

Residents' income distribution effect of business tax replaced with VAT reform—based on CGE model

Changan Chen, Zhifang Su & Wenjun Shuai

To cite this article: Changan Chen, Zhifang Su & Wenjun Shuai (2022) Residents' income distribution effect of business tax replaced with VAT reform—based on CGE model, Economic Research-Ekonomiska Istraživanja, 35:1, 2793-2808, DOI: [10.1080/1331677X.2021.1980732](https://doi.org/10.1080/1331677X.2021.1980732)

To link to this article: <https://doi.org/10.1080/1331677X.2021.1980732>



© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 25 Sep 2021.



Submit your article to this journal [↗](#)



Article views: 741



View related articles [↗](#)



View Crossmark data [↗](#)

Residents' income distribution effect of business tax replaced with VAT reform—based on CGE model

Changan Chen^a, Zhifang Su^a and Wenjun Shuai^b

^aSchool of Economics and Finance, Huaqiao University, Quanzhou, China; ^bSchool of Economics and Management, Fuzhou University, Fuzhou, China

ABSTRACT

Using the 2012 input-output table of China, this study constructs a computable general equilibrium model by embedding the value-added tax (VAT) deduction mechanism into the price model and analyses the effect of replacing the business tax with the VAT reform on residents' income distribution. The study shows that the VAT reform is generally conducive to residents' income distribution. Specifically, the VAT reform decreases the indirect tax burden of residents, increases their real income, and narrows down the relative income gap between urban and rural residents. From the perspective of differences between the before- and after-tax Gini coefficients (the MT index), both the pilot VAT reform and VAT reform improve the residents' income distribution. The VAT reform also improves the welfare of households.

ARTICLE HISTORY

Received 16 May 2021

Accepted 9 September 2021

KEYWORDS

Business tax replaced with VAT reform; income distribution; the CGE model

JEL CODES

D58; H22; H25

1. Introduction

Replacement of business tax with the value-added tax (VAT), the VAT reform for short, has been hailed as a concrete step towards deepening China's taxation sector reforms and an important governmental decision on structural tax reduction in the New Era. Since the tax-sharing system reform in China, the country follows both the business tax and VAT models. However, after China's economic development, the drawbacks of adopting both the models are becoming increasingly prominent, like the country's double taxation, VAT deductible chain interruption, and so on. Therefore, in order to reduce the tax burdens of all industries, China implemented the VAT reform, first launching the pilot VAT enlargement reform in Shanghai on 1 January 2012 in the transportation and some selected modern service industries, and then extending it to other regions and industries in 2013. By May 2016, the VAT reform was extended to all sectors, slashing the tax burden of businesses significantly.

According to the State Administration of Taxation, the VAT reform reduced the accumulated tax burden of businesses by over 2 trillion yuan from 2012 to 2017.¹

CONTACT Changan Chen  comeccn@126.com

© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The tax reform reduced the tax burden of enterprises and also significantly impacted the residents' income distribution (Ni et al., 2016). Therefore, under the current political and economic environment, how has the VAT reform affected the residents' indirect tax burden and income distribution in China? VAT is regressive and business tax is progressive in China (Nie & Liu, 2010), has the VAT reform improved or worsened the residents' income distribution? Studies in the literature have so far found little evidence to answer this question. In this paper, we try to answer the above question and attempt to provide valuable theories and recommendations for deepening the tax reforms in the New Era.

Using the 2012 input-output table of China, we construct a computable general equilibrium (CGE) model by introducing a VAT deduction mechanism and try to analyse the income distribution effects of the VAT reform. On the whole, this study mainly contributes on the following two points. First, at the theoretical level, we improve the VAT reform CGE model setup proposed by Tian and Hu (2014) and Ge et al. (2015). We divide the fixed assets into tangible movable property and real property for setting up the VAT reform CGE model, making the model more practical with the VAT reform and the policy evaluation results more accurate. Second, at the practical level, the extant studies were made from the perspective of the '1 + 6' pilot VAT reform or considered the influence of the VAT reform on urban residents' consumption, but we construct the VAT reform CGE model using seven urban and five rural household groups and set up two types of policy scenarios, namely the pilot and comprehensive VAT reforms, based on the VAT reform's industry-by-industry pilot characteristics. Besides, considering the aspects of tax burden, residents' income, the MT index, and household welfare, we comprehensively examine the impact of the VAT reform on residents' income distribution.

The remainder of this paper is organized as follows. Section 2 presents a literature review. In Sec. 3, we adopt the taxation principle of VAT and embed the VAT deduction mechanism into the price model, construct a CGE model, and explain the measurement methods and data. Section 4 presents the VAT reform policy simulation results and analyses the influence of the VAT reform on residents' income distribution. The final section concludes the paper, offering some important implications.

