workers have other occupations that may be reported as primary. It is not clear which of the other three sources for a count of FTPT-jobs in agricultural services is best so the middle value is used.

Data on FTE-jobs by industry are derived from the count of FTPT-jobs and a ratio of FTE-jobs to FTPT-jobs from BEA, NIPA tables 6.5 and 6.4 on industry employment as FTE and FTPT. Essentially, the NIPA data are at

[1] For BEA data see table SA27-wage and salary employment by industry, *http://www.bea.gov/regional/spi/*. For BLS data see the database for national employment, all employees, *http://www.bls.gov/ces/*. For BLS employment projections, see historical data on industry output and employment, *http://www.bls.gov/emp/empind2.htm*.

[2] See BEA Regional Economic Accounts: Methodologies, Local Area Personal Income and Employment Methodology for more details on the data adjustments, *http://www.bea.gov/regional/docs/lapi2007/*.

[3] For USDA-NASS data, see *http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1063*. For USDA-ERS data, see *http://www.ers.usda.gov/Briefing/ARMS/*. The BLS-CES data do not include employment for the agricultural industries, while the BLS employment projections data have a count of 1,010,000 hired workers for the farm sector. The larger value from the BLS data seems to compensate for a low count of hired workers in the agricultural service industry. For this reason, the BLS data are not used.

[4] See *http://www.bls.gov/cew/home.htm*.

3-digit NAICS, whereas the industry detail in the input-output accounts can be at 6-digit NAICS for some industries, so the same ratio is used for groups of industries.

Data on the count of self-employed persons by industry for nonfarm industries are taken from the BLS employment projections data. The data are the count of self-employed plus unpaid family workers by industry and are derived from the Current Population Survey. The 10.047 million total self-employed (including farmers) in the BLS projections data compares well with the total in the BEA NIPA data (table 6.7) of 9.963 million. The BEA notes that the count includes active proprietors or partners who devote a majority of their working hours to their unincorporated businesses. How partners are counted makes a significant difference in comparison with the BEA Regional Economic Account data where the self-employed count is much larger at 29 million because it includes all partners no matter how active they are in the business. For this reason the BEA regional data are not used. The count of self-employed for the farm industries are from the USDA-ERS ARMS survey data. The 1.781 million aggregate count for farm self-employed is almost twice the aggregate count of 0.945 million from the BLS employment projections data. The difference is due primarily to the ARMS data including proprietors who have other jobs that may be their primary occupation, whereas the BLS self-employed data are a count of proprietors who treat farming as their primary occupation.

The aggregate counts of the employment measures are comparable to published numbers in the BEA NIPA tables. The 137.653 million FTPT-jobs are slightly larger than the aggregate count of 136.578 million in the BEA NIPA table 6.4 for domestic industries. The 124.053 million FTE-jobs compares well with the aggregate count of 123.312 million in the BEA NIPA table 6.5. The 10.882 million self-employed workers are larger than the aggregate count of 9.963 million in the BEA NIPA table 6.7, due primarily to the treatment of self-employed farmers.

Production workers (prod-jobs) are distinguished from nonproduction workers in the BLS, CES survey data and in the historical database developed for BLS employment projections. In these databases, a production worker is not identical with the production occupation in the standard occupation classification system, but includes workers in this occupational category. Production workers in the CES and employment projections data are those workers directly involved with the production activity of the business. In the service industries, production workers exclude supervisory employees and owners. In goods-producing industries, production workers also exclude other categories of occupations that are not directly involved in production. This would include support staff such as accountants, secretaries, and administrative assistants. The distinction is not as precise as the distinction among standard occupational categories, but can still be useful for some types of economic analysis. The production-nonproduction workers are distinguished by industry at the 3- to 4-digit NAICS codes. On average, they account for about 75 percent of total jobs. In the FANIOM model, a percent of all FTE-jobs that are production jobs is calculated by industry. Also, 65 percent of the self-employed by industry are combined with the production workers for the employment measure “prod-jobs plus self-employed.”

Appendix 2—Reallocating Proprietors' Income From Capital to Labor Income

Proprietors' income is a part of industry operating surplus (capital income) in the input-output accounts. For this report, proprietors' income is taken out of capital income and added to labor income. This reallocation is consistent with the treatment of proprietors as labor and earning a return on their labor. In consequence, an increase in labor and labor income from a fiscal stimulus will involve an increase in work by proprietors and the income they receive from this work. Reallocating proprietors' income from capital income to labor income will affect the induced effects in the multiplier process. Both IMPLAN and RIMS II input-output multipliers include this reallocation of proprietors' income from capital income to labor income.

To reallocate proprietors' income in the input-output accounts from capital income to labor income by detailed industry, it is necessary to disaggregate the more aggregate industry data on proprietors' income from BEA NIPA table 6.12. This report uses detailed industry data on the number of proprietors by industry to disaggregate proprietors' income. As a result, all proprietors' income is treated as a return to labor, which is not a bad approximation since proprietors' income is net of consumption of fixed capital (depreciation), which can be treated as a return to capital and is included in the capital income of the input-output accounts. Proprietors' income is about 20 percent of capital income and about 12.6 percent of labor income.

