

*Research article***SAM-based analysis of China’s economic system and measurement of the effects of a VAT rate cut after the tax reform****Kewei Ma<sup>1</sup>, Guido Ferrari<sup>2,3,\*</sup> and Zichuan Mi<sup>1</sup>**<sup>1</sup> School of Statistics, Shanxi University of Finance and Economics, China<sup>2</sup> Department of Statistics, Computer Science, Applications “G. Parenti”, University of Florence, Italy<sup>3</sup> Renmin University of China, China**\* Correspondence:** Email: [guido.ferrari@unifi.it](mailto:guido.ferrari@unifi.it); Tel: +390552751547.

**Abstract:** In this paper, based on a 2015 social accounting matrix (SAM) for China elaborated by us, we conducted a comprehensive analysis of the structure of China’s economic system using the impact multiplier model. Having this analysis as a background, we focused on the tax reform China completed in 2016, moving from a bifurcated system based on a business tax (BT) and Value Added Tax (VAT) to an entirely VAT-based system. The effects of this reform remain under observation and discussion, regarding not only the reduction in the tax burden on the industrial and service sectors but also economic improvements. Nonetheless, currently, an analysis of the existing literature on the topic indicated consensus that the reform had positive effects in both respects. Given this context, it would be interesting to analyse what effects a selective reduction in the VAT rate would have on China’s economy under this new VAT-based system. To the best of our knowledge, no such analysis has been performed. We attempted to fill this gap and, based on the above purpose-built SAM, we conducted an impact multiplier analysis of the aforementioned effects. Several results have been achieved. From the estimation of the industry-level endogenous coefficients there is evidence of a considerable average degree of integration among the industries and of the key role of “Manufacturing” in China’s production structure. Moreover, the significant orientation of the industries to the production of value added is highlighted. The analysis of the impact of the indirect tax reform have demonstrated that making the central government the sole operator of indirect taxes is a general advantage. Overall, there is evidence that the economic system strongly reacts—by a nearly 4% increasing—to an average VAT cut of 1.2% for 6 industries, thus highlighting its elasticity to this kind of exogenous shocks.

**Keywords:** VAT; SAM; endogenous account; exogenous account; impact multiplier

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**JEL Codes:** E16, E27, C40

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## 1. Introduction

The importance of China's economic system, its development and its weight in the world scenario, have been ever increasing in the last decades. In spite of this, and the many social accounting matrices (SAM)s for China that have been built in the last twenty years, an overall SAM-based analysis of the structure of China's economy that would allow to get an in-depth knowledge of the inter-sector relationships has not been attempted yet. To the end of filling this gap, we elaborated a double-version 2015 SAM for China, the first one quite detailed and the second one more aggregated. The elaboration of a SAM for China at this level of updating and industries, factors and institutional sectors detail is something totally new that brings a remarkable contribution to the improvement of the knowledge in the field. Then, we used the more aggregated version to conduct a comprehensive analysis of the structure of country's economic system using the impact multiplier model, searching for the level of integration of the productive structure, factors and final demand, the interdependencies among the various industries and the role played by them in the economic growth. This analysis represents an innovative contribution to the understanding of the mechanisms that govern the functioning of the economic system as a whole and provide useful tools for government economic policy.

China's government has undertaken the reform of the indirect taxation system. With tax reform complete and the entire country under the VAT regime, it is extremely interesting to evaluate the impact of this new regime on China's economic system through a general analysis—something that has not yet been done and puts a new and enlarged light in the panorama of studies concerning the economic effects of indirect taxation changes—that allows us to study any interrelationship and the stimulus-response effects to VAT rate cuts for given productive sectors. Indeed, in its nature of indirect tax, VAT typically bears on the production structure and through it, on value added and on household expenditure. Therefore, it is reasonable at all and highly informative and effective to perform the analysis of its impact on the economic fabric in the light of the more general analysis of the overall economic system implemented by means of the SAM based impact multiplier model and of the economic reality that inspired the VAT reform.

In this paper, employing the aforementioned China's 2015 aggregated SAM, and based on the impact multiplier model, we conduct a never so far performed comprehensive analysis of the structure of country's economic system, and address, for the first time, how to measure the effects on the economic system of cuts in VAT rate due to government policy decisions.

Specifically, the remaining of the paper is organized as follows. In Section 2 we discuss the state of the art in the elaboration of SAMs for China and illustrate the double-version SAM for China that we have developed. In Section 3, by designing the impact multiplier model, identifying the exogenous and endogenous accounts, and solving the model, *i.e.*, estimating the endogenous coefficients and the impact multipliers, we conduct the SAM-based analysis of China's economic system. In Section 4, after illustrating and discussing the literature on the overall effects of China's tax reform, we perform the SAM-based analysis of VAT cuts on China's economic system through the impact multiplier model. Section 5 develops our conclusions.

## 2 The existing SAMs for China

### 2.1. *The State of the art*

A number of SAMs have been elaborated to represent the structure of China's economic system. Li (2008) produced a 2002 seven-industry financial SAM for China to shed light on the linkages between the real and financial sides of China's economy. Zeng and Shen (2014) constructed a macro SAM based on the forestry sector following the 2007 I-O table for China, in addition to other statistical data. They verified the accounts related to the forestry sector with reliable estimates of data not included in the Statistical Yearbook of China that could be used as a basis for analysing carbon policy based on a CGE model. A 1997 SAM for China, the source of which was not specified, was used by Li et al. (2004), to develop several policy simulation scenarios and use structural path analysis to analyse the characteristics of the Chinese industrial structure and income distribution. In his thesis dissertation, Qin (2011) constructed a SAM for Beijing, Tianjin, and Hebei based on the 2007 I-O table, accounting information from the 2008 Customs, Finance and Tax Yearbooks of China, and household and government revenue and expenditure from China Statistical Yearbook 2008. Binjian and Sakamoto (2013) compiled a 2002 macro SAM for China to calibrate a CGE model and analyse the effects of macroeconomic policies on income disparities under different assumptions about the factor market in China. Keogh-Brown et al. (2016) analysed the economic burden of Alzheimer's disease in China using a CGE model calibrated on a 2011 SAM for China that was extracted from the GTAP 9 database. To simulate various scenarios of the regional economic and environmental effects of discharge fees using a CGE model, Fang et al. (2016) developed a water resource-water-environment extended 2012 SAM for Jiangsu province. Zhang and Diao (2013), in the framework of activities of the International Food Policy Research Institute (IFPRI), constructed a 2007 SAM for China, covering 61 industries, four types of factors, and rural and urban households, with the aim of assessing the impact of the 2008–2009 global recession and the Chinese government's stimulus policy on China's economic growth. To conclude our overview of the SAMs specifically built to analyze the overall Chinese economic system, it is worth mentioning the environmentally extended social accounting matrix (ESAM) using Chinese data from 1990 proposed by Xie (2000) and Xie and Saltzman (2000).

### 2.2. *Our special-purpose SAM*

All of the above-mentioned SAMs have merits and defects: some of them are detailed enough to be candidates to serve as a basis for our analysis; others are too aggregated or too specifically oriented towards detailed and sectoral objectives. However, they all share a negative feature for the purpose of our analysis: they are too dated. Even those that are attractive because of their detailed structure and reliability, such as that developed by IFPRI, are far from representing the current structure of China's economic system, specifically in terms of productivity, which grew dramatically, approximately 15% on an annual basis, from 2008 to 2015 and therefore needs to be represented by a SAM that is as up to date as possible.

Consequently, we relied on the 2015 SAM for China purpose built by us at the School of Statistics of the Shanxi University of Finance & Economics and further refined at the Department of Statistics, Computer Sciences, Applications of the University of Florence. It is based on a 2012 42-industry I-O

table for China at producers' prices (China Statistical Yearbook, 2016) and on the Flow of Funds Accounts (Physical Transactions) 2012 (China Statistical Yearbook, 2014).

We first elaborated a  $67 \times 67$  2012 SAM consisting of 42 industries, 5 institutional sectors (Non-financial corporations, Financial Institutions, General government, Households and the Rest of the World, (RoW)), with a detailed specification of the operations of the primary and secondary income distributions. The data in the SAM were balanced using the cross-entropy (CE) method (Robinson et al., 2001).

We further updated the SAM to 2015 using the CE method, obtaining a  $44 \times 44$  2015 SAM consisting of 19 industries, because in 2015, GDP data were available for only 19 industries, and such data are imposed as constraints when conducting CE extension. This SAM-version is not reported here but is available on request.

Furthermore, we conducted the 2015 CE updating of the  $67 \times 67$  2012 SAM as follows: since the 2015 GDP data were not sufficiently detailed to be imposed as the constraints for the CE extension, we retained as benchmarks all of the 19 industries and, based on the linearity underlying the I-O model (that is, constant returns to scale and no technical progress), for the items composing each of the 19 industries, we calculated the percentage out of the total and have subdivided the GDP for the respective industry according to this percentage. Thereafter, we applied the CE method by employing as the constraints the newly calculated 42 GDPs (the conversion details are reported in Table 1). The resulting  $67 \times 67$  2015 SAM-version consisting of 42 industries is not reported here but is available on request.

### 3. SAM-based analysis of China's economic system

#### 3.1. *The impact multiplier model: exogenous and endogenous accounts identification*

To design the impact multiplier model, we need to identify the exogenous account as well as the endogenous ones. The exogenous account, that is, the policy instrument, is the result of the aggregation of the following sets of accounts: (i) PA expenditure, (ii) capital accounts, and (iii) RoW. Specifically, the following eight accounts were aggregated under the label "Government": 1) Government expenditure, 2) Capital transfers, 3) Gross fixed capital formation, 4) Changes in inventories, 5) Acquisition less disposal of non-financial assets, 6) Net lending, 7) Non-financial corporations, 8) Financial corporations, 9) General government, 10) RoW current account, and 11) RoW capital account.

The endogenous accounts, that is, the policy objectives, are the following sets of accounts: (i) value of goods and services produced (industries), (ii) payment of factors (Gross Value Added (GVA), or alternatively, Gross Domestic Product (GDP)), and (iii) households' income, totalling 33 in the 19-industry 2015 SAM version and 56 in the 42-industry 2015 SAM version.