2. Literature review

While a few studies in the literature have examined the income redistribution effects of the VAT reform, the current studies mainly focus on the impact of the VAT reform on the indirect tax burden of urban residents from the perspective of consumption. Ni et al. (2016) introduced the VAT deduction mechanism to the input-output price model for calculating the tax burden, set up different scenarios of VAT reform and tax collection capabilities, analysed the price effect of VAT reform using simulation, and then combined the Chinese urban residents' consumption and expenditure grouping data with the China Family Panel Studies (CFPS) data. They also analysed the impact of the VAT reform on the indirect tax burden and income redistribution of urban residents. The study found that the tax burden as well as tax-bearing rate declined in all income groups, indicating that the VAT reform slightly

improved the income distribution of urban residents. Du (2015) used micro-simulation methods to simulate the impact of the pilot VAT reform on the income redistribution of urban residents, to find that the VAT reform reduced the internal equality and improved the income distribution of low-income residents by reducing their average tax burden. The micro-simulation method transferred the tax burden to the micro-family through tax on assumption and thus enabled a more specific analysis of the tax policies and more wide use of the policies in an actual tax incidence analysis. However, as the micro-simulation method seldom considers the impact of tax burden changes on household consumption, this could result in a policy evaluation bias. Yang and Guo (2017) built a VAT deduction model with focus on practical administration and combined the input-output table to measure the indirect tax burden of each product before and after the VAT reform. They used grouped data taken from urban household surveys and the micro-simulation method to analyse the impact of the VAT reform on residents' indirect tax burden and income redistribution and their mechanism. They also used the extended linear expenditure system (ELES) to estimate the impact of the VAT reform on household consumption, to find that the average indirect tax burden of all the income groups in urban areas reduced after the VAT reform and improved in income redistribution as the tax burden declined more for the low- than high-income families. Ge et al. (2015) and Wang (2016) used the CGE model for research. Ge et al. (2015) combined the standard CGE model with the calculation method for the output tax-input tax VAT payable, to construct the VAT reform CGE model. They studied the VAT reform from the dual perspective of income and consumption, to find that it increased the income of all residents in urban and rural areas and narrowed down the income gap between the urban and rural residents. Wang (2016) constructed a CGE model based on the general equilibrium theory of indirect tax incidence, decomposed the income distribution indicators such as Gini coefficient and MT index using the method applied for decomposing the income distribution effects, and examined the VAT reform impact on the relative change in residents' income. He found that while all the Gini coefficients of the country in both the urban and rural areas decreased, the residents' income distribution improved after the VAT reform.

Some scholars used the DID model to study the impact of the VAT reform on residents' income share and equity (Liu & Luo, 2019; Su et al., 2021). Su et al. (2021) carried out empirical analysis using the DID model and the micro data of listed companies for the period 2009–2015. They showed that the VAT reform led to a significant 5.96% increase in labour share, which reached the maximum level in the second year after reform implementation. A further impact mechanism analysis showed that the VAT reform improved the enterprises' investment in fixed assets as complementary relationship between capital and labour and thus increased the labour demand and average wage rate and consequently the labour share. Liu and Luo (2019) used the PSM-DID model with 96 samples covering 24 provinces from 2010 to 2013 for a regression study. They found that the VAT reform exacerbated the degree of income inequality in the pilot areas. Some scholars examined the factors influencing residents' income inequality from the perspective of basic public services (Liu & He, 2019), minimum wage regulation (Zhan et al., 2020), education and innovation

(Akram et al., 2020; Gil-Alana et al., 2020; Veselinović et al., 2020), and entrepreneurship (Lecuna, 2020).

In general, studies in the literature show two aspects of deficiencies. Existing studies mainly used input-output price models (Ni et al., 2016) and micro-simulation methods (Du, 2015; Yang & Guo, 2017) for their empirical analysis. These methods examine the impact of only a single mechanism. The literature considering the above two methods study the impact of the VAT reform from the perspective of only consumption. However, the VAT reform can affect the income distribution of residents through multiple mechanisms, such as by changing the relative prices of goods and services affecting the household consumption expenditure and the relative remuneration of labour and capital affecting household income. It can also adjust the household income comprehensively from the points of both household consumption and income. Therefore, the relative research limitation is obvious. Furthermore, studies using the CGE model can quantify the cross influence and comprehensive impact of various important macro-economic variables and examine the impact of multiple mechanisms at the same time. A few studies in the literature (Ge et al., 2015; Wang, 2016) adopting the CGE model to study the impact of the VAT reform on consumption and residents' income reveal the following three shortcomings. First, VAT is regarded as a tax on added value and defined as the effective tax rate multiplied by the added value. This is inconsistent with the VAT deduction practice in China and therefore cannot accurately capture the variation in progress of the VAT reform. Second, as only the pilot VAT reform is simulated, the situation after the VAT reform is not taken into consideration. Third, when setting the capital input tax in the CGE model, no distinction is made between the different types of fixed assets, and the input tax rate is uniformly deducted at 17%. However, during the pilot VAT reform, the tax on fixed assets belonging to tangible movable property (the statutory tax rate is 17%) can be deducted from the input tax, whereas the real property tax cannot be deducted. Following the VAT reform, if the real property or real property construction in progress is obtained in the current period and taken as fixed assets in accounting, the input tax can be deducted under the statutory tax rate of 11%. Therefore, it would be difficult to fully assess the effect of the VAT reform under a constant capital input tax rate.

