Estimating nationwide impacts using an input-output model with fuzzy parameters

Michael L. Lahr [1] and Ganna V. Makarkina
Rutgers, The State University of New Jersey, New Brunswick, USA
"KROK" University, Kyiv, Ukraine

Abstract. An oft-forgotten feature of input-output models (IO models) is the inherent incompleteness and inaccuracy of the underlying survey data that are used to build them. Many different techniques have been applied to resolve these data issues. Here we introduce an approach based on the fuzzy set theory. To do so, we articulate the lack of reliability of technical coefficient values, assuming the quantities themselves are equivalently expressed as a finite set of discrete values. The discrete values reflect domains coefficient sizes. The domains are defined by quantitative (membership) functions—quasi-probability density membership functions—that parallel density functions of "true" cell values. The relative sizes of the domains of the fuzzy components suggest the relative reliabilities when bi-proportionally adjusting the I-O accounts, given known exogenous factors. The membership functions enable the use of a quasi-stochastic programing model to estimate fuzzy impacts of changes in final demand. Results of the fuzzy model are compared to results estimated via classically created IO model.

In this paper, we estimate impact of different elements of the final demand on the US economy. Gaussian membership functions are employed to describe the technical coefficients. The domains for the functions are defined via cluster analyses of data in the US Make and Use tables. The impacts derived from both absolute and relative changes in the final demand for separate industries and the group of independent industries on the gross output for 60 industries of the national economy are subsequently estimated via I-O model with the fuzzy matrix of technical coefficients.

We next extend the initial model by also fuzzifying different components of final demand: investment and international trade flows. After adding fuzzified versions of these components of national accounts, the technical coefficients are even further fuzzified. The known final demands on the US economy are re-estimated, now with fuzzified technical coefficients, investment, and trade. We still find the estimated difference between the fuzzy and classical results to be fairly small; this suggests that the fuzzy approach may be a promising way to update and reconcile input-output data.

[*] Corresponding author: lahr@ejb.rutgers.edu

Introduction

An input--output table is a basic framework to explore impacts on an economic system based on its structural characteristics. One of the main issues in estimating the impacts is incompleteness and inaccuracy of input-output data. Researchers highlight various causes of this issue: updating data irregularly, using different sources to build IO tables, lack of data, sampling and non-sampling measurement errors. Analysis of existing approaches that are used to update IO tables indicates that they do not always yield reasonable results, either because they ignore various errors in IO tables, because they do not reconcile different sources of errors, or because they are based on gross simplifications of reality.

To handle this issue, we propose a fuzzy approach for updating IO data that permits the estimation of impacts with sufficient accuracy using initial roughly hewn components of an input-output model. This approach employs the fuzzy set theory to articulate the lack of reliability of technical coefficient values, assuming the quantities themselves are equivalently expressed as a finite set of discrete values. The discrete values reflect domains coefficient sizes. The domains are defined by quantitative (membership) functions—quasi-probability density membership functions—that parallel density functions of "true" cell values. The relative sizes of the domains of the fuzzy components suggest the relative reliabilities when bi-proportionally adjusting the I-O accounts, given known exogenous factors. The membership functions enable the use of a quasi-stochastic programing model to estimate fuzzy impacts of changes in final demand.

Here we estimate impact of different elements in the final demand on the US economy. Gaussian membership functions are employed to describe the technical coefficients. The domains for the functions are defined via cluster analysis of data in the US Make and Use tables. The impacts derived from both absolute and relative changes in the final demand for separate industries and the group of independent industries on the gross output for 60 industries of the national economy are subsequently estimated via I-O model with the fuzzy matrix of technical coefficients.

We next extend the initial model by also fuzzifying different components of final demand: investment, export and import. The impact of the same elements of the final demand on the US economy is estimated using two I-O models: (1) I-O model with fuzzy technical coefficients and fuzzy investment and (2) I-O model with fuzzy technical coefficients, fuzzy investment and fuzzy international trade flows. Results of impact estimating for each fuzzy model are compared to results estimated via classically created I-O model.

2. Review of existing approaches to updating I-O data

Using I-O models for estimating different impacts should be based on complete and error-free data. In practice, the construction of I-O tables is associated with a lot of problems that can be grouped into three categories: data accuracy, data actuality, and data completeness.

The problem of *data accuracy* takes place because of the use of a variety of data sources to build the I-O tables. The main of data sources are the Economic Census, the Department of Agriculture, Education, and Energy, and data from a number of private organizations []. As a result, the initial I-O table is composed of dizzying array of different data sources, each of which contains its own sampling and measurement errors and, hence, inherent reliability. Data accuracy turns out to be a particular problem in international trade accounts kept by different countries; that is, exports of commodity x from Country A to Country B do not generally equal the imports of x that Country B received from Country A.

The problem of *data actuality* pertains to the lag in time between the date the accounts represent and the data of publication of the accounts. This lag occurs due to the time that is needed to process data from all possible sources into a reliable set of input-output accounts. Each added data source induces reconciliation issues, due to mutual definitional incompatibilities. For example, from survey to publication, in the United States it takes on the order of seven years to produce official quinquennial benchmark input-output accounts. Annual national income and product data are published with a shorter lag but also tend to offer less sector detail as a result. In essence data actuality becomes an issue because additional efforts are required to reconcile the heterogeneous data sets of the I-O table, which typically are collected at different time frequencies.

The problem of *data completeness* is associated with the inability of obtaining some official information for I-O tables. This can be either for certain cells or entire sections of I-O tables; in a fact, it may be that just a marginal amount of information for the tables. This can be an acute problem in many developing nations (e.g., Haiti, the Gaza Strip, and Afghanistan) as well as at the regional level for many developed nations. In the United States (U.S.), for example, no officially published regional I-O tables derived from survey data have ever been published; so collecting and reconciling information to build regional accounts in the U.S. requires specialized inferences and assumptions (Lahr, 2001b). Moreover, even in countries like U.S., which produce many industry-based data series at small areal levels, data for regional industries with a very small but nonzero set of establishments must often be interpolated due to government assurances during data collection that guarantee nonrelease of information that could reveal an establishment's competitive position (so called, "disclosure issues").

Analysis of existing methods indicates that researchers has focused the greatest attention on finding an efficient way of updating IO tables based on available data. In particular, there are the RAS method, the GRAS method, EUKLEMS method, the Kuroda's method, Euro method, Squared Differences methods and Harthoon and van Dalen's method. The results obtained by Temirshoev et al., 2011 show that the most effective among these methods are the RAS method, its modification GRAS method as well as Kuroda's method. According to Baranov et al., 2013, each of the methods can be formally presented as a mathematic problem for estimating a new matrix A "as closer as possible" to the given benchmark matrix A. It means minimizing the following criterion under constraints on equality row and column totals to given values:

$$F(\mathrm{x}) = \sum_{\mathrm{i,j}} \mathrm{f}_{\mathrm{ij}}(x_{\mathrm{ij}}) \to \min \tag{1}$$

where a function f_{ij} depends on a matrix A.

In particular, widely used for updating SAMs the RAS method is based on the bi-proportional transformation each element of a matrix A:

$$x_{\mathrm{ij}} = r_i a_{ij} s_j, \tag{2}$$

under constraints

$$\sum_{\mathrm{j}} r_i a_{\mathrm{ij}} s_j = SL_i, \ \sum_{\mathrm{i}} r_i a_{\mathrm{ij}} s_j = SC_j, \ \ i, j \in N \tag{3}$$

where a_{ij} - elements of matrix A; r_i, s_j - adjustment coefficient for rows and columns correction; SL_i SC_j - row and column totals; N – the number of industries.

In this case, we have the following minimization problem:

$$F(\mathrm{x}) = \sum_{\mathrm{i,j}} x_{\mathrm{ij}} \ln(x_{\mathrm{ij}} / a_{\mathrm{ij}}) \to \min \tag{4}$$

If a matrix A includes zero or negative elements, the GRAS method should be employed using the following criterion:

$$F(\mathrm{x}) = \sum_{\mathrm{i,j}} \left| x_{\mathrm{ij}} \right| \ln(x_{\mathrm{ij}} / a_{\mathrm{ij}}) \to \min \tag{5}$$

Using any of these methods, we update matrix A and estimate impacts by employing the following classical model:

$$x = (I - A)^{-1} y, \tag{6}$$

where $A = (a_{ij}), i \in N, j \in N$ – the matrix of direct input-output coefficients;

$x = (x_i), i \in N$ – the vector of gross output by industry;

$y = (y_i), i \in N$ – the vector of final demand by industry; N – the number of industries.

Equation (6) assumes a deterministic nature of a matrix of direct input-output (IO) coefficients (matrix A). In reality, this is not the case since, as noted earlier, various errors are inherent to the source data upon which I-O tables are based. It means, if **y** is perfectly known, **x** cannot be because matrix A is not deterministic. *So* **x** *can be obtained via Equation (1) only in exceptional cases*. Thus, deterministic methods only partially handle data issues above.

Due to builders of economic models continue to seek more efficient, cost-effective approaches that yield more accurate estimates of economic and environmental impacts. Such approaches were key in developing several time-series-based multiregional international input-output (world MRIO) databases (Tukker and Dietzenbacher, 2013). During development of these various databases, every one of the research teams dealt with issues of data accuracy, data actuality, and data completeness in different ways. On issues of data completeness, the EORA database made the most heroic leaps, as its national accounts for countries that have not produced I-O tables for decades (e.g., Argentina), if ever (e.g., Haiti). Indeed, the research team has told us that they focused "on standardization, automation, and advance computation" to achieve "labor and cost savings" (Lenzen et al., 2013, p. 39). Moreover, they admit (p. 39) that the "Results will generally be uncertain at the sectoral level and for small sectors, but not necessarily uncertain for small countries, especially not for small countries with high-quality I-O data." In this vein, Lenzen et al. (2006, 2009, 2010) have shown that unknown data are often not entirely unknowable; rather they have ranges and limits and sometimes even known probability distributions.

The above suggests that stochastic approaches might be applied. The stochastic nature of interindustry transactions, presented in a matrix of direct I-O coefficients as well as in Make and Use Tables, has been studied by Roland-Holst, 1989; Yermoliev and Yastremsky, 1997; Dietzenbacher, 2006 and others**.** Yermoliev and Yastremsky presented an approach that minimizes the variance inherent with our estimates of **x**. They note, if it is not possible to get the realistic balance using deterministic **y** and **x** due to nondeterministic nature of a matrix A, we at least want to find an approach that minimizes the variance inherent with our estimates of **x**. In particular, the output vector can be estimated by minimizing the expected sum of squared residuals:

$$M\left\|x - A(\theta)\cdot x - y\right\|^2 \xrightarrow[x]{} \min \qquad (7)$$

where $A(\theta)$ is the nondeterministic matrix of direct input-output coefficients that values depend on the state of the nature.

If elements of matrix $A(\theta)$ are interpreted as a random variable with a certain probability distribution function, we can find a solution to problem (7) using a stochastic programming problem. *The existence of nonnegative solution* to this problem was proved by Yermoliev and

Yastremsky (1997), who use a stochastic matrix of direct input-output coefficients to estimate the impact of a final demand vector on the output vector, given nonnegative values of final demand.

But sufficiently robust results from such an approach require knowledge of the statistical distribution of I-O matrix elements. Unfortunately, such distributions are rather expensive and complicated to obtain in practice. Therefore, stochastic methods tend to lean on assumptions that oversimplify reality and, thus data accuracy and data completeness issues remain intractable via application of such methods.

Considering cell estimation error in input-output tables as a combination of both sampling errors and bias (systematic measurement errors) (Thorobecke, 2003), we propose an approach that allows to estimate impact with sufficient accuracy using "smeared" initial data. This approach is based on the fuzzy set theory (Zadeh, 1975). The important feature of fuzzy models is the ability to process heterogenous input data increasing the overall reliability of outputs for the modelling object.

Firstly, we employ a fuzzy approach to describe the direct I-O coefficients using a finite set of Likert-type assessments (terms). The quantitative description of coefficients is transformed to quantitative (membership) functions with domain that reflects of coefficient sizes. These functions are presented as quasi-probability density functions, which enable to use of a quasi-stochastic programing to estimate fuzzy impacts. Next, we extend the initial input-output model by the fuzzification of different components of the final demand. We estimate impacts using two types of such model: an I-O model with fuzzy investment and an I-O model with fuzzy investment, export and import. To develop our I-O models with fuzzy parameters we used the data in the US Make and Use tables in 2009-2011. The impacts derived from both absolute and relative changes in the final demand for separate industries and the group of independent industries on the gross output for 60 industries of the national economy are subsequently estimated via three different I-O models with fuzzy parameters. Results of impact estimating for each fuzzy model are compared to results estimated via classically created I-O model. Then we analyze factors of error sensitivity.

3. The estimate impacts using an I-O model with a fuzzy matrix of direct I-O coefficients

If deterministic methods update a matrix A via a criterion of "closeness" this matrix to any given one and apply updated matrix to estimate impacts, then the Yermoliev-Yastremsky method finds a new output vector x via a criterion of "closeness" this vector to the vector x, estimated based on a stochastic matrix A and given final demand vector y. According to the Yermoliev-

Yastremsky method, a vector x is estimated as a solution of a stochastic programming problem. Let's consider employing a stochastic programming problem (7) in case of fuzzy interpretation for matrix A:

$$M\left\| x-\tilde{A}\cdot x-y \right\|^2 \xrightarrow[x]{} \min \tag{8}$$

where $\tilde{A}$ - fuzzy matrix of direct IO coefficients.

If $\tilde{A}$ is a fuzzy matrix of direct input-output coefficients, each element of the matrix is therefore the expected value for some continuous distribution function (the membership function) that can be interpreted mathematically as some probability density function (let's call it quasi-probability function). If each coefficient of the matrix is presented as the expected value of the appropriate quasi-probability function and the exogenous final demand vector is nonnegative, *the existence of a nonnegative solution* to problem (8) can therefore be assumed by analogy. It means that we can find the solution to this problem using a quasi-stochastic programming.

To implement the fuzzy interpretation of problem (8) for estimating economic impacts we use the following steps:

Step 1. The fuzzification a matrix of direct input-output coefficients.

Step 2. The estimate of changes in the gross output of industries as a result of impact different elements of the final demand for the US economy using an I-O model with fuzzy matrix A.

Step 3. The comparison of fuzzy results with corresponding ones obtained via a classical approach and the analysis of factors of error sensitivity.

Step 1. The fuzzification of a matrix of direct input-output coefficients is described in Appendix A. Using this approach, we define each I-O coefficient as the linguistic variable that values (terms) describe types of interindustrial relationship. The terms are described by fuzzy variables that correspond with fuzzy subsets. Using these subsets as domains, we define the membership function for each type of interindustrial relationship. Finally, each element of an existing matrix is updated by the expected value for the appropriate membership function. Thus, we get a roughly hewn fuzzy matrix A that contains only a limited set of different values of I-O coefficients.

In this case, we select the numeric intervals for fuzzy subsets by K-means clustering using the three matrices of direct input-output coefficients that were derived from Make and Use Tables for the US economy in 2009-2011. Next, based on the numeric intervals we identify continuous

Gaussian functions as the membership functions for seven types of interindustrial relationship. We estimated function parameters using MATLAB's *Fuzzy Logic Tool Box*. From this, we calculated expected value for each function.

As a result of this step, each input-output coefficient was replaced by the expected value of the membership function for its appropriate fuzzy variable α :

$$a_{ij} \rightarrow \tilde{a}_{ij} = M\left(\mu_{\tilde{A}(\alpha)}\right) \tag{9}$$

Step 2. We apply the fuzzy matrix of direct input-output coefficients to estimate the vector of gross output for all industries. Let's present the criterion (2) as following:

$$\sum_{i=1}^{N}\left[\sum_{j=1}^{N}\tilde{a}_{ij}x_j + y_i - x_i\right] \underset{x}{\rightarrow} min, i \in N, j \in N \tag{10}$$

where $\tilde{A} = (\tilde{a}_{ij}), i \in N, j \in N$ – the fuzzy matrix of direct input-output coefficients;

$x = (x_i), i \in N$ – the vector of gross output by industry;

$y = (y_i), i \in N$ – the vector of final demand by industry; N – the number of industries.

To estimate the vector x, criterion (10) is differentiated with respect to each x_i . Setting partial derivatives equal to zero, we have the following system of N equations:

$$\begin{gathered}\frac{\partial\left[\sum_{i=1}^{n}\left(\sum_{j=1}^{N}\tilde{a}_{ij}x_j + y_i - x_i\right)^2\right]}{\partial x_1} = 0; \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \frac{\partial\left[\sum_{i=1}^{n}\left(\sum_{j=1}^{N}\tilde{a}_{ij}x_j + y_i - x_i\right)^2\right]}{\partial x_N} = 0\end{gathered} \tag{11}$$

The system of equations (4) allows us to estimate the impact of elements of the vector of final demand y on the changes in the vector of gross output x.

Let's estimate the impact from the 10% increase in the final demand for separate industries on the gross output for 60 industries for the US economy using Equations (4). The Table 1, Appendix C contains the results of the estimate for the following industries:

- GOV – Government (the share in the total gross output is 9.75%);
- HS - Housing Services (6.03%);
- 42 - Wholesale trade (4.82%);
- 23 – Construction (3.91%);
- 722 - Food services and drinking places (2.46%);

- 523 - Securities, commodity contracts, and investments (1.57%);
- 484 - Truck transportation (1.00%);
- 326 - Plastics and rubber products (0.72%).

These results, presented in the column "Fuzzy", characterize the rate of change in each element of the vector x, calculated by formula:

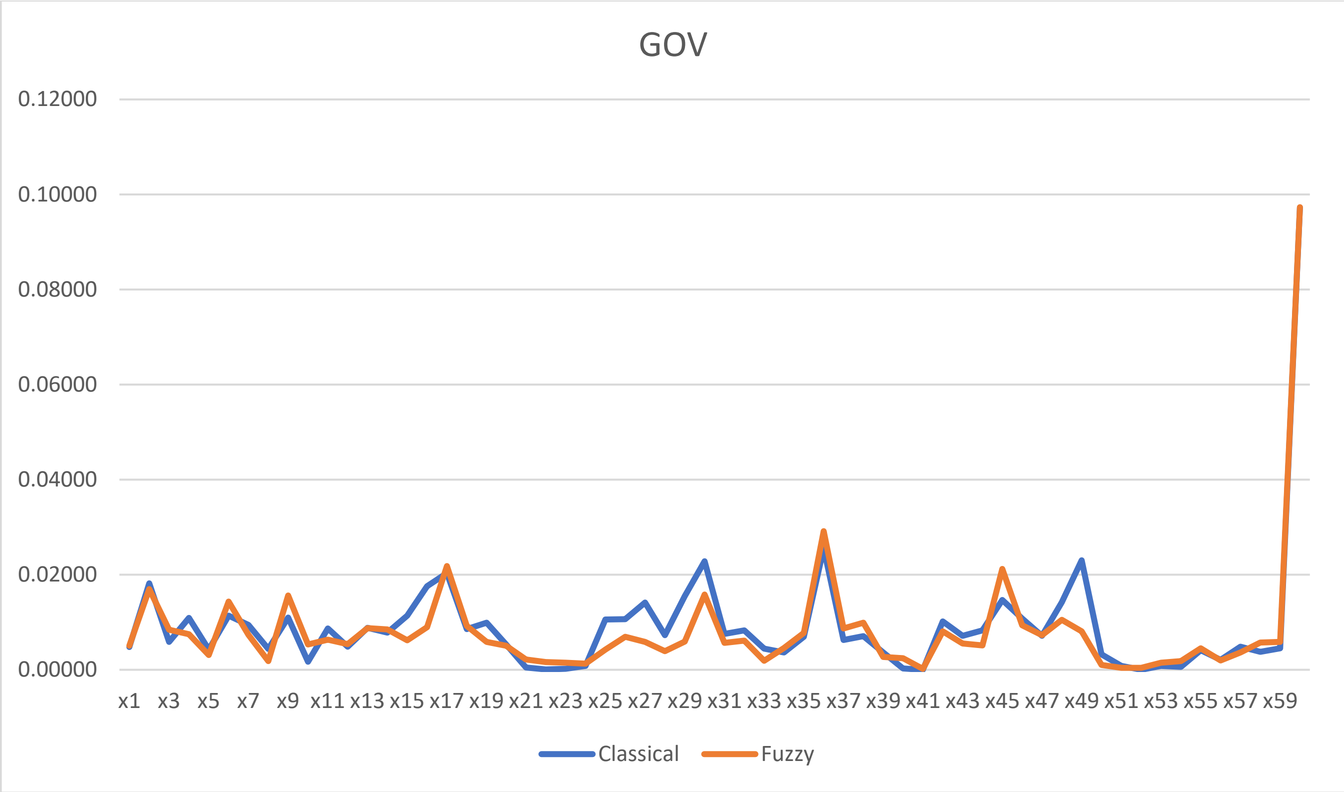
$$\tilde{\delta}_i = \frac{\tilde{x}_i^1}{\tilde{x}_i^0} - 1, i \in N \tag{12}$$

where $\tilde{x}_i^0$ - the basic value of gross output for the industry i, estimated using the basic vector of the final demand; $\tilde{x}_i^1$ - the new value of gross output for the industry i, estimated as a result of change in the vector of the final demand.

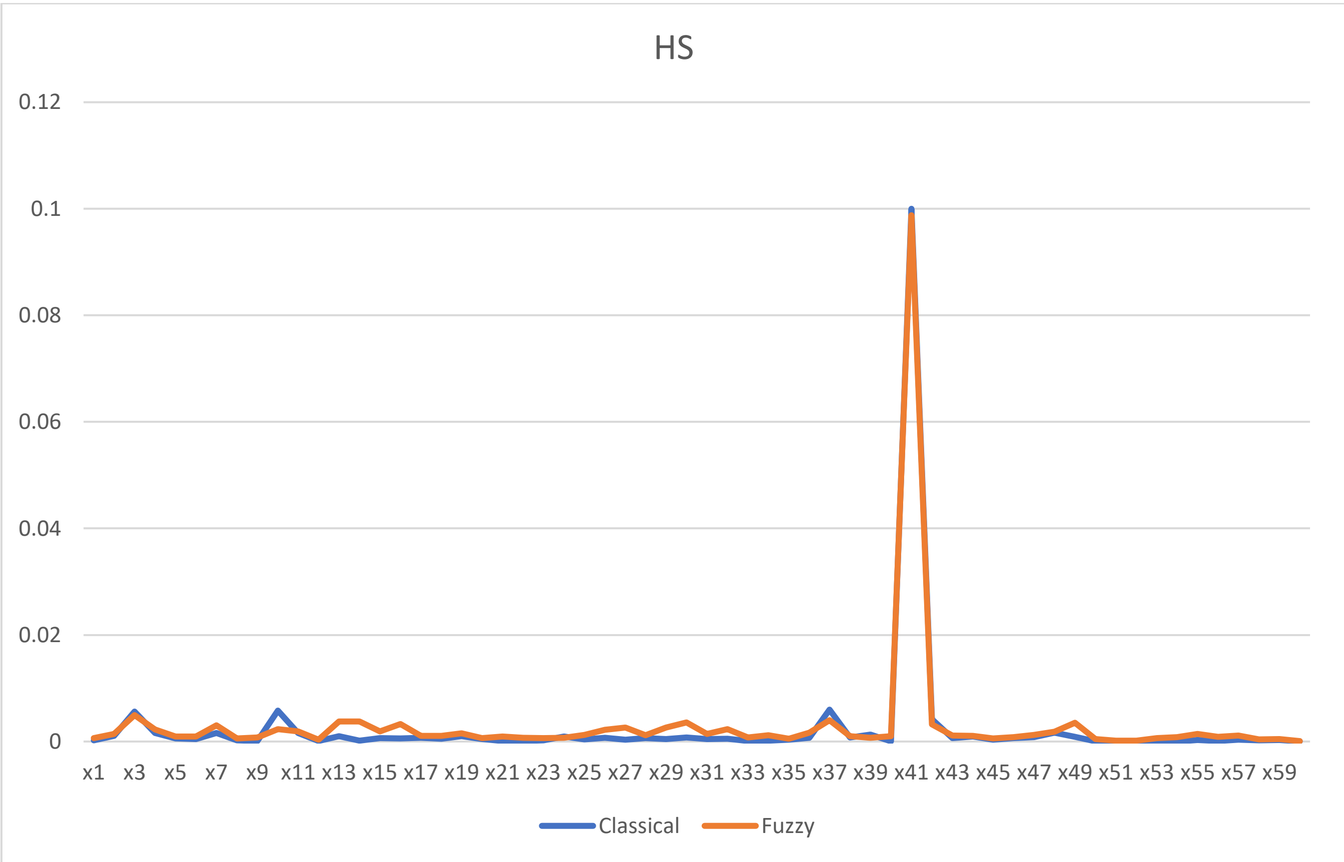
Step 3. To compare the fuzzy results with classical ones, we estimate the same impacts using the formula of classical multiplier (6). The classical rate of changes in the gross output is presented in the column "Classical" of the Table 1, Appendix C. The pictures 1-4 present the rate of change in the gross output for 60 industries of the US economy estimated for four of largest industries using both fuzzy and classical models. As we see, the fuzzy result is very close to classical one.

To measure the accuracy of the results, obtained using the I-O model with fuzzy matrix A (model 1), we calculate the estimation error as the absolute deviation between a fussy rate of change and a classical one expressed as a percentage. The estimation error for different industries is shown in column “Error 1” in Table 2, Appendix C and in Picture 5. In most cases the error does not exceed 0.5% that is a quiet sufficient result for an I-O model with a matrix of direct input-output coefficients described by only seven different values. The most significant error takes place for the industries with large share in the final demand of the US economy. For instance, the error maximum value 1.5% is obtained for the largest industry of the US economy - Government. Other major factor of error sensitivity is the source of change in the final demand: for five from eight observed industries the estimation error is largest for the industry where final demand is changed. Note, that except in the case of obtaining the very significant error as a result of change in the industrial final demand, *the largest errors are observed for the small industries that share in the total gross output for the US economy is from 0.1% to 0.4%*.