**Table 1.** Conversion table from 42 to 19 industries.

<b>42 Industry 2012 SAM</b>		<b>19 Industry 2012 SAM</b>	
1	Farming, Forestry, Animal Production & Fishery	1	Agriculture, Forestry, Animal Husbandry & Fishery
2	Mining and Washing of Coal	2	Mining
3	Extraction of Crude Petroleum and Natural Gas		
4	Mining of Metal Ores		
5	Mining and Quarrying of Nonmetallic Mineral and Other Mineral		
6	Manufacture of Food and Tobacco	3	Manufacturing
7	Manufacture of Textiles		
8	Manufacture of Textile Wearing Apparel, Footwear, Leather, Fur, Feather and Its Products		
9	Processing of Timbers and Manufacture of Furniture		
10	Papermaking, Printing and Manufacture of Articles for Culture, Education and Sports Activities		
11	Manufacture of Refined Petroleum, Coke Products, Processing of Nuclear Fuel		
12	Manufacture of Chemicals and Chemical Products		
13	Manufacture of Nonmetallic Mineral Products		
14	Manufacture and Processing of Metals		
15	Manufacture of Fabricated Metal Products, Except Machinery and Equipment		
16	Manufacture of General-Purpose Machinery		
17	Manufacture of Special-Purpose Machinery		
18	Manufacture of Transport Equipment		
19	Manufacture of Electrical Machinery and Apparatus		
20	Manufacture of Communication Equipment, Computer and Other Electronic Equipment		
21	Manufacture of Measuring Instruments		
22	Other Manufacture		
23	Scrap and Waste		
24	Repair of Fabricated Metal Products, Machinery and Equipment		
25	Production and Supply of Electricity and Steam	4	Production and Supply of Electricity, Heat, Gas and Water
26	Production and Distribution of Gas		
27	Production and Distribution of Water		
28	Construction	5	Construction
29	Wholesale and Retail Trades	6	Wholesale and Retail Trades
30	Hotels and Catering Services	7	Hotels and Catering Services
31	Transport, Storage and Post	8	Transport, Storage and Post
32	Information Transmission, Software and Information Technology	9	Information Transmission, Software and Information Technology
33	Financial Intermediation	10	Financial Intermediation
34	Real Estate	11	Real Estate
35	Leasing and Business Services	12	Leasing and Business Services
36	Scientific Research and Technical Services	13	Scientific Research and Technical Services
37	Management of Water Conservancy, Environment and Public Facilities	14	Management of Water Conservancy, Environment and Public Facilities
38	Service to Households, Repair and Other Services	15	Service to Households, Repair and Other Services
39	Education	16	Education
40	Health and Social Service	17	Health and Social Service
41	Culture, Sports and Entertainment	18	Culture, Sports and Entertainment
42	Public Management, Social Security and Social Organization	19	Public Management, Social Security and Social Organization

### 3.2. The model solution: the impact multiplier matrix

We obtained the model solution, that is, the estimation of the impact multipliers and then the total demand of the endogenous accounts resulting from an increase in the concerned exogenous account, as follows (Ferrari et al., 2018).

We refer to the 19-industry 2015 SAM and denote by  $x_{ij}$  the payments from endogenous account  $j$  to endogenous account  $i$  ( $i, j=1, 2, \dots, 33$ ) or, equivalently, the receipts of endogenous account  $i$  from endogenous account  $j$ ;  $z_i$  represents the payments from the exogenous account to endogenous account  $i$ , and  $l_j$  represents the receipts of the exogenous account from endogenous account  $j$  and from itself, which are considered leakages, because they exit the endogenous part of the economic system and do not contribute to the multiplicative process (Bellù, 2012). The row sum for endogenous account  $i$  is  $X_i = \sum_{j=1}^{33} x_{ij} + z_i$ , and that for exogenous account is  $l_s = \sum_{s=1}^{34} l_s$ . The column sum for endogenous account  $j$  is  $X_j = \sum_{i=1}^{33} x_{ij} + l_j$ , and that for the exogenous account is  $Z = \sum_{i=1}^{33} z_i + l_{34}$ . For  $i=j$ ,  $X_i = X_j$ .

Similarly to I-O analysis, we define the endogenous accounts coefficients:  $a_{ij} = \frac{x_{ij}}{X_j}$  ( $i, j = 1, 2, \dots, 33$ ), and the leakage coefficients,  $L_j = \frac{l_j}{X_j}$  ( $j=1, 2, \dots, 34$ ).

Thus, the row sum for endogenous account  $i$  can be rewritten as follows:

$$X_i = \sum_{j=1}^{33} a_{ij} X_j + z_i \quad (i = 1, 2, \dots, 33) \quad (1)$$

meaning that the economic system can be represented by a system of simultaneous linear equations<sup>1</sup>. In matrix form:

$$\mathbf{X} = \mathbf{A}\mathbf{X} + \mathbf{Z} \quad (2)$$

where  $\mathbf{X}$  is the  $(33 \times 1)$  vector of the 19-industry 2015 SAM industries' and sectors' total demand accounts, including endogenous and exogenous accounts,  $\mathbf{A}$  is the  $(33 \times 33)$  matrix of the endogenous accounts coefficients describing the structure of the economy, and  $\mathbf{Z}$  is the  $(33 \times 1)$  vector of the exogenous account.

Solving (2) with respect to  $\mathbf{X}$  yields:  $\mathbf{X}(\mathbf{I}-\mathbf{A}) = \mathbf{Z}$

and finally,

$$\mathbf{X} = (\mathbf{I}-\mathbf{A})^{-1} \mathbf{Z} = \mathbf{M} \mathbf{Z} \quad (3)$$

where the  $(33 \times 33)$   $(\mathbf{I}-\mathbf{A})^{-1} = \mathbf{M}$  inverse matrix is the impact multiplier matrix.

The column vectors  $\mathbf{A}_{ij}$ ,  $i=1, \dots, 21$ ;  $j=1, \dots, 19$  of the endogenous coefficient matrix, although to a lesser extent than the technical coefficients in I-O analysis, permit the evaluation of the degree of

<sup>1</sup> This is equivalent to the following: (i) assume the absence of substitution between different inputs and factors for all productive sectors and between different final goods for all institutions; (ii) assume that the exogenous expenditure is fully supplied by goods and services from the economic system, that is, that the economic system does not encounter constraints in terms of productive capacity (hypothesis of surplus productive capacity); and (iii) assume that the prices of goods and services do not change because of the impact of changes on exogenous demand (hypothesis of fixed prices).

integration of industry  $j$  within China's productive structure, the overall interdependency of industries, and the composition of its GVA and, therefore, the intensity of labour and capital employed.

Because each impact multiplier  $M_{ij}$ ,  $i=j=1, \dots, 33$ , can be interpreted as the partial derivative,  $\frac{\partial X_i}{\partial Z_j}$ , of  $X_i$  with respect to  $Z_j$ , it measures the variation in endogenous account  $i$  that is attributable to a unitary increase in exogenous demand for endogenous account  $j$ .

We have estimated the endogenous coefficients matrix and the impact multiplier matrix, reported in Table 2 and Table 3, respectively.

### 3.3. Discussion of the results

Examining Table 2 reveals the main characteristics of industry interdependency and of GVA composition. A reading of the costs (columns) altogether reveals satisfactory average interdependency, meaning a good integration of industries, except for the somewhat lower interdependency between the group of goods industries (items 1 to 7) and some types of service industries, such as "Scientific Research and Technical Services", "Management of Water Conservancy, etc.", "Services to Households, etc.", "Education", "Health and Social Service", "Culture, Sports and Entertainments", and "Public Management, etc.". Note the good integration degree of "Manufacturing" with the other goods industries, with values of the costs that often range from 2.5% to 5% (see column 3, rows 1, 2, 6, 7, 10). In terms of entries (reading by row), there is evidence of an even better integration of "Manufacturing", with coefficient values generally ranging between 10% and 30% and a peak at 50% (see row 3). Another noteworthy finding is the degree of integration of "Construction", "Hotels and Catering Services", "Information Transmission, Software and Information Technology", "Real Estate", and "Management of Water, etc.". Finally, "Financial Intermediation" exhibits an input cost structure that indicates weak integration compared to its good integration performance on the entry side, meaning that financial activity is scarcely dependent on other industries, which viceversa are heavily dependent on it, as is typical in advanced economies.

Out of the total costs, GVA represents a substantial share for several industries. For "Education" it represents approximately 82% (rows 20–21, column 16), with 72% absorbed by compensation of employees (row 20) and 10% only to gross operating surplus (row 21); for "Agriculture, Forestry, etc." it represents more than 62% (rows 20–21, column 1), with 60%—that's practically the total—absorbed by compensation of employees; for "Real Estate" it represents 67% (rows 20–21, column 11), with 56% to gross operating surplus and 10% to compensation of employees. These examples demonstrate the clear labour orientation of the first two industries and the capital orientation of the third one. These are "high GVA producer" industries. Other industries, such as "Health and Social Services", "Wholesale and Retail Trade", "Service to Households, etc.", and "Information Transmission, Software, etc." exhibit GVA shares ranging from approximately 51% to approximately 55%, although in these cases there is no clear evidence of whether they are labour oriented or capital oriented. These are "medium GVA producer" industries. The GVAs of the other industries take 48% or less of the total cost, and there is no clear evidence in favour of them having a labour or capital orientation. These are "medium-low GVA producer" industries.

Table 2a. 19-industry SAM 2015 endogenous accounts coefficients.