3. Specification of the VAT CGE model

3.1. Standard CGE model

Gross outputs are defined using two levels of nested production functions in the standard CGE model. In the first level, the production technology is specified as a constant elasticity of substitution (CES) function of value added, public capital, and aggregate intermediate input. The manufacturer makes production decisions focusing on maximization of profits or minimization of costs. The production function, first-order optimal condition, and price equation are defined as follows:

$$QA_a = \alpha_a^A \left[\delta_a^A QVA_a^{\rho_a^A} + (1 - \delta_a^A) QINTA_a^{\rho_a^A} \right]^{\frac{1}{\rho_a^A}} \quad a \in A \quad (1)$$

$$\frac{PVA_a}{PINTA_a} = \frac{\delta_a^A}{(1 - \delta_a^A)} \left(\frac{QINTA_a}{QVA_a} \right)^{1 - \rho_a^A} \tag{2}$$

$$PA_a \cdot QA_a = (1 + tbus_a)(PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a) \tag{3}$$

Here, subscript *a* denotes the production activities of each department; the complete set of *a* is A. QA, QVA, and QINTA denote the quantity of output, added value, and intermediate inputs of production activities, respectively. PA, PVA and, PINTA stand for the price of production activities, aggregate price of added value, and total price of intermediate inputs, respectively. α_a^A , δ_a^A , and *tbus_a* represent the scale parameter, share parameter, and business tax rate, respectively.

In the second level, value added is specified using a CES function of labour and private capital. QVA can be defined as the supply equation of the factor market; its production function, first-order optimal condition, and price equation are defined as follows:

$$QVA_a = \alpha_a^{va} [\delta_{La}^{va} QLD_a^{\rho_a^{va}} + (1 - \delta_{La}^{va}) QKD_a^{\rho_a^{va}}]^{\frac{1}{\rho_a^{va}}} \tag{4}$$

$$\frac{WL \cdot (1 + tval)}{WK \cdot (1 + tvak)} = \frac{\delta_{La}^{va}}{(1 - \delta_{La}^{va})} \left(\frac{QKD_a}{QLD_a} \right)^{1 - \rho_a^{va}} \tag{5}$$

$$PVA_a \cdot QVA_a = (1 + tval) \cdot WL \cdot QLD_a + (1 + tvak) \cdot WK \cdot QKD_a \tag{6}$$

Here, QLD and QKD denote the demand for labour and capital in different industries, respectively; WL and WK denote the prices of labour and capital, respectively; α_a^{va} is the scale parameter; δ_{La}^{va} is the share parameter; and *tval* and *tvak* represent the labour and capital VAT rates, respectively.

Intermediate inputs are combined using a Leontief function to produce an aggregate intermediate input. In an open economy, intermediate inputs include the aggregated domestic supply of domestically produced goods and imported goods, that is QQ, whose price is PQ. The complete set of commodities QQ is C; this includes imported commodities but excludes export commodities. The function is defined as follows:

$$QINT_{ca} = ica_{ca} \cdot QINTA_a \quad a \in A, c \in C \tag{7}$$

$$PINTA_a = \sum_{c \in C} ica_{ca} \cdot PQ_c \tag{8}$$

Here, *ica* is the input-output coefficient of the intermediate input, that is the number of products of sector *c* used to produce one unit of the intermediate input of sector *a*. The above eight equations comprise the standard CGE model production module.

3.2. The VAT reform CGE model

In the above standard CGE model, VAT can be treated as levies imposed on value added goods, that is elements of levies imposed on labour and capital. This is not consistent with the current VAT system in China. In tax practices, we impose VAT by product sales and the touch buckle income tax contained in intermediate products and capital, that is ‘VAT payable = output tax – input tax’. Therefore, if we directly multiply VAT by the VAT rate, the simulation results may be biased when analysing the tax reform, especially the VAT reform. To analyse the social and economic effects of the VAT reform in a scientific and reasonable manner, this VAT deduction mechanism must be added to the model to better describe the change in VAT reform mechanism and accurately and objectively describe the influence of the VAT reform. Considering the methods used by Wang and Fan (2012), Tian and Hu (2014), and Ge et al. (2015), we further introduce the VAT deduction mechanism into the input-output price equation and embed it into the production module of the standard CGE model. The specific definition is as follows:

$$VAT = \text{output tax} - \text{intermediate input tax} - \text{fixed asset input tax} \quad (9)$$

$$\text{output tax} = PA_a \cdot (QA_a - \text{stock}_a) \frac{tvad_a}{1 + tvad_a} \quad (10)$$

$$\text{intermediate input tax} = \sum_{ccC} ica_{ca} \cdot PQ_c \cdot QINTA_a \cdot \frac{tvad_c}{1 + tvad_c} \quad (11)$$

$$\text{fixed asset input tax} = tvak_a \cdot WK \cdot QKD_a \quad (12)$$

Here, stock_a denotes the increase in inventory, $tvad_a$ denotes the statutory output VAT rate of each commodity’s sales department, and $tvak_a$ denotes the tax deduction rate of fixed assets. Following the methods used by Tian and Hu (2014), Ge et al. (2015), and Yang and Guo (2017), we divide the VAT input tax into two parts, the intermediate input tax and fixed asset input tax. Here, the fixed asset input tax can be further divided into tangible movable property input tax and real property input tax based on the fixed assets’ properties. Prior to the VAT reform and during the pilot 1 + 6 industry VAT reform, only the fixed assets acquired as tangible movable property could be deducted for input tax, and the real property could not be deducted. However, after the VAT reform, the input tax on real estate and real estate construction in progress obtained during the current period and calculated as fixed assets in the accounting system can be deducted for two years: 60% in the first year and the remaining 40% in the second year. According to Yang and Guo (2017), we can assume that 50% is deducted each year.