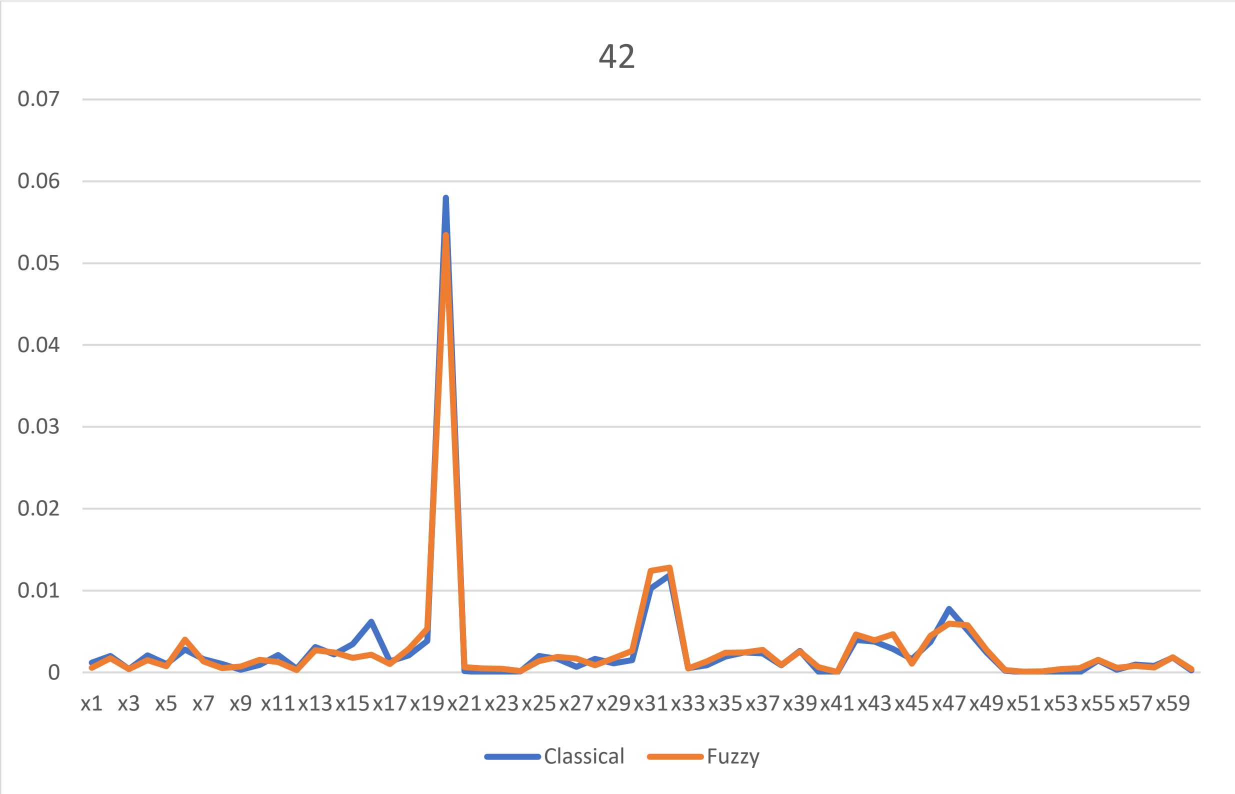
Now let's estimate impacts from the 10% increase in the vector of final demand y for different groups of industries (Table 1). Next, the same impact for all elements of these three groups is estimated, and finally this impact is estimated for all elements of the vector y. The estimation error is presented in column “Error 1” in Table 3, Appendix C and in Picture 6.



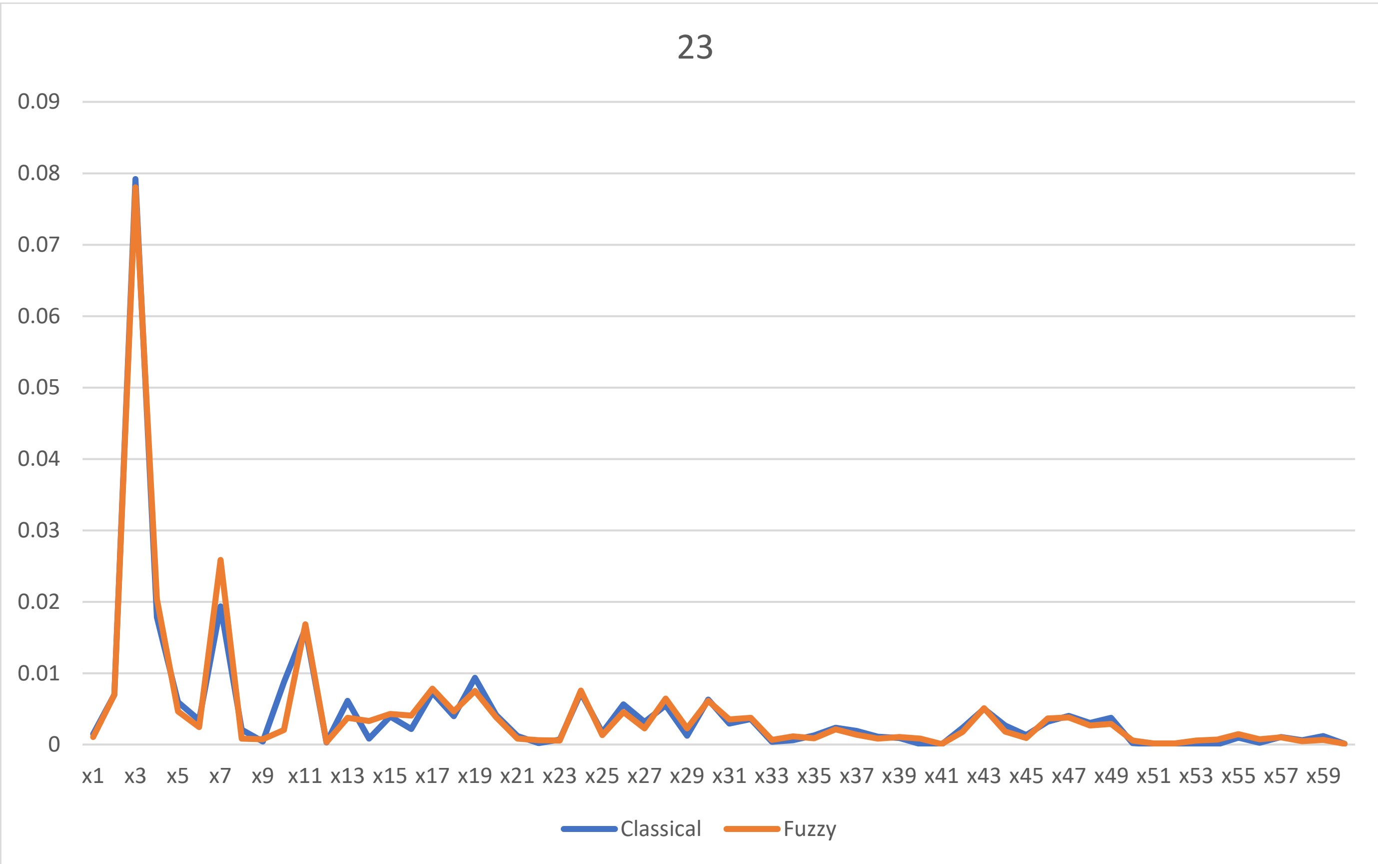
Pict 1. The classical and fuzzy rate of changes in the industrial gross output as a result of the 10% increase in the final demand for the industry Government (GOV)



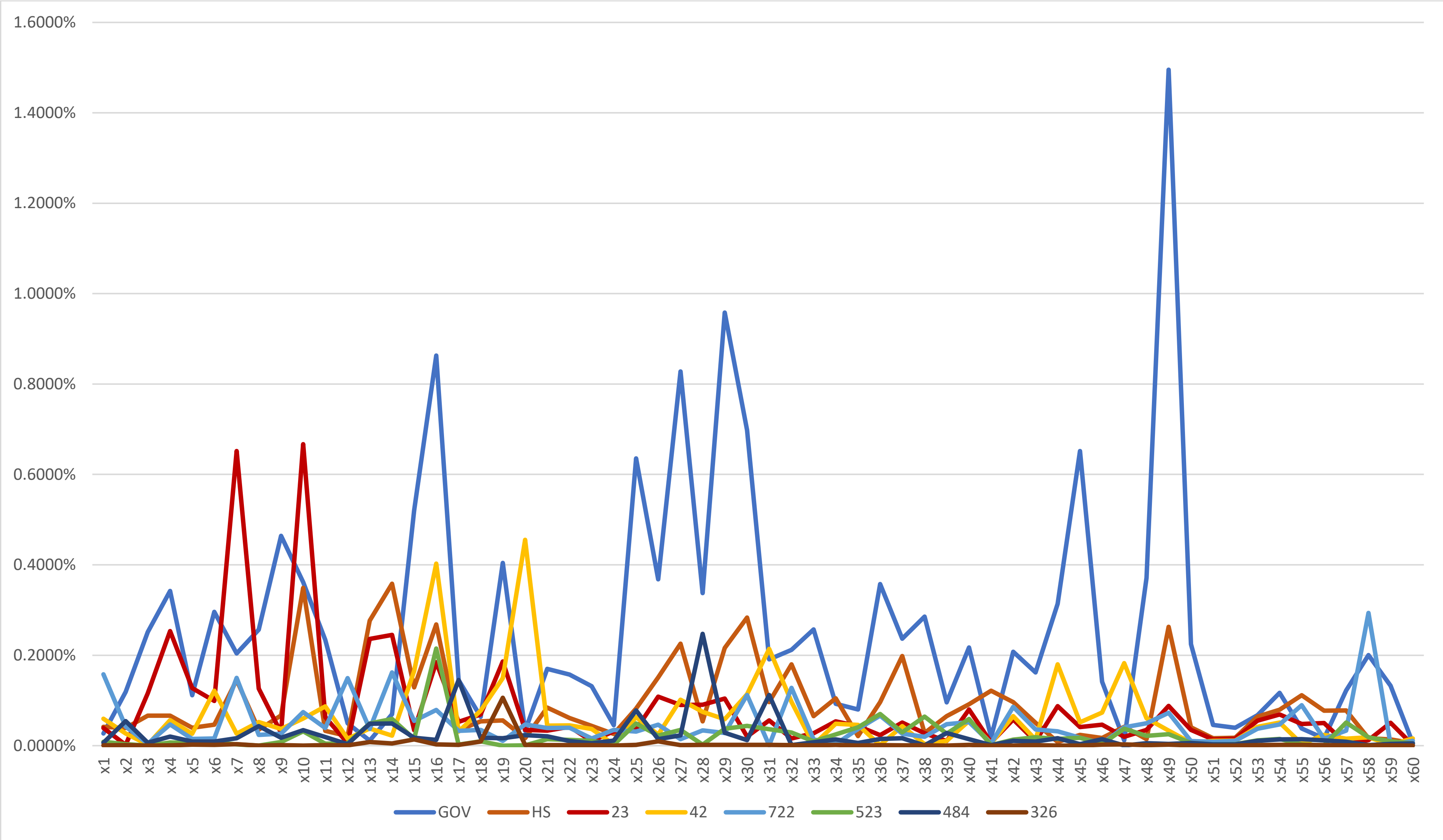
Pict 2. The classical and fuzzy rate of changes in the industrial gross output as a result of the 10% increase in the final demand for the industry Housing Services (HS)



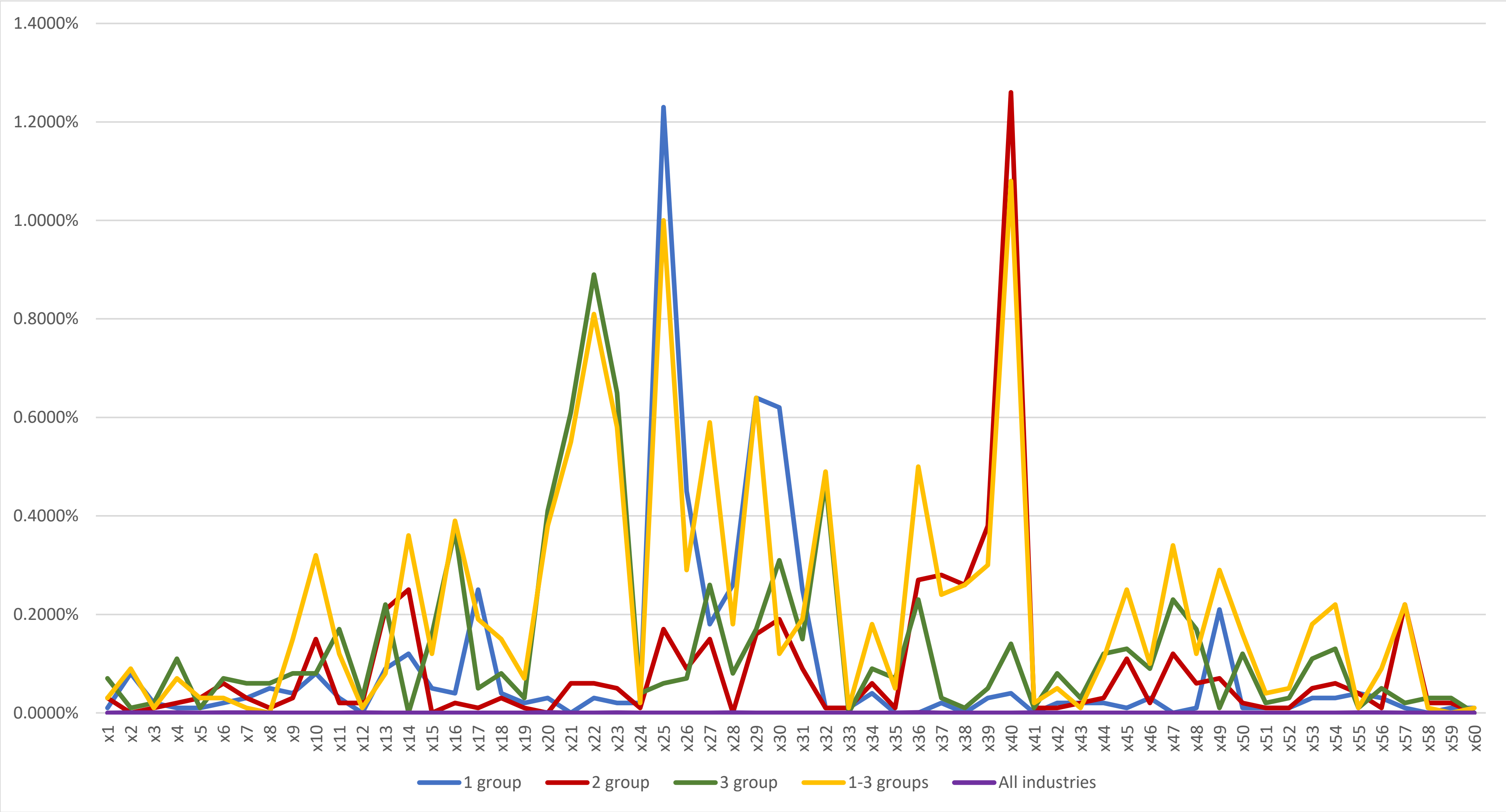
Pict 3. The classical and fuzzy rate of changes in the industrial gross output as a result of the 10% increase in the final demand for the industry Wholesale trade (42)



Pict 4. The classical and fuzzy rate of changes in the industrial gross output as a result of the 10% increase in the final demand for the industry Construction (23)



Picture 5. The estimation error for impact from the 10% increase in the final demand for the separate industries for the US economy: model 1



Pict 6. The estimation error for impact from the 10% increase in the final demand for groups of industries of the US economy: model 1

Table 1. The group of industries with the different share in the total gross output for the US economy

Industrial code	Industrial name	Share in the total final demand
1 group		
481	Air transportation	0.6296%
482	Rail transportation	0.1478%
483	Water transportation	0.2136%
484	Truck transportation	0.8261%
485	Transit and ground passenger transportation	0.2087%
486	Pipeline transportation	0.0222%
487OS	Other transportation and support activities	0.1826%
	Total:	**2.2306%**
2 group		
521CI	Federal Reserve banks, credit intermediation, and related activities	1.6549%
523	Securities, commodity contracts, and investments	1.2129%
524	Insurance carriers and related activities	1.7586%
525	Funds, trusts, and other financial vehicles	0.8085%
	Total:	**5.4349%**
3 group		
42	Wholesale trade	4.7453%
441	Motor vehicle and parts dealers	0.8151%
445	Food and beverage stores	1.1457%
452	General merchandise stores	1.2620%
4A0	Other retail	4.0570%
	Total:	**12.0251%**

Note, involving more industries for impact estimating does not drive larger errors: the estimation error for groups does not exceed 0.5% in most cases. Moreover, the maximum error value is even smaller than this one obtained for the estimate impacts for separate industries. As expected, the largest number of the significant errors is observed when we estimate the impact for the third group of industries as well as the impact of three groups of industries together. *The important result is obtained when estimating the impact from the 10% increase in the final demand for all industries of the US economy: the error is very small for each industry. This can mean the mutual compensation of the different estimation errors*.

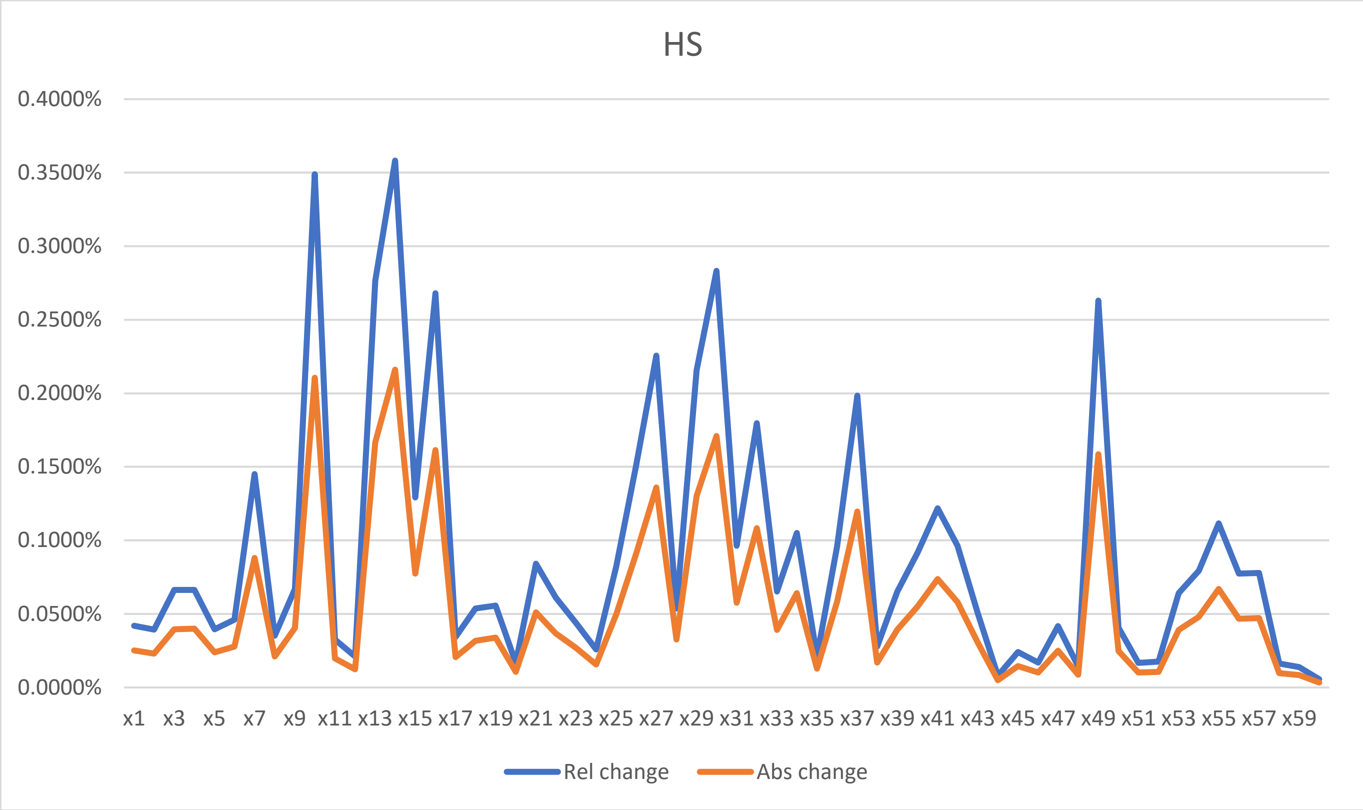
The estimation error for groups of industries confirms that the maximum error value for the industry is a result of change in the final demand for this industry. As we see in Table 4, the maximum error is obtained mostly for industries where we increase the final demand. For instance, when impact is estimated for the first group, the maximum error is observed for the following industries of this group: 481, 484, 486, 432 and 487OS.

Another significant factor of the error sensitivity is a number of different elements, which describe types of interindustrial relationship in the columns of the fuzzy matrix A. The estimated correlation shows the significant impact of strong and very strong interindustrial relationship on the estimation error: for first group R = 0.51, for second group R = 0.45, for third group R = 0.61 and for all three groups R = 0.70.

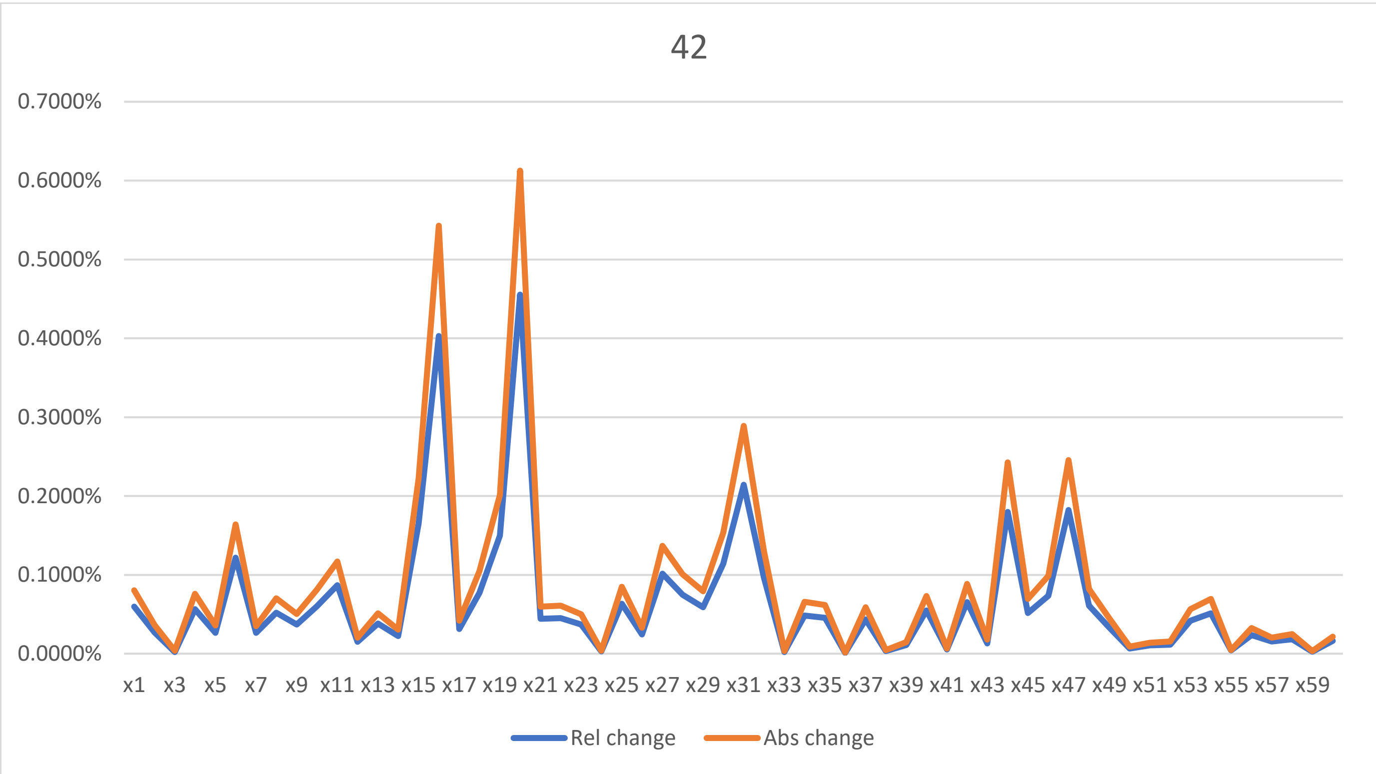
To get more information about the impact of different factors on the error, we estimate impact of changes in the final demand on some constant value for eight separate industries, mentioned above. This allows us to estimate the error in case of significant variability of the final demand elements. In particular, let's implement Step 1-3 to examine the fuzzy and classical impact from the change in the final demand on $100,000 billion for each of these industries. The estimation error is presented in column “Error for absolute change in final demand” of Table 4, Appendix C. The column “Error for relative change in final demand” of this table includes the error estimated as a result of the 10% increase in the final demand for the same industries. In the case of the absolute change in the final demand, the error changes in proportion to the degree of change in the certain element of final demand.