Endogenous accounts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Agriculture, Forestry,	1	0,1179	0,0003	0,0526	0,0001	0,0079	0,0001	0,0102	0,0985	0,0014	0,0000	0,0001	0,0050	0,0069	0,0534	0,0035	0,0031	0,0025	0,0022	0,0000
Mining	2	0,0000	0,0558	0,0480	0,1586	0,0043	0,0000	0,0006	0,0001	0,0000	0,0000	0,0000	0,0000	0,0006	0,0016	0,0007	0,0006	0,0010	0,0005	0,0006
Manufacturing	3	0,1755	0,1080	0,4611	0,1182	0,5070	0,0227	0,2100	0,2833	0,1379	0,0293	0,0123	0,2490	0,2373	0,1583	0,1966	0,0480	0,3379	0,1536	0,1121
Production and Supply	4	0,0083	0,0321	0,0227	0,3186	0,0133	0,0068	0,0166	0,0111	0,0083	0,0035	0,0044	0,0018	0,0050	0,0265	0,0164	0,0043	0,0062	0,0059	0,0087
Construction	5	0,0001	0,0016	0,0014	0,0048	0,0316	0,0020	0,0074	0,0041	0,0035	0,0060	0,0178	0,0018	0,0048	0,0194	0,0059	0,0034	0,0028	0,0078	0,0135
Wholesale and Retail	6	0,0150	0,0093	0,0341	0,0141	0,0234	0,0218	0,0202	0,0642	0,0220	0,0085	0,0031	0,0376	0,0291	0,0219	0,0305	0,0072	0,0364	0,0419	0,0229
Transport, Storage	7	0,0112	0,0148	0,0260	0,0158	0,0339	0,0240	0,1222	0,0185	0,0094	0,0135	0,0040	0,0395	0,0283	0,0315	0,0225	0,0160	0,0126	0,0343	0,0561
Hotels and Catering	8	0,0008	0,0023	0,0035	0,0021	0,0050	0,0036	0,0111	0,0016	0,0047	0,0215	0,0031	0,0285	0,0248	0,0108	0,0108	0,0110	0,0044	0,0198	0,0365
Information Transm.	9	0,0011	0,0012	0,0020	0,0041	0,0141	0,0025	0,0093	0,0047	0,1075	0,0201	0,0033	0,0046	0,0047	0,0097	0,0046	0,0101	0,0133	0,0108	0,0315
Financial Intermediation	10	0,0152	0,0279	0,0249	0,0727	0,0398	0,0365	0,0948	0,0177	0,0394	0,0529	0,0952	0,0695	0,0446	0,0734	0,0248	0,0294	0,0161	0,0226	0,0363
Real Estate	11	0,0000	0,0001	0,0005	0,0002	0,0001	0,0379	0,0037	0,0114	0,0188	0,0480	0,0258	0,0080	0,0055	0,0040	0,0509	0,0062	0,0063	0,0123	0,0114
Leasing and Business	12	0,0004	0,0116	0,0124	0,0047	0,0081	0,0690	0,0120	0,0110	0,0376	0,0655	0,0301	0,0486	0,0217	0,0163	0,0182	0,0038	0,0012	0,0162	0,0172
Scientific Research	13	0,0051	0,0063	0,0074	0,0043	0,0370	0,0026	0,0012	0,0000	0,0101	0,0011	0,0001	0,0004	0,1071	0,0027	0,0001	0,0044	0,0007	0,0010	0,0004
Management of Water	14	0,0012	0,0005	0,0006	0,0056	0,0001	0,0003	0,0004	0,0002	0,0004	0,0007	0,0002	0,0026	0,0002	0,0129	0,0008	0,0003	0,0004	0,0010	0,0017
Service to Households	15	0,0008	0,0025	0,0027	0,0023	0,0046	0,0047	0,0146	0,0038	0,0022	0,0036	0,0013	0,0054	0,0095	0,0354	0,0160	0,0067	0,0063	0,0095	0,0188
Education	16	0,0002	0,0004	0,0002	0,0002	0,0006	0,0005	0,0007	0,0004	0,0007	0,0042	0,0003	0,0004	0,0019	0,0030	0,0009	0,0108	0,0026	0,0015	0,0100
Health and Soc Serv	17	0,0001	0,0002	0,0002	0,0003	0,0002	0,0002	0,0002	0,0001	0,0000	0,0002	0,0000	0,0000	0,0001	0,0002	0,0002	0,0002	0,0048	0,0003	0,0031
Culture Sports and	18	0,0000	0,0007	0,0009	0,0018	0,0012	0,0006	0,0015	0,0020	0,0025	0,0067	0,0013	0,0012	0,0020	0,0028	0,0027	0,0023	0,0015	0,0287	0,0104
Public Management	19	0,0004	0,0003	0,0005	0,0003	0,0004	0,0004	0,0005	0,0003	0,0016	0,0008	0,0011	0,0071	0,0009	0,0015	0,0015	0,0010	0,0006	0,0010	0,0066
Compensation of Empl	20	0,6025	0,1386	0,0905	0,0880	0,1710	0,2518	0,2123	0,2981	0,1897	0,2396	0,1095	0,2206	0,2600	0,2979	0,4108	0,7187	0,4580	0,2896	0,5290
Gross Operating Surplus	21	0,0234	0,1167	0,0885	0,1460	0,0640	0,2904	0,1958	0,0978	0,3592	0,4008	0,5632	0,1658	0,1721	0,1846	0,1327	0,1043	0,0768	0,1827	0,0719
Net Taxes on Production	22	-0,0263	0,0654	0,0358	0,0370	0,0311	0,2216	0,0114	0,0320	0,0210	0,0682	0,1237	0,0360	0,0256	0,0052	0,0415	0,0038	0,0045	0,0337	0,0000
Interest	23	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Distributed Income of Corporations	24	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Rent on Land, Natural Resources, and Subsoil Assets	25	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Other Property Income	26	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Current Taxes on Income, Wealth, etc.	27	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Payment to Social Security	28	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Social Security Welfare Allowances	29	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Other Income Transfers	30	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Household Expenditure	31	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Households	32	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
	33	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000



**Table 2b.** 19-industry SAM 2015 endogenous accounts coefficients.

Endogenous accounts		20	21	22	23	24	25	26	27	28	29	30	31	32	33
Agriculture, Forestry,	1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,1037	0,0000
Mining	2	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0008	0,0000
Manufacturing	3	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,3822	0,0000
Production and Supply ...	4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0250	0,0000
Construction	5	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Wholesale and Retail ...	6	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0631	0,0000
Transport, Storage ...	7	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0324	0,0000
Hotels and Catering ...	8	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0590	0,0000
Information Transm. ...	9	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0297	0,0000
Financial Intermediation	10	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0483	0,0000
Real Estate	11	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,1041	0,0000
Leasing and Business ...	12	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0055	0,0000
Scientific Research ...	13	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0012	0,0000
Management of Water ...	14	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0025	0,0000
Service to Households. ...	15	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0390	0,0000
Education	16	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0336	0,0000
Health and Social Service	17	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0541	0,0000
Culture, Sports and ...	18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0141	0,0000
Public Management. ...	19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0016	0,0000
Compensation of Employees	20	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Gross Operating Surplus	21	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Net Taxes on Production	22	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Interest	23	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0159
Distributed Income of Corporations	24	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Rent on Land, Natural Resources, and Subsoil Assets	25	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0001
Other Property Income	26	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Current Taxes on Income, Wealth, etc.	27	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0139
Payment to Social Security	28	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0564
Social Security Welfare	29	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Allowances	30	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Other Income Transfers	31	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0096
Household Expenditure	32	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,4152
Households	33	0,9990	0,1820	0,0000	0,1941	0,0766	0,0000	0,8902	0,0000	0,0000	1,0000	1,0000	0,2851	0,0000	0,2445