Appendix 3—Food Assistance National Input-Output Multiplier (FANIOM) Model

The FANIOM model is programmed in the GAMS software where it is treated as a system of simultaneous equations (Brooke et al., 1992). Model parameters are calibrated to data from the 2002 Benchmark Input-Output Accounts data, National Income and Product Accounts, and measures of employment from various sources. The model is solved either as a system of simultaneous equations (PATH solver) or as an optimization problem where the change in industry production squared is treated as an objective function to be minimized subject to the system of simultaneous equations (MINOS or CONOPT solver). Still, the solution values are not affected by the choice of solution algorithms, nor by the use of GAMS instead of some other software to solve the IOM model. The advantage of using the GAMS software is in the specification of the model as a system of algebraic equations. This is particularly helpful in the treatment of the induced effects for labor and capital income, and for calculating the domestic multiplier effects by adjusting for the import share of demand. GAMS syntax provides flexibility in how these features of the IOM model are specified. For instance, the induced effects from labor income with only production workers adjusting is a straightforward modeling specification given the data.

The multiplier measures are calculated from the model solution values for industry production, GDP or value added, and employment. The change in the value of production, GDP, and employment from the initial base value relative to the exogenous change in final demand is the multiplier. Each type of multiplier (types I, II, and III, with or without import adjustment) is derived from a different model and solved separately in a sequence of model statements and solve statements. Summary reports of the results from the sequence of model solutions are easy to prepare.

Listed below are the variables, parameters, and model equations for the type III multiplier with import adjustment. The type III multiplier includes direct, indirect, and induced effects from labor and capital income, and an adjustment for imports that reduces the share of domestic demand that is fulfilled by domestic production. Specification of a few key parameters is also listed below. Value added/GDP and employment are not treated as variables, but are calculated from base ratios with industry production.

To clarify some of the model notation, uppercase names are endogenous variables and lowercase names are parameters. GAMS code is in terms of set notation. Industry-commodity set notation is "ic" and equivalently "jc." Industries and commodities are not distinguished in the set notation but they are distinguished in the input-output account make-and-use matrices as well as industry production, value added, and final demand.

There are subsets of "ic": "icmyes" is for industry-commodity where imports exist, "icyes" is for industry-commodity where production occurs, while "icnot" is where no production occurs. In the benchmark input-output accounts, there are several special industries-commodities that do not involve domestic production, and they are given special treatment in the input-output multiplier model so that change in final demand equals change in value added (see second-to-last equation). The special sectors are noncomparable imports (s00300), used goods (s00402), and rest-of-world industry (s00900). The last equation is a quadratic objective function that minimizes the squared change in industry production that occurs from an exogenous change in final demand (“dfd(ic)”).

Variables:

XDUP(ic)	Industry production
XDCOMUP(ic)	Commodity supply from domestic production
XXDCOMUP(ic)	Domestic commodity supply from domestic production
INTUSEUP(ic)	Intermediate use of (domestic and imported) commodity
FDUP(ic)	Final demand for commodity
IMPORTUP(ic)	Imports by commodity
CDUP(ic)	Household consumption by commodity
YHCON	Household income spent in consumption
YHGROSS	Household gross income
INCTAX	Household income tax
SAVINGS	Household savings
YHLABNET	Household income from labor net of labor tax (soc-sec & medical)
YHCAPNET	Household income from industry capital income (operating surplus)
VALABUP(ic)	Industry labor income including proprietors’ income
VACAPUP(ic)	Industry capital income or operating surplus net of proprietors income
ADJIOC(icnot)	Non-producing industry dummy variable
OBJIOM	Objective function value

Parameters:

iomc(ic,jc)	Make matrix, industry ic making commodity jc
iouc(ic,jc)	Use coefficient matrix, use of commodity ic by industry jc
export(ic)	Export of commodity ic
gd(ic)	Government demand, exogenous
invfxd(ic)	Fixed investment
dst(ic)	Inventory change
dfd(ic)	Exogenous change in final demand
mtoxratio(ic)	Import to x ratio, where x is domestic demand (intermediate plus final)
cdsh(ic)	Share of household income consumed on commodity ic
yhgovtrn0	Government transfer income to households
yhoth0	Other income to households
inctaxr	Household income tax rate, calculated from NIPA data

savr	Household savings rate, calculated from NIPA data
labtaxr	Labor tax for Social Security and Medicare, calculated from NIPA
data alabr(ic)	Ratio of industry labor income (include proprietors' income) to industry production
vacapr(ic)	Ratio of industry capital income (operating surplus) to industry production
yhcapfrac	Fraction of capital income that households receive, calculated from NIPA data
vat0	Total value added or GDP, summed over all industries from input-output account

Specification of Key Parameters for Multiplier Calculations:

XXDCOM(IC) = INTUSE(IC) + FD(IC) - IMPORT(IC)
MtoXratio(IC) = IMPORT(IC)/(INTUSE(IC) + FD(IC))
FD(IC) = CD(IC) + GD(IC) + INVFXD(IC) + DST(IC)
VALABR(IC) = VALAB(IC) / XD(IC)
VACAPR(IC) = VACAP(IC) / XD(IC)
JBR(IC,iemp) = JOBS(IC,iemp) / XD(IC)

Consumption adjusted for trade and transportation margins

CDTT(ICTT) = SUM(IC, IOMARGFD(IC,"F01000",ICTT))
CDMRKT(IC) = CD(IC) - CDTT(IC)
CDMRGR(IC,ICTT) = IOMARGFD(IC,"F01000",ICTT) / CDMRKT(IC)
CDPURCH(IC) = CDMRKT(IC)*(1+SUM(ICTT, CDMRGR(IC,ICTT)

Income data and calibration

yhlabnet0 = (1-labtaxr)*sum(ic, valab(ic))
yhcap0 = yhcapfrac * sum(ic, vacap(ic))
labtaxr = labtax0 / sum(ic, valab(ic))
yhcapfrac = 0.467
yhgross0 = yhcon0 + inctax0 + savings0
yhcon0 = sum(ic,cd(ic))
inctaxr = inctax0 / yhgross0
savr = savings0 / ((1-inctaxr)*yhgross0)
yhoth0 = yhgross0 - yhlabnet0 - yhcap0 - yhgovtrn0

Model Equations:

(1) XDUP(icyes)	=	SUM(jc, iomc(icyes,jc) * XDCOMUP(jc))
(2) XDCOMUP(icyes)	=	XXDCOMUP(icyes) + export(icyes)
(3) XXDCOMUP(ic)	=	INTUSEUP(ic) + FDUP(ic) - IMPORTUP(ic)
(4) INTUSEUP(ic)	=	SUM(jc, iouc(ic,jc) * XDUP(jc))
(5) FDUP(ic)	=	CDUP(ic) + gd(ic) + invfxd(ic) + dst(ic) + dfd(ic)
(6) IMPORTUP(icmyes)	=	mtoxratio(icmyes) * (FDUP(icmyes) + INTUSEUP(icmyes))
(7) CDUP(ic)	=	cdsh(ic)*YHCON
(8) YHCON	=	YHGROSS - INCTAX - SAVINGS
(9) YHGROSS	=	YHLABNET + YHCAPNET + yhgovtrn0 + yhoth0
(10) INCTAX	=	inctaxr * YHGROSS
(11) SAVINGS	=	savr * (1-inctaxr) * YHGROSS
(12) YHLABNET	=	(1-labtaxr) * sum(ic, VALABUP(ic))
(13) VALABUP(ic)	=	valabr(ic) * XDUP(ic)
(14) V ACAPUP(ic)	=	vacapr(ic) * XDUP(ic)
(15) YHCAPNET	=	yhcapfrac * sum(ic, VACAPUP(ic))
(16) -ADJIOC(icnot) * SUM(jc, iouc(icnot,jc) *XDUP(jc))	=	FDUP(icnot) + export(icnot) - IMPORTUP(icnot)
(17) OBJIOM	=	SUM(ic, (XDUP(ic)-XD(ic)) *(XDUP(ic)-XD(ic)))

Given the solution values for the model variables, the multipliers for production, GDP, and employment are calculated as follows:

TDFD	=	sum(ic, dfd(ic)) total exogenous change in final demand
TXDUP	=	SUM(IC, XDUP.L(IC)) total industry production after fiscal stimulus
DTXD	=	TXDUP - TXD total change in industry production *## adjustment of value added for special sectors with no production
IOUSEU1(IC)	=	SUM(JC, IOUC(JC,IC)*XDUP.L(IC))
IOUC(ICNOT,JC)	=	IOUC(ICNOT,JC) * ADJIOC.L(ICNOT)
IOUSEU(IC)	=	SUM(JC, IOUC(JC,IC)*XDUP.L(IC))
VAUP(IC)	=	VAR(IC) * XDUP.L(IC) + (IOUSEU1(IC)-IOUSEU(IC))
VAUPT	=	SUM(IC, VAUP(IC)) total value added or GDP after fiscal stimulus

DVAT	=	VAUPT – VAT0 total change GDP
JOBSUP(IC,iemp)	=	JBR(IC,iemp)*XDUP.L(IC) industry employment after fiscal stimulus
DJOBST(iemp)	=	SUM(IC, JBR(IC,iemp)*XDUP.L(IC)) - JOBST(iemp) total change in emp

Multiplier measures:

TIOEM("TOTAL","IOM-prod")	=	DTXD / TDFD
TIOEM("TOTAL","IOM-va")	=	DVAT0 / TDFD
TIOEM("TOTAL","IOM-hired")	=	1000* DJOBST("hired") / TDFD
TIOEM("TOTAL","IOM-fte")	=	1000* DJOBST("fte") / TDFD
TIOEM("TOTAL","IOM-self")	=	1000* DJOBST("self") / TDFD