The obtained results give us the limit of changes in the industrial final demand. Pictures 7-10 show the comparison of the error from the 10% increase in the final demand (the relative change in the final demand) with the error from the increase in the final demand on $100,000 billion (the absolute change in the final demand). Depending on the industry share in the total final demand, the increase in the industry final demand on $100,000 billion results the different rates of change in the final demand: 6% for Housing Services (HS), 13% for Wholesale trade (42), 19% for Food services and drinking places (722) and 53% for Securities, commodity contracts, and investments (523). We can see, it does not make sense to increase the final demand more than 20% because the maximum error will extremely rise for larger change (as we see on Picture 9).

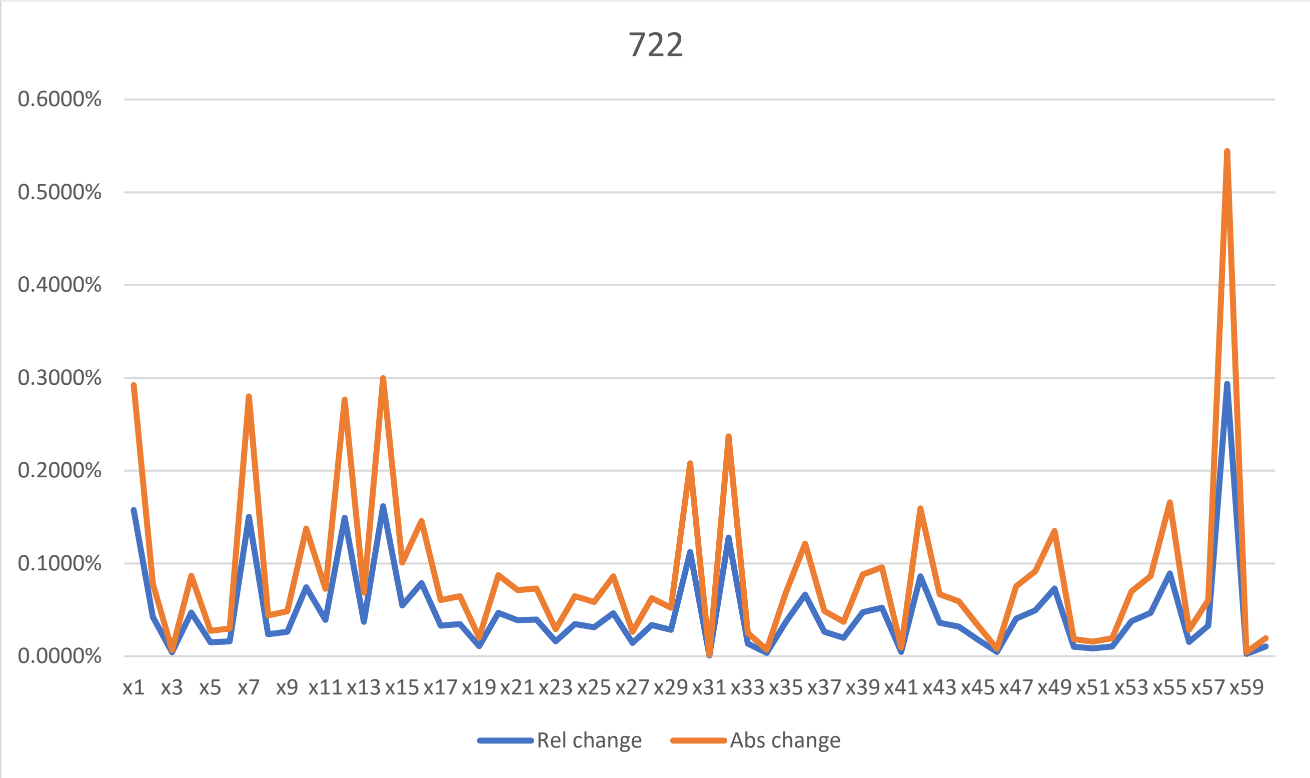
Thus, using an IO model with fuzzy direct matrix of input-output coefficients yields sufficient accuracy when estimating impacts from the increase in the final demand to 20% for separate industries and their groups. Error is sensitive to the size of industry (a share of industry in the total gross output for an economy), the number of industries for the impact estimate (how many industries are used for the impact estimate), the source of impact (what industry and group of them change the final demand) and the number of "big" coefficients in the column of the fuzzy matrix A (how many elements, which characterize "strong" and "very strong" interindustrial relationship each column of the fuzzy matrix A includes).



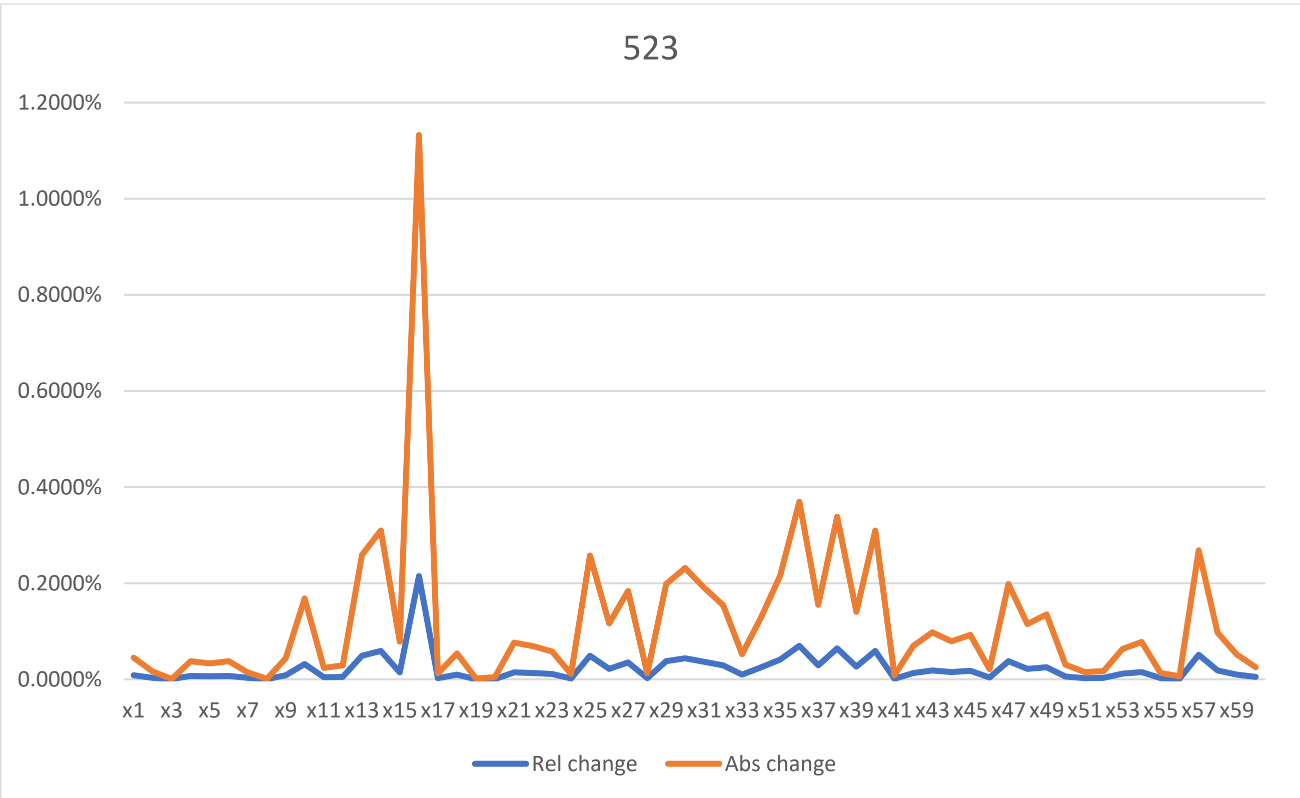
Picture 7. The error for impact from relative and absolute change in the final demand for Housing Services (HS)



Picture 8. The error for impact from relative and absolute change in the final demand for Wholesale trade (42)



Picture 9. The error for impact from relative and absolute change in the final demand for Food services and drinking places (722)



Picture 10. The error for impact from relative and absolute change in the final demand for Securities, commodity contracts, and investments (523)

4. The estimate impacts using an IO model with a fuzzy matrix of direct IO coefficients and fuzzy investment as components of the final demand

The analytical value of the model (10) – (11) is increased in case of the fuzzy interpretation not only a matrix of the direct IO coefficients but a vector of final demand. For instance, when we study impacts of different types of investment on the economic system, the modified IO model with fuzzy parameters looks like the following:

$$\sum_{i=1}^{N}\left[\sum_{j=1}^{N}\tilde{a}_{ij}x_j+\widetilde{ip}_{ij}y_i+\widetilde{if}_{ij}y_i+\widetilde{is}_{ij}y_i+d_{ij}y_i-x_i\right]\underset{x}{\rightarrow}min\,,i\in N,j\in N \qquad (13)$$

where $\tilde{A}=\left(\tilde{a}_{ij}\right),i\in N,j\in N$ – the fuzzy matrix of direct input-output coefficients;

$\widetilde{IP}=\left(\widetilde{ip}_{ij}\right),i\in N,j\in N$ – the fuzzy diagonal matrix of shares of the industrial private investment in the final demand;

$\widetilde{IF}=\left(\widetilde{if}_{ij}\right),i\in N,j\in N$ – the fuzzy diagonal matrix of shares of industrial federal investment in the final demand;

$\widetilde{IS}=\left(\widetilde{is}_{ij}\right),i\in N,j\in N$ – the fuzzy diagonal matrix of shares of industrial state and local investment shares in the final demand;

$D=\left(d_{ij}\right),i\in N,j\in N$ – the diagonal matrix of shares of industrial final demand net of investment in the final demand;

$x=(x_i),i\in N$ – the vector of gross output by industry;

$y=(y_i),i\in N$ – the vector of final demand by industry;

N – the number of industries

By analogy with model (10) – (11), we differentiate criterion (13) with respect to each x and set obtained partial derivatives equal to zero. As a result, we have the new system of N equations:

$$\frac{\partial\left[\sum_{i=1}^{n}\left(\sum_{j=1}^{N}\tilde{a}_{ij}x_j+\widetilde{ip}_{ij}y_i+\widetilde{if}_{ij}y_i+\widetilde{is}_{ij}y_i+d_{ij}y_i-x_i\right)^2\right]}{\partial x_1}=0;$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \qquad (14)$$

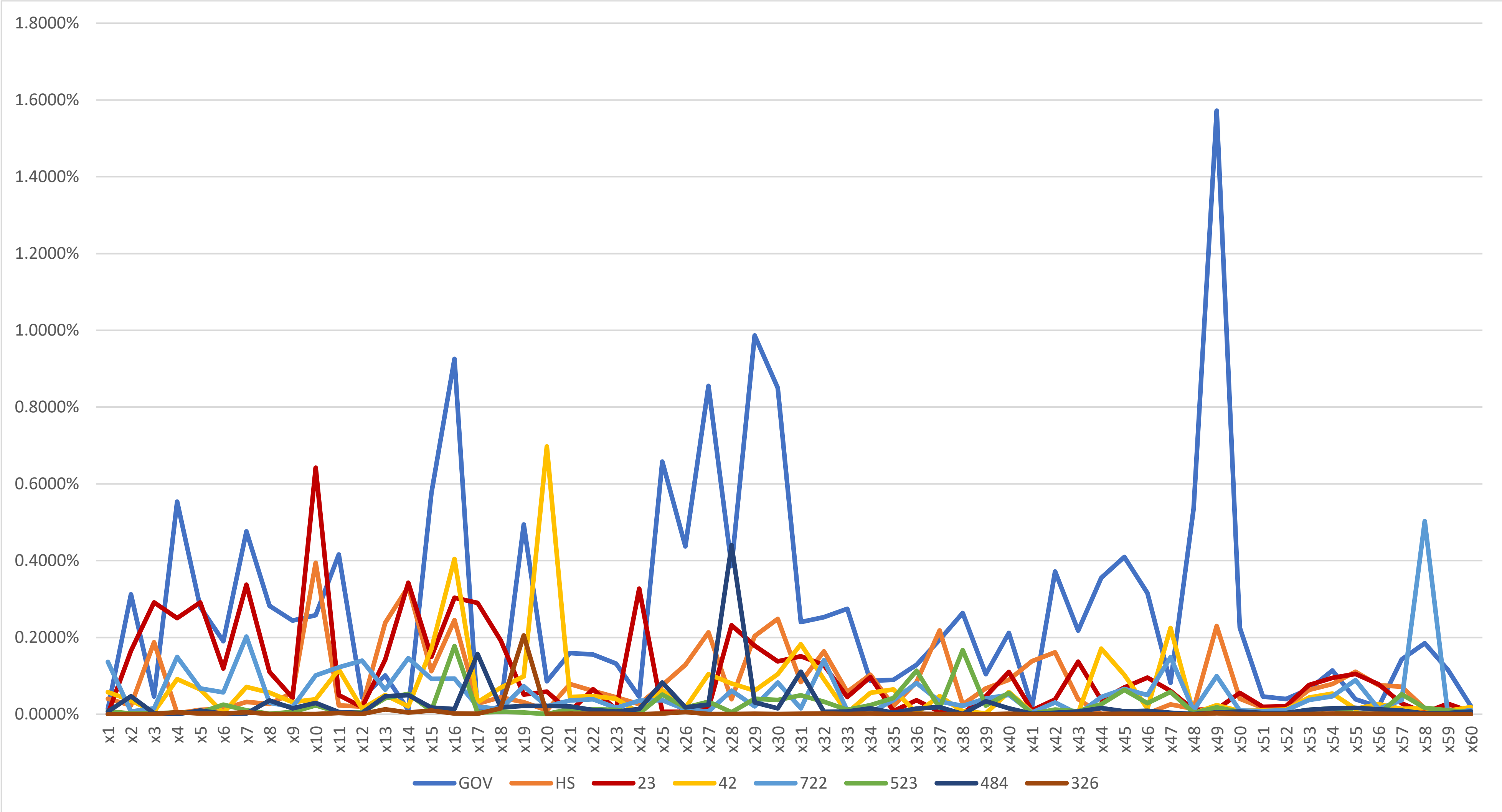
$$\frac{\partial\left[\sum_{i=1}^{n}\left(\sum_{j=1}^{N}\tilde{a}_{ij}x_j+\widetilde{ip}_{ij}y_i+\widetilde{if}_{ij}y_i+\widetilde{is}_{ij}y_i+d_{ij}y_i-x_i\right)^2\right]}{\partial x_N}=0.$$

For the fuzzy interpretation of investment (Step 1), we derive three vectors of the investment - private, federal and social and local - from input-output tables for the US economy in 2009-2011. While the elements of each vector characterize the share of certain type of investment in the total final demand, we can define these elements as the linguistic variable *"Intensity of investment into the industry"* (Appendix B). Using the same procedure as for the matrix of direct input-output coefficient we replaced each element of the investment vectors the expected value of the appropriate membership function. Then we transformed the updated vectors to three diagonal investment matrices.

Let's employ the modified IO model (model 2) for estimating of the impact of the 10% increase in the final demand for the separate industries as well as groups of them on the gross output (Step 2). The results for separate industries are presented in column "Error 2" of the Table 2, Appendix C. To compare how IO models with different fuzzy components work (Step 3), the table includes results obtained via the IO model (10) - (11) (model 1): the column "Error1" shows the error for this fuzzy model.

Picture 11 represents estimation error for eight separate industries. The important achievement is that the estimation error is quite small: in most cases error still does not exceed 0.5% and the largest one is 1.57%. At the same time, the error increases for some industries. One of the major factors of this result is not only a share of the industry in the total gross output but the change in the final demand for the industry as that we recognized for the first model. If we exclude the maximal error values as a result of change in the final demand for certain industries, the remaining significant errors are observed not only for small industries, unlike model 1. In our opinion, the major factor of the increase in the estimation error is the accuracy of the fuzzy description for real values of investment vectors' elements. Thus, if the real value of elements belongs to "the overlap area" for two fuzzy intervals (subsets), we can expect a significant error for the appropriate industry (as we see in the slide). The error also increases when "big" values as well as zero-values of real investment coefficients are replaced by the expectation of an appropriate membership function.

The results of the impact estimation for group of industries using both fuzzy IO model 2 and model 1 are presented in Table 3, Appendix C. The columns "Error 1" and "Error 2" have the same meaning as for the columns with these names in Table 2, Appendix C. According to Table 3 the impact from changes in the final demand for the groups of industries does not significantly increase the estimation error. Moreover, in case of estimating impacts for three groups, the maximum error value decreases for some industries, and in case of estimating impacts for all industries estimation errors are not significant at all. *Hence, as for model 1 the effect of mutual error compensation is observed for model 2*.



Pict 11. The estimation error for impact from the 10% increase in the final demand for separate industries of the US economy: model 2

Now let's estimate impact from the changes in the final demand on $100,000 billion for the same eight separate industries that we have used before. The estimation error is presented in column “Error 2” of Table 4, Appendix C. The comparison of relative and absolute change in the final demand indicates that in case of change in final demand on $100.000 billion significant increasing in error is observed ever for Whole sale trade (42) where this absolute change is equal of the 13% increase in the final demand. For Food service and drinking places, 722 (the 19% increase in the final demand) the maximum error value is almost doubled.

Thus, when estimate impacts using an IO models with different fuzzy components we should explore limits to change in final demand that provide the sufficient accuracy for the impact estimate.

5. The estimate impacts using an IO model with a fuzzy matrix of direct IO coefficients, fuzzy investment and fuzzy international trade flows

Finally, we modify our IO model by the fuzzification of international trade flows. The new IO model is presented as the following:

$$\sum_{i=1}^{N}\left[\sum_{j=1}^{N}\tilde{a}_{ij}x_j+\widetilde{ip}_{ij}y_i+\widetilde{if}_{ij}y_i+\widetilde{is}_{ij}y_i+\widetilde{imp}_{ij}y_i-\widetilde{exp}_{ij}y_i+d_{ij}^{0}y_i-x_i\right]\underset{x}{\rightarrow}min, \quad (15)$$

where $\tilde{A}=\left(\tilde{a}_{ij}\right), i\in N, j\in N$ – the fuzzy matrix of direct input-output coefficients;

$\widetilde{IP}=\left(\widetilde{ip}_{ij}\right), i\in N, j\in N$ – the fuzzy diagonal matrix of industrial private investment shares in the final demand;

$\widetilde{IF}=\left(\widetilde{if}_{ij}\right), i\in N, j\in N$ – the fuzzy diagonal matrix of industrial federal investment shares in the final demand;

$\widetilde{IS}=\left(\widetilde{is}_{ij}\right), i\in N, j\in N$ – the fuzzy diagonal matrix of industrial state and local investment shares in the final demand;

$\widetilde{Exp}=(\widetilde{exp}_i), i\in N$ – the fuzzy diagonal matrix of export shares in the final demand;

$\widetilde{Imp}=(\widetilde{imp}_i), i\in N$ – the fuzzy diagonal matrix of import shares in the final demand;

$D^0=\left(d_{ij}^{0}\right), i\in N, j\in N$ – the diagonal matrix of shares of industrial final demand net of investment and international trade in the final demand;

$x=(x_i), i\in N$ – the vector of gross output by industry;

$y=(y_i), i\in N$ – the vector of final demand by industry;

N – the number of industries.

Differentiating criterion (15) with respect to each x and setting partial derivatives equal to zero, we have the following system of equations:

$$\frac{\partial\left[\sum_{i=1}^{n}\left(\sum_{j=1}^{N}\tilde{a}_{ij}x_j+\widetilde{ip}_{ij}y_i+\widetilde{if}_{ij}y_i+\widetilde{is}_{ij}y_i+\widetilde{imp}_{ij}y_i-\widetilde{exp}_{ij}y_i+d_{ij}^{0}y_i-x_i\right)^2\right]}{\partial x_1}=0;$$

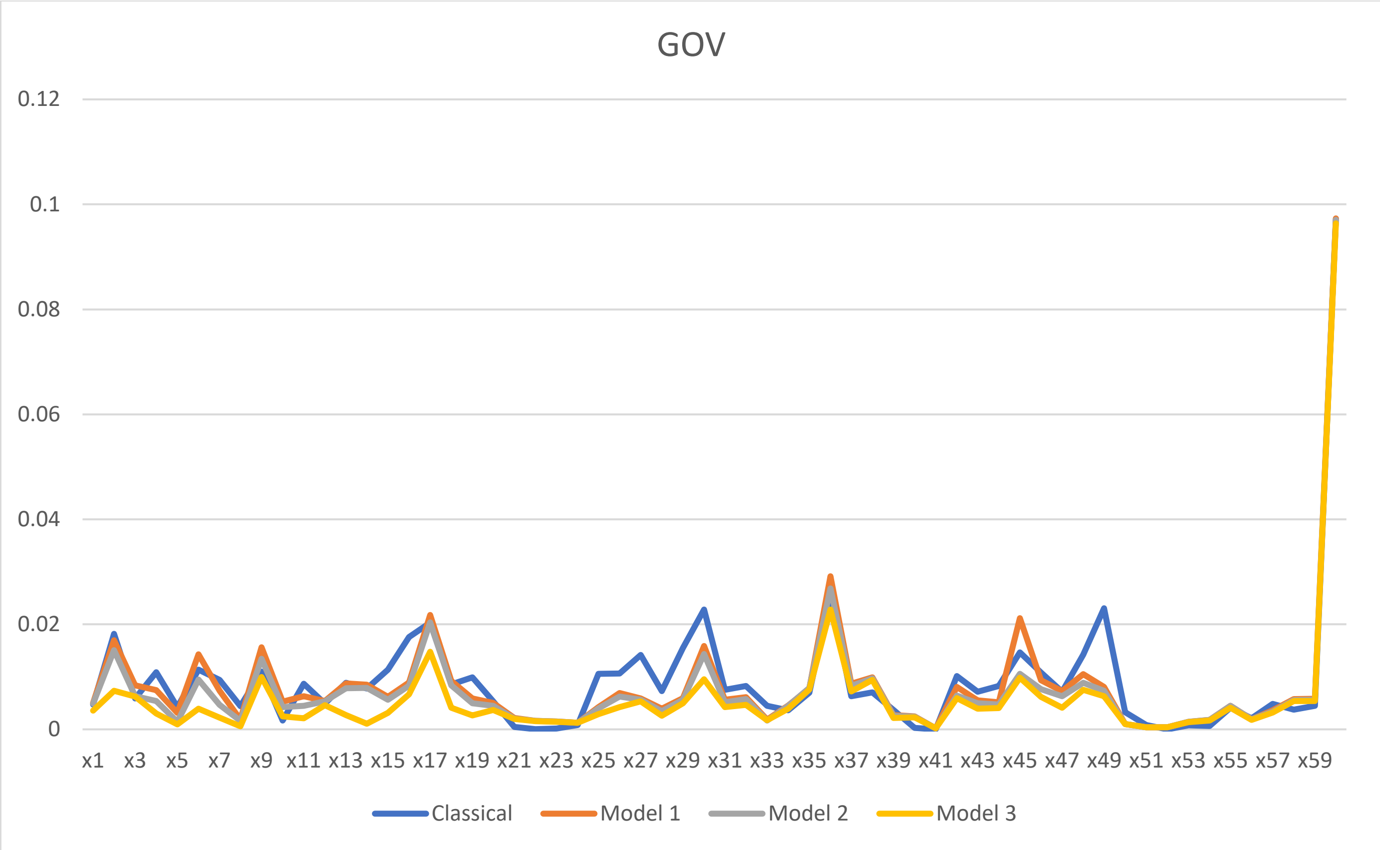
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (16)$$

$$\frac{\partial\left[\sum_{i=1}^{n}\left(\sum_{j=1}^{N}\tilde{a}_{ij}x_j+\widetilde{ip}_{ij}y_i+\widetilde{if}_{ij}y_i+\widetilde{is}_{ij}y_i+\widetilde{imp}_{ij}y_i-\widetilde{exp}_{ij}y_i+d_{ij}^{0}y_i-x_i\right)^2\right]}{\partial x_N}=0.$$

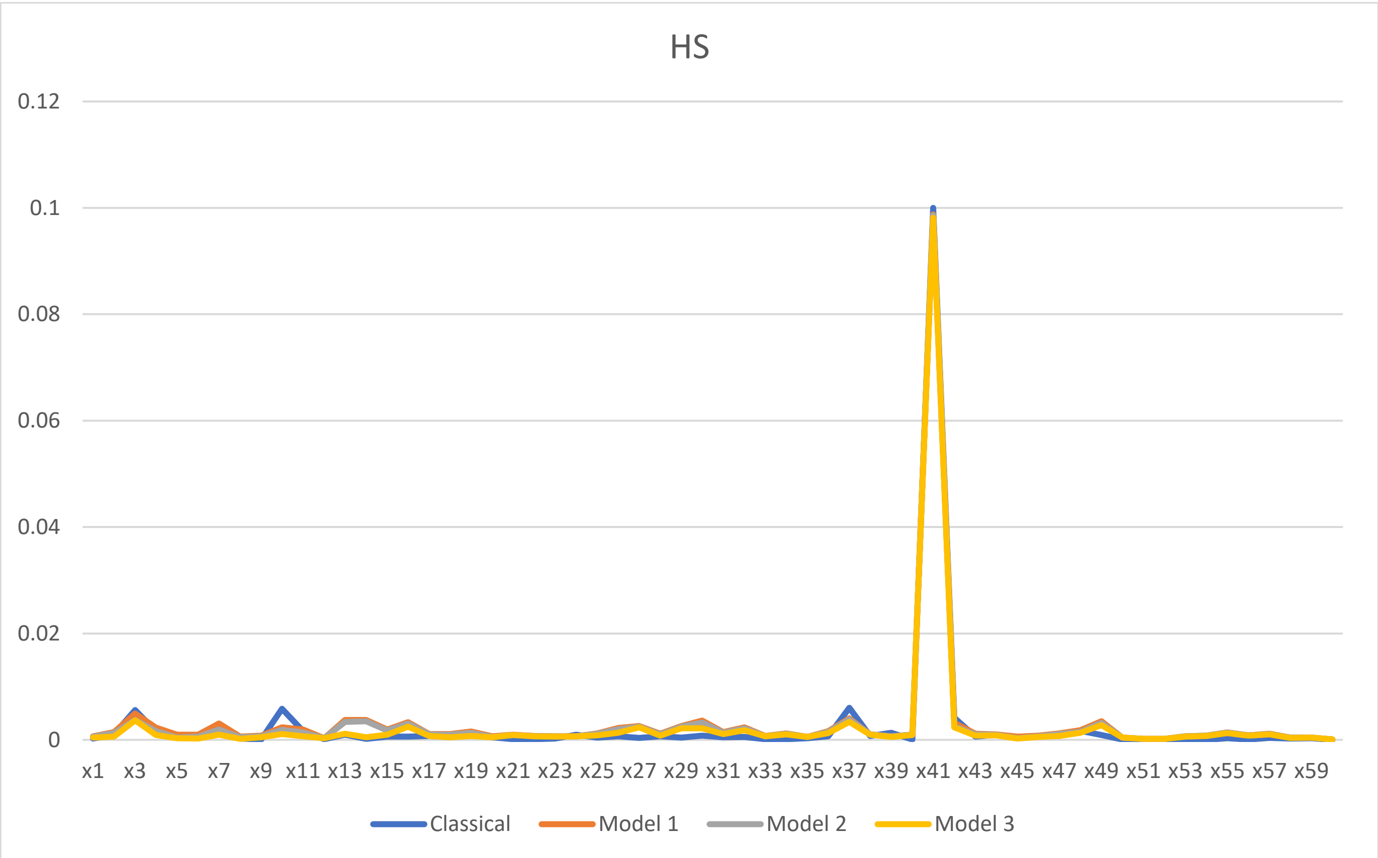
In this case, we fuzzify matrices of international trade flows using two linguistic variables *"Intensity of export flow by the industry"* and *"Intensity of import flow by the industry"* (see Appendix B). As for previous models, we replace the existing elements of the export vector and the import vector to the expectation of appropriate membership functions and transform the updated vectors to diagonal matrices.