**Table 3a.** 19-industry SAM 2015 impact multiplier coefficients.

Endogenous accounts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Agriculture, Forestry, Mining	1	1.2873	0.0679	0.1979	0.1041	0.1689	0.0901	0.1355	0.2510	0.1049	0.0944	0.0703	0.1319	0.1445	0.1892	0.1383	0.1456	0.1585	0.1149	0.1470
Manufacturing	2	0.0717	1.1013	0.1421	0.3019	0.1051	0.0377	0.0681	0.0758	0.0520	0.0389	0.0290	0.0655	0.0712	0.0697	0.0686	0.0564	0.0832	0.0552	0.0661
Production and Supply	3	1.1001	0.5425	2.4155	0.8610	1.6064	0.5529	1.0136	1.1796	0.7943	0.5864	0.4259	1.0512	1.1175	0.9719	1.0177	0.8404	1.3086	0.8460	0.9872
Construction	4	0.0886	0.0848	0.1118	1.5336	0.1072	0.0536	0.0909	0.0897	0.0657	0.0506	0.0405	0.0678	0.0778	0.1060	0.0920	0.0729	0.0887	0.0657	0.0853
Wholesale and Retail	5	0.0068	0.0054	0.0084	0.0137	1.0407	0.0074	0.0152	0.0110	0.0097	0.0121	0.0228	0.0087	0.0124	0.0274	0.0136	0.0101	0.0101	0.0141	0.0218
Transport, Storage	6	0.1173	0.0562	0.1284	0.0939	0.1320	1.0845	0.1063	0.1593	0.0952	0.0744	0.0517	0.1242	0.1243	0.1112	0.1211	0.1005	0.1394	0.1194	0.1230
Hotels and Catering	7	0.0896	0.0541	0.1060	0.0866	0.1261	0.0752	1.2049	0.0954	0.0671	0.0655	0.0422	0.1128	0.1067	0.1054	0.0950	0.0864	0.0937	0.0982	0.1385
Information Transm.	8	0.0530	0.0252	0.0408	0.0389	0.0494	0.0394	0.0530	1.0452	0.0411	0.0581	0.0318	0.0694	0.0707	0.0553	0.0559	0.0638	0.0523	0.0577	0.0884
Financial Intermed	9	0.0335	0.0158	0.0258	0.0301	0.0440	0.0245	0.0379	0.0325	1.1426	0.0450	0.0222	0.0310	0.0330	0.0394	0.0334	0.0440	0.0448	0.0360	0.0680
Real Estate	10	0.1255	0.0852	0.1314	0.1989	0.1616	0.1146	0.2043	0.1241	0.1269	1.1342	0.1566	0.1705	0.1532	0.1794	0.1311	0.1321	0.1277	0.1108	0.1516
Leasing and Business	11	0.0885	0.0375	0.0593	0.0594	0.0694	0.0980	0.0729	0.0849	0.0805	0.1099	1.0753	0.0751	0.0778	0.0796	0.1283	0.0976	0.0870	0.0764	0.0998
Scientific Research ...	12	0.0448	0.0362	0.0608	0.0514	0.0637	0.1037	0.0603	0.0587	0.0800	0.1025	0.0595	1.0967	0.0714	0.0633	0.0638	0.0451	0.0502	0.0557	0.0663
Management of Water	13	0.0198	0.0143	0.0248	0.0195	0.0608	0.0104	0.0142	0.0147	0.0225	0.0094	0.0067	0.0130	1.1334	0.0164	0.0128	0.0162	0.0162	0.0119	0.0139
Service to Households.	14	0.0049	0.0024	0.0039	0.0109	0.0037	0.0027	0.0034	0.0036	0.0029	0.0031	0.0020	0.0056	0.0034	1.0164	0.0041	0.0036	0.0039	0.0037	0.0052
Education	15	0.0353	0.0173	0.0272	0.0262	0.0335	0.0271	0.0421	0.0326	0.0251	0.0264	0.0187	0.0314	0.0385	0.0647	1.0456	0.0414	0.0381	0.0344	0.0530
Health and Soc Serv	16	0.0246	0.0102	0.0152	0.0151	0.0183	0.0161	0.0179	0.0195	0.0162	0.0201	0.0128	0.0173	0.0205	0.0223	0.0210	1.0361	0.0241	0.0181	0.0334
Culture, Sports and	17	0.0374	0.0148	0.0223	0.0219	0.0263	0.0237	0.0256	0.0290	0.0230	0.0239	0.0185	0.0249	0.0276	0.0287	0.0307	0.0388	1.0373	0.0252	0.0382
Public Management.	18	0.0129	0.0063	0.0100	0.0116	0.0120	0.0091	0.0118	0.0127	0.0114	0.0156	0.0083	0.0111	0.0128	0.0138	0.0139	0.0154	0.0134	1.0387	0.0234
Compensation of Empl	19	0.0031	0.0016	0.0030	0.0025	0.0033	0.0026	0.0030	0.0028	0.0040	0.0031	0.0028	0.0097	0.0036	0.0040	0.0041	0.0036	0.0033	0.0031	1.0095
Gross Oper Surplus	20	1.0757	0.3479	0.5365	0.4892	0.6537	0.5231	0.6207	0.7591	0.5185	0.5326	0.3280	0.6140	0.6938	0.7346	0.7980	1.0941	0.8842	0.6291	0.9690
Net Taxes on Prod	21	0.3426	0.2957	0.4332	0.5336	0.4606	0.5356	0.5484	0.4333	0.6673	0.6693	0.7711	0.4966	0.5232	0.5220	0.4713	0.4023	0.4248	0.4647	0.4298
Interest	22	0.0670	0.1204	0.1473	0.1538	0.1550	0.2906	0.1087	0.1383	0.1026	0.1401	0.1782	0.1356	0.1298	0.1011	0.1431	0.0887	0.1148	0.1199	0.1015
Distr Income of Corp	23	0.1188	0.0834	0.1213	0.1406	0.1322	0.1517	0.1458	0.1297	0.1659	0.1694	0.1849	0.1367	0.1450	0.1444	0.1394	0.1333	0.1313	0.1296	0.1349
Rent on Land, Nat	24	0.0228	0.0190	0.0278	0.0339	0.0297	0.0344	0.0349	0.0281	0.0421	0.0423	0.0484	0.0318	0.0335	0.0334	0.0305	0.0265	0.0277	0.0298	0.0281
Res, and Subsoil Ass	25	0.0057	0.0048	0.0070	0.0085	0.0074	0.0086	0.0088	0.0070	0.0106	0.0107	0.0122	0.0080	0.0084	0.0084	0.0076	0.0066	0.0069	0.0075	0.0070
Other Property Inc	26	0.0042	0.0032	0.0046	0.0055	0.0050	0.0057	0.0057	0.0048	0.0067	0.0068	0.0076	0.0052	0.0056	0.0055	0.0052	0.0048	0.0048	0.0050	0.0049
Current Taxes on	27	0.0488	0.0300	0.0443	0.0505	0.0489	0.0527	0.0540	0.0491	0.0602	0.0610	0.0642	0.0504	0.0540	0.0545	0.0527	0.0537	0.0510	0.0483	0.0531
Income, Wealth, etc.	28	0.1050	0.0471	0.0691	0.0687	0.0802	0.0819	0.0767	0.0869	0.0714	0.0755	0.0645	0.0766	0.0836	0.0848	0.0916	0.1100	0.0952	0.0756	0.1014
Social Security Welf	29	0.0489	0.0428	0.0573	0.0612	0.0623	0.0904	0.0551	0.0601	0.0559	0.0640	0.0712	0.0587	0.0602	0.0550	0.0633	0.0559	0.0576	0.0547	0.0568
Allowances	30	0.0145	0.0127	0.0170	0.0182	0.0185	0.0267	0.0164	0.0178	0.0167	0.0191	0.0213	0.0175	0.0179	0.0164	0.0188	0.0166	0.0171	0.0162	0.0169
Other Income Transf	31	0.0251	0.0136	0.0201	0.0221	0.0226	0.0237	0.0240	0.0233	0.0256	0.0261	0.0260	0.0228	0.0246	0.0250	0.0249	0.0271	0.0248	0.0221	0.0260
Househ Expenditure	32	0.6792	0.2645	0.3982	0.3881	0.4707	0.4292	0.4585	0.5239	0.4180	0.4323	0.3375	0.4507	0.4996	0.5182	0.5530	0.7026	0.5904	0.4518	0.6375
Households	33	1.6360	0.6370	0.9591	0.9348	1.1337	1.0338	1.1044	1.2619	1.0068	1.0411	0.8130	1.0856	1.2033	1.2481	1.3318	1.6922	1.4220	1.0882	1.5355

**Table 3b.** 19-industry SAM 2015 impact multiplier coefficients.

Endogenous accounts		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Agriculture, Forestry,	1	0.1564	0.0434	0.0429	0.0591	0.0270	0.0429	0.1427	0.0429	0.0429	0.1565	0.1565	0.0662	0.2737	0.1565	0.0119	0.0451	0.0429
Mining	2	0.0550	0.0153	0.0151	0.0208	0.0095	0.0151	0.0502	0.0151	0.0151	0.0551	0.0551	0.0233	0.0963	0.0551	0.0042	0.0159	0.0151
Manufacturing	3	0.8309	0.2307	0.2278	0.3139	0.1433	0.2278	0.7585	0.2278	0.2278	0.8317	0.8317	0.3519	1.4547	0.8317	0.0632	0.2397	0.2278
Production and Supply	4	0.0704	0.0195	0.0193	0.0266	0.0121	0.0193	0.0643	0.0193	0.0193	0.0705	0.0705	0.0298	0.1232	0.0705	0.0054	0.0203	0.0193
Construction	5	0.0062	0.0017	0.0017	0.0024	0.0011	0.0017	0.0057	0.0017	0.0017	0.0062	0.0062	0.0026	0.0109	0.0062	0.0005	0.0018	0.0017
Wholesale and Retail ...	6	0.1002	0.0278	0.0275	0.0378	0.0173	0.0275	0.0914	0.0275	0.0275	0.1003	0.1003	0.0424	0.1754	0.1003	0.0076	0.0289	0.0275
Transport, Storage ...	7	0.0716	0.0199	0.0196	0.0270	0.0123	0.0196	0.0653	0.0196	0.0196	0.0716	0.0716	0.0303	0.1253	0.0716	0.0054	0.0206	0.0196
Hotels and Catering ...	8	0.0594	0.0165	0.0163	0.0224	0.0102	0.0163	0.0542	0.0163	0.0163	0.0595	0.0595	0.0252	0.1040	0.0595	0.0045	0.0171	0.0163
Information Transm... ..	9	0.0362	0.0100	0.0099	0.0137	0.0062	0.0099	0.0330	0.0099	0.0099	0.0362	0.0362	0.0153	0.0634	0.0362	0.0028	0.0104	0.0099
Financial Intermediation	10	0.1052	0.0292	0.0288	0.0397	0.0181	0.0288	0.0960	0.0288	0.0288	0.1053	0.1053	0.0445	0.1841	0.1053	0.0080	0.0303	0.0288
Real Estate	11	0.1037	0.0288	0.0284	0.0392	0.0179	0.0284	0.0946	0.0284	0.0284	0.1038	0.1038	0.0439	0.1815	0.1038	0.0079	0.0299	0.0284
Leasing and Business ...	12	0.0392	0.0109	0.0107	0.0148	0.0068	0.0107	0.0358	0.0107	0.0107	0.0392	0.0392	0.0166	0.0686	0.0392	0.0030	0.0113	0.0107
Scientific Research ...	13	0.0111	0.0031	0.0030	0.0042	0.0019	0.0030	0.0101	0.0030	0.0030	0.0111	0.0111	0.0047	0.0194	0.0111	0.0008	0.0032	0.0030
Management of Water	14	0.0036	0.0010	0.0010	0.0014	0.0006	0.0010	0.0033	0.0010	0.0010	0.0036	0.0036	0.0015	0.0063	0.0036	0.0003	0.0010	0.0010
Service to Households.	15	0.0394	0.0109	0.0108	0.0149	0.0068	0.0108	0.0359	0.0108	0.0108	0.0394	0.0394	0.0167	0.0689	0.0394	0.0030	0.0114	0.0108
Education	16	0.0295	0.0082	0.0081	0.0111	0.0051	0.0081	0.0269	0.0081	0.0081	0.0295	0.0295	0.0125	0.0517	0.0295	0.0022	0.0085	0.0081
Health and Social Service	17	0.0457	0.0127	0.0125	0.0173	0.0079	0.0125	0.0417	0.0125	0.0125	0.0458	0.0458	0.0194	0.0801	0.0458	0.0035	0.0132	0.0125
Culture, Sports and ...	18	0.0147	0.0041	0.0040	0.0055	0.0025	0.0040	0.0134	0.0040	0.0040	0.0147	0.0147	0.0062	0.0257	0.0147	0.0011	0.0042	0.0040
Public Management. ...	19	0.0027	0.0007	0.0007	0.0010	0.0005	0.0007	0.0025	0.0007	0.0007	0.0027	0.0027	0.0011	0.0047	0.0027	0.0002	0.0008	0.0007
Compensation of Empl	20	1.3624	0.1006	0.0994	0.1369	0.0625	0.0994	0.3308	0.0994	0.0994	0.3628	0.3628	0.1535	0.6345	0.3628	0.0276	0.1045	0.0994
Gross Operating Surplus	21	0.2805	1.0779	0.0769	0.1060	0.0484	0.0769	0.2560	0.0769	0.0769	0.2807	0.2807	0.1188	0.4910	0.2807	0.0213	0.0809	0.0769
Net Taxes on Production	22	0.0819	0.0227	1.0225	0.0309	0.0141	0.0225	0.0748	0.0225	0.0225	0.0820	0.0820	0.0347	0.1434	0.0820	0.0062	0.0236	0.0225
Interest	23	0.1185	0.2284	0.0901	1.4866	0.0785	0.0901	0.1173	0.0901	0.0901	0.1186	0.1186	0.2954	0.1369	0.1186	0.1438	0.8422	0.0901
Distr Income of Corp	24	0.0194	0.0667	0.0070	0.0502	1.0165	0.0070	0.0209	0.0070	0.0070	0.0194	0.0194	0.0287	0.0315	0.0194	0.0843	0.0567	0.0070
Rent on Land, Nat Res, and Subsoil Ass	25	0.0048	0.0169	0.0016	0.0084	0.0041	1.0016	0.0053	0.0016	0.0016	0.0048	0.0048	0.0048	0.0079	0.0048	0.0231	0.0053	0.0016
Other Property Income	26	0.0039	0.0099	0.0022	0.0281	0.0029	0.0022	1.0037	0.0022	0.0022	0.0039	0.0039	0.0162	0.0052	0.0039	0.0036	0.0520	0.0022
Current Taxes on Income, Wealth, etc.	27	0.0508	0.0797	0.0175	0.1071	0.0236	0.0175	0.0493	1.0175	0.0175	0.0509	0.0509	0.0675	0.0505	0.0509	0.0747	0.1592	0.0175
Payment to Soc Sec	28	0.1280	0.0433	0.0880	0.0604	0.0382	0.0880	0.1208	0.0880	1.0880	0.1282	0.1282	0.0684	0.0787	0.1282	0.0166	0.0497	0.0880
Social Security Welfare Allowances	29	0.0558	0.0449	0.2171	0.0671	0.0713	0.2171	0.0659	0.2171	0.2171	1.0559	0.0559	0.0777	0.0606	0.0559	0.0305	0.0647	0.2171
Other Income Transfers	30	0.0165	0.0138	0.0633	0.0199	0.0209	0.0633	0.0194	0.0633	0.0633	0.0165	1.0165	0.0228	0.0180	0.0165	0.0099	0.0191	0.0633
Household Expenditure Households	31	0.0278	0.0294	0.0112	0.0488	0.0104	0.0112	0.0264	0.0112	0.0112	0.0278	0.0278	1.0325	0.0230	0.0278	0.0216	0.0752	0.0112
	32	0.8355	0.2320	0.2291	0.3156	0.1441	0.2291	0.7627	0.2291	0.2291	0.8363	0.8363	0.3539	1.4627	0.8363	0.0635	0.2410	0.2291
	33	2.0123	0.5587	0.5518	0.7602	0.3470	0.5518	1.8369	0.5518	0.5518	2.0143	2.0143	0.8523	1.1145	2.0143	0.1530	0.5805	0.5518