Thus, prior to the VAT reform and during the pilot 1 + 6 industry VAT reform, $tvak_a = \frac{17\%}{1+17\%}$ multiplies by the proportion of new tangible movable property investment in total capital. After the VAT reform, $tvak_a = \frac{17\%}{1+17\%}$ multiplies by the new tangible movable property investment as a proportion of total capital and $\frac{11\%}{1+11\%} \times 50\%$ multiplies by the proportion of the new real estate investment in total capital.

By combining the above formulas, we obtain formula (13):

$$\begin{aligned} \text{value-added tax} = & PA_a \cdot (QA_a - \text{stock}_a) \frac{tvad_a}{1 + tvad_a} - \sum_{c \in C} ica_{ca} \cdot PQ_c \cdot QINTA_a \\ & \cdot \frac{tvad_c}{1 + tvad_c} - tvak_a \cdot WK \cdot QKD_a \end{aligned} \quad (13)$$

In fact, the preferential tax policies and tax collection efficiency of the industries are different. The theoretical VAT payable calculated by formula (13) often differs from the actual VAT. Therefore, in this paper, we introduce a tax levy rate to adjust: tax levy rate = actual tax levy/theoretical tax payable. For the tax levy rate, we make the following assumptions. First, in the original VAT department, the tax levy and management system is relatively complete and the tax levy and management efficiency is relatively stable. We assume that the tax levy rate of the original VAT paying department remains unchanged before and after the VAT reform.² Second, for the VAT paying industries newly added during the pilot VAT reform, the preferential tax policies enjoyed do not change much, and so we assume that the newly added VAT industries remain unchanged before and after the VAT reform.

The levy rate of the original VAT department can be denoted as follows:

$$\begin{aligned} Leiv_a = & VAT_a / [PA_a \cdot (QA_a - \text{stock}_a) \frac{tvad_a}{1 + tvad_a} - \sum_{c \in C1} ica_{ca} \cdot PQ_c \cdot QINTA_a \\ & \cdot \frac{tvad_c}{1 + tvad_c} - tvak_a \cdot WK \cdot QKD_a], a \in A_1, c \in C_1 \end{aligned} \quad (14)$$

For the newly added VAT department, the levy rate during the pilot VAT reform period is expressed as formula (15):

$$Leiv_a = BUST_a / [PA_a \cdot (QA_a - \text{stock}_a) \cdot tb_a] a \in A_2 \quad (15)$$

Here, A1 and C1 denote the production and commodity collections of the original VAT industry, respectively; A2 and C2 denote the production and commodity collections of the VAT reform, respectively; tb_a is the legal tax rate of business tax; VAT_a is the actual VAT paid by the original VAT industry; and $BUST_a$ is the actual business tax paid by the VAT reform industry.

In the standard CGE model production module, the input-output equation includes the VAT deduction mechanism, the levy rate, and other production taxes. Now, formula (3) can be rewritten as follows:

$$\begin{aligned} \text{sales income} = & \text{intermediate input} + \text{value added} + \text{VAT} + \text{business tax} \\ & + \text{other production taxes} \end{aligned} \quad (16)$$

$$\begin{aligned} \text{sales income} - & \text{value-added output tax} - \text{business tax} - \text{other production tax} \\ = & \text{intermediate input} - \text{intermediate input tax} + \text{value added} - \text{fixed asset input tax} \end{aligned} \quad (17)$$

Furthermore, the ‘intermediate input-intermediate input tax’ is internalized into the intermediate input price PINTA, with the ‘value added-fixed asset input tax’ internalized into the value-added summary price PVA, to obtain the CGE model of the VAT reform production module. This design enables the CGE model to accurately measure the VAT payable and characterize the changes in industry input tax before and after the VAT reform and also reflect the substitution relationship between the intermediate and element inputs. Therefore, formula (3) can again be rewritten as follows:

$$PA_a \cdot \left[QA_a - (QA_a - stock_a) \frac{tvad_a}{1 + tvad_a} Leiv_a \right] \cdot (1 - tiq_a - tbus_a) \tag{18}$$

$$= PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$$

The input tax of intermediate inputs is internalized into PINTA. From the different assumptions of the tax levy rate, we can define the PINTA expression (19) as follows:

$$PINTA_a = \sum_{c \in C} ica_{ca} \cdot PQ_c - \sum_{c \in C1} ica_{ca} \cdot PQ_c \frac{tvad_c}{1 + tvad_c} \cdot Leiv_a \cdot tt_a \tag{19}$$