The rates of change in industry output as a result of the 10% increase in the final demand for four of largest industries of the US economy estimated using three models with fuzzy parameters are shown in Pictures 12-15. The estimation error for the model (15) - (16) (model 3) are presented in the column "Error 3" (see the Table 2, Appendix C). The Picture 16 demonstrates error 3 for eight separate industries. The same column name in the Table 3, Appendix C presents the results of this impact for the groups of industries mentioned above. We can recognize that the fuzzification both the export and import flows for our IO model significantly increases the estimation error. For the model 3 as well as model 1 and model 2, the estimation error value depends on a share of the industry in the total gross output: the maximum number of significant errors takes place when estimating impact of the largest industries for the US economy. The maximum error value for the model 3 is more sensitive to the source of impacts: the maximum error significantly increases for the industries where the final demand is changed. Note, this effect is mostly observed for medium and small industries. In particular, when we estimate impacts of separate industries mentioned above using model 3, the maximum error is obtained not for Governments (as we see for both model 1 and model 2) but for Wholesale trade (42).

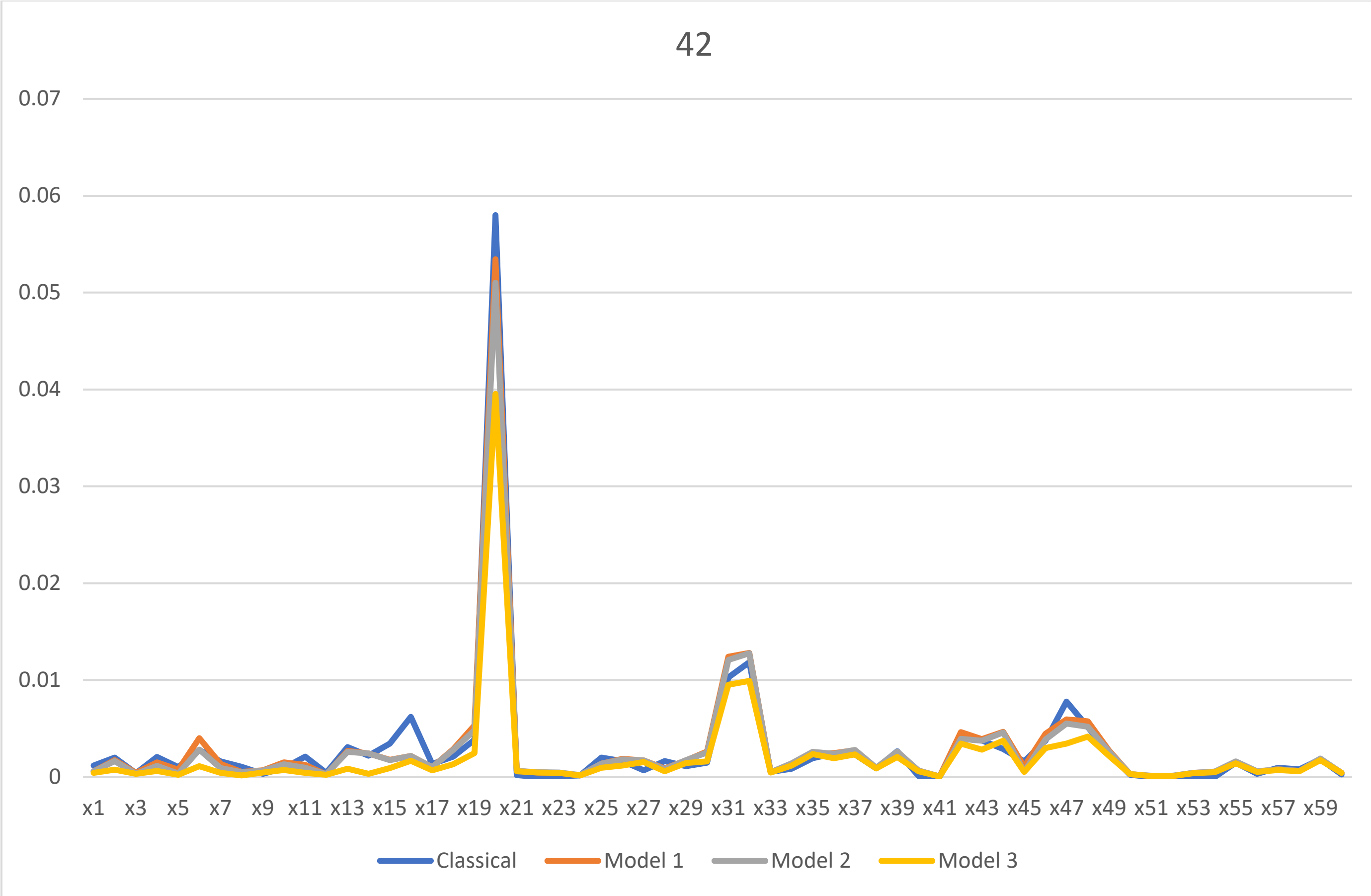
In this case, we can distinguish two more factors that result the largest errors. First of them is the replacing the biggest elements of the real trade matrix, especially diagonal export matrix by an appropriate fuzzy value (the expectation of the certain membership function). For example, when we estimate impact from the 10% increase of the final demand for Construction (23), the estimation error for industry 11 extremely increased to from 0.06% (for the first model) to 0.84%.



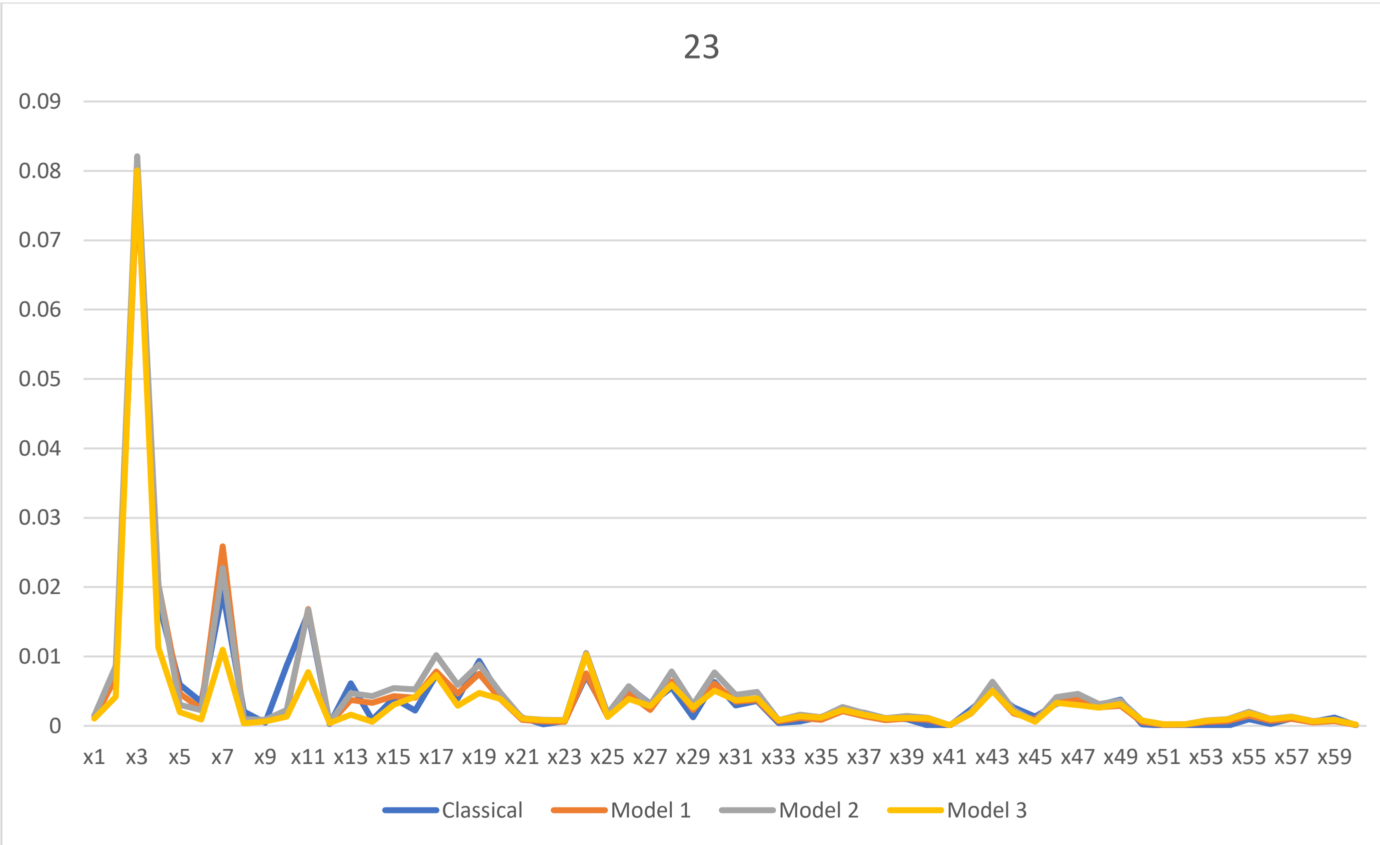
Picture . The classical and fuzzy rates of change in the industry output as a result of the 10% increase in final demand for the Government (GOV): model 1, model 2 and model 3



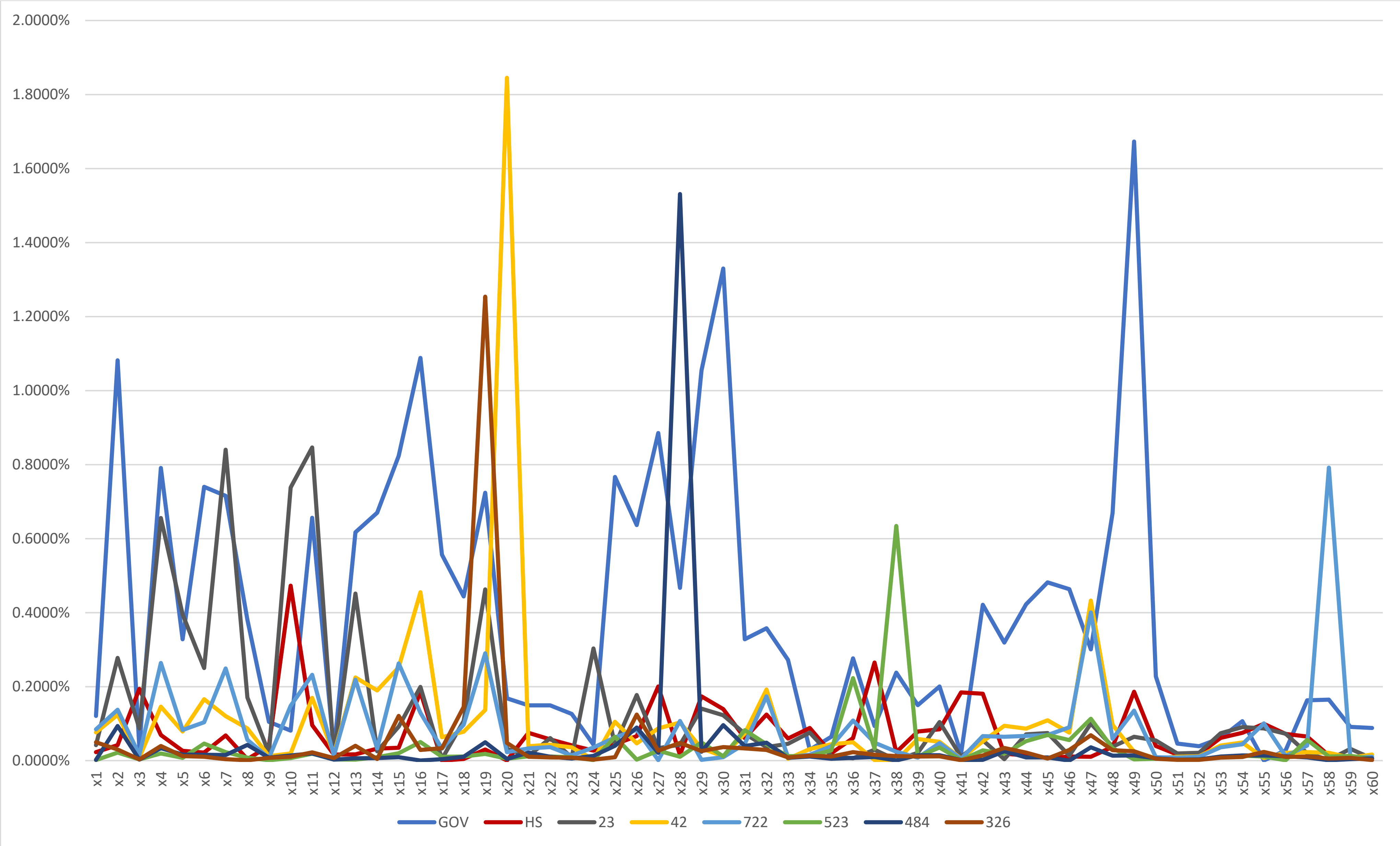
Picture . The classical and fuzzy rates of change in the industry output as a result of the 10% increase in final demand for the Housing Services (HS): model 1, model 2 and model 3



Picture . The classical and fuzzy rates of change in the industry output as a result of the 10% increase in final demand for the Wholesale trade (42): model 1, model 2 and model 3



Picture . The classical and fuzzy rates of change in the industry output as a result of the 10% increase in final demand for the Construction (23): model 1, model 2 and model 3



Pict 16. The estimation error for impact from the 10% increase in the final demand for separate industries of the US economy: model 3

Real value of element 11 in import matrix imp_{11} = 5.59 is replaced by fuzzy one $\widetilde{imp}_{11}$ = 7.81 (see the Table xxxx in Appendix B). Second factor is replacing both "big" values and zero values of real elements to fuzzy value of this element.

The estimate of the impact of the same change in the final demand in the groups of industries as well as in all industries produces the most dramatical error increase. We obtain the biggest number of very large errors for changing in the final demand for three groups of industries; the largest error is 1.90%. The major factor of this result is the fuzzy description of smallest elements of export and import matrices. As we mentioned above, both "big" values and zero values of real elements in these matrices are replaced to fuzzy values. As a result, we obtain very rough interpretation of export-import elements. In particular, we have the largest error 1.90% for industry 20. Real value of element 20 in export matrix exp_{20} = 0.194 is replaced to fuzzy value $\widetilde{exp}_{20}$ =0.015 and real value of element 20 in import matrix imp_{20} = 0.0429 is replaced to fuzzy value $\widetilde{exp}_{20} = 0.0073$ (see Table xxx and Table xxxx in Appendix B).

The error as a result of the impact of changes in the final demand on \$100,000 billion is represented in the column “Error 3” of Table 4, Appendix C. We see that fuzzifying of trade flows significantly decreases the accuracy of impact estimation not only for industries with a large rate of change in the final demand. Thus, a fuzzy approach looks like an efficient way to estimate impact under condition of lacking or inaccurate input-output data in case of not significant variability of initial values used to develop a fuzzy model.

Conclusion

One of the main issues when estimating economic impacts using an input-output model is the lack of accurate and complete initial input-output data. The analysis of existing approaches to updating IO tables indicates that they are often insufficient for real applications since they generally ignore issues of data quality and reliability. We propose a fuzzy approach that yields sufficiently accurate results of the impact estimating based on a "smear" of input-output data. According to this approach, we convert a finite set of Likert-type assessments into quantitative estimates for direct I-O coefficients. Using expected values of quasi-probability density functions for the quantitative interpretation of coefficient values, we employ quasi-stochastic programming for estimating impacts.

The approach was applied for the US economy. To fuzzify a matrix of direct I-O coefficients we linked Likert-type assessments for the coefficients to quantitative ones via Gaussian membership functions. The domain for these functions were defined via cluster analysis of the matrices of direct I-O coefficients derived from Make and Use tables for the US economy in 2009-2011. Replacing existing values of the matrix of direct I-O coefficients by expected values for these membership function, we obtained *a roughly hewn fuzzy matrix A that contains only seven different values of I-O coefficients*. The impacts from both relative and absolute changes in the final demand for separate industries and the group of independent industries on the gross output for 60 industries of the national economy were subsequently estimated via an I-O model with a fuzzy matrix A. Using an input-output model with fuzzy IO coefficients for estimating impacts provides the sufficiently accurate results in case of the final demand changes are not more than 20%.

We next extend the initial model by also fuzzifying different components of final demand: investment and international trade flows. Employing an input-output model with two types of fuzzy parameters - input-output coefficients and investment - slightly decreases the accuracy of the results of impact estimate. When estimating impacts based on an input-output model with three types of fuzzy parameters - input-output coefficients, investment and export-import, the accuracy of results significantly decreases but it is still quite sufficient in case of change in final demand to 10%.

The major factors of the error sensitivity for a model with fuzzy matrix A are the share of industry in the total gross output, the source of impacts, the number of industries for impact estimates, the degree of change in the final demand, and the number of "big" coefficients in the columns of the fuzzy matrix A. The factors of the error sensitivity for models with fuzzy final demand components are also the accuracy of the fuzzy description for the final demand components and the element variability of the final demand components.

Thus, a fuzzy approach can be an efficient, cost-effective way for estimating impacts of different exogenous factors on the economic system under condition of lacking or inaccurate input-output data. At the same time, builders of input-output model should apply this approach taking account of its limits.

References

Álvarez-Martínez, María Teresa and Michael L. Lahr. 2016. "Gaming, States and Tax Revenues—The Tortoise or the Hare: A CGE Comparative Assessment of Diversified Casino Resorts and Games-only Casinos, *Growth and Change,* 47, 236–258.

Баранов Э.Ф., Ким И.А., Пионтковский Д.И., Старицына Е.А. Вопросы построения таблиц «затраты – выпуск» России в международных классификаторах, *Экономический журнал ВШЭ*, 2014, 7-38.

Dietzenbacher, E. (2006) Multiplier Estimates: to Bias or not to Bias? *Journal of Regional Science*, 46, 773–786.

Gilchrist, D. and L. St. Louis. (2004) An algorithm for the consistent inclusion of partial information in the revision of input-output tables. *Economic Systems Research*, *16*, 149-156.

Golan, A., Judge, G. and Robinson, S. (1994) Recovering information from incomplete or partial multisectoral economic data. *Review of Economics and Statistics*, 76, 541-9.

Günlük-Senesen, G. and Bates, J. (1988) Some Experiments With Methods of Adjusting Unbalanced Data Matrices. *Journal of the Royal Statistical Society, Series A*, 151, 473–490.

Harrigan, J. and Buchanan, I. 1984. A quadratic programming approach to input-output estimation and simulation. *Journal of Regional Science*, 24, 339–358.

Jackson, R. and A. Murray. (2004) Alternative input-output matrix updating formulations, *Economic Systems Research*, 16, 135-148.

Jiang, Xuemei, Erik Dietzenbacher, and Bart Los. (2010) "Targeting the collection of superior data for the estimation of the intermediate deliveries in regional input–output tables," *Environment and Planning A*, 42, 2508-2526.

Junius, T. and Oosterhaven, J. (2003) The Solution of Updating or Regionalizing a Matrix with Both Positive and Negative Elements. *Economic Systems Research*, 15, 87–96.

Lahr, M. L. (2001a) "A Strategy for Producing Hybrid Regional Input-Output Tables," in Michael L. Lahr and Erik Dietzenbacher, eds, *Input-Output Analysis: Frontiers and Extensions*. Palgrave: New York, pp. 211–242.

_____. (2001b) "Reconciling Domestication Techniques, the Notion of Re-exports and Some Comments on Regional Accounting," *Economic Systems Research*, 13, 165-179.

Lenzen, Manfred, Blanca Gallego, and Richard Wood. (2006) "A Flexible Approach to matrix Balancing under Partial Information," *Journal of Applied Input-Output Analysis*, 11/12, 1–24.

_____. (2009) "Matrix Balancing under Conflicting Information," *Economic Systems Research*, 21, 23–44

Lenzen, Manfred, Richard Wood, and Thomas Wiedmann. (2010) "Uncertainty Analysis for Multi-Region Input-Output Models—A Case Study of the U.K.'s Carbon Footprint," *Economic Systems Research*, 22, 43–63.

Lenzen, Manfred, Daniel Moran, Keiichiro Kanemoto, and Arne Geschke. (2013) "Building Eora: A Global Multi-regional Input-Output Database at High Country and Sector Resolution," *Economic Systems Research*, 25, 20–49.

Makarkina, G. (2008) Models and methods for planning of socio-economic development of the industrial region (Kramatorsk, Donbass State Engineering Academy).

Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advances in Health Science Education. Vol 15(5)*, 625-632.

Polenske, K (1997) Current Uses of the RAS Technique: A Critical Review. In András Simonovits and Albert E. Steenge (eds.), *Prices, Growth and Cycles: Essays in Honour of András Brody* (Basingstoke, England: Macmillan Press Ltd.), 58-88.

Round, J. (2003) Social Accounting Matrices and SAM-based Multiplier Analysis, In L A Pereira da Silva and F Bourguignon (eds), *Techniques for Evaluating the Poverty Impact of Economic Policies* (World Bank and Oxford University Press), Chapter 14.

Robinson, S., A. Cattaneo, and M. El-Said (1998) Estimating a Social Accounting Matrix Using Cross Entropy Methods. Trade and Macroeconomics Division, International Food Policy Research Institute.

Robinson, S. and El-Said, M., 2000. CAMS Code for Estimating a Social Accounting Matrix (SAM) Using Cross Entropy (CE) Methods. *TMD Discussion Paper*. № 64. Dec.

Roland-Holst, D., 1989. Bias and Stability of Multiplier Estimates. *Review of Economics and Statistics*, 71, 718–21.

Rueda-Cantuche, J. and ten Raa, T. (2009) The Choice of Model in the Construction of Industry Coefficients Matrices. *Economic Systems Research*, 21(4), 363–376.

Rueda-Cantuche, J., Amores, A. and Fernández, E. (2010) Does bias really matter in input-output analysis? An almost definite answer. http://www.iioa.org/conferences/19th/papers/files/305_20110504011_DoesbiasreallymatterinIOA.pdf

Schneider, M. and Zenios, S. (1990) A comparative study of algorithms for matrix balancing. *Oper. Res.*, 38, 439–455.

Szyrmer, J. (1989) "Trade-Off between Error and Information in the RAS Procedure,” in Ronald E. Miller, Karen R. Polenske and Adam Z. Rose, eds, *Frontiers of Input-Output Analysis*. New York: Oxford University Press, pp. 258-277.

Thorbecke, E. (2003) Towards a Stochastic Social Accounting Matrix for Modelling. *Economic Systems Research*, 15, 185-196.

Temurshoev, U., Miller, R. and Bouwmeester, M. (2013) A note on the GRAS method. *Economic Systems Research,* 25 (3), 361-367.

Tukker, Arnold and Erik Dietzenbacher (2013) “Global Multiregional Input–Output Frameworks: An Introduction and Outlook,” *Economic Systems Research*, 25, 1–19

Van der Ploeg, F. (1982) Reliability and the Adjustment of Sequences of Large Economic Accounting Matrices. *Journal of the Royal Statistical Society*, 145, Part 2, 169-194.

Yermoliev, Y. and Yastremsky, A. (1997) Stochastic models and methods in economic planning (Moscow, Nauka).

Zadeh, L.A. “Fuzzy Sets,” *Information and Control*,” 8, 338-353.

_____. (1975) The concept of a linguistic variable and its application to approximate reasoning. *Information Sciences (1)*, 119-249.

Appendix A: The fuzzification of the matrix of direct input-output coefficients

The fuzzification of the matrix of direct input-output coefficients means to interpret elements of this matrix as a linguistic variable. According to the fuzzy set theory, a linguistic variable is defined on some quantitative scale using ordinary words and phrases. The linguistic variable is described by verbal values.