The impact multiplier coefficients reported in Table 3 confirm, on average, the evidence that emerges from the above analysis of the endogenous coefficients. The relevance of “Manufacturing” within the productive structure is definitively confirmed. Indeed, the related impact multipliers speak to this: the direct multiplier, with its very high value of 2.42 (row 3, column 3), shows the highly dynamic and reactive character of this industry, able to highly multiply self-stimulative activity, and to profoundly respond to the indirect demand from the other industries. Indeed, by column, the indirect multipliers confirm the remarkable average indirect effect of increased demand for manufacturing products on the other industries, namely on “Agriculture, Forestry, etc.”, with 20% (row 1, column 3), “Mining”, with 14% (row 2, column 3), and “Wholesale and Retail, etc.”, and “Financial Intermediation”, both with 13% (row 6, column 3, and row 10, column 3, respectively). Although this industry is not a great GVA producer, the reaction to increases in manufacturing demand on labour and capital is remarkable, with impact multiplier effects of 54% (row 20, column 3) and 43% (row 21, column 3), respectively. A notable indirect reaction is observed for variations in household expenditure, at 40%, and for income variation: for household income, the multiplier effect is 96%, whereas that of non-financial corporation income is 43%. By row, the indirect multipliers show the very high average impact of the increased demand for the products of all the other industries on “Manufacturing” (see row 3, where its response to unitary increases in demand for products is in several cases higher than 100%). The responses of “Manufacturing” to increased labour demand, social security payments, allowances, household income households’ expenditure are also remarkable (row 3).

### 3.4. Impact multiplier decomposition

The nature of the links in China’s economy can be better analysed if the impact multipliers are decomposed. Decomposition also creates more transparency of the exogenous shock effects represented by a variation in a given exogenous demand on the output structure and functional and institutional distribution, redistribution and use of income (Pyatt and Round, 1979). We decompose the 19 industry SAM 2015 coefficient matrix,  $S$ , as follows:  $S = Q + R$  where

$$S = \begin{bmatrix} A & 0 & C \\ V & 0 & 0 \\ 0 & Y & H \end{bmatrix}; \quad Q = \begin{bmatrix} A & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & H \end{bmatrix}; \quad R = \begin{bmatrix} 0 & 0 & C \\ V & 0 & 0 \\ 0 & Y & 0 \end{bmatrix} \quad (4)$$

The three matrices contain:  $S$ , the SAM direct coefficients,  $Q$ , the blocks of the diagonal, and  $R$ , the off-diagonal blocks. Regarding the sub-matrices:  $A$  = matrix of technical coefficients;  $V$  = matrix of VA coefficients;  $Y$  = matrix of VA distribution coefficients;  $C$  = matrix of expenditure coefficients; and  $H$  = matrix of institutional and household distribution coefficients.

Then, we can write the supply and demand balance equation as follows:

$$\begin{bmatrix} X \\ V \\ Y \end{bmatrix} = S \begin{bmatrix} X \\ V \\ Y \end{bmatrix} + \begin{bmatrix} ex \\ ev \\ ey \end{bmatrix} \quad (5)$$

where  $X$  = vector of sector supply;  $V$  = vector of VA by categories;  $Y$  = vector of household incomes;  $ex$  = vector of exogenous commodity demand;  $ev$  = vector of exogenous VA; and  $ey$  = vector of exogenous household incomes. Equivalently:

$$\begin{bmatrix} X \\ V \\ Y \end{bmatrix} = (I - S)^{-1} \begin{bmatrix} ex \\ ev \\ ey \end{bmatrix} \quad (6)$$

where  $(I - S)^{-1}$  represents the matrix of SAM impact multipliers.

We rework (4) using matrix decomposition. After simple algebra, we obtain

$$\begin{bmatrix} X \\ V \\ Y \end{bmatrix} = T \begin{bmatrix} X \\ V \\ Y \end{bmatrix} + (I - Q)^{-1} \begin{bmatrix} ex \\ ev \\ ey \end{bmatrix} \quad (7)$$

where  $T = (I - Q)^{-1}R$ .

Let us now rewrite (5) as follows:

$$x = Tx + (I - Q)^{-1}ex \quad (8)$$

where

$$x = \begin{bmatrix} X \\ V \\ Y \end{bmatrix}; \quad ex = \begin{bmatrix} ex \\ ev \\ ey \end{bmatrix}. \quad (9)$$

We multiply (8) through by  $T$  and then substitute for  $Tx$  from (8) in the same equation. After some algebraic manipulations, we obtain:

$$x = T^2x + T(I - Q)^{-1}ex + (I - Q)^{-1}ex \quad (10)$$

Again, we multiply through (7) by  $T$  and substitute for  $Tx$  and obtain:

$$x = M_3M_2M_1ex \quad (11)$$

where

$$M_3 = (I - T^3)^{-1} \quad (12)$$

$$M_2 = (I + T + T^2) \quad (13)$$

$$M_1 = (I - Q)^{-1}. \quad (14)$$

In matrix form:

$$M_1 = \begin{bmatrix} (I - A)^{-1} & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & (I - H)^{-1} \end{bmatrix} \quad (15)$$

$$M_2 = \begin{bmatrix} I & (I - A)^{-1}C(I - H)^{-1}Y & (I - A)^{-1}C \\ V & I & V(I - A)^{-1}C \\ (I - H)^{-1}YV & (I - H)^{-1}Y & I \end{bmatrix} \quad (16)$$

$$M_3 = \begin{bmatrix} [I - (I - A)^{-1}C(I - H)^{-1}YV]^{-1} & 0 & 0 \\ 0 & [I - V(I - A)^{-1}C(I - H)^{-1}Y]^{-1} & 0 \\ 0 & 0 & [I - (I - H)^{-1}YV(I - A)^{-1}C]^{-1} \end{bmatrix} \quad (17)$$

Thus, matrix  $\mathbf{M}$  has been decomposed into three multiplicative components,  $\mathbf{M}_1$ ,  $\mathbf{M}_2$  and  $\mathbf{M}_3$ , which contain own (intragroup or direct effect), extra-group (indirect or open loop), and inter-group (cross or closed loop) multipliers, respectively.

Because of the key role it maintains in China's economic structure as stressed above, in Table 4, the decomposition of "Manufacturing" industry vector,  $j=3$ ,  $M_{i3}$  ( $i=1, \dots, 33$ ) =  $M_{1i3}$  ( $i=1, \dots, 19$ )  $M_{3i3}$  ( $i=20, \dots, 33$ )  $M_{3i3}$  ( $i=1, \dots, 19$ ), is shown as an example.