Here, tt_a denotes the policy variable. If the department is a VAT payment department, $tt_a = 1$, otherwise it is 0. From the above analysis, the input tax of fixed assets can be reflected by the capital price. Therefore, the input tax of fixed assets is internalized into the PVA, to result in formulas (20) and (21) as follows:

$$WK' = (1 - Leiv_a \cdot tvak_a) \cdot WK \tag{20}$$

$$PVA_a \cdot QVA_a = WL \cdot QLD_a + (1 - Leiv_a \cdot tvak_a) \cdot WK \cdot QKD_a \tag{21}$$

Correspondingly, formula (5) can be rewritten as

$$\frac{WL}{WK \cdot (1 - Leiv_a \cdot tvak_a)} = \frac{\delta_{La}^{va}}{(1 - \delta_{La}^{va})} \left(\frac{QKD_a}{QLD_a} \right)^{1 - \rho_a^{va}} \tag{22}$$

In this paper, formulas (1, 2, 4, 7, 18, 19, 21), and (22) comprise the VAT reform CGE model’s production module. The VAT reform CGE model’s characteristics are mainly reflected in the following three aspects. First, all products that originally levied business tax are changed to levy VAT, the business tax rate is adjusted to $tvad_a=0$, and the output tax rate $tvad_a$ is calculated by the pilot tax rate. These changes are reflected in formula (18). Second, when the VAT reform sectors are used as intermediate input sectors, the input tax can be deducted. This feature is reflected in formula (20). Third, the VAT reform expanded the scope of deduction for new capital investment. This is reflected in formulas (21) and (22).

Other modules mainly refer to the standard CGE model. See Chang (2017) for more information.

3.3. Social accounting matrix

Fan et al. (2010) explain the preparation of China's macro social accounting matrix (SAM) in detail. We follow them in preparing China's 2012 SAM. Most of the data for this study are obtained from China input-output table (2012), while the data on imports and exports, savings, and government transfer payments are obtained from the China Statistical Yearbook (2013), the data on intersectional transfer payments and tariffs are obtained from the Flow of Funds Table (2013) and China Fiscal Yearbook (2013), and the data on VAT and business tax are obtained from the China Tax Yearbook (2013). A part of the foreign account data comes from the Balance of Payments (2013); it is converted at the average annual exchange rate. We further subdivide the accounts of production, goods, residents, and indirect taxes from the macro SAM. We divide the production and commodity markets into 42 sectors as follows: 1 agricultural sector, 27 industrial sectors, and 14 service sectors. Residents are divided into urban and rural groups. Then, from the household survey data of the National Bureau of Statistics, we divide the urban residents into seven groups and rural residents into five groups based on their income. While the urban residents are divided into the lowest-income (10%), low-income (10%), lower-middle-income (20%), middle-income (20%), upper-middle-income (20%), high-income (10%), and highest-income (10%) household groups, rural residents are divided into low-income (20%), low-middle-income (20%), middle-income (20%), middle-high-income (20%) and high-income (20%) household groups. The data of residents' income and expenditure are taken from household surveys of the National Bureau of Statistics. The data of rural residents come from the Chinese Household Survey Yearbook (2013), while the data of urban residents are taken from the China Urban (Town) Life and Prices Yearbook (2012).

3.4. Parameter selection

In addition to taking the data for the CGE model directly from the SAM table, we obtain the share and scale parameters for the model through calibration of the SAM table and other parameters, such as the elasticity parameters, from external data material. The elasticity parameters include the substitution elasticity of value-added and intermediate inputs, labour and capital, and domestic goods and export goods. These substitution elasticity parameters are mainly obtained from Zheng and Fan (1999), Zhao and Wang (2008), and Zhai and Hertel (2005). Using these elasticity parameters and the micro SAM table, we can calibrate the scale and share parameters. The fixed assets investment data in each sector in 2012 are obtained from the Statistical Yearbook of Fixed Asset Investment in China (2013), where 'equipment purchase' represents the new tangible investment of each sector and 'construction and installation engineering' represents the new real estate investment of each sector.

4. Vat reform effect on residents' income distribution: an analysis

In this study, we investigate the effect of the VAT reform on residents' income distribution by setting up two policy scenarios, one during the pilot VAT reform and the other after the comprehensive VAT reform, as follows:

Period 1: The pilot VAT reform is implemented in the 1 + 6 industries, that is the transport industry (excluding railway transport) and some selected modern service industries, specifically road transport, waterway transport, air transport, pipeline transport, R&D and technical services, information technology services, cultural and creative services, auxiliary logistics services, tangible personal property rental services, and visa consultancy services. During this period, the policy shock came as statutory replacement of business tax with VAT in the abovementioned 1 + 6 pilot industries.

Period 2: The comprehensive VAT reform is implemented in all industries. After the pilot VAT reform in the 1 + 6 industries, the reform was implemented in 2013 and 2016 in all industries, including the radio, film and television, railway transport industries and the postal, telecommunication, financial, construction, real estate, and other modern services (consumer-oriented services). During this period, a policy shock occurred as replacement of business tax with VAT at the statutory rates in all industries.