Formally, linguistic variable is characterized by a set:

$$\langle \beta, T(\beta), U \rangle, \tag{*}$$

where β – the name of linguistic variable;

$T(\beta)$ - term-set for linguistic variable β;

$U = \{u\}$ - definitional domain of each verbal value (term) for this linguistic variable.

Each verbal value of the linguistic variable is described by a fuzzy variable, which corresponds to a certain fuzzy subset:

$\tilde{\mathbf{A}}(\alpha) = \{\langle \mu_{\tilde{A}(\alpha)}(u)/u \rangle\}, u \in U$ – fuzzy subset of the set U, which describes the restrictions on possible values of fuzzy variable α;

$\langle \mu_{\tilde{A}(\alpha_q)}(u)/u \rangle$, где $u \in U, \mu_{\tilde{A}(\alpha_q)} \in [0;1]$ – membership function.

For each specific value $u \in U$ the value $\mu_{\tilde{A}(\alpha_q)}(u)$ takes a specific value from a closed interval [0, 1], which is called *the degree of membership* of u to fuzzy set $\tilde{A}(\alpha_q)$.

So, let's define each input-output coefficient as linguistic variable β = "Type of interindustrial relationship." Definitional domain of values for this linguistic variable U = *[0.000000; 0.312829]* is obtained based on input-output tables derived from the Make and Use tables for the US economy for 2009-2011. This gives the following definition of the linguistic variable:

$$\langle \text{«Type of interindustrial relationship"»}, T(\beta = 7), [0.000000; 0.312829] \rangle$$

The term-set for verbal values of the linguistic variable β = "Type of interindustrial relationship" is represented as:

$T(\beta)$ = *{"Very Weak", "Weak, "Below Medium", "Medium", "Above Medium", "Strong", "Very Strong"}.*

To create a fuzzy subset $\tilde{A}(\alpha_q)$ for a fuzzy variable α_q for the given type of interindustrial relationship $T(\beta = q)$, it is necessary to select the numerical interval that characterizes the definitional domain of this fuzzy variable. To calculate basic intervals for the domains of our fuzzy variables, we employ the procedure of the classification of elements of the matrix of direct input-output coefficients by the K-means clustering. Using this approach, we obtain following clusters that contains coefficients for $\beta = 7$ types (classes) of interindustrial relationship:

$$\begin{aligned}
&\beta = \text{"Very Weak"} \rightarrow \alpha_1 : \left(\underline{a}_{ij}(\alpha_1), \ldots, \bar{a}_{ij}(\alpha_1)\right) \\
&\beta = \text{"Weak"} \rightarrow \alpha_2 : \left(\underline{a}_{ij}(\alpha_2), \ldots, \bar{a}_{ij}(\alpha_2)\right) \\
&\beta = \text{"Below Medium"} \rightarrow \alpha_3 : \left(\underline{a}_{ij}(\alpha_3), \ldots, \bar{a}_{ij}(\alpha_3)\right) \\
&\beta = \text{"Medium"} \rightarrow \alpha_4 : \left(\underline{a}_{ij}(\alpha_4), \ldots, \bar{a}_{ij}(\alpha_4)\right) \\
&\beta = \text{"Above Medium"} \rightarrow \alpha_5 : \left(\underline{a}_{ij}(\alpha_5), \ldots, \bar{a}_{ij}(\alpha_5)\right) \\
&\beta = \text{"}Strong\text{"} \rightarrow \alpha_6 : \left(\underline{a}_{ij}(\alpha_6), \ldots, \bar{a}_{ij}(\alpha_6)\right) \\
&\beta = \text{"Very Strong"} \rightarrow \alpha_7 : \left(\underline{a}_{ij}(\alpha_7), \ldots, \bar{a}_{ij}(\alpha_7)\right)
\end{aligned} \qquad (**)$$

In order to get stable cluster structure of interindustrial relationship we have used input-output tables for 2009-2011. Employing the cluster procedure for each of three years, we obtain the following set of clusters:

$$\beta = q : \left(\underline{a}^t_{ij}(\alpha_q), \ldots, \bar{a}^t_{ij}(\alpha_q)\right), q \in Q, t \in T .$$

Next, we create the basic domains based on three clusters for each α_q like the following:

$$\underline{a}^0_{ij}(\alpha_q) = \max_{t \in T}\left\{\underline{a}^t_{ij}(\alpha_q)\right\}, q \in Q \,, \; \bar{a}^0_{ij}(\alpha_q) = \max_{t \in T}\left\{\bar{a}^t_{ij}(\alpha_q)\right\}, q \in Q \,.$$

Considering these intervals as inconstant due to different errors in coefficients, which can take place any time, we should give them a fuzzy interpretation. It means that we expand bounds for basic domains according to the condition:

$$\text{if } \; \bar{a}^0_{ij}(\alpha_q) < \underline{a}^0_{ij}(\alpha_{q+1}) \; \text{ we set } \; \bar{a}_{ij}(\alpha_q) = \underline{a}^0_{ij}(\alpha_{q+1}), \; \underline{a}_{ij}(\alpha_{q+1}) = \bar{a}^0_{ij}(\alpha_q).$$

Note, we should never change a lower bound for the first cluster (class), which is equal to a minimal element of the matrix of direct input-output coefficients $\underline{a}_{ij}(\alpha_1) = 0,$ and an upper bound for the last class, which is equal to a maximal element of this matrix $\bar{a}_{ij}(\alpha_7) = 0.312829.$ As a result of steps, mentioned above, we get definitional domain for seven types of the intersectoral relationship.

Next, based on estimated domains, we define the related membership functions for each type of the intersectoral relationship. In this case, the membership functions are defined as the continuous Gaussian functions:

$$\mu_{\tilde{A}(\alpha_q)}(u) = e^{-\frac{(u-b)^2}{2c^2}}, u \in U, \alpha_q \in \alpha, \tilde{A}(\alpha_q) \in A \qquad (***)$$

To estimate parameters of these functions we use MATLAB's *Fuzzy Logic Tool Box*. Finally, we calculate an expected value for the membership functions by the formula:

$$M_{\tilde{A}(\alpha_q)}(u) = \frac{\int_{\underline{U}}^{\overline{U}} u \cdot \exp\left[\frac{-(u-b)^2}{2c^2}\right] du}{\int_{\underline{U}}^{\overline{U}} \exp\left[\frac{-(u-b)^2}{2c^2}\right] du}, u \in U, \alpha_q \in \alpha, \tilde{A}(\alpha_q) \in A \qquad (****)$$

The results of the calculations are represented in Table x. Using this table, we replace the elements of the matrix of direct input-output coefficients by the expected values from the membership function for the appropriate fuzzy variable.

Table x.

Fuzzy interpretation of the matrix of direct input-output coefficients

Cluster	**Terms, which characterize the type of interindustrial relationships**	**The definitional domain of the fuzzy variables**		**The expectation of the membership function for the fuzzy variables**
1	«Very Weak»	0.000000	0.006483	0.000723
2	«Weak»	0.005752	0.021035	0.012000
3	«Below Medium»	0.018238	0.047533	0.031000
4	«Medium»	0.040851	0.093104	0.064000
5	«Above Medium»	0.080524	0.171885	0.121000
6	«Strong»	0.167367	0.519709	0.308000
7	«Very Strong»	0.340852	0.650144	0.488000

Appendix B: The fuzzification of the final demand components: investment, export and import

Let's consider the fuzzification of investment and international trade flows as the final demand components. For the fuzzy interpretation of investment (see the model (7)-(8)) we derive three vectors of the investment - private, federal and social and local - from input-output tables for the US economy for 2009-2011. While the elements of each vector characterize the share of certain type of investment in the total final demand, we can define these elements as the linguistic variable *"Intensity of investment into the industry"*. According to IO data for 2009-2011, the domain for this linguistic variable is *U = [0.000000; 4.720704]*. This gives the following definition for the linguistic variable:

$$\left\langle \text{«Intensity of investment into the industry"»}, T(\beta=7), [0.000000; 4.720704] \right\rangle$$

The term-set for verbal values of the linguistic variable β = *"Intensity of investment into the industry"* is represented as:

$T(\beta)$ = *{"Very Weak", "Weak, "Below Medium", "Medium", "Above Medium", "Strong", "Very Strong"}.*

Employing the K-means clustering for three years, we obtain three groups of clusters. Using procedure, which was described in Appendix A, we transform the clusters to domains for the fuzzy variables that quantitively describe the term-set for this linguistic variable. Then, we define related Gaussian functions for the fuzzy variables and calculate their expectations. Based on results of calculations, we replace elements of the vectors for the model (7)-(8) by the expectations from the membership functions (Table xx). As a result, we have fuzzified vectors of private, federal and state and local investment for estimating impacts based in the system of equations (8).

Table xx.

Fuzzy interpretation of the investment vectors

Cluster	**Terms, which characterize intensity of investment into the industry**	**The definitional domain of the fuzzy variables**		**The expectation of the membership function for the fuzzy variables**
1	«Very Weak»	0.000000	0.032001	0.000888
2	«Weak»	0.029948	0.100339	0.060000
3	«Below Medium»	0.083609	0.196669	0.134000
4	«Medium»	0.170121	0.432716	0.286000
5	«Above Medium»	0.256828	0.687322	0.445000
6	«Strong»	0.468695	1.589472	0.950000
7	«Very Strong»	0.881792	4.720704	2.708000

To fuzzily international trade flows, we define elements of the vector that characterizes the shares of export in the total final demand as the following linguistic variable *"Intensity of export flow by the industry"*. Analysis of the input-output tables for 2010-2011 gives the following definition of the linguistic variable:

$$\langle \text{«Intensity of export flow by the industry"»}, T(\beta = 7), [0.000000; 3.955629] \rangle$$

Using the same term-set for verbal values of this linguistic variable, we employ the clustering to define domain for each fuzzy variable. Next, we find Gaussian membership function and calculate the expectations. Table xxx presents the result of calculations.

Table xxx.

Fuzzy interpretation of the export vector

Cluster	Terms, which characterize intensity of export flow by industry	The definitional domain of the fuzzy variables		The expectation of the membership function for the fuzzy variables
1	«Very Weak»	0.000000	0.125974	0.015000
2	«Weak»	0.113075	0.342504	0.210000
3	«Below Medium»	0.293098	0.554116	0.419000
4	«Medium»	0.481074	0.869430	0.659000
5	«Above Medium»	0.811996	1.532824	1.140000
6	«Strong»	1.214143	3.208537	2.090000
7	«Very Strong»	2.262254	3.955629	3.069000

Using the same idea, each element of the vector with the shares of import in the total final demand can be described by the following linguistic variable "Intensity of import flow by the industry". The term-set, fuzzy variables and Gaussian membership function expectations for this linguistic variable are shown in Table xxxx.

Table xxxx.

Fuzzy interpretation of the import vector

Cluster	Terms, which characterize intensity of import flow by industry	The definitional domain of the fuzzy variables		The expectation of the membership function for the fuzzy variables
1	«Very Weak»	0.000000	0.064957	0.007728
2	«Weak»	0.059845	0.229246	0.132000
3	«Below Medium»	0.200300	0.455410	0.220000
4	«Medium»	0.438743	0.792708	0.601000
5	«Above Medium»	0.755128	2.386375	1.462000
6	«Strong»	1.017800	5.593505	2.940000
7	«Very Strong»	4.605137	11.371165	7.812000

Appendix C

Table 1. The classical and fuzzy rate of changes in the industrial gross output as a result of the 10% increase in the final demand for the separate industries for the US economy: model 1

Code	Element of vector X	GOV		HS		23		42		722		523		484		326	
		Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy
111-113	x1	0.00475	0.00502	0.00022	0.00063	0.00147	0.00108	0.00118	0.00058	0.00662	0.00819	0.00009	0.00018	0.00008	0.00014	0.00011	0.00012
211-22	x2	0.01818	0.01699	0.00105	0.00145	0.00695	0.00697	0.00201	0.00174	0.00274	0.00316	0.00038	0.00042	0.00222	0.00277	0.00011	0.00012
23	x3	0.00587	0.00839	0.00560	0.00494	0.07919	0.07803	0.00040	0.00042	0.00050	0.00046	0.00011	0.00011	0.00011	0.00017	0.00001	0.00001
332	x4	0.01091	0.00749	0.00160	0.00226	0.01784	0.02037	0.00207	0.00151	0.00408	0.00361	0.00034	0.00042	0.00073	0.00093	0.00020	0.00021
333	x5	0.00424	0.00312	0.00055	0.00095	0.00593	0.00466	0.00103	0.00076	0.00113	0.00098	0.00014	0.00020	0.00029	0.00038	0.00005	0.00008
334	x6	0.01136	0.01432	0.00048	0.00094	0.00344	0.00245	0.00278	0.00400	0.00137	0.00121	0.00060	0.00053	0.00027	0.00036	0.00008	0.00009
335	x7	0.00941	0.00737	0.00162	0.00307	0.01935	0.02587	0.00163	0.00136	0.00293	0.00143	0.00033	0.00036	0.00031	0.00047	0.00009	0.00006
3361MV	x8	0.00441	0.00185	0.00023	0.00058	0.00207	0.00081	0.00105	0.00053	0.00072	0.00048	0.00012	0.00012	0.00089	0.00132	0.00002	0.00002
3364OT	x9	0.01099	0.01563	0.00009	0.00076	0.00045	0.00073	0.00033	0.00070	0.00026	0.00053	0.00009	0.00017	0.00012	0.00029	0.00001	0.00002
337	x10	0.00168	0.00529	0.00583	0.00234	0.00871	0.00205	0.00092	0.00152	0.00214	0.00140	0.00012	0.00044	0.00006	0.00040	0.00004	0.00004
321-339	x11	0.00867	0.00633	0.00160	0.00193	0.01622	0.01685	0.00212	0.00125	0.00327	0.00288	0.00029	0.00033	0.00041	0.00061	0.00014	0.00015
311FT	x12	0.00488	0.00537	0.00012	0.00033	0.00028	0.00034	0.00043	0.00028	0.00783	0.00932	0.00007	0.00013	0.00004	0.00007	0.00001	0.00002
313TT	x13	0.00885	0.00874	0.00098	0.00375	0.00610	0.00374	0.00309	0.00271	0.00299	0.00262	0.00023	0.00073	0.00033	0.00081	0.00048	0.00040
315AL	x14	0.00780	0.00849	0.00016	0.00374	0.00085	0.00330	0.00222	0.00244	0.00062	0.00224	0.00019	0.00077	0.00016	0.00065	0.00002	0.00007
322	x15	0.01138	0.00618	0.00063	0.00192	0.00394	0.00429	0.00344	0.00179	0.00477	0.00423	0.00050	0.00065	0.00041	0.00058	0.00027	0.00041
323	x16	0.01757	0.00894	0.00061	0.00329	0.00219	0.00404	0.00621	0.00218	0.00277	0.00198	0.00320	0.00535	0.00048	0.00060	0.00003	0.00006
324	x17	0.02035	0.02180	0.00073	0.00107	0.00730	0.00783	0.00133	0.00102	0.00169	0.00201	0.00026	0.00023	0.00369	0.00514	0.00006	0.00008
325	x18	0.00858	0.00922	0.00052	0.00105	0.00397	0.00465	0.00209	0.00286	0.00204	0.00239	0.00025	0.00035	0.00037	0.00055	0.00078	0.00069
326	x19	0.00991	0.00587	0.00101	0.00157	0.00935	0.00749	0.00383	0.00533	0.00541	0.00551	0.00032	0.00032	0.00081	0.00064	0.00704	0.00598
42	x20	0.00535	0.00502	0.00047	0.00063	0.00417	0.00382	0.05800	0.05344	0.00209	0.00256	0.00017	0.00018	0.00065	0.00088	0.00009	0.00011
441	x21	0.00048	0.00218	0.00012	0.00096	0.00118	0.00084	0.00019	0.00063	0.00019	0.00058	0.00004	0.00018	0.00037	0.00017	0.00001	0.00002
445	x22	0.00005	0.00162	0.00011	0.00072	0.00021	0.00063	0.00002	0.00047	0.00003	0.00043	0.00001	0.00013	0.00002	0.00012	0.00000	0.00001
452	x23	0.00017	0.00149	0.00022	0.00066	0.00068	0.00057	0.00006	0.00043	0.00023	0.00039	0.00001	0.00012	0.00006	0.00011	0.00000	0.00001
4A0	x24	0.00083	0.00128	0.00094	0.00068	0.00725	0.00757	0.00015	0.00018	0.00053	0.00018	0.00003	0.00005	0.00014	0.00025	0.00001	0.00001
481	x25	0.01057	0.00421	0.00041	0.00123	0.00170	0.00134	0.00200	0.00137	0.00132	0.00100	0.00091	0.00042	0.00066	0.00144	0.00005	0.00003
482	x26	0.01062	0.00695	0.00069	0.00220	0.00562	0.00454	0.00164	0.00188	0.00287	0.00334	0.00023	0.00045	0.00233	0.00219	0.00024	0.00034
483	x27	0.01417	0.00589	0.00035	0.00261	0.00318	0.00228	0.00068	0.00170	0.00141	0.00155	0.00014	0.00049	0.00022	0.00045	0.00004	0.00005
484	x28	0.00728	0.00391	0.00063	0.00117	0.00552	0.00642	0.00164	0.00089	0.00256	0.00222	0.00024	0.00022	0.04759	0.04512	0.00010	0.00012

Table 1. The classical and fuzzy rate of changes in the industrial gross output as a result of the 10% increase in the final demand for the separate industries for the US economy: model 1 (continue)

Code	Element of vector X	GOV		HS		23		42		722		523		484		326	
		Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy	Classical	Fuzzy
485	x29	0.01552	0.00594	0.00045	0.00261	0.00124	0.00229	0.00113	0.00172	0.00129	0.00157	0.00087	0.00050	0.00016	0.00045	0.00003	0.00005
486	x30	0.02284	0.01586	0.00078	0.00361	0.00630	0.00610	0.00148	0.00262	0.00191	0.00304	0.00028	0.00072	0.00247	0.00234	0.00009	0.00010
487OS	x31	0.00754	0.00563	0.00048	0.00145	0.00295	0.00350	0.01027	0.01241	0.00187	0.00188	0.00189	0.00153	0.00684	0.00796	0.00005	0.00007
493	x32	0.00827	0.00615	0.00055	0.00234	0.00359	0.00375	0.01185	0.01282	0.00320	0.00192	0.00078	0.00049	0.00269	0.00270	0.00008	0.00007
511	x33	0.00446	0.00189	0.00009	0.00075	0.00038	0.00066	0.00052	0.00050	0.00032	0.00045	0.00028	0.00018	0.00005	0.00013	0.00000	0.00001
512	x34	0.00363	0.00455	0.00014	0.00119	0.00061	0.00115	0.00087	0.00135	0.00086	0.00083	0.00034	0.00059	0.00010	0.00023	0.00001	0.00003
513	x35	0.00697	0.00777	0.00032	0.00053	0.00130	0.00086	0.00193	0.00239	0.00110	0.00073	0.00098	0.00139	0.00024	0.00018	0.00002	0.00002
514	x36	0.02558	0.02916	0.00067	0.00164	0.00235	0.00212	0.00245	0.00246	0.00261	0.00194	0.00621	0.00551	0.00031	0.00046	0.00006	0.00005
521CI	x37	0.00630	0.00866	0.00601	0.00403	0.00190	0.00139	0.00232	0.00275	0.00158	0.00132	0.00240	0.00270	0.00046	0.00063	0.00004	0.00003
523	x38	0.00706	0.00992	0.00075	0.00103	0.00108	0.00081	0.00088	0.00091	0.00095	0.00075	0.04803	0.04739	0.00023	0.00023	0.00002	0.00002
524	x39	0.00366	0.00270	0.00133	0.00067	0.00094	0.00104	0.00265	0.00254	0.00152	0.00200	0.00118	0.00144	0.00069	0.00096	0.00002	0.00002
525	x40	0.00027	0.00245	0.00006	0.00097	0.00005	0.00085	0.00010	0.00065	0.00007	0.00059	0.00110	0.00169	0.00002	0.00017	0.00000	0.00002
HS	x41	0.00000	0.00019	0.10000	0.09878	0.00000	0.00007	0.00000	0.00005	0.00000	0.00005	0.00000	0.00001	0.00000	0.00001	0.00000	0.00000
ORE	x42	0.01016	0.00808	0.00417	0.00320	0.00237	0.00179	0.00398	0.00463	0.00484	0.00570	0.00114	0.00127	0.00049	0.00060	0.00003	0.00003
532RL	x43	0.00713	0.00552	0.00062	0.00113	0.00498	0.00508	0.00378	0.00391	0.00313	0.00349	0.00092	0.00110	0.00138	0.00147	0.00007	0.00008
5411	x44	0.00827	0.00513	0.00096	0.00104	0.00268	0.00181	0.00288	0.00468	0.00194	0.00162	0.00155	0.00140	0.00031	0.00048	0.00005	0.00005
5415	x45	0.01468	0.02120	0.00034	0.00058	0.00134	0.00093	0.00160	0.00108	0.00114	0.00096	0.00108	0.00091	0.00020	0.00024	0.00002	0.00003
5412OP	x46	0.01080	0.00938	0.00064	0.00081	0.00319	0.00365	0.00373	0.00447	0.00251	0.00247	0.00135	0.00131	0.00034	0.00048	0.00005	0.00008
55	x47	0.00715	0.00727	0.00081	0.00122	0.00400	0.00380	0.00777	0.00595	0.00875	0.00834	0.00198	0.00160	0.00093	0.00094	0.00018	0.00021
561	x48	0.01420	0.01049	0.00167	0.00181	0.00301	0.00266	0.00515	0.00576	0.00330	0.00380	0.00141	0.00162	0.00075	0.00080	0.00006	0.00007
562	x49	0.02305	0.00809	0.00088	0.00351	0.00376	0.00288	0.00243	0.00276	0.00353	0.00280	0.00053	0.00078	0.00065	0.00061	0.00008	0.00006
61	x50	0.00326	0.00101	0.00004	0.00045	0.00022	0.00056	0.00022	0.00029	0.00017	0.00027	0.00003	0.00008	0.00002	0.00008	0.00000	0.00001
621	x51	0.00084	0.00039	0.00000	0.00017	0.00001	0.00015	0.00001	0.00011	0.00002	0.00010	0.00000	0.00003	0.00000	0.00003	0.00000	0.00000
622	x52	0.00000	0.00040	0.00000	0.00018	0.00000	0.00015	0.00000	0.00011	0.00000	0.00010	0.00000	0.00003	0.00000	0.00003	0.00000	0.00000
623	x53	0.00079	0.00146	0.00000	0.00065	0.00001	0.00057	0.00000	0.00042	0.00001	0.00039	0.00000	0.00012	0.00000	0.00011	0.00000	0.00001
624	x54	0.00063	0.00180	0.00000	0.00079	0.00001	0.00069	0.00001	0.00052	0.00001	0.00047	0.00000	0.00015	0.00000	0.00014	0.00000	0.00002
711AS	x55	0.00411	0.00449	0.00028	0.00140	0.00097	0.00145	0.00148	0.00152	0.00221	0.00131	0.00057	0.00055	0.00017	0.00031	0.00002	0.00004
713	x56	0.00209	0.00194	0.00008	0.00086	0.00025	0.00075	0.00032	0.00056	0.00036	0.00051	0.00015	0.00016	0.00003	0.00015	0.00001	0.00002
721	x57	0.00484	0.00362	0.00037	0.00115	0.00107	0.00102	0.00094	0.00079	0.00105	0.00072	0.00081	0.00030	0.00011	0.00020	0.00003	0.00002
722	x58	0.00375	0.00575	0.00025	0.00041	0.00061	0.00049	0.00080	0.00061	0.08043	0.07749	0.00037	0.00055	0.00011	0.00013	0.00002	0.00001
81	x59	0.00451	0.00584	0.00030	0.00043	0.00117	0.00066	0.00183	0.00185	0.00138	0.00140	0.00031	0.00022	0.00018	0.00014	0.00002	0.00001
GOV	x60	0.09726	0.09733	0.00003	0.00008	0.00009	0.00011	0.00025	0.00041	0.00019	0.00030	0.00016	0.00011	0.00014	0.00019	0.00000	0.00000

Table 2. The estimation error for impact from the 10% increase in the final demand for the separate industries for the US economy: model 1, model 2 and model 3