Sub-vector  $M_{1i3}$  shows how the effects of the exogenous shock represented by increased demand for "Manufacturing" products are passed on to other industries. In other words, this vector represents the "within account" effects, that is, the multiplier effects that the exogenous shock to the block of accounts of these industries has on the block itself. Thus, an injection of 1 euro to demand for "Manufacturing" products leads to a 12.34% increase in "Agriculture, Forestry, etc." demand, a 11.59% increase in "Mining", a 101.94% increase in "Manufacturing", and so forth, up to a 0.3% increase in "Public Management, etc." demand. This effect concerns only industry accounts, and therefore,  $M_{1i3} = 0$ ,  $i=20, \dots, 33$ . Sub-vector  $M_{2i3}$  captures "cross" or "spillover" effects, showing the effects of the exogenous shock that are transmitted to endogenous accounts of blocks other than the industry block, due to the circular flow of income. Thus, the same 1 euro injection increases "Compensation of Employees" by 9.05%, "Gross Operating Surplus" by 8.85% (thus, overall, GVA is increased by 17.90%), and "Household Expenditure" by 7.13%, "Households", "Non-financial Corporations", and "General Government" income by 17.18%, 8.82%, and 7.56%, respectively. This effect concerns only factors' and institutions' accounts, and therefore  $M_{2i3} = 0$ ,  $i=1, \dots, 19$ . Sub-vector  $M_{3i3}$  shows, for each industry, the induced portion of the closed-loop effect, *i.e.*, the circular structure of the system from exogenous to endogenous accounts. The economic interpretation of  $M_{3i3}$  is that the variation in "Manufacturing" demand has travelled out from the original block that first felt the shock, through all the other blocks, and back to "Manufacturing". Consequently, the effect of the above 1 euro shock to "Agriculture" that travels out of it to return through the blocks of factors and institutions to yield variation in "Manufacturing" demand is 1.95%, the effect of the shock to "Industry" that travels out of it to return through the factors and institutions blocks to variation in "Manufacturing" demand is 0.69%, and so forth, up to the 0.03% effect that travels out of "Other Services" to return through factors and institutions blocks to variation in "Manufacturing" demand. As the "Manufacturing" accounts belongs to the industry block, no  $M_{33i}$  coefficient exists other than those of the industry block (that is,  $M_{3i3} = 0$ ,  $i=20, \dots, 33$ ).

**Table 4.** Impact multiplier decomposition for “Manufacturing”.

Endogenous accounts	Manufacturing Impact Multiplier Decomposition				
		$M_{3i}$	$M_{31i}$	$M_{32i}$	$M_{33i}$
Agriculture, Forestry, Animal Husbandry and Fishery	1	0.1979	0.1234	0	0.0195
Mining	2	0.1421	0.1159	0	0.0069
Manufacturing	3	2.4155	2.0194	1	1.1038
Production and Supply of Electricity, Heat, Gas and Water	4	0.1118	0.0783	0	0.0088
Construction	5	0.0084	0.0054	0	0.0008
Wholesale and Retail Trades	6	0.1284	0.0807	0	0.0125
Transport, Storage and Post	7	0.1060	0.0719	0	0.0089
Hotels and Catering Services	8	0.0408	0.0125	0	0.0074
Information Transmission, Software and Information Technology	9	0.0258	0.0086	0	0.0045
Financial Intermediation	10	0.1314	0.0813	0	0.0131
Real Estate	11	0.0593	0.0098	0	0.0129
Leasing and Business Services	12	0.0608	0.0421	0	0.0049
Scientific Research and Technical Services	13	0.0248	0.0195	0	0.0014
Management of Water Conservation, Environment and Public Facilities	14	0.0039	0.0022	0	0.0005
Service to Households, Repair and Other Services	15	0.0272	0.0085	0	0.0049
Education	16	0.0152	0.0011	0	0.0037
Health and Social Services	17	0.0223	0.0005	0	0.0057
Culture, Sports and Entertainment	18	0.0100	0.0030	0	0.0018
Public Management, Social Security and Social Organizations	19	0.0030	0.0017	0	0.0003
Compensation of Employees	20	0.5365	0	0.0905	0
Gross Operating Surplus	21	0.4332	0	0.0885	0
Net Taxes on Production	22	0.1473	0	0.0358	0
Interest	23	0.1213	0	0.0244	0
Distributed Income of Corporations	24	0.0278	0	0.0057	0
Rent on Land, Natural Resources, and Subsoil Assets	25	0.0070	0	0.0014	0
Other Property Income	26	0.0046	0	0.0009	0
Current Taxes on Income, Wealth, etc.	27	0.0443	0	0.0087	0
Payment to Social Security	28	0.0691	0	0.0130	0
Social Security Welfare	29	0.0573	0	0.0125	0
Allowances	30	0.0170	0	0.0037	0
Other Income Transfers	31	0.0201	0	0.0039	0
Households' Expenditure	32	0.3982	0	0.0713	0
Households	33	0.9591	0	0.1718	0

#### 4. SAM-based analysis of VAT cuts on China's economic system

##### 4.1. China's tax reform: an appraisal of its economic and fiscal effects

###### 4.1.1. The story

By May 1, 2016, China had entirely abandoned its former indirect double taxation system and implemented a new value-added tax (VAT) system that is collected centrally. It replaced the business

tax (BT) system that had been collected by local governments, moving to a unified VAT system applicable to all goods and services. This reform more closely aligned China's tax system with international standards, although it still possesses its own unique characteristics and complexities (Shira and Associates, 2016).

China's indirect tax system was implemented through a bifurcated regime in which a VAT applied to the sale and importation of goods, and a BT applied to the services, and this system had been in place since the country's opening up to the world economy in 1978 and subsequent bold reforms. The system underwent a major overhaul in 1994, as the VAT was expanded to include the sale of goods, and processing and repair services.

The latest phase of the reform began in 2012 in Shanghai with the aim of reducing the tax payments of smaller mainland firms when the transportation industry and modern service industries were included. In 2014 railway transport, postal services and the telecommunications industry were included. In 2016 the VAT was comprehensively implemented as the country's only indirect tax, finally including construction, real estate, finance<sup>2</sup> and life services, effectively replacing the BT system. The tax reform, which is currently being tested, is part of government's efforts to restructure the Chinese economy from one driven by labour-intensive manufacturing to one that is service-oriented by easing the tax burden on service industries, which have historically paid a disproportionate share.

Indeed, in 2015, services represented more than half of China's Gross Domestic Product (GDP) for the first time, and were growing at a faster rate than any other sector of the economy. Accordingly, the Chinese government fully included the entire service sector under the VAT regime to further propel growth in services and consumption as the country pivots away from low-value-added industries. The broader introduction of the VAT was also designed to encourage low-end manufacturers to upgrade their technology and capabilities, and invest in research and development to move up the value chain.

China's fiscal reforms can be recognized as having helped maintain sustainable growth, thereby achieving the goal of the so-called New Normal, that is, shifting from quantity to quality. This means shifting economic growth from high-speed to middle-to-high speed and shifting the balance of growth away from heavy-industrial investment and toward domestic consumption.

#### 4.1.2. Economic and fiscal effects

Since the reform was fully implemented approximately a year and a half ago, it is currently too early to evaluate its economic effects, except for the short-term ones. Nonetheless—for the sake of the analysis we intend to conduct—here are interesting and useful, albeit somewhat few, studies in this vein.

Gourdon et al. (2014) focused on export VAT rebates and reported that a 1% rebate results in a 7% increase in exports. A VAT refund is equivalent to a decrease in the VAT rate, and thus, the inverse multiplier effect is very high. Since exports are almost entirely manufactures, we would not be that far from the truth if we concluded that a 1% decrease in VAT results in a 5–6% increase in

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<sup>2</sup> As affirmed by Wolfers et al. (2016), "China's VAT system contains three key features that represent breakthrough policies among VAT/GST systems around the world". One of these features is the application of VAT to the financial service sector, specifically, to: i) interest income, ii) fee and commission-based income, iii) net gains from trading in financial products, and iv) general insurance products.



manufacturing products. For international shippers importing from and exporting to China, VAT implementation entails a 6% rise in shipping costs, as claimed by Maersk et al. (2013), an integrated transport and logistics company, with multiple brands, and a global leader in container shipping and ports. Thus, as the VAT for shipping increased by 6%, a 1% increase in VAT should result in a parallel 1% increase in costs. The same result is reached by Cavas (2013) regarding China-US import-export. Again, Yue (2015), reported the same finding for the transport industry (where the VAT rate is 11%): each percentage point increase in the VAT results in an approximately one-percentage-point increase in costs. Moreover, the results of his regression analysis indicate that the regression coefficient between enterprise performance and the VAT policy is 4.35. This represents the direct VAT multiplier for enterprise performance, which roughly confirms, *mutatis mutandis*, what has been indirectly obtained for manufacturing.

Du (2015), on the basis of the input-output (I-O) table and Urban Household Survey data, analysed the impact of China's VAT expansion reform on the joint income redistribution effects of VAT and BT on urban households, by comparing the Gini coefficient and general entropy indexes before and after the reform. He finds that the reform improved the redistribution effects of the two taxes by lowering the average tax burden and narrowing the income gap "within" the low-income household group. Since this reform did not deliver a considerable tax cut to the expenditure items that are particularly important for the low-income households, the income gap "between" the household groups with different income levels is nearly unaffected.

Positives and negatives—with the former being predominant—can be traced if we limit the analysis to the first period of the reform, that is, up to and including 1994. As highlighted by Gordon and Li (2002), while the 1994 fiscal innovations in the tax law, in accounting procedures, in banking, and in tariff rates, that led China to have a fiscal structure much more similar to those of developed economies, did initially generate very rapid growth, it created its own problems. As argued by Gordon and Li (2002), for example, tax competition undermined the tax base, and local governments had an incentive to protect local firms facing high tax rates, while the national government still had a competing incentive to protect large firms. While this system may not be quite as supportive of entry and growth as the previous system, it should deal well with many of the problems that arose under the previous system.

To analyse the overall effects of the tax reform up to 1994, Toh and Lin (2004) applied a computable general equilibrium (CGE) model. The results of the simulations indicate small aggregate welfare gains. However, household groups are worse off because of the redistribution of resources from the household to the government sectors. There will be a substantial increase in government revenue, and the prudent and productive use of the increased revenue could improve household welfare. This result also suggests that the statutory rates introduced in 1994 may be too high from an equal yield perspective. Their analysis also suggested that further improvements in the tax system could be obtained by extending a consumption-type VAT to other sectors that were not included in the reform as of their writing.