4.1. *Vat reform effect on residents' indirect tax burden*

A tax burden is the decrease in households' real purchasing power due to taxation. This is usually quantified as the amount of tax paid in consumers' total expenditures. It is essentially a problem of income distribution. In this study, we first simulate the price and effective indirect tax rate of goods (services) in all sectors after the VAT reform, and then compare the consumer goods (services) tax rate before and after the VAT reform. The effective tax rate of each sector is defined as $\tau_c = (PQ_c^1 - PQ_c^0)/PQ_c^0$, where PQ_c^0 is the price of goods (services) with no VAT or business tax (the VAT and business tax rates are zero), and PQ_c^1 is the base or post-shock equilibrium price of goods (services). The expenditures of all income groups are then multiplied by their corresponding effective tax rates, to obtain the tax burden of each group.

Table 1 shows the VAT reform effect on residents' indirect tax burden. From the table, the indirect tax burden during the pilot VAT reform period decreased by 0.59% for all residents, 0.60% for urban residents, and 0.53% for rural residents. The

Table 1. VAT reform effect on residents' indirect tax burden.

Groups	Before VAT reform (1)	Pilot VAT reform (2)	Comprehensive VAT reform (3)	(2)–(1)	(3)–(1)
hhr1	6.46%	5.94%	4.27%	–0.52%	–2.19%
hhr2	6.50%	5.98%	4.29%	–0.52%	–2.22%
hhr3	6.63%	6.10%	4.35%	–0.53%	–2.28%
hhr4	6.73%	6.20%	4.39%	–0.53%	–2.34%
hhr5	6.86%	6.30%	4.46%	–0.56%	–2.40%
hhu1	7.09%	6.57%	4.31%	–0.52%	–2.77%
hhu2	7.15%	6.59%	4.41%	–0.55%	–2.74%
hhu3	7.18%	6.61%	4.46%	–0.57%	–2.72%
hhu4	7.24%	6.64%	4.51%	–0.60%	–2.73%
hhu5	7.34%	6.73%	4.57%	–0.61%	–2.78%
hhu6	7.41%	6.78%	4.60%	–0.63%	–2.81%
hhu7	7.57%	6.93%	4.65%	–0.64%	–2.92%
Rural	6.67%	6.14%	4.37%	–0.53%	–2.30%
Urban	7.33%	6.73%	4.54%	–0.60%	–2.79%
National	7.18%	6.59%	4.50%	–0.59%	–2.68%

Source: Author's calculations.

indirect tax burden after the VAT reform decreased by 2.68% for all residents, 2.79% for urban residents, and 2.30% for rural residents. (1) After the VAT reform, the tax burden decreased to a certain extent for both the urban and rural residents. (2) The indirect tax burden decreased to a larger extent for the urban than rural residents. This is probably due to China's unique urban–rural structure, where urban residents incur larger expenditures on services compared to rural residents, who incur larger expenditures on necessities. Following the VAT reform, the prices of most services decreased to a larger extent than did the prices of necessities (Ni et al., 2016). Therefore, with their tax burden decreasing to a larger extent, urban residents gained relatively more from the VAT reform. (3) The indirect tax burden of the higher income groups decreased to a relatively larger extent. This means that higher income households gained more from the VAT reform.

4.2. *Vat reform effect on residents' income*

The effect of the VAT reform on residents' income is shown in Table 2. The table shows a considerable difference between the pilot and comprehensive VAT reform periods. In Period 1, the income increased by 0.02% for rural residents, 0.28% for low-income rural residents, and 0.06% for low- and middle-income rural residents. In contrast, the income decreased by 0.43% for urban residents, 0.38% for urban residents with the highest income, and 0.43%–0.45% for all other urban residents. In Period 2, however, the income increased by 0.87% for all residents, 1.72% for rural residents, and 0.67% for urban residents. The relative income gap within groups showed a downward trend as the income of each group improved. The structural tax reduction due to the VAT reform directly improved the economic performance of enterprises and promoted the wage growth of employees, thereby contributing to residents' income growth.

From the above analyses, we can conclude that (1) the VAT reform improved residents' income—the residents' income showed greater improvement after the VAT reform than during the pilot VAT reform—and (2) the VAT reform narrowed down the income gaps within the urban and rural resident groups. As the income of each

Table 2. VAT reform effect on residents' income.

Pilot VAT reform		Comprehensive VAT reform	
Groups	Income change	Groups	Income change
hhr1	0.28%	hhr1	2.37%
hhr2	0.06%	hhr2	1.88%
hhr3	−0.01%	hhr3	1.73%
hhr4	−0.05%	hhr4	1.62%
hhr5	0.01%	hhr5	1.61%
hhu1	−0.44%	hhu1	0.71%
hhu2	−0.45%	hhu2	0.70%
hhu3	−0.45%	hhu3	0.69%
hhu4	−0.45%	hhu4	0.66%
hhu5	−0.44%	hhu5	0.65%
hhu6	−0.43%	hhu6	0.65%
hhu7	−0.38%	hhu7	0.67%
Rural	0.02%	Rural	1.72%
Urban	−0.43%	Urban	0.67%
National	−0.34%	National	0.87%

Source: Author's calculations.

group improved, the relative income gaps within the urban and rural resident groups showed a downward trend after the VAT reform. Specifically, the income gap between the lowest- and highest-income rural households reduced by 0.76%, whereas the corresponding gap for urban households reduced by only 0.04%. Therefore, the VAT reform narrowed down the income gap by a larger extent for the rural than urban residents.