Code	Element of vector X	GOV			HS			42			23		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
111-113	x1	0.0270%	0.0138%	0.1211%	0.0419%	0.0402%	0.0230%	0.0597%	0.0575%	0.0761%	0.0390%	0.0007%	0.0418%
211-22	x2	0.1189%	0.3123%	1.0820%	0.0393%	0.0233%	0.0422%	0.0268%	0.0362%	0.1240%	0.0019%	0.1654%	0.2775%
23	x3	0.2516%	0.0464%	0.0346%	0.0664%	0.1874%	0.1938%	0.0022%	0.0061%	0.0081%	0.1156%	0.2915%	0.0871%
332	x4	0.3423%	0.5540%	0.7911%	0.0663%	0.0026%	0.0691%	0.0565%	0.0918%	0.1460%	0.2534%	0.2506%	0.6554%
333	x5	0.1118%	0.2789%	0.3279%	0.0396%	0.0112%	0.0263%	0.0264%	0.0648%	0.0788%	0.1273%	0.2914%	0.3953%
334	x6	0.2959%	0.1902%	0.7400%	0.0462%	0.0142%	0.0215%	0.1216%	0.0034%	0.1659%	0.0991%	0.1190%	0.2503%
335	x7	0.2043%	0.4765%	0.7157%	0.1451%	0.0318%	0.0680%	0.0264%	0.0708%	0.1202%	0.6520%	0.3373%	0.8401%
3361MV	x8	0.2567%	0.2822%	0.3807%	0.0351%	0.0271%	0.0039%	0.0520%	0.0563%	0.0872%	0.1264%	0.1103%	0.1706%
3364OT	x9	0.4644%	0.2439%	0.1045%	0.0669%	0.0561%	0.0394%	0.0371%	0.0312%	0.0122%	0.0284%	0.0428%	0.0197%
337	x10	0.3616%	0.2583%	0.0813%	0.3490%	0.3946%	0.4727%	0.0603%	0.0389%	0.0196%	0.6669%	0.6422%	0.7383%
321-339	x11	0.2338%	0.4164%	0.6562%	0.0327%	0.0233%	0.0960%	0.0868%	0.1167%	0.1695%	0.0633%	0.0502%	0.8462%
311FT	x12	0.0495%	0.0437%	0.0274%	0.0210%	0.0197%	0.0163%	0.0152%	0.0138%	0.0183%	0.0055%	0.0184%	0.0119%
313TT	x13	0.0115%	0.1009%	0.6170%	0.2766%	0.2381%	0.0170%	0.0382%	0.0497%	0.2246%	0.2360%	0.1424%	0.4514%
315AL	x14	0.0697%	0.0109%	0.6696%	0.3582%	0.3323%	0.0326%	0.0224%	0.0208%	0.1896%	0.2452%	0.3428%	0.0255%
322	x15	0.5202%	0.5756%	0.8234%	0.1292%	0.1119%	0.0347%	0.1652%	0.1704%	0.2518%	0.0346%	0.1496%	0.0918%
323	x16	0.8631%	0.9255%	1.0880%	0.2679%	0.2450%	0.1853%	0.4028%	0.4044%	0.4552%	0.1844%	0.3038%	0.1989%
324	x17	0.1453%	0.0053%	0.5563%	0.0342%	0.0273%	0.0001%	0.0312%	0.0314%	0.0630%	0.0527%	0.2900%	0.0044%
325	x18	0.0638%	0.0199%	0.4437%	0.0537%	0.0439%	0.0046%	0.0773%	0.0690%	0.0784%	0.0688%	0.1927%	0.1072%
326	x19	0.4045%	0.4940%	0.7238%	0.0557%	0.0317%	0.0298%	0.1496%	0.0985%	0.1367%	0.1862%	0.0515%	0.4628%
42	x20	0.0327%	0.0855%	0.1685%	0.0167%	0.0105%	0.0002%	0.4554%	0.6975%	1.8451%	0.0350%	0.0586%	0.0316%
441	x21	0.1701%	0.1591%	0.1491%	0.0842%	0.0791%	0.0752%	0.0443%	0.0447%	0.0392%	0.0335%	0.0063%	0.0122%
445	x22	0.1572%	0.1553%	0.1492%	0.0611%	0.0606%	0.0573%	0.0451%	0.0474%	0.0431%	0.0416%	0.0653%	0.0611%
452	x23	0.1314%	0.1316%	0.1262%	0.0440%	0.0443%	0.0415%	0.0370%	0.0401%	0.0358%	0.0101%	0.0126%	0.0089%
4A0	x24	0.0456%	0.0454%	0.0434%	0.0259%	0.0262%	0.0272%	0.0028%	0.0040%	0.0027%	0.0318%	0.3271%	0.3032%
481	x25	0.6352%	0.6579%	0.7664%	0.0823%	0.0755%	0.0441%	0.0634%	0.0624%	0.1047%	0.0357%	0.0066%	0.0421%
482	x26	0.3678%	0.4374%	0.6363%	0.1510%	0.1289%	0.0664%	0.0244%	0.0169%	0.0466%	0.1085%	0.0063%	0.1771%
483	x27	0.8276%	0.8555%	0.8852%	0.2257%	0.2133%	0.2001%	0.1016%	0.1044%	0.0872%	0.0901%	0.0157%	0.0336%
484	x28	0.3374%	0.3860%	0.4667%	0.0538%	0.0393%	0.0149%	0.0746%	0.0803%	0.1032%	0.0905%	0.2316%	0.0431%
485	x29	0.9581%	0.9865%	1.0544%	0.2159%	0.2034%	0.1737%	0.0587%	0.0614%	0.0332%	0.1043%	0.1788%	0.1407%
486	x30	0.6979%	0.8504%	1.3299%	0.2833%	0.2486%	0.1393%	0.1139%	0.1045%	0.0117%	0.0201%	0.1374%	0.1225%

Table 2. The estimation error for impact from the 10% increase in the final demand for the separate industries for the US economy: model 1, model 2 and model 3 (continue)

Code	Element of vector X	GOV			HS			42			23		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
487OS	x31	0.1910%	0.2398%	0.3277%	0.0963%	0.0837%	0.0611%	0.2142%	0.1826%	0.0733%	0.0558%	0.1511%	0.0725%
493	x32	0.2118%	0.2530%	0.3577%	0.1797%	0.1641%	0.1242%	0.0967%	0.0910%	0.1923%	0.0160%	0.1281%	0.0365%
511	x33	0.2570%	0.2748%	0.2722%	0.0653%	0.0585%	0.0594%	0.0019%	0.0039%	0.0052%	0.0272%	0.0449%	0.0456%
512	x34	0.0927%	0.0869%	0.0292%	0.1050%	0.1033%	0.0882%	0.0483%	0.0558%	0.0310%	0.0537%	0.0969%	0.0757%
513	x35	0.0802%	0.0896%	0.0644%	0.0211%	0.0217%	0.0201%	0.0457%	0.0649%	0.0444%	0.0435%	0.0081%	0.0126%
514	x36	0.3577%	0.1286%	0.2762%	0.0962%	0.0837%	0.0610%	0.0010%	0.0034%	0.0496%	0.0234%	0.0364%	0.0062%
521CI	x37	0.2368%	0.1939%	0.0937%	0.1984%	0.2185%	0.2650%	0.0435%	0.0475%	0.0015%	0.0511%	0.0064%	0.0296%
523	x38	0.2857%	0.2640%	0.2378%	0.0279%	0.0256%	0.0229%	0.0034%	0.0075%	0.0003%	0.0273%	0.0020%	0.0019%
524	x39	0.0956%	0.1041%	0.1497%	0.0653%	0.0675%	0.0784%	0.0109%	0.0024%	0.0585%	0.0101%	0.0465%	0.0214%
525	x40	0.2173%	0.2120%	0.2006%	0.0915%	0.0895%	0.0845%	0.0549%	0.0573%	0.0509%	0.0800%	0.1104%	0.1041%
HS	x41	0.0190%	0.0190%	0.0196%	0.1217%	0.1385%	0.1841%	0.0054%	0.0059%	0.0058%	0.0071%	0.0101%	0.0104%
ORE	x42	0.2078%	0.3722%	0.4212%	0.0964%	0.1616%	0.1810%	0.0656%	0.0037%	0.0519%	0.0581%	0.0383%	0.0548%
532RL	x43	0.1618%	0.2179%	0.3191%	0.0507%	0.0394%	0.0185%	0.0132%	0.0031%	0.0943%	0.0099%	0.1373%	0.0041%
5411	x44	0.3138%	0.3554%	0.4222%	0.0080%	0.0007%	0.0142%	0.1800%	0.1710%	0.0864%	0.0873%	0.0370%	0.0711%
5415	x45	0.6518%	0.4098%	0.4817%	0.0240%	0.0052%	0.0071%	0.0516%	0.1024%	0.1089%	0.0414%	0.0700%	0.0746%
5412OP	x46	0.1417%	0.3155%	0.4630%	0.0168%	0.0017%	0.0110%	0.0734%	0.0146%	0.0756%	0.0466%	0.0952%	0.0134%
55	x47	0.0120%	0.0821%	0.3008%	0.0416%	0.0258%	0.0105%	0.1823%	0.2248%	0.4327%	0.0197%	0.0610%	0.1000%
561	x48	0.3712%	0.5358%	0.6694%	0.0143%	0.0141%	0.0370%	0.0607%	0.0028%	0.0966%	0.0349%	0.0114%	0.0376%
562	x49	1.4954%	1.5722%	1.6729%	0.2629%	0.2297%	0.1860%	0.0333%	0.0237%	0.0242%	0.0877%	0.0128%	0.0647%
61	x50	0.2248%	0.2256%	0.2275%	0.0407%	0.0402%	0.0395%	0.0067%	0.0084%	0.0064%	0.0348%	0.0559%	0.0542%
621	x51	0.0457%	0.0458%	0.0461%	0.0166%	0.0167%	0.0165%	0.0105%	0.0112%	0.0105%	0.0136%	0.0194%	0.0191%
622	x52	0.0397%	0.0396%	0.0391%	0.0175%	0.0176%	0.0173%	0.0115%	0.0122%	0.0115%	0.0153%	0.0213%	0.0209%
623	x53	0.0675%	0.0653%	0.0607%	0.0642%	0.0632%	0.0614%	0.0417%	0.0437%	0.0405%	0.0556%	0.0764%	0.0738%
624	x54	0.1170%	0.1143%	0.1068%	0.0794%	0.0785%	0.0752%	0.0512%	0.0541%	0.0491%	0.0689%	0.0947%	0.0903%
711AS	x55	0.0380%	0.0394%	0.0005%	0.1115%	0.1110%	0.0994%	0.0041%	0.0144%	0.0068%	0.0480%	0.1053%	0.0870%
713	x56	0.0158%	0.0189%	0.0275%	0.0774%	0.0757%	0.0724%	0.0238%	0.0262%	0.0213%	0.0503%	0.0780%	0.0730%
721	x57	0.1221%	0.1427%	0.1632%	0.0778%	0.0717%	0.0649%	0.0154%	0.0142%	0.0227%	0.0043%	0.0280%	0.0197%
722	x58	0.2002%	0.1847%	0.1649%	0.0163%	0.0152%	0.0138%	0.0183%	0.0160%	0.0213%	0.0125%	0.0048%	0.0020%
81	x59	0.1324%	0.1157%	0.0910%	0.0140%	0.0127%	0.0109%	0.0024%	0.0092%	0.0082%	0.0507%	0.0273%	0.0317%
GOV	x60	0.0061%	0.0213%	0.0883%	0.0056%	0.0056%	0.0057%	0.0161%	0.0189%	0.0165%	0.0015%	0.0063%	0.0058%

Table 2. The estimation error for impact from the 10% increase in the final demand for the separate industries for the US economy: model 1, model 2 and model 3 (continue)

Code	Element of vector X	722			523			484			326		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
111-113	x1	0.1576%	0.1364%	0.0849%	0.0087%	0.0080%	0.0018%	0.0063%	0.0072%	0.0022%	0.0008%	0.0002%	0.0004977
211-22	x2	0.0421%	0.0070%	0.1375%	0.0032%	0.0016%	0.0216%	0.0545%	0.0465%	0.0938%	0.0015%	0.0009%	0.0002988
23	x3	0.0044%	0.0156%	0.0157%	0.0002%	0.0029%	0.0032%	0.0062%	0.0027%	0.0028%	0.0000%	0.0009%	3.042E-05
332	x4	0.0469%	0.1490%	0.2640%	0.0071%	0.0045%	0.0191%	0.0200%	0.0001%	0.0334%	0.0006%	0.0052%	0.0003968
333	x5	0.0150%	0.0672%	0.0827%	0.0062%	0.0045%	0.0075%	0.0089%	0.0099%	0.0167%	0.0023%	0.0018%	0.0001202
334	x6	0.0160%	0.0572%	0.1038%	0.0068%	0.0249%	0.0460%	0.0092%	0.0010%	0.0159%	0.0015%	0.0018%	0.0001049
335	x7	0.1502%	0.2025%	0.2492%	0.0028%	0.0105%	0.0229%	0.0167%	0.0022%	0.0153%	0.0031%	0.0052%	3.686E-05
3361MV	x8	0.0236%	0.0303%	0.0563%	0.0003%	0.0014%	0.0084%	0.0434%	0.0359%	0.0425%	0.0004%	0.0007%	1.24E-05
3364OT	x9	0.0264%	0.0188%	0.0069%	0.0083%	0.0058%	0.0011%	0.0173%	0.0153%	0.0079%	0.0011%	0.0008%	7.316E-05
337	x10	0.0742%	0.1014%	0.1482%	0.0318%	0.0233%	0.0068%	0.0343%	0.0295%	0.0141%	0.0001%	0.0006%	0.0001059
321-339	x11	0.0391%	0.1222%	0.2318%	0.0045%	0.0050%	0.0187%	0.0193%	0.0055%	0.0195%	0.0015%	0.0034%	0.0002247
311FT	x12	0.1492%	0.1393%	0.0136%	0.0053%	0.0052%	0.0033%	0.0034%	0.0033%	0.0030%	0.0005%	0.0004%	6.967E-05
313TT	x13	0.0370%	0.0637%	0.2186%	0.0492%	0.0418%	0.0026%	0.0483%	0.0468%	0.0062%	0.0078%	0.0127%	0.0004031
315AL	x14	0.1618%	0.1462%	0.0331%	0.0588%	0.0533%	0.0093%	0.0492%	0.0502%	0.0067%	0.0052%	0.0044%	4.679E-05
322	x15	0.0546%	0.0921%	0.2628%	0.0148%	0.0093%	0.0197%	0.0173%	0.0171%	0.0093%	0.0136%	0.0093%	0.0012111
323	x16	0.0788%	0.0926%	0.1291%	0.2149%	0.1776%	0.0502%	0.0125%	0.0135%	0.0005%	0.0026%	0.0022%	0.0002862
324	x17	0.0327%	0.0197%	0.0323%	0.0023%	0.0038%	0.0107%	0.1450%	0.1566%	0.0039%	0.0019%	0.0012%	0.0003355
325	x18	0.0348%	0.0133%	0.0973%	0.0096%	0.0072%	0.0108%	0.0178%	0.0179%	0.0107%	0.0089%	0.0153%	0.0014521
326	x19	0.0109%	0.0732%	0.2900%	0.0000%	0.0046%	0.0182%	0.0167%	0.0215%	0.0495%	0.1060%	0.2053%	0.012537
42	x20	0.0468%	0.0205%	0.0228%	0.0006%	0.0007%	0.0051%	0.0234%	0.0219%	0.0043%	0.0020%	0.0008%	0.0004778
441	x21	0.0389%	0.0358%	0.0333%	0.0145%	0.0135%	0.0118%	0.0206%	0.0203%	0.0214%	0.0013%	0.0012%	0.000105
445	x22	0.0395%	0.0388%	0.0368%	0.0129%	0.0127%	0.0110%	0.0102%	0.0110%	0.0102%	0.0015%	0.0015%	8.768E-05
452	x23	0.0161%	0.0164%	0.0142%	0.0108%	0.0113%	0.0093%	0.0055%	0.0068%	0.0057%	0.0014%	0.0014%	8.161E-05
4A0	x24	0.0348%	0.0350%	0.0351%	0.0020%	0.0020%	0.0015%	0.0114%	0.0136%	0.0127%	0.0001%	0.0003%	2.84E-05
481	x25	0.0312%	0.0368%	0.0628%	0.0489%	0.0512%	0.0642%	0.0780%	0.0826%	0.0401%	0.0019%	0.0021%	9.421E-05
482	x26	0.0465%	0.0130%	0.0833%	0.0220%	0.0175%	0.0028%	0.0144%	0.0181%	0.0894%	0.0099%	0.0060%	0.0012461
483	x27	0.0143%	0.0070%	0.0013%	0.0349%	0.0326%	0.0268%	0.0229%	0.0250%	0.0213%	0.0012%	0.0009%	0.0002702
484	x28	0.0337%	0.0612%	0.1074%	0.0023%	0.0048%	0.0106%	0.2474%	0.4402%	1.5310%	0.0019%	0.0003%	0.0004779
485	x29	0.0282%	0.0207%	0.0023%	0.0376%	0.0401%	0.0488%	0.0288%	0.0306%	0.0242%	0.0018%	0.0014%	0.0002566
486	x30	0.1123%	0.0829%	0.0094%	0.0440%	0.0369%	0.0118%	0.0124%	0.0153%	0.0961%	0.0017%	0.0005%	0.0003652

Table 2. The estimation error for impact from the 10% increase in the final demand for the separate industries for the US economy: model 1, model 2 and model 3 (continue)

Code	Element of vector X	722			523			484			326		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
487OS	x31	0.0007%	0.0153%	0.0455%	0.0363%	0.0496%	0.0824%	0.1121%	0.1110%	0.0398%	0.0018%	0.0011%	0.0003326
493	x32	0.1278%	0.1406%	0.1737%	0.0293%	0.0326%	0.0441%	0.0010%	0.0064%	0.0487%	0.0015%	0.0019%	0.0002863
511	x33	0.0137%	0.0093%	0.0101%	0.0097%	0.0115%	0.0124%	0.0077%	0.0072%	0.0075%	0.0009%	0.0008%	8.81E-05
512	x34	0.0034%	0.0046%	0.0156%	0.0251%	0.0236%	0.0124%	0.0139%	0.0154%	0.0112%	0.0018%	0.0018%	0.0001362
513	x35	0.0371%	0.0362%	0.0388%	0.0409%	0.0426%	0.0278%	0.0061%	0.0041%	0.0052%	0.0002%	0.0002%	0.0001077
514	x36	0.0664%	0.0814%	0.1083%	0.0699%	0.1131%	0.2228%	0.0149%	0.0147%	0.0075%	0.0012%	0.0016%	0.0002293
521CI	x37	0.0265%	0.0330%	0.0486%	0.0294%	0.0160%	0.0322%	0.0163%	0.0187%	0.0096%	0.0006%	0.0008%	0.0001591
523	x38	0.0199%	0.0217%	0.0240%	0.0641%	0.1672%	0.6341%	0.0008%	0.0007%	0.0005%	0.0005%	0.0004%	0.0001229
524	x39	0.0474%	0.0412%	0.0078%	0.0265%	0.0221%	0.0108%	0.0279%	0.0337%	0.0144%	0.0001%	0.0001%	0.0001082
525	x40	0.0521%	0.0508%	0.0474%	0.0591%	0.0555%	0.0357%	0.0146%	0.0155%	0.0148%	0.0019%	0.0013%	0.0001175
HS	x41	0.0048%	0.0047%	0.0052%	0.0012%	0.0012%	0.0017%	0.0012%	0.0012%	0.0017%	0.0000%	0.0000%	1.153E-05
ORE	x42	0.0859%	0.0304%	0.0663%	0.0133%	0.0120%	0.0275%	0.0109%	0.0038%	0.0020%	0.0004%	0.0002%	0.0001428
532RL	x43	0.0359%	0.0006%	0.0645%	0.0185%	0.0075%	0.0188%	0.0093%	0.0068%	0.0254%	0.0010%	0.0004%	0.0003394
5411	x44	0.0319%	0.0451%	0.0668%	0.0151%	0.0264%	0.0529%	0.0165%	0.0163%	0.0088%	0.0000%	0.0008%	0.00022
5415	x45	0.0177%	0.0658%	0.0692%	0.0177%	0.0631%	0.0694%	0.0034%	0.0075%	0.0085%	0.0001%	0.0013%	5.775E-05
5412OP	x46	0.0047%	0.0500%	0.0897%	0.0039%	0.0285%	0.0555%	0.0143%	0.0090%	0.0001%	0.0022%	0.0008%	0.000286
55	x47	0.0405%	0.1486%	0.4001%	0.0377%	0.0584%	0.1130%	0.0004%	0.0039%	0.0359%	0.0030%	0.0001%	0.0006836
561	x48	0.0494%	0.0103%	0.0592%	0.0219%	0.0037%	0.0334%	0.0056%	0.0007%	0.0133%	0.0011%	0.0000%	0.0002845
562	x49	0.0729%	0.0994%	0.1350%	0.0254%	0.0179%	0.0036%	0.0036%	0.0044%	0.0138%	0.0022%	0.0028%	0.0002499
61	x50	0.0101%	0.0098%	0.0092%	0.0057%	0.0056%	0.0050%	0.0060%	0.0068%	0.0064%	0.0006%	0.0006%	5.192E-05
621	x51	0.0085%	0.0084%	0.0083%	0.0028%	0.0029%	0.0026%	0.0027%	0.0030%	0.0029%	0.0002%	0.0003%	2.242E-05
622	x52	0.0105%	0.0104%	0.0103%	0.0033%	0.0033%	0.0030%	0.0031%	0.0033%	0.0033%	0.0004%	0.0004%	2.339E-05
623	x53	0.0376%	0.0371%	0.0358%	0.0116%	0.0114%	0.0104%	0.0107%	0.0114%	0.0108%	0.0014%	0.0009%	7.94E-05
624	x54	0.0468%	0.0465%	0.0441%	0.0149%	0.0152%	0.0132%	0.0138%	0.0152%	0.0137%	0.0017%	0.0016%	9.649E-05
711AS	x55	0.0893%	0.0891%	0.1005%	0.0027%	0.0026%	0.0110%	0.0145%	0.0167%	0.0138%	0.0020%	0.0013%	0.0002344
713	x56	0.0152%	0.0143%	0.0121%	0.0009%	0.0006%	0.0009%	0.0117%	0.0126%	0.0116%	0.0012%	0.0011%	9.718E-05
721	x57	0.0330%	0.0365%	0.0407%	0.0511%	0.0522%	0.0559%	0.0086%	0.0096%	0.0086%	0.0005%	0.0007%	0.0001114
722	x58	0.2936%	0.5030%	0.7917%	0.0183%	0.0168%	0.0109%	0.0012%	0.0021%	0.0012%	0.0005%	0.0005%	5.822E-05
81	x59	0.0024%	0.0016%	0.0079%	0.0098%	0.0103%	0.0128%	0.0041%	0.0032%	0.0041%	0.0006%	0.0005%	7.276E-05
GOV	x60	0.0105%	0.0107%	0.0102%	0.0048%	0.0049%	0.0056%	0.0049%	0.0070%	0.0064%	0.0004%	0.0000%	1.431E-05

Table 3. The estimation error for impact from the 10% increase in the final demand for different groups of industries for the US economy: model 1, model 2 and model 3

Code	Element of vector X	Group 1			Group 2			Group 3		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
111-113	x1	0.0100%	0.0107%	0.0007%	0.0300%	0.0280%	0.0126%	0.0700%	0.0715%	0.1292%
211-22	x2	0.0800%	0.0255%	0.0545%	0.0000%	0.0137%	0.0725%	0.0100%	0.0602%	0.3471%
23	x3	0.0200%	0.0049%	0.0151%	0.0100%	0.0162%	0.0146%	0.0200%	0.0491%	0.0524%
332	x4	0.0100%	0.0349%	0.0249%	0.0200%	0.0176%	0.0580%	0.1100%	0.2104%	0.3380%
333	x5	0.0100%	0.0300%	0.0200%	0.0300%	0.0134%	0.0231%	0.0100%	0.1322%	0.1697%
334	x6	0.0200%	0.0103%	0.0097%	0.0600%	0.1061%	0.1582%	0.0700%	0.1190%	0.3660%
335	x7	0.0300%	0.0112%	0.0188%	0.0300%	0.0240%	0.0668%	0.0600%	0.1878%	0.3054%
3361MV	x8	0.0500%	0.0343%	0.0157%	0.0100%	0.0006%	0.0257%	0.0600%	0.0991%	0.2789%
3364OT	x9	0.0400%	0.0154%	0.0246%	0.0300%	0.0223%	0.0102%	0.0800%	0.0610%	0.0229%
337	x10	0.0800%	0.0645%	0.0155%	0.1500%	0.1160%	0.0604%	0.0800%	0.0103%	0.1245%
321-339	x11	0.0300%	0.0117%	0.0183%	0.0200%	0.0161%	0.0569%	0.1700%	0.2580%	0.3881%
311FT	x12	0.0000%	0.0024%	0.0024%	0.0200%	0.0143%	0.0119%	0.0300%	0.0319%	0.0470%
313TT	x13	0.0900%	0.0759%	0.0141%	0.2100%	0.1817%	0.0107%	0.2200%	0.3370%	1.0200%
315AL	x14	0.1200%	0.1168%	0.0032%	0.2500%	0.2218%	0.0220%	0.0000%	0.0419%	0.5680%
322	x15	0.0500%	0.0349%	0.0151%	0.0000%	0.0200%	0.0929%	0.1600%	0.2184%	0.4898%
323	x16	0.0400%	0.0351%	0.0049%	0.0200%	0.0918%	0.2719%	0.3700%	0.1862%	0.1708%
324	x17	0.2500%	0.2104%	0.0396%	0.0100%	0.0146%	0.0350%	0.0500%	0.0634%	0.1432%
325	x18	0.0400%	0.0293%	0.0107%	0.0300%	0.0166%	0.0343%	0.0800%	0.0472%	0.2080%
326	x19	0.0200%	0.0411%	0.0211%	0.0100%	0.0342%	0.0780%	0.0300%	0.1438%	0.5340%
42	x20	0.0300%	0.0194%	0.0106%	0.0000%	0.0089%	0.0162%	0.4100%	0.6891%	1.8832%
441	x21	0.0000%	0.0045%	0.0045%	0.0600%	0.0592%	0.0614%	0.6100%	0.7195%	1.1342%
445	x22	0.0300%	0.0282%	0.0018%	0.0600%	0.0547%	0.0565%	0.8900%	1.0187%	1.3542%
452	x23	0.0200%	0.0213%	0.0013%	0.0500%	0.0469%	0.0487%	0.6500%	0.7730%	1.0879%
4A0	x24	0.0200%	0.0172%	0.0028%	0.0100%	0.0079%	0.0091%	0.0400%	0.3906%	0.5226%
481	x25	1.2300%	0.7093%	0.5207%	0.1700%	0.1752%	0.2043%	0.0600%	0.0710%	0.1643%
482	x26	0.4500%	0.6640%	0.2140%	0.0900%	0.0692%	0.0262%	0.0700%	0.0309%	0.1111%
483	x27	0.1800%	0.1205%	0.0595%	0.1500%	0.1422%	0.1461%	0.2600%	0.2465%	0.2165%
484	x28	0.2600%	0.4566%	0.1966%	0.0000%	0.0069%	0.0202%	0.0800%	0.0233%	0.1787%
485	x29	0.6400%	0.3545%	0.2855%	0.1600%	0.1760%	0.1862%	0.1700%	0.1574%	0.0999%
486	x30	0.6200%	0.7242%	0.1042%	0.1900%	0.1574%	0.0814%	0.3100%	0.2465%	0.0189%