A number of studies have analysed and discussed the reform in itself, including its effects on taxation and the fiscal advantages and disadvantages for specific economic sectors. For example, Zhang and Lu (2017) analysed the influence of VAT on the air transportation industry, while Wan (2016) estimated that more than 97% of tax payers will pay less tax under the VAT regime, saving a total of over 300 billion yuan, and that sectors such as manufacturing that already use VAT would also save over 300 billion yuan in tax payments due to an increased number of deductible items. The transition from the mixed to the purely VAT system has been studied, with respect to the minor tax

burden on the industrial and services sectors, and the consequent development opportunities, as well with respect to the household income distribution.

The widespread finding is that the reform resulted in a reduced tax burden, except for small service entrepreneurs in Shanghai (as we will see in a moment) (Zheng and Shu, 2017, *South China Morning Post*, 2016). It is then evident that these positive effects transfer to the whole economy.

A comprehensive appreciation of the reform, that is, an examination of the entire period until 2016, is provided by Xinhua (2017), with a focus on services. Xinhua (2017) stressed the value of the reform because China is relying on services, particularly high-value-added services in finance and technology, to reduce the economy's traditional reliance on heavy industry and investment, extending the VAT reform across all industries will encourage the development of the service sector, support industry upgrading, stimulate consumption and support supply-side structural reform. The reform has streamlined the tax system, reduced and standardized double central and local government fiscal responsibilities and eliminated taxation barriers between manufacturing and service sectors to increase the weight of the service sector in China's economy. This view is definitely shared by the *Financial Tribune* (2017), which affirms that the VAT reform has given impetus to economic growth and boosted entrepreneurship. Moreover, the reform has the potential to stimulate mass innovation and create a favourable climate for private enterprises by reducing corporate burdens.

A discordant voice is represented by Ren's (2016) view that the reform, which has intended to reduce the tax payments of smaller mainland service firms, appears to have had the opposite effect on many entrepreneurs, who contend that they have become victims of the new system. As small service entrepreneurs in Shanghai claim, while before 2012, the tax was imposed on service companies based on their sales revenues, after the reform the amount levied was calculated based on the value they added to their products and services, and the pilot scheme proved unsuccessful<sup>3</sup>. As a result, two-thirds of Shanghai-based companies ended up paying more tax under the new system, as demonstrated by a survey. In stark contrast, Zhao Yang, chief economist with Nomura, Asia's global investment bank, said, "while the VAT reform could initially result in a higher tax burden owing to ineffective enforcement, appearing to have had no immediate positive impact on businesses, taking a long view, it will benefit the development of privately owned companies".

#### *4.2. The economic effects of a VAT rate reduction government policy*

China's government, with the aim of stimulating the economy, may implement a balanced policy consisting of reducing the VAT rates of industries that are important in terms of production volume flanked by industries with low production volume. Actually, this intervention can consist of cutting the VAT for "Manufacturing", "Construction", and "Transport, Storage, etc." by 1.5%, the VAT for "Information, Transmission, etc.", and "Financial Intermediation" by 1%, and the VAT for "Real Estate" by 0.5%. These cuts result in increased exogenous demand for the products of the respective industries that may be quantified based on the conclusions on the economic effects of the fiscal reform reported in Sub-paragraph 4.1.2, particularly those obtained by Gourdon et al. (2014) on exports. Moreover, Barrell and Weale (2009), in discussing the theoretical effects of the 2008 VAT reduction in the UK, found that a temporary 1% cut in VAT resulted in an approximately

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<sup>3</sup> Under the VAT system, the value of invoices issued by suppliers of raw materials is measured against the value of the sales invoices that service companies issue to their customers.

0.95% increase in household consumption per quarter. A rough linear extension over the year would lead to an expected 3.9–4.0% increase. As a result, an average inverse multiplier of a 1% VAT rate cut/demand increase equal to 5% for China seems appropriate.

Therefore, the exogenous demand for the above industries' products will modify as follows (hundred million yuan): "Manufacturing": 229,990; "Construction": 176,542; "Transport, Storage, and Post": 11,659; "Information, Transmission, etc.": 11,473; "Financial Intermediation": 1,713; and "Real Estate": 12,227. The exogenous account vector adjusts accordingly (see column 3 of Table 5).

The total demand vector resulting from equation (3) due to the VAT shock is reported in column 5 of Table 5. Columns 6 and 7 report the percentage and absolute changes of total demand after the VAT cut shock.

There is evidence that a 1.5% VAT cut for "Manufacturing", "Construction", and "Transport, Storage and Post" yields increases in demand for the products of these industries of 6.4%, 7.4% and 5.9%, respectively. A 1% VAT cut for "Information, Transmission, Software, etc." and "Financial Intermediation" yields increases in demand for the products of these industries of 5.0% and 5.5%, respectively. A 0.5% VAT cut for "Real Estate" yields a 4.3% increase in the demand for its products (column 7, figures in bold).

It is worth stressing the absolute increase in "Manufacturing", which accounts for 59,977 hundred million yuan, or 1,874.0 billion PPP USD, as well as those of "Construction" and "Transport, Storage and Post", accounting for 12,978 hundred million yuan, or 405.6 billion PPP USD and 4,289 hundred million yuan, or 134.0 PPP USD, respectively (column 8).

Turning from the above industries, directly affected by the shock, the remainder of the productive sector responds, on average, to the shock with a 3.9% increase in demand, although this varies, sometimes greatly, across industries. These range from 6.2% increase for "Mining", which is very close to that of "Manufacturing", to the very small 1.7% and 1.4% observed for "Education" and "Conservancy, Environment, etc.", respectively. The overall increase for China's productive sector is 5.4%, in absolute terms equal to 108,844 hundred million yuan, or 3,401 billion PPP USD.

**Table 5.** Exogenous account column vectors and total demand column vectors prior to and after the shock.

Endogenous accounts		Exogenous account		Total demand		Total demand change (%)	Total demand increase (100 million yuan)
		(100 million yuan)		(100 million yuan)			
		Prior shock	After shock	Prior shock	After shock		
Agriculture, Forestry, Animal Husbandry, etc.	1	9,310	9,310	104,917	110,369	5.20	5,452
Mining	2	1,107	1,107	59,583	63,254	6.16	3,670
Manufacturing	3	213,944	<b>229,990</b>	942,299	1,002,276	<b>6.36</b>	59,977
Production and Supply of Electricity, Heat, Gas, etc.	4	142	142	55,286	58,526	5.86	3,241
Construction	5	164,225	<b>176,542</b>	175,193	188,171	<b>7.41</b>	12,978
Wholesale and Retail Trades	6	18,203	18,203	86,664	90,510	4.44	3,846
Transport, Storage and Post	7	10,846	<b>11,659</b>	72,674	76,962	<b>5.90</b>	4,289
Hotels and Catering Services	8	545	545	28,404	29,746	4.73	1,343
Information Transmission, Software, etc.	9	10,926	<b>11,473</b>	32,545	34,167	<b>4.98</b>	1,622
Financial Intermediation	10	1,632	<b>1,713</b>	81,663	86,137	<b>5.48</b>	4,473
Real Estate	11	11,929	<b>12,227</b>	52,361	54,600	<b>4.28</b>	2,239
Leasing and Business Services	12	5,481	5,481	40,511	42,390	4.64	1,879
Scientific Research and Technical Services	13	10,399	10,399	29,454	30,626	3.98	1,173
Management of Water Conservancy, etc.	14	5,676	5,676	7,896	8,010	1.44	114
Service to Households, Repair and Other Services	15	113	113	18,552	19,458	4.88	906
Education	16	18,564	18,564	29,332	29,831	1.70	498
Health and Social Service	17	12,734	12,734	27,732	28,455	2.61	723
Culture, Sports and Entertainment	18	2,874	2,874	9,747	10,075	3.35	327
Public Management, Social Security, etc.	19	42,253	42,253	44,307	44,401	0.21	94
Compensation of Employees	20	2,059	2,059	355,373	372,962	4.95	17,589
Gross Operating Surplus	21	0	0	254,010	267,729	5.40	13,719
Net Taxes on Production	22	0	0	79,669	84,151	5.63	4,482
Interest	23	7,698	7,698	100,648	104,500	3.83	3,852
Distributed Income of Corporations	24	4,069	4,069	30,204	31,084	2.91	880
Rent on Land, Natural Resources, and Subsoil Assets	25	0	0	6,743	6,964	3.28	221
Other Property Income	26	51	51	3,438	3,584	4.28	147
Current Taxes on Income, Wealth, etc.	27	0	0	36,025	37,438	3.92	1,413
Payment to Social Security	28	0	0	46,354	48,577	4.80	2,223
Social Security Welfare	29	0	0	39,118	40,906	4.57	1,789
Allowances	30	0	0	11,688	12,218	4.54	531
Other Income Transfers	31	2,236	2,236	17,446	18,091	3.70	645
Households' Expenditure	32	0	0	265,980	278,904	4.86	12,924
Households	33	0	0	640,637	671,766	4.86	31,128
Non-financial Corporations	34	112,622	112,622	419,171	432,868	3.27	13,697
Financial Corporations	35	0	0	112,473	117,411	4.39	4,938
General Government	36	9,873	9,873	236,867	247,698	4.57	10,831

Outside the productive structure, very significant increases are recorded by the two GVA components, “Compensation of Employees”, with 4.9%, and “Gross Operating Surplus”, with 5.4%. Noteworthy are the percentage increasings recorded by “Household Expenditure”, and for the income categories, by “Household”, “Financial Corporations”, and “General Government”, all between 4.5% and 5.0% (column 8).

In addition, we conducted detailed complementary analysis of the absolute value increases of the six industries targeted by the fiscal intervention.

Let us begin with “Manufacturing”. As shown in Table 6, where in column 22 is reported the total exogenous output, in column 23 its absolute increase, in column 24 the household expenditure and in column 25 its absolute increase, the most relevant share of its 59,977 hundred million yuan total demand increase is represented by the 38,991 hundred million yuan increase (65.0%) recorded by total intermediate output (see second cell of the column “Absolute increase”). If we consider the further 4940 hundred million yuan (8.2%) represented by the increase in “Household Expenditure”, making the total of the endogenous share of the total demand equal to 73.2%, we can conclude that little is left to the increases in the exogenous share of total demand. A similar and more pronounced case is observed for “Transport, Storage and Post”, with endogenous share accounting for 80.5%, and “Financial Intermediation”, with endogeus share accounting for 98.1% and practically no share for the exogenous demand. Also for “Real Estate” the endogenous share of the total demand is very high (approximately 86%), but here approximately 60% is taken by the “Household Expenditure” increase. Conversely, we observe an entirely different behaviour for “Construction”, where only 5.1% of the total increase in demand is taken by the increase in total intermediate output, and no increase is taken by “Household Expenditure”, making the exogenous share absolutely dominant (approximately 95%), confirming the uniqueness of this industry.