4.3. *Vat reform effect on residents' income distribution*

This paper uses the Musgrave and Thin (MT) index (Musgrave & Thin, 1948) to measure the VAT reform effect on residents' income distribution. Defined as $MT = G_x - G_y$, the MT index is widely used to estimate the income distribution effect of taxation, and indicates the difference between the before-tax and after-tax Gini coefficients. $MT > 0$ implies a positive taxation effect on narrowing the income gaps and promoting income equity, while $MT < 0$ implies the opposite. Kakwani (1984) further decomposed the MT index into horizontal equity (HE) and vertical equity (VE), and proposed the equation $MT = (C_y - G_y) + Kt/(1 - t)$. Here, C_y is the concentration index for after-tax income ranked by the before-tax income. Therefore, $C_y - G_y$ indicates the taxpayer's income ranking variation after taxation and measures the HE. t is the average tax rate,³ $K = C_T - G_x$ is the difference between the concentration index of tax payable C_T and the Gini coefficient for before-tax income G_x and reflects tax progressivity. The partial derivative of VE with respect to t is $\partial VE/\partial t = Kt/(1 - t)^2$, implying that a progressive tax ($K > 0$) worsens income equity because the tax is not horizontally equitable in this case and VE would decrease with the decrease in the average tax rate t ($\partial VE/\partial t > 0$). A regressive tax ($K < 0$), on the contrary, improves income equity because the tax is horizontally equitable in this case and VE would increase with the decrease in the average tax rate t ($\partial VE/\partial t < 0$). The various index measures on the income distribution effect of the VAT reform are shown in Table 3.

From Table 3, the VAT reform generally improves the income distribution of residents. (1) The MT index was -0.001437 before the VAT reform, -0.001345 during

Table 3. VAR reform effect on residents' income distribution.

Groups	Indicators	Before VAT reform	Pilot VAT reform	Comprehensive VAT reform
Rural	MT index	-0.003703	-0.003402	-0.002444
	HE	0	0	0
	VE	-0.003703	-0.003402	-0.002444
	K	-0.077152	-0.077318	-0.078998
	t	0.045803	0.042144	0.030007
Urban	MT index	-0.001157	-0.001093	-0.000711
	HE	0	0	0
	VE	-0.001157	-0.001093	-0.000711
	K	-0.026575	-0.027452	-0.026816
	t	0.041737	0.038296	0.025845
National	MT index	-0.001437	-0.001345	-0.001011
	HE	0	0	0
	VE	-0.001437	-0.001345	-0.001011
	K	-0.032357	-0.033081	-0.036914
	t	0.042536	0.039055	0.026669

Source: Author's calculations.

the pilot VAT reform, and 0.001011 after the VAT reform. The MT index improved during the pilot VAT reform and after the VAT reform, implying a positive VAT reform effect on residents' income distribution. (2) The MT index is larger after the VAT reform than during the pilot VAT reform period, implying that the comprehensive VAT reform leads to larger improvement in residents' income distribution. (3) The decomposition of MT index reveals a zero HE component, implying that the income distribution effect of the VAT reform is solely VE. (4) K is -0.0324 before the VAT reform, -0.0331 during the pilot VAT reform, and -0.0331 after the VAT reform, implying that business tax and VAT are both regressive before and after the VAT reform, and that regressivity is enhanced after the VAT reform. However, the VAT reform significantly reduced the average tax rate: the national average tax rate was 4.25% before the VAT reform, and it reduced to 3.91% and 2.67% respectively during the pilot and comprehensive VAT reform periods. The reduced average tax rate following the VAT reform offset the negative influence of enhanced indirect tax regressivity on residents' income redistribution, with the former showing a greater influence. Therefore, the VAT reform generally improved residents' income redistribution.

4.4. *Vat reform effect on residents' welfare*

From the above analyses, the VAT reform influenced residents' welfare mainly in the following three ways. First, it influenced residents' consumption level by changing the prices of goods (services). Second, it changed the prices of intermediate and factor inputs to optimize the enterprises' factor structure and thereby influenced residents' income through factor distribution. Third, in a CGE model, the VAT reform changed the transfer payment of government to residents and thereby influenced residents' income.

Table 4 shows the residents' welfare from the VAT reform. It generally improved residents' welfare from the perspective of equivalent variation (EV). (1) At the

Table 4. VAT reform effect on residents' welfare.

Pilot VAT reform Groups	EV	CV	Comprehensive VAT reform		
			Groups	EV	CV
hhr1	54.77	54.32	hhr1	315.57	306.18
hhr2	45.67	45.29	hhr2	322.24	312.65
hhr3	47.55	47.16	hhr3	360.02	349.31
hhr4	51.28	50.86	hhr4	413.23	400.94
hhr5	78.02	77.38	hhr5	546.02	529.78
hhu1	8.20	8.12	hhu1	279.43	271.44
hhu2	12.90	12.78	hhu2	348.22	338.27
hhu3	36.04	35.71	hhu3	822.54	799.04
hhu4	50.37	49.90	hhu4	983.24	955.14
hhu5	70.81	70.15	hhu5	1229.13	1194.01
hhu6	51.00	50.53	hhu6	790.23	767.65
hhu7	97.01	96.11	hhu7	1205.13	1170.69
Rural	55.46	55.00	Rural	391.41	379.77
Urban	48.35	47.91	Urban	869.28	844.44
National	51.72	51.27	National	642.63	624.05

Source: Author's calculations.

national level, the residents' welfare increased by 51.72 during the pilot VAT reform and by 642.63 after the VAT reform. This shows a relatively smaller improvement from the former on residents' welfare. (2) The rural residents' welfare increased by 55.46 and 391.41 and urban residents' welfare increased by 48.35 and 642.63 during the pilot and comprehensive VAT Reform periods, respectively. This implies a larger improvement in rural residents' welfare during the pilot VAT reform and larger improvement in urban residents' welfare after the VAT reform. (3) For both urban and rural residents, the change in EV following the VAT reform is larger for the high- than low-income groups, implying a larger improvement in the high- rather than low-income groups' welfare after the VAT reform.

4.5. Robustness test

For a robustness test, we need factors rather than elastic parameters, which often need to be obtained through external data. Tables 1 and 4 use the substitution elasticity of each industry obtained from Zheng and Fan (1999), Zhao and Wang (2008), and Zhai and Hertel (2005). If the substitution elasticity is different, will it seriously affect the previous simulation results and conclusions? We use different elasticity values to test the robustness of our results. From the literature (Zhao & Wang, 2008), the factor substitution elasticity of China's secondary industry's value-added production function is about 0.5–1.5. From a simulation of the second scenario of the VAT reform, we set the factor substitution elasticity of the value added production function of the secondary industry to 0.8, 1.1, and 1.3, respectively, to simulate the changes in impact results following the exogenous parameter changes. From the results, the change in exogenous parameters has little effect on the original CGE model, with most of the variables changing in the same direction, indicating better stability of the VAT reform CGE model.

5. Conclusions

Using the 2012 input-output table of China, this paper embeds the VAT deduction mechanism into the price model and constructs a CGE model to simulate indexes such as residents' income change, tax burden change, MT index, HE, VE, tax progressivity K, average tax rate, equivalent variation, and compensating variation in residents' welfare, and analyse the residents' income distribution effect of replacing business tax with the VAT reform. We find the VAT reform generally conducive to residents' income distribution.

First, the VAT reform reduced the indirect tax burden of both the urban and rural residents of China. The tax reduction was greater after the VAT reform than during the pilot VAT reform. Second, the VAT reform improved residents' income and narrowed down the income gap between the urban and rural residents. Furthermore, the VAT reform led to better improvement in rural residents' income than urban residents' income. Third, the reduced average tax rate following the VAT reform offset the negative influence of enhanced indirect tax regressivity on residents' income redistribution, with the former having greater influence. Therefore, the VAT reform

generally improved the residents' income redistribution. Furthermore, compared to the pilot VAT reform, the comprehensive VAT reform led to larger improvement in residents' income distribution. Fourth, from the residents' welfare perspective, the VAT reform significantly improved residents' welfare. Specifically, the urban residents obtained greater welfare than rural residents and high-income residents obtained greater welfare than low-income residents.

This study contributed to the literature mainly on the following two aspects. First, as regards the research method, this study divided the fixed assets into tangible movable property and real property to set the VAT reform CGE model. This is a more practical approach with the VAT reform and a good supplement for the future study of China's policy reform using the CGE model. Second, as regards the research content, this study constructed a VAT reform CGE model consisting of seven urban and five rural household groups and set up two types of policy scenarios, the pilot and comprehensive VAT reforms, based on industry-by-industry pilot characteristics of the VAT reform. Moreover, as this study comprehensively examined the VAT reform effect on residents' income distribution from the various tax burden, resident income, MT index, and household welfare aspects, the research content of the study is more comprehensive and richer. The study can provide strong data support for government departments to introduce more accurate and effective control policies.

The findings of this study have important implications. First, we need to further improve the income distribution effect of taxation. We should consider reducing the VAT rates of such industries as food, clothing, and medicines that are closely linked to the low- and middle-income residents' livelihood in order to further relieve their tax burden. Second, the average VAT rates have been effectively reduced in recent years, thanks to policies such as degenerating the VAT rates and tax reliefs of small-scale taxpayers in order to improve the residents' income distribution. Furthermore, a tax relief mechanism should be developed such that it incorporated the VAT, consumption tax, personal income tax, housing property tax, and