Table 3. The estimation error for impact from the 10% increase in the final demand for different groups of industries for the US economy: model 1, model 2 and model 3 (continue)

Code	Element of vector X	Group 1			Group 2			Group 3		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
487OS	x31	0.2500%	0.4534%	0.2034%	0.0900%	0.1210%	0.1682%	0.1500%	0.0227%	0.3686%
493	x32	0.0100%	0.0023%	0.0077%	0.0100%	0.0043%	0.0266%	0.4700%	0.1600%	0.7345%
511	x33	0.0100%	0.0123%	0.0023%	0.0100%	0.0167%	0.0117%	0.0000%	0.0097%	0.0102%
512	x34	0.0400%	0.0365%	0.0035%	0.0600%	0.0540%	0.0389%	0.0900%	0.0920%	0.0446%
513	x35	0.0000%	0.0044%	0.0044%	0.0100%	0.0105%	0.0223%	0.0700%	0.0805%	0.0512%
514	x36	0.0000%	0.0043%	0.0043%	0.2700%	0.3480%	0.4920%	0.2300%	0.2664%	0.3598%
521CI	x37	0.0200%	0.0168%	0.0032%	0.2800%	0.5491%	0.9785%	0.0300%	0.0052%	0.0838%
523	x38	0.0000%	0.0032%	0.0032%	0.2600%	0.4046%	0.8985%	0.0100%	0.0131%	0.0237%
524	x39	0.0300%	0.0346%	0.0046%	0.3800%	0.6626%	0.4940%	0.0500%	0.0386%	0.0750%
525	x40	0.0400%	0.0350%	0.0050%	1.2600%	1.4202%	1.8348%	0.1400%	0.1389%	0.1282%
HS	x41	0.0000%	0.0036%	0.0036%	0.0100%	0.0065%	0.0075%	0.0100%	0.0142%	0.0144%
ORE	x42	0.0200%	0.0063%	0.0137%	0.0100%	0.0552%	0.0642%	0.0800%	0.4070%	0.5208%
532RL	x43	0.0200%	0.0441%	0.0241%	0.0200%	0.0409%	0.0822%	0.0300%	0.0460%	0.2273%
5411	x44	0.0200%	0.0087%	0.0113%	0.0300%	0.0832%	0.1243%	0.1200%	0.0898%	0.0274%
5415	x45	0.0100%	0.0412%	0.0312%	0.1100%	0.2002%	0.2061%	0.1300%	0.2545%	0.2659%
5412OP	x46	0.0300%	0.0053%	0.0247%	0.0200%	0.0939%	0.1435%	0.0900%	0.0858%	0.2671%
55	x47	0.0000%	0.0183%	0.0183%	0.1200%	0.1662%	0.2779%	0.2300%	0.3962%	0.8584%
561	x48	0.0100%	0.0209%	0.0109%	0.0600%	0.1284%	0.1687%	0.1700%	0.0459%	0.2561%
562	x49	0.2100%	0.1554%	0.0546%	0.0700%	0.0410%	0.0209%	0.0100%	0.0619%	0.1710%
61	x50	0.0100%	0.0132%	0.0032%	0.0200%	0.0240%	0.0258%	0.1200%	0.1133%	0.1059%
621	x51	0.0100%	0.0065%	0.0035%	0.0100%	0.0119%	0.0128%	0.0200%	0.0251%	0.0242%
622	x52	0.0100%	0.0075%	0.0025%	0.0100%	0.0139%	0.0148%	0.0300%	0.0293%	0.0283%
623	x53	0.0300%	0.0264%	0.0036%	0.0500%	0.0489%	0.0516%	0.1100%	0.1051%	0.0996%
624	x54	0.0300%	0.0335%	0.0035%	0.0600%	0.0610%	0.0633%	0.1300%	0.1298%	0.1217%
711AS	x55	0.0400%	0.0430%	0.0030%	0.0400%	0.0420%	0.0492%	0.0100%	0.0178%	0.0215%
713	x56	0.0300%	0.0279%	0.0021%	0.0100%	0.0085%	0.0107%	0.0500%	0.0473%	0.0387%
721	x57	0.0100%	0.0137%	0.0037%	0.2200%	0.2225%	0.2226%	0.0200%	0.0279%	0.0428%
722	x58	0.0000%	0.0010%	0.0010%	0.0200%	0.0111%	0.0217%	0.0300%	0.0364%	0.0449%
81	x59	0.0100%	0.0061%	0.0039%	0.0200%	0.0271%	0.0268%	0.0300%	0.0246%	0.0033%
GOV	x60	0.0100%	0.0070%	0.0030%	0.0000%	0.0005%	0.0003%	0.0000%	0.0032%	0.0008%

Table 3. The estimation error for impact from the 10% increase in the final demand for different groups of industries for the US economy: model 1, model 2 and model 3 (continue)

Code	Element of vector X	Group 1 - 3			All industries		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
111-113	x1	0.0300%	0.0330%	0.1127%	0.0001%	0.0000%	0.0007%
211-22	x2	0.0900%	0.0491%	0.6593%	0.0006%	0.0005%	0.0003%
23	x3	0.0100%	0.0588%	0.0589%	0.0003%	0.0002%	0.0002%
332	x4	0.0700%	0.2628%	0.4931%	0.0003%	0.0001%	0.0004%
333	x5	0.0300%	0.1758%	0.2344%	0.0000%	0.0002%	0.0002%
334	x6	0.0300%	0.2354%	0.5673%	0.0002%	0.0001%	0.0000%
335	x7	0.0100%	0.2244%	0.4194%	0.0003%	0.0002%	0.0001%
3361MV	x8	0.0000%	0.0644%	0.3633%	0.0002%	0.0001%	0.0004%
3364OT	x9	0.1500%	0.0991%	0.0266%	0.0002%	0.0000%	0.0000%
337	x10	0.3200%	0.1907%	0.0286%	0.0001%	0.0001%	0.0001%
321-339	x11	0.1200%	0.2841%	0.5082%	0.0001%	0.0007%	0.0000%
311FT	x12	0.0100%	0.0143%	0.0332%	0.0005%	0.0004%	0.0003%
313TT	x13	0.0800%	0.0795%	1.0384%	0.0001%	0.0000%	0.0003%
315AL	x14	0.3600%	0.2968%	0.6007%	0.0001%	0.0001%	0.0001%
322	x15	0.1200%	0.2029%	0.6073%	0.0001%	0.0002%	0.0000%
323	x16	0.3900%	0.1295%	0.4250%	0.0001%	0.0000%	0.0000%
324	x17	0.1900%	0.1327%	0.1771%	0.0000%	0.0004%	0.0001%
325	x18	0.1500%	0.0931%	0.2683%	0.0001%	0.0006%	0.0000%
326	x19	0.0700%	0.2192%	0.7075%	0.0000%	0.0001%	0.0000%
42	x20	0.3800%	0.6784%	1.9051%	0.0009%	0.0004%	0.0003%
441	x21	0.5500%	0.6648%	1.0760%	0.0002%	0.0003%	0.0002%
445	x22	0.8100%	0.9358%	1.2676%	0.0001%	0.0002%	0.0003%
452	x23	0.5800%	0.7052%	1.0165%	0.0003%	0.0006%	0.0001%
4A0	x24	0.0200%	0.3655%	0.4970%	0.0001%	0.0001%	0.0001%
481	x25	1.0000%	0.4644%	0.6580%	0.0000%	0.0006%	0.0001%
482	x26	0.2900%	0.5636%	1.5225%	0.0002%	0.0001%	0.0004%
483	x27	0.5900%	0.2676%	0.8195%	0.0001%	0.0001%	0.0000%
484	x28	0.1800%	0.4876%	1.7530%	0.0004%	0.0002%	0.0002%
485	x29	0.6400%	0.3361%	0.4024%	0.0001%	0.0001%	0.0000%
486	x30	0.1200%	0.3201%	0.9353%	0.0001%	0.0000%	0.0000%

Table 3. The estimation error for impact from the 10% increase in the final demand for different groups of industries for the US economy: model 1, model 2 and model 3 (continue)

Code	Element of vector X	Group 1 - 3			All industries		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
487OS	x31	0.1900%	0.5518%	1.3002%	0.0000%	0.0004%	0.0001%
493	x32	0.4900%	0.1579%	0.8367%	0.0001%	0.0003%	0.0006%
511	x33	0.0100%	0.0142%	0.0067%	0.0000%	0.0000%	0.0003%
512	x34	0.1800%	0.1825%	0.1186%	0.0001%	0.0000%	0.0004%
513	x35	0.0500%	0.0744%	0.0417%	0.0000%	0.0000%	0.0000%
514	x36	0.5000%	0.6194%	0.8667%	0.0010%	0.0004%	0.0005%
521CI	x37	0.2400%	0.5269%	1.0550%	0.0001%	0.0000%	0.0001%
523	x38	0.2600%	0.4147%	0.9175%	0.0001%	0.0000%	0.0000%
524	x39	0.3000%	0.5894%	0.5684%	0.0000%	0.0000%	0.0007%
525	x40	1.0800%	1.2456%	1.6698%	0.0002%	0.0000%	0.0002%
HS	x41	0.0200%	0.0237%	0.0248%	0.0004%	0.0004%	0.0005%
ORE	x42	0.0500%	0.4694%	0.5917%	0.0000%	0.0006%	0.0006%
532RL	x43	0.0100%	0.1312%	0.3854%	0.0002%	0.0002%	0.0001%
5411	x44	0.1100%	0.0157%	0.1426%	0.0001%	0.0002%	0.0002%
5415	x45	0.2500%	0.4958%	0.5131%	0.0001%	0.0001%	0.0001%
5412OP	x46	0.1000%	0.1749%	0.4220%	0.0001%	0.0001%	0.0002%
55	x47	0.3400%	0.5805%	1.2087%	0.0000%	0.0000%	0.0003%
561	x48	0.1200%	0.1951%	0.4615%	0.0001%	0.0002%	0.0004%
562	x49	0.2900%	0.1336%	0.1053%	0.0000%	0.0000%	0.0001%
61	x50	0.1600%	0.1499%	0.1461%	0.0001%	0.0001%	0.0001%
621	x51	0.0400%	0.0434%	0.0441%	0.0000%	0.0000%	0.0000%
622	x52	0.0500%	0.0507%	0.0512%	0.0000%	0.0000%	0.0000%
623	x53	0.1800%	0.1814%	0.1796%	0.0002%	0.0004%	0.0001%
624	x54	0.2200%	0.2238%	0.2193%	0.0000%	0.0002%	0.0001%
711AS	x55	0.0100%	0.0195%	0.0273%	0.0004%	0.0008%	0.0001%
713	x56	0.0900%	0.0838%	0.0788%	0.0003%	0.0003%	0.0003%
721	x57	0.2200%	0.2360%	0.2496%	0.0001%	0.0004%	0.0002%
722	x58	0.0100%	0.0245%	0.0150%	0.0001%	0.0000%	0.0000%
81	x59	0.0000%	0.0087%	0.0358%	0.0001%	0.0001%	0.0001%
GOV	x60	0.0100%	0.0097%	0.0076%	0.0002%	0.0002%	0.0001%

Table 4. The error for impact from relative and absolute change in the final demand for the separate industries for the US economy: model 1

Code	Element of vector X	GOV		HS		42		23	
		Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand
111-113	x1	0.0270%	0.0103%	0.0419%	0.0252%	0.0597%	0.0803%	0.0390%	0.0461%
211-22	x2	0.1189%	0.0455%	0.0393%	0.0230%	0.0268%	0.0362%	0.0019%	0.0017%
23	x3	0.2516%	0.0965%	0.0664%	0.0395%	0.0022%	0.0038%	0.1156%	0.1363%
332	x4	0.3423%	0.1317%	0.0663%	0.0399%	0.0565%	0.0760%	0.2534%	0.2988%
333	x5	0.1118%	0.0430%	0.0396%	0.0239%	0.0264%	0.0358%	0.1273%	0.1500%
334	x6	0.2959%	0.1140%	0.0462%	0.0277%	0.1216%	0.1641%	0.0991%	0.1169%
335	x7	0.2043%	0.0782%	0.1451%	0.0880%	0.0264%	0.0351%	0.6520%	0.7689%
3361MV	x8	0.2567%	0.0987%	0.0351%	0.0212%	0.0520%	0.0701%	0.1264%	0.1492%
3364OT	x9	0.4644%	0.1787%	0.0669%	0.0405%	0.0371%	0.0503%	0.0284%	0.0338%
337	x10	0.3616%	0.1391%	0.3490%	0.2105%	0.0603%	0.0813%	0.6669%	0.7858%
321-339	x11	0.2338%	0.0900%	0.0327%	0.0197%	0.0868%	0.1169%	0.0633%	0.0744%
311FT	x12	0.0495%	0.0188%	0.0210%	0.0124%	0.0152%	0.0204%	0.0055%	0.0068%
313TT	x13	0.0115%	0.0046%	0.2766%	0.1666%	0.0382%	0.0512%	0.2360%	0.2781%
315AL	x14	0.0697%	0.0269%	0.3582%	0.2161%	0.0224%	0.0304%	0.2452%	0.2892%
322	x15	0.5202%	0.2002%	0.1292%	0.0775%	0.1652%	0.2223%	0.0346%	0.0410%
323	x16	0.8631%	0.3321%	0.2679%	0.1614%	0.4028%	0.5426%	0.1844%	0.2175%
324	x17	0.1453%	0.0560%	0.0342%	0.0207%	0.0312%	0.0420%	0.0527%	0.0621%
325	x18	0.0638%	0.0248%	0.0537%	0.0318%	0.0773%	0.1045%	0.0688%	0.0813%
326	x19	0.4045%	0.1557%	0.0557%	0.0338%	0.1496%	0.2013%	0.1862%	0.2191%
42	x20	0.0327%	0.0128%	0.0167%	0.0107%	0.4554%	0.6126%	0.0350%	0.0413%
441	x21	0.1701%	0.0657%	0.0842%	0.0511%	0.0443%	0.0599%	0.0335%	0.0390%
445	x22	0.1572%	0.0605%	0.0611%	0.0366%	0.0451%	0.0610%	0.0416%	0.0492%
452	x23	0.1314%	0.0506%	0.0440%	0.0269%	0.0370%	0.0500%	0.0101%	0.0119%
4A0	x24	0.0456%	0.0176%	0.0259%	0.0156%	0.0028%	0.0037%	0.0318%	0.0373%
481	x25	0.6352%	0.2448%	0.0823%	0.0497%	0.0634%	0.0850%	0.0357%	0.0424%
482	x26	0.3678%	0.1416%	0.1510%	0.0910%	0.0244%	0.0329%	0.1085%	0.1279%
483	x27	0.8276%	0.3184%	0.2257%	0.1360%	0.1016%	0.1368%	0.0901%	0.1061%
484	x28	0.3374%	0.1299%	0.0538%	0.0326%	0.0746%	0.1007%	0.0905%	0.1067%
485	x29	0.9581%	0.3685%	0.2159%	0.1304%	0.0587%	0.0792%	0.1043%	0.1230%
486	x30	0.6979%	0.2683%	0.2833%	0.1710%	0.1139%	0.1535%	0.0201%	0.0237%

Table 4. The error for impact from relative and absolute change in the final demand for the separate industries for the US economy: model 1 (continue)

Code	Element of vector X	GOV		HS		42		23	
		Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand
487OS	x31	0.1910%	0.0733%	0.0963%	0.0576%	0.2142%	0.2890%	0.0558%	0.0658%
493	x32	0.2118%	0.0816%	0.1797%	0.1084%	0.0967%	0.1302%	0.0160%	0.0188%
511	x33	0.2570%	0.0989%	0.0653%	0.0392%	0.0019%	0.0032%	0.0272%	0.0327%
512	x34	0.0927%	0.0355%	0.1050%	0.0640%	0.0483%	0.0658%	0.0537%	0.0636%
513	x35	0.0802%	0.0309%	0.0211%	0.0127%	0.0457%	0.0616%	0.0435%	0.0513%
514	x36	0.3577%	0.1379%	0.0962%	0.0585%	0.0010%	0.0015%	0.0234%	0.0277%
521CI	x37	0.2368%	0.0911%	0.1984%	0.1196%	0.0435%	0.0587%	0.0511%	0.0602%
523	x38	0.2857%	0.1100%	0.0279%	0.0169%	0.0034%	0.0047%	0.0273%	0.0324%
524	x39	0.0956%	0.0368%	0.0653%	0.0394%	0.0109%	0.0147%	0.0101%	0.0118%
525	x40	0.2173%	0.0839%	0.0915%	0.0550%	0.0549%	0.0732%	0.0800%	0.0934%
HS	x41	0.0190%	0.0071%	0.1217%	0.0737%	0.0054%	0.0065%	0.0071%	0.0089%
ORE	x42	0.2078%	0.0800%	0.0964%	0.0581%	0.0656%	0.0883%	0.0581%	0.0686%
532RL	x43	0.1618%	0.0624%	0.0507%	0.0305%	0.0132%	0.0179%	0.0099%	0.0117%
5411	x44	0.3138%	0.1206%	0.0080%	0.0049%	0.1800%	0.2426%	0.0873%	0.1032%
5415	x45	0.6518%	0.2511%	0.0240%	0.0145%	0.0516%	0.0695%	0.0414%	0.0490%
5412OP	x46	0.1417%	0.0547%	0.0168%	0.0102%	0.0734%	0.0988%	0.0466%	0.0551%
55	x47	0.0120%	0.0043%	0.0416%	0.0250%	0.1823%	0.2456%	0.0197%	0.0235%
561	x48	0.3712%	0.1427%	0.0143%	0.0086%	0.0607%	0.0819%	0.0349%	0.0411%
562	x49	1.4954%	0.5752%	0.2629%	0.1585%	0.0333%	0.0451%	0.0877%	0.1033%
61	x50	0.2248%	0.0866%	0.0407%	0.0248%	0.0068%	0.0092%	0.0348%	0.0408%
621	x51	0.0457%	0.0176%	0.0166%	0.0101%	0.0105%	0.0140%	0.0136%	0.0159%
622	x52	0.0397%	0.0153%	0.0175%	0.0106%	0.0115%	0.0155%	0.0153%	0.0182%
623	x53	0.0675%	0.0260%	0.0642%	0.0391%	0.0417%	0.0565%	0.0556%	0.0659%
624	x54	0.1170%	0.0452%	0.0794%	0.0480%	0.0512%	0.0694%	0.0689%	0.0816%
711AS	x55	0.0380%	0.0147%	0.1115%	0.0670%	0.0041%	0.0047%	0.0480%	0.0575%
713	x56	0.0158%	0.0057%	0.0774%	0.0466%	0.0238%	0.0327%	0.0503%	0.0596%
721	x57	0.1221%	0.0464%	0.0778%	0.0473%	0.0154%	0.0204%	0.0044%	0.0051%
722	x58	0.2002%	0.0769%	0.0163%	0.0098%	0.0183%	0.0248%	0.0125%	0.0148%
81	x59	0.1324%	0.0509%	0.0140%	0.0084%	0.0024%	0.0033%	0.0507%	0.0598%
GOV	x60	0.0062%	0.0022%	0.0056%	0.0034%	0.0161%	0.0218%	0.0015%	0.0023%

Table 4. The error for impact from relative and absolute change in the final demand for the separate industries for the US economy: model 1 (continue)

ode	Element of vector X	722		523		484		326	
		Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand
111-113	x1	0.1576%	0.2922%	0.0087%	0.0452%	0.0063%	0.0492%	0.0008%	0.0517%
211-22	x2	0.0421%	0.0781%	0.0032%	0.0166%	0.0545%	0.4193%	0.0015%	0.1542%
23	x3	0.0044%	0.0068%	0.0002%	0.0008%	0.0063%	0.0519%	0.0000%	0.0064%
332	x4	0.0469%	0.0868%	0.0071%	0.0377%	0.0200%	0.1555%	0.0006%	0.0715%
333	x5	0.0150%	0.0275%	0.0062%	0.0329%	0.0089%	0.0693%	0.0023%	0.1882%
334	x6	0.0160%	0.0297%	0.0068%	0.0375%	0.0092%	0.0701%	0.0015%	0.1122%
335	x7	0.1502%	0.2800%	0.0028%	0.0142%	0.0167%	0.1225%	0.0031%	0.2268%
3361MV	x8	0.0236%	0.0440%	0.0003%	0.0013%	0.0434%	0.3355%	0.0004%	0.0412%
3364OT	x9	0.0264%	0.0484%	0.0083%	0.0441%	0.0173%	0.1320%	0.0011%	0.0838%
337	x10	0.0742%	0.1374%	0.0318%	0.1685%	0.0343%	0.2649%	0.0001%	0.0174%
321-339	x11	0.0391%	0.0725%	0.0045%	0.0240%	0.0193%	0.1499%	0.0015%	0.1236%
311FT	x12	0.1492%	0.2765%	0.0053%	0.0292%	0.0034%	0.0274%	0.0005%	0.0024%
313TT	x13	0.0370%	0.0686%	0.0492%	0.2593%	0.0483%	0.3744%	0.0078%	0.6072%
315AL	x14	0.1618%	0.2998%	0.0588%	0.3097%	0.0492%	0.3819%	0.0052%	0.3849%
322	x15	0.0546%	0.1009%	0.0148%	0.0782%	0.0173%	0.1357%	0.0136%	1.0122%
323	x16	0.0788%	0.1459%	0.2149%	1.1327%	0.0125%	0.0962%	0.0026%	0.1994%
324	x17	0.0327%	0.0607%	0.0023%	0.0122%	0.1450%	1.1218%	0.0019%	0.1477%
325	x18	0.0348%	0.0647%	0.0096%	0.0535%	0.0178%	0.1417%	0.0089%	0.6642%
326	x19	0.0109%	0.0203%	0.0000%	0.0018%	0.0167%	0.1292%	0.1060%	8.2231%
42	x20	0.0468%	0.0873%	0.0006%	0.0045%	0.0234%	0.1845%	0.0020%	0.1619%
441	x21	0.0389%	0.0712%	0.0145%	0.0763%	0.0206%	0.1619%	0.0013%	0.0864%
445	x22	0.0395%	0.0729%	0.0129%	0.0689%	0.0102%	0.0800%	0.0015%	0.0943%
452	x23	0.0161%	0.0291%	0.0108%	0.0578%	0.0055%	0.0417%	0.0014%	0.0769%
4A0	x24	0.0348%	0.0645%	0.0020%	0.0110%	0.0114%	0.0878%	0.0001%	0.0122%
481	x25	0.0312%	0.0584%	0.0489%	0.2580%	0.0780%	0.6046%	0.0019%	0.1438%
482	x26	0.0465%	0.0862%	0.0220%	0.1165%	0.0144%	0.1112%	0.0099%	0.7645%
483	x27	0.0143%	0.0262%	0.0349%	0.1836%	0.0229%	0.1774%	0.0012%	0.0911%
484	x28	0.0337%	0.0626%	0.0023%	0.0124%	0.2474%	1.9158%	0.0019%	0.1365%
485	x29	0.0282%	0.0522%	0.0376%	0.1987%	0.0288%	0.2234%	0.0018%	0.1344%
486	x30	0.1123%	0.2079%	0.0440%	0.2315%	0.0124%	0.0971%	0.0017%	0.1320%

Table 4. The error for impact from relative and absolute change in the final demand for the separate industries for the US economy: model 1 (continue)