Regarding the supply side depicted in Table 7, the large absolute value, 42,099 hundred million yuan, of the increase in the total input of “Manufacturing”, and that of “Construction”, equal to 9507 hundred million yuan, are particularly notable when compared to the very low value (661 hundred million yuan) of total output.

Note the absolute value increases in the GVAs of “Manufacturing” and “Construction” (see again Table 7), at 10,735 and 3,050 hundred million yuan, respectively.

**Table 6.** The 6 selected industries' output by endogenous accounts and household expenditure values prior to and after the shock (100 million yuan).

Endogen accounts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total	Absol incr	32	Absol incr
Manufact	Prior shock	18416	6433	434464	6536	88822	1963	15263	8047	4488	2392	642	10087	6989	1250	3647	1409	9371	1498	4969	626686		101669	
	After shock	19373	6830	462118	6919	95402	2050	16164	8428	4712	2523	670	10554	7267	1268	3825	1433	9615	1548	4979	665677	38991	106609	4940
Construc	Prior shock	10	93	1364	268	5543	170	535	116	115	493	932	72	141	153	110	100	79	76	596	10968		0	
	After shock	10	98	1451	283	5954	178	567	122	121	520	972	75	147	156	115	102	81	79	597	11629	661	0	0
Transp, Stor and Post	Prior shock	1177	881	24500	872	5933	2081	8880	525	305	1102	212	1601	832	249	418	468	349	335	2486	53206		8621	
	After shock	1238	935	26060	923	6373	2173	9404	550	320	1162	221	1676	865	253	439	476	358	346	2491	56263	3056	9040	419
Inform, Transm, etc.	Prior shock	111	73	1842	229	2470	219	677	132	3500	1638	174	187	140	76	84	297	369	106	1395	13718		7901	
	After shock	117	77	1959	242	2653	229	717	138	3674	1728	182	196	145	78	89	302	378	109	1398	14410	692	8285	384
Financial Intermed	Prior shock	1590	1661	23493	4018	6974	3165	6888	502	1284	4321	4983	2817	1313	579	461	862	448	220	1607	67186		12846	
	After shock	1673	1763	24989	4254	7491	3305	7295	526	1348	4558	5196	2947	1365	588	483	877	459	228	1610	70954	3768	13470	624
Real Est	Prior shock	2	9	508	10	17	3284	266	322	613	3919	1351	324	163	32	945	182	175	120	504	12743		27689	
	After shock	2	9	540	10	19	3430	282	338	643	4134	1409	339	169	32	991	185	179	124	505	13339	595	29035	1345
Compens of Empl	Prior shock	63215	8256	85272	4863	29962	21822	15430	8466	6173	19569	5734	8936	7657	2353	7622	21082	12700	2823	23439	355373		0	
	After shock	66500	8765	90699	5148	32181	22790	16340	8867	6481	20641	5980	9350	7962	2387	7994	21440	13031	2917	23488	372962	17589	0	
Gross Operating Surplus	Prior shock	2455	6951	83380	8070	11210	25164	14231	2778	11691	32731	29489	6718	5068	1458	2462	3060	2131	1781	3184	254010		0	
	After shock	2582	7379	88687	8543	12040	26281	15071	2909	12274	34524	30750	7029	5270	1479	2582	3112	2186	1840	3191	267729	13719	0	

**Table 7.** The 6 selected industries input and GVA values prior to and after the shock by endogenous accounts (100 million yuan).

Endogenous accounts		Manufacturing		Construction		Transport, etc.		Information, etc.		Financial, etc.		Real Estate	
		Prior shock	After shock	Prior shock	After shock	Prior shock	After shock	Prior shock	After shock	Prior shock	After shock	Prior shock	After shock
Agriculture, Forestry, Animal Husbandry and Fishery	1	49582	52737	1379	1481	742	785	47	49	1	1	7	8
Mining	2	45242	48122	757	813	40	42	0	0	0	0	2	2
Manufacturing	3	434464	462118	88822	95402	15263	16164	4488	4712	2392	2523	642	670
Production and Supply of Electricity, Heat, Gas and Water	4	21375	22736	2331	2503	1206	1277	271	284	287	302	232	242
Construction	5	1364	1451	5543	5954	535	567	115	121	493	520	932	972
Wholesale and Retail Trades	6	32163	34210	4097	4401	1465	1552	716	752	692	730	163	170
Transport, Storage and Post	7	24500	26060	5933	6373	8880	9404	305	320	1102	1162	212	221
Hotels and Catering Services	8	3296	3505	869	933	808	855	152	160	1756	1853	160	167
Information Transmission, Software and Inf Technology	9	1842	1959	2470	2653	677	717	3500	3674	1638	1728	174	182
Financial Intermediation	10	23493	24989	6974	7491	6888	7295	1284	1348	4321	4558	4983	5196
Real Estate	11	508	540	17	19	266	282	613	643	3919	4134	1351	1409
Leasing and Business Services	12	11706	12451	1413	1518	872	923	1224	1285	5349	5643	1577	1645
Scientific Research and Technical Services	13	7007	7453	6482	6962	87	93	329	346	89	94	8	8
Manag of Water Cons, Environment and Public Facil	14	595	633	23	25	27	29	12	12	54	57	9	10
Service to Households, Repair and Other Services	15	2512	2672	804	864	1062	1124	73	77	298	314	67	70
Education	16	230	245	110	118	49	51	23	24	344	363	16	17
Health and Social Service	17	194	206	39	42	17	18	0	0	17	18	0	0
Culture, Sports and Entertainment	18	828	880	205	220	110	117	80	84	546	576	66	69
Public Management, Social Security and Social Organ	19	513	546	77	82	38	40	53	56	65	68	59	62
Total		661415	703514	128346	137853	39032	41335	13286	13948	23363	24643	10660	11116
Absolute incr (after shock figure less prior shock figure)			42099		9507		2303		662		1280		456
Compensation of Employees	20	85272	90699	29962	32181	15430	16340	6173	6481	19569	20641	5734	5980
Gross Operating Surplus	21	83380	88687	11210	12040	14231	15071	11691	12274	32731	34524	29489	30750
Total (GVA)		168652	179387	41172	44222	29661	31411	17864	18755	52300	55165	35224	36730
Absolute incr (after shock figure less prior shock figure)			10735		3050		1750		890		2865		1506
Net Taxes on Production	22	33768	35917	5455	5859	827	876	682	716	5572	5877	6477	6754

## 5 Conclusion

In this paper, we concentrated on the analysis of China's economic system and in the measurement of VAT reform effects on the system itself. We used a 19 industry 2015 SAM for China, identified the exogenous and endogenous accounts and conducted an impact multiplier analysis. The industry-level endogenous coefficients provide evidence of a considerable average degree of integration among the industries, excluding a lower interdependency between the group of industries producing goods and some types of industries producing services, meaning a weak "communicability" that likely still exists in the relationships among the state-owned enterprises. "Manufacturing" stands out among the other industries, thus confirming its key role in China's economy. In terms of GVA, there is evidence that 21% of industries is high GVA producer, divided into half labour-oriented and half capital-oriented, whereas another 21% is medium GVA producer, with no clear labour or capital orientation definition. The remaining industries are medium-low GVA producers. All these results are reaffirmed, and strengthened by the evidence from the impact multipliers, which confirms the dynamism and reactivity of "Manufacturing", and by their decomposition into three components, showing that the direct and the intergroup effects concern the industry accounts only, whereas the indirect effect relates to all the other endogenous accounts. This is the economic reality that inspired the tax reform.

Afterwards, we have discussed how the longstanding efforts at reforming China's indirect tax system concluded in 2016 represented a turning point in the country's economic and social equilibrium and have demonstrated that making the central government the sole operator of indirect taxes is a general advantage because it reduces the tax burden borne by enterprises.

To measure the effects of the exogenous shock represented by VAT cuts, we employed a model, with the government cutting the tax to different rates for a group of selected industries. The consequent total demand increases for these industries have a multifaceted impact on the economic system. First, there is evidence that the industries have an inversely proportionate positive reaction to the VAT cut through the mediation of the aforementioned total demand increase: the greater the cut, the greater the increase in industry total demand. For example, a 1.5% VAT cut generates increases in total demand in three crucial industries, *i.e.* "Manufacturing", "Construction" and "Transport, Storage and Post", in a range from approximately 6% to 7%. This is a strong response, which can be better appreciated in absolute terms: in the largest case of "Manufacturing", little less than 2000 million PPP USD, an absolutely remarkable and meaningful value, even for a large economy as big as that of China. A 1% VAT cut prompts a little smaller response from the "Information, Transmission, Software, etc." and "Financial Intermediation" industries: approximately 5.0% and 5.5%, respectively. A 0.5% VAT cut yields an increase in total demand for "Real Estate" industry of more than 4%.

Overall, there is evidence of a strong average response by the whole economic system (nearly 4%) to an average VAT cut of 1.2% for 6 industries. An analogous strong positive reaction is observed for



GVA, whose labour and capital components respond on average by more than 5%, as well as by private consumption and institutions' income, for which the rates of increase are only slightly lower.

Considering the increases in absolute values for the 6 industries targeted by the exogenous shock reveals that over two-thirds of the total demand increase is due to endogenous increases, with the most relevant share taken by total intermediate output, except for the "Real Estate" industry, which exhibits a much higher share taken by final expenditure. The case of "Construction" is very peculiar, as there is evidence of an increase almost entirely due to exogenous factors.

To conclude and summarize, the picture that emerges from our analysis is that of a highly integrated economic system, in which the manufacturing sector plays a crucial role. This system is highly reactive to exogenous shocks represented by VAT cuts, meaning that the tax lever represents a powerful tool for the government to make economic policy.

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## Conflict of interest

The authors declare no conflict of interest in this paper.

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