Code	Element of vector X	722		523		484		326	
		Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand	Error for relative change in final demand	Error for absolute change in final demand
487OS	x31	0.0007%	0.0016%	0.0363%	0.1905%	0.1121%	0.8662%	0.0018%	0.1400%
493	x32	0.1278%	0.2369%	0.0293%	0.1546%	0.0010%	0.0074%	0.0015%	0.1150%
511	x33	0.0137%	0.0251%	0.0097%	0.0527%	0.0077%	0.0574%	0.0009%	0.0593%
512	x34	0.0034%	0.0070%	0.0251%	0.1298%	0.0139%	0.1067%	0.0018%	0.1188%
513	x35	0.0371%	0.0689%	0.0409%	0.2156%	0.0061%	0.0468%	0.0002%	0.0100%
514	x36	0.0664%	0.1213%	0.0699%	0.3699%	0.0149%	0.1137%	0.0012%	0.0614%
521CI	x37	0.0265%	0.0489%	0.0294%	0.1550%	0.0163%	0.1257%	0.0006%	0.0425%
523	x38	0.0199%	0.0369%	0.0641%	0.3384%	0.0008%	0.0070%	0.0005%	0.0358%
524	x39	0.0474%	0.0881%	0.0265%	0.1402%	0.0279%	0.2169%	0.0001%	0.0100%
525	x40	0.0521%	0.0959%	0.0591%	0.3096%	0.0146%	0.1111%	0.0019%	0.1301%
HS	x41	0.0048%	0.0095%	0.0012%	0.0083%	0.0012%	0.0113%	0.0000%	0.0119%
ORE	x42	0.0859%	0.1592%	0.0133%	0.0700%	0.0109%	0.0845%	0.0004%	0.0344%
532RL	x43	0.0359%	0.0667%	0.0185%	0.0981%	0.0093%	0.0715%	0.0010%	0.0801%
5411	x44	0.0319%	0.0591%	0.0151%	0.0794%	0.0165%	0.1263%	0.0000%	0.0100%
5415	x45	0.0177%	0.0328%	0.0177%	0.0927%	0.0034%	0.0255%	0.0001%	0.0031%
5412OP	x46	0.0047%	0.0081%	0.0039%	0.0209%	0.0143%	0.1133%	0.0022%	0.1595%
55	x47	0.0405%	0.0752%	0.0377%	0.1987%	0.0004%	0.0046%	0.0030%	0.2456%
561	x48	0.0494%	0.0915%	0.0219%	0.1149%	0.0056%	0.0429%	0.0011%	0.0840%
562	x49	0.0729%	0.1349%	0.0254%	0.1354%	0.0036%	0.0293%	0.0022%	0.1595%
61	x50	0.0101%	0.0184%	0.0057%	0.0303%	0.0060%	0.0474%	0.0006%	0.0515%
621	x51	0.0085%	0.0158%	0.0028%	0.0152%	0.0027%	0.0207%	0.0002%	0.0232%
622	x52	0.0105%	0.0194%	0.0033%	0.0174%	0.0031%	0.0234%	0.0004%	0.0247%
623	x53	0.0376%	0.0699%	0.0116%	0.0632%	0.0107%	0.0843%	0.0014%	0.0907%
624	x54	0.0468%	0.0864%	0.0149%	0.0776%	0.0138%	0.1046%	0.0017%	0.1113%
711AS	x55	0.0893%	0.1658%	0.0027%	0.0133%	0.0145%	0.1095%	0.0020%	0.1329%
713	x56	0.0152%	0.0284%	0.0009%	0.0063%	0.0117%	0.0908%	0.0012%	0.0759%
721	x57	0.0330%	0.0604%	0.0511%	0.2684%	0.0086%	0.0704%	0.0005%	0.0279%
722	x58	0.2936%	0.5444%	0.0183%	0.0970%	0.0012%	0.0093%	0.0005%	0.0331%
81	x59	0.0024%	0.0044%	0.0098%	0.0517%	0.0041%	0.0317%	0.0006%	0.0388%
GOV	x60	0.0105%	0.0195%	0.0048%	0.0252%	0.0049%	0.0406%	0.0004%	0.0034%

Table 5. The error for impact from the change in the final demand on $100,000 billion for the separate industries: model 1, model 2 and model 3

Code	Element of vector X	GOV			HS			42			23		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
111-113	x1	0.0103%	0.0052%	0.0467%	0.0252%	0.0241%	0.0139%	0.0803%	0.0773%	0.1029%	0.0461%	0.0010%	0.0496%
211-22	x2	0.0455%	0.1198%	0.4158%	0.0230%	0.0137%	0.0260%	0.0362%	0.0484%	0.1675%	0.0017%	0.1942%	0.3267%
23	x3	0.0965%	0.0170%	0.0131%	0.0395%	0.1129%	0.1167%	0.0038%	0.0067%	0.0099%	0.1363%	0.3440%	0.1034%
332	x4	0.1317%	0.2129%	0.3043%	0.0399%	0.0015%	0.0417%	0.0760%	0.1236%	0.1966%	0.2988%	0.2954%	0.7721%
333	x5	0.0430%	0.1072%	0.1260%	0.0239%	0.0069%	0.0154%	0.0358%	0.0874%	0.1059%	0.1500%	0.3434%	0.4657%
334	x6	0.1140%	0.0732%	0.2844%	0.0277%	0.0085%	0.0127%	0.1641%	0.0050%	0.2231%	0.1169%	0.1401%	0.2949%
335	x7	0.0782%	0.1829%	0.2750%	0.0880%	0.0199%	0.0404%	0.0351%	0.0950%	0.1616%	0.7689%	0.3977%	0.9900%
3361MV	x8	0.0987%	0.1087%	0.1465%	0.0212%	0.0165%	0.0023%	0.0701%	0.0758%	0.1175%	0.1492%	0.1302%	0.2011%
3364OT	x9	0.1787%	0.0938%	0.0403%	0.0405%	0.0339%	0.0237%	0.0503%	0.0422%	0.0167%	0.0338%	0.0504%	0.0233%
337	x10	0.1391%	0.0994%	0.0310%	0.2105%	0.2380%	0.2852%	0.0813%	0.0524%	0.0264%	0.7858%	0.7567%	0.8700%
321-339	x11	0.0900%	0.1605%	0.2526%	0.0197%	0.0141%	0.0577%	0.1169%	0.1580%	0.2283%	0.0744%	0.0586%	0.9972%
311FT	x12	0.0188%	0.0163%	0.0106%	0.0124%	0.0121%	0.0099%	0.0204%	0.0182%	0.0250%	0.0068%	0.0213%	0.0144%
313TT	x13	0.0046%	0.0390%	0.2377%	0.1666%	0.1435%	0.0102%	0.0512%	0.0666%	0.3025%	0.2781%	0.1680%	0.5317%
315AL	x14	0.0269%	0.0044%	0.2575%	0.2161%	0.2006%	0.0198%	0.0304%	0.0281%	0.2555%	0.2892%	0.4043%	0.0300%
322	x15	0.2002%	0.2211%	0.3170%	0.0775%	0.0673%	0.0207%	0.2223%	0.2291%	0.3386%	0.0410%	0.1763%	0.1081%
323	x16	0.3321%	0.3561%	0.4185%	0.1614%	0.1476%	0.1117%	0.5426%	0.5448%	0.6134%	0.2175%	0.3580%	0.2345%
324	x17	0.0560%	0.0019%	0.2137%	0.0207%	0.0165%	0.0000%	0.0420%	0.0423%	0.0845%	0.0621%	0.3411%	0.0055%
325	x18	0.0248%	0.0076%	0.1708%	0.0318%	0.0268%	0.0027%	0.1045%	0.0938%	0.1054%	0.0813%	0.2273%	0.1261%
326	x19	0.1557%	0.1904%	0.2787%	0.0338%	0.0191%	0.0179%	0.2013%	0.1324%	0.1846%	0.2191%	0.0606%	0.5453%
42	x20	0.0128%	0.0323%	0.0646%	0.0107%	0.0066%	0.0000%	0.6126%	0.9387%	2.4851%	0.0413%	0.0696%	0.0369%
441	x21	0.0657%	0.0612%	0.0575%	0.0511%	0.0480%	0.0454%	0.0599%	0.0604%	0.0528%	0.0390%	0.0075%	0.0141%
445	x22	0.0605%	0.0596%	0.0569%	0.0366%	0.0360%	0.0344%	0.0610%	0.0640%	0.0582%	0.0492%	0.0766%	0.0720%
452	x23	0.0506%	0.0505%	0.0481%	0.0269%	0.0272%	0.0254%	0.0500%	0.0540%	0.0484%	0.0119%	0.0148%	0.0104%
4A0	x24	0.0176%	0.0174%	0.0167%	0.0156%	0.0157%	0.0164%	0.0037%	0.0053%	0.0036%	0.0373%	0.3855%	0.3572%
481	x25	0.2448%	0.2538%	0.2953%	0.0497%	0.0456%	0.0266%	0.0850%	0.0833%	0.1405%	0.0424%	0.0078%	0.0496%
482	x26	0.1416%	0.1684%	0.2445%	0.0910%	0.0777%	0.0399%	0.0329%	0.0228%	0.0628%	0.1279%	0.0074%	0.2091%
483	x27	0.3184%	0.3291%	0.3405%	0.1360%	0.1286%	0.1206%	0.1368%	0.1406%	0.1175%	0.1061%	0.0185%	0.0395%
484	x28	0.1299%	0.1487%	0.1797%	0.0326%	0.0239%	0.0092%	0.1007%	0.1085%	0.1394%	0.1067%	0.2728%	0.0508%
485	x29	0.3685%	0.3795%	0.4055%	0.1304%	0.1226%	0.1048%	0.0792%	0.0828%	0.0446%	0.1230%	0.2107%	0.1659%
486	x30	0.2683%	0.3271%	0.5115%	0.1710%	0.1499%	0.0841%	0.1535%	0.1407%	0.0157%	0.0237%	0.1619%	0.1445%

Table 5. The error for impact from the change in the final demand on $100,000 billion for the separate industries: model 1, model 2 and model 3 (continue)

Code	Element of vector X	GOV			HS			42			23		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
487OS	x31	0.0733%	0.0919%	0.1261%	0.0576%	0.0502%	0.0367%	0.2890%	0.2459%	0.0983%	0.0658%	0.1781%	0.0854%
493	x32	0.0816%	0.0974%	0.1376%	0.1084%	0.0990%	0.0749%	0.1302%	0.1225%	0.2595%	0.0188%	0.1510%	0.0435%
511	x33	0.0989%	0.1055%	0.1046%	0.0392%	0.0349%	0.0356%	0.0032%	0.0056%	0.0075%	0.0327%	0.0529%	0.0538%
512	x34	0.0355%	0.0337%	0.0113%	0.0640%	0.0624%	0.0536%	0.0658%	0.0750%	0.0425%	0.0636%	0.1140%	0.0892%
513	x35	0.0309%	0.0346%	0.0250%	0.0127%	0.0130%	0.0121%	0.0616%	0.0873%	0.0599%	0.0513%	0.0097%	0.0150%
514	x36	0.1379%	0.0499%	0.1061%	0.0585%	0.0505%	0.0368%	0.0015%	0.0041%	0.0663%	0.0277%	0.0431%	0.0072%
521CI	x37	0.0911%	0.0745%	0.0360%	0.1196%	0.1316%	0.1597%	0.0587%	0.0639%	0.0020%	0.0602%	0.0075%	0.0349%
523	x38	0.1100%	0.1016%	0.0915%	0.0169%	0.0156%	0.0138%	0.0047%	0.0100%	0.0004%	0.0324%	0.0021%	0.0022%
524	x39	0.0368%	0.0400%	0.0569%	0.0394%	0.0406%	0.0474%	0.0147%	0.0032%	0.0785%	0.0118%	0.0549%	0.0253%
525	x40	0.0839%	0.0819%	0.0772%	0.0550%	0.0538%	0.0509%	0.0732%	0.0770%	0.0684%	0.0934%	0.1298%	0.1220%
HS	x41	0.0071%	0.0071%	0.0075%	0.0737%	0.0835%	0.1109%	0.0065%	0.0071%	0.0075%	0.0089%	0.0118%	0.0121%
ORE	x42	0.0800%	0.1432%	0.1619%	0.0581%	0.0974%	0.1096%	0.0883%	0.0054%	0.0699%	0.0686%	0.0454%	0.0652%
532RL	x43	0.0624%	0.0838%	0.1229%	0.0305%	0.0239%	0.0113%	0.0179%	0.0040%	0.1268%	0.0117%	0.1618%	0.0048%
5411	x44	0.1206%	0.1367%	0.1622%	0.0049%	0.0003%	0.0085%	0.2426%	0.2302%	0.1166%	0.1032%	0.0439%	0.0839%
5415	x45	0.2511%	0.1576%	0.1852%	0.0145%	0.0032%	0.0043%	0.0695%	0.1377%	0.1465%	0.0490%	0.0824%	0.0881%
5412OP	x46	0.0547%	0.1215%	0.1783%	0.0102%	0.0010%	0.0066%	0.0988%	0.0200%	0.1016%	0.0551%	0.1127%	0.0160%
55	x47	0.0043%	0.0318%	0.1157%	0.0250%	0.0156%	0.0062%	0.2456%	0.3029%	0.5837%	0.0235%	0.0716%	0.1180%
561	x48	0.1427%	0.2062%	0.2574%	0.0086%	0.0086%	0.0225%	0.0819%	0.0039%	0.1299%	0.0411%	0.0134%	0.0437%
562	x49	0.5752%	0.6046%	0.6434%	0.1585%	0.1385%	0.1122%	0.0451%	0.0323%	0.0321%	0.1033%	0.0150%	0.0761%
61	x50	0.0866%	0.0870%	0.0875%	0.0248%	0.0245%	0.0240%	0.0092%	0.0113%	0.0086%	0.0408%	0.0661%	0.0638%
621	x51	0.0176%	0.0176%	0.0178%	0.0101%	0.0101%	0.0100%	0.0140%	0.0149%	0.0140%	0.0159%	0.0228%	0.0223%
622	x52	0.0153%	0.0153%	0.0151%	0.0106%	0.0105%	0.0104%	0.0155%	0.0165%	0.0154%	0.0182%	0.0251%	0.0247%
623	x53	0.0260%	0.0247%	0.0233%	0.0391%	0.0385%	0.0372%	0.0565%	0.0592%	0.0547%	0.0659%	0.0906%	0.0872%
624	x54	0.0452%	0.0440%	0.0412%	0.0480%	0.0477%	0.0452%	0.0694%	0.0730%	0.0664%	0.0816%	0.1120%	0.1065%
711AS	x55	0.0147%	0.0150%	0.0004%	0.0670%	0.0664%	0.0594%	0.0047%	0.0187%	0.0097%	0.0575%	0.1241%	0.1027%
713	x56	0.0057%	0.0071%	0.0102%	0.0466%	0.0457%	0.0434%	0.0327%	0.0359%	0.0291%	0.0596%	0.0917%	0.0860%
721	x57	0.0464%	0.0546%	0.0620%	0.0473%	0.0432%	0.0399%	0.0204%	0.0194%	0.0308%	0.0051%	0.0335%	0.0231%
722	x58	0.0769%	0.0711%	0.0634%	0.0098%	0.0092%	0.0082%	0.0248%	0.0216%	0.0288%	0.0148%	0.0056%	0.0023%
81	x59	0.0509%	0.0445%	0.0350%	0.0084%	0.0077%	0.0065%	0.0033%	0.0123%	0.0110%	0.0598%	0.0322%	0.0374%
GOV	x60	0.0022%	0.0082%	0.0339%	0.0034%	0.0033%	0.0036%	0.0218%	0.0255%	0.0220%	0.0023%	0.0074%	0.0072%

Table 5. The error for impact from the change in the final demand on $100,000 billion for the separate industries: model 1, model 2 and model 3 (continue)

Code	Element of vector X	722			523			484			326		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
111-113	x1	0.2922%	0.2528%	0.1570%	0.0452%	0.0426%	0.0118%	0.0492%	0.0562%	0.0222%	0.0517%	0.0126%	3.9037%
211-22	x2	0.0781%	0.0115%	0.2556%	0.0166%	0.0071%	0.1138%	0.4193%	0.3529%	0.7316%	0.1542%	0.0250%	2.2889%
23	x3	0.0068%	0.0280%	0.0293%	0.0008%	0.0152%	0.0190%	0.0519%	0.0284%	0.0240%	0.0064%	0.0210%	0.2380%
332	x4	0.0868%	0.2762%	0.4894%	0.0377%	0.0242%	0.1004%	0.1555%	0.0008%	0.2583%	0.0715%	0.4019%	3.0920%
333	x5	0.0275%	0.1244%	0.1527%	0.0329%	0.0237%	0.0429%	0.0693%	0.0763%	0.1291%	0.1882%	0.1344%	0.9077%
334	x6	0.0297%	0.1059%	0.1918%	0.0375%	0.1319%	0.2444%	0.0701%	0.0069%	0.1253%	0.1122%	0.1304%	0.7964%
335	x7	0.2800%	0.3767%	0.4629%	0.0142%	0.0553%	0.1212%	0.1225%	0.0101%	0.1215%	0.2268%	0.3925%	0.2973%
3361MV	x8	0.0440%	0.0562%	0.1041%	0.0013%	0.0075%	0.0427%	0.3355%	0.2766%	0.3287%	0.0412%	0.0596%	0.1254%
3364OT	x9	0.0484%	0.0344%	0.0125%	0.0441%	0.0312%	0.0063%	0.1320%	0.1185%	0.0608%	0.0838%	0.0616%	0.5854%
337	x10	0.1374%	0.1879%	0.2747%	0.1685%	0.1233%	0.0376%	0.2649%	0.2275%	0.1098%	0.0174%	0.0509%	0.7983%
321-339	x11	0.0725%	0.2268%	0.4294%	0.0240%	0.0269%	0.0978%	0.1499%	0.0458%	0.1521%	0.1236%	0.2256%	1.7495%
311FT	x12	0.2765%	0.2585%	0.0248%	0.0292%	0.0284%	0.0153%	0.0274%	0.0311%	0.0227%	0.0024%	0.0007%	0.5343%
313TT	x13	0.0686%	0.1183%	0.4050%	0.2593%	0.2201%	0.0145%	0.3744%	0.3625%	0.0471%	0.6072%	0.9688%	3.1402%
315AL	x14	0.2998%	0.2712%	0.0614%	0.3097%	0.2814%	0.0490%	0.3819%	0.3907%	0.0503%	0.3849%	0.3373%	0.3446%
322	x15	0.1009%	0.1712%	0.4867%	0.0782%	0.0474%	0.1044%	0.1357%	0.1335%	0.0684%	1.0122%	0.6844%	9.3824%
323	x16	0.1459%	0.1716%	0.2392%	1.1327%	0.9357%	0.2636%	0.0962%	0.1041%	0.0033%	0.1994%	0.1604%	2.2230%
324	x17	0.0607%	0.0367%	0.0603%	0.0122%	0.0202%	0.0575%	1.1218%	1.2119%	0.0272%	0.1477%	0.0984%	2.5694%
325	x18	0.0647%	0.0250%	0.1799%	0.0535%	0.0369%	0.0556%	0.1417%	0.1390%	0.0828%	0.6642%	1.2288%	11.2840%
326	x19	0.0203%	0.1362%	0.5380%	0.0018%	0.0236%	0.0956%	0.1292%	0.1658%	0.3831%	8.2231%	15.9388%	97.2764%
42	x20	0.0873%	0.0374%	0.0427%	0.0045%	0.0052%	0.0268%	0.1845%	0.1693%	0.0332%	0.1619%	0.0626%	3.7127%
441	x21	0.0712%	0.0662%	0.0611%	0.0763%	0.0712%	0.0603%	0.1619%	0.1567%	0.1658%	0.0864%	0.0779%	0.8312%
445	x22	0.0729%	0.0718%	0.0681%	0.0689%	0.0679%	0.0601%	0.0800%	0.0880%	0.0814%	0.0943%	0.0914%	0.6810%
452	x23	0.0291%	0.0295%	0.0262%	0.0578%	0.0577%	0.0506%	0.0417%	0.0502%	0.0444%	0.0769%	0.0758%	0.6247%
4A0	x24	0.0645%	0.0646%	0.0652%	0.0110%	0.0109%	0.0083%	0.0878%	0.1057%	0.0976%	0.0122%	0.0130%	0.2223%
481	x25	0.0584%	0.0687%	0.1167%	0.2580%	0.2696%	0.3385%	0.6046%	0.6437%	0.3104%	0.1438%	0.1593%	0.7240%
482	x26	0.0862%	0.0242%	0.1540%	0.1165%	0.0928%	0.0144%	0.1112%	0.1391%	0.6937%	0.7645%	0.4651%	9.6698%
483	x27	0.0262%	0.0128%	0.0026%	0.1836%	0.1714%	0.1407%	0.1774%	0.1918%	0.1650%	0.0911%	0.0684%	2.0969%
484	x28	0.0626%	0.1135%	0.1995%	0.0124%	0.0268%	0.0564%	1.9158%	3.4080%	11.8502%	0.1365%	0.0075%	3.6919%
485	x29	0.0522%	0.0382%	0.0042%	0.1987%	0.2114%	0.2579%	0.2234%	0.2375%	0.1869%	0.1344%	0.1110%	1.9869%
486	x30	0.2079%	0.1538%	0.0172%	0.2315%	0.1949%	0.0627%	0.0971%	0.1191%	0.7442%	0.1320%	0.0419%	2.8343%

Table 5. The error for impact from the change in the final demand on $100,000 billion for the separate industries: model 1, model 2 and model 3 (continue)

Code	Element of vector X	722			523			484			326		
		Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3	Error 1	Error 2	Error 3
487OS	x31	0.0016%	0.0284%	0.0839%	0.1905%	0.2603%	0.4332%	0.8662%	0.8552%	0.3086%	0.1400%	0.0847%	2.5792%
493	x32	0.2369%	0.2606%	0.3223%	0.1546%	0.1718%	0.2313%	0.0074%	0.0492%	0.3791%	0.1150%	0.1575%	2.2218%
511	x33	0.0251%	0.0170%	0.0182%	0.0527%	0.0614%	0.0667%	0.0574%	0.0567%	0.0560%	0.0593%	0.0478%	0.6554%
512	x34	0.0070%	0.0086%	0.0288%	0.1298%	0.1260%	0.0659%	0.1067%	0.1210%	0.0921%	0.1188%	0.1136%	1.0789%
513	x35	0.0689%	0.0672%	0.0720%	0.2156%	0.2247%	0.1461%	0.0468%	0.0318%	0.0402%	0.0100%	0.0105%	0.8304%
514	x36	0.1213%	0.1498%	0.2004%	0.3699%	0.5982%	1.1743%	0.1137%	0.1160%	0.0559%	0.0614%	0.0977%	1.7696%
521CI	x37	0.0489%	0.0610%	0.0898%	0.1550%	0.0847%	0.1700%	0.1257%	0.1446%	0.0737%	0.0425%	0.0589%	1.2339%
523	x38	0.0369%	0.0401%	0.0443%	0.3384%	0.8819%	3.3418%	0.0070%	0.0050%	0.0040%	0.0358%	0.0299%	0.9652%
524	x39	0.0881%	0.0765%	0.0134%	0.1402%	0.1163%	0.0573%	0.2169%	0.2608%	0.1089%	0.0100%	0.0020%	0.8081%
525	x40	0.0959%	0.0936%	0.0879%	0.3096%	0.2931%	0.1872%	0.1111%	0.1203%	0.1105%	0.1301%	0.1246%	0.9118%
HS	x41	0.0095%	0.0095%	0.0098%	0.0083%	0.0083%	0.0081%	0.0113%	0.0124%	0.0121%	0.0119%	0.0118%	0.0859%
ORE	x42	0.1592%	0.0566%	0.1220%	0.0700%	0.0668%	0.1447%	0.0845%	0.0244%	0.0138%	0.0344%	0.0214%	1.1417%
532RL	x43	0.0667%	0.0010%	0.1196%	0.0981%	0.0392%	0.0989%	0.0715%	0.0510%	0.1980%	0.0801%	0.0090%	2.6250%
5411	x44	0.0591%	0.0834%	0.1236%	0.0794%	0.1388%	0.2790%	0.1263%	0.1281%	0.0683%	0.0100%	0.0453%	1.7089%
5415	x45	0.0328%	0.1220%	0.1283%	0.0927%	0.3324%	0.3655%	0.0255%	0.0578%	0.0666%	0.0031%	0.1000%	0.4427%
5412OP	x46	0.0081%	0.0929%	0.1657%	0.0209%	0.1491%	0.2921%	0.1133%	0.0724%	0.0024%	0.1595%	0.0491%	2.2249%
55	x47	0.0752%	0.2755%	0.7422%	0.1987%	0.3084%	0.5990%	0.0046%	0.0307%	0.2792%	0.2456%	0.0127%	5.2726%
561	x48	0.0915%	0.0191%	0.1099%	0.1149%	0.0195%	0.1744%	0.0429%	0.0058%	0.1027%	0.0840%	0.0035%	2.2105%
562	x49	0.1349%	0.1840%	0.2499%	0.1354%	0.0962%	0.0203%	0.0293%	0.0343%	0.1077%	0.1595%	0.2093%	1.9480%
61	x50	0.0184%	0.0179%	0.0167%	0.0303%	0.0299%	0.0259%	0.0474%	0.0524%	0.0499%	0.0515%	0.0500%	0.4237%
621	x51	0.0158%	0.0157%	0.0154%	0.0152%	0.0152%	0.0138%	0.0207%	0.0228%	0.0220%	0.0232%	0.0227%	0.1699%
622	x52	0.0194%	0.0194%	0.0191%	0.0174%	0.0173%	0.0158%	0.0234%	0.0255%	0.0247%	0.0247%	0.0242%	0.1742%
623	x53	0.0699%	0.0688%	0.0666%	0.0632%	0.0618%	0.0554%	0.0843%	0.0909%	0.0862%	0.0907%	0.0875%	0.6221%
624	x54	0.0864%	0.0854%	0.0815%	0.0776%	0.0762%	0.0673%	0.1046%	0.1130%	0.1059%	0.1113%	0.1077%	0.7561%
711AS	x55	0.1658%	0.1655%	0.1868%	0.0133%	0.0129%	0.0579%	0.1095%	0.1322%	0.1045%	0.1329%	0.1282%	1.8102%
713	x56	0.0284%	0.0266%	0.0221%	0.0063%	0.0047%	0.0051%	0.0908%	0.0991%	0.0916%	0.0759%	0.0719%	0.7668%
721	x57	0.0604%	0.0682%	0.0758%	0.2684%	0.2771%	0.2975%	0.0704%	0.0756%	0.0622%	0.0279%	0.0399%	0.8704%
722	x58	0.5444%	0.9323%	1.4673%	0.0970%	0.0891%	0.0584%	0.0093%	0.0156%	0.0096%	0.0331%	0.0368%	0.4661%
81	x59	0.0044%	0.0031%	0.0148%	0.0517%	0.0549%	0.0677%	0.0317%	0.0249%	0.0325%	0.0388%	0.0434%	0.5640%
GOV	x60	0.0195%	0.0196%	0.0191%	0.0252%	0.0251%	0.0301%	0.0406%	0.0540%	0.0493%	0.0034%	0.0033%	0.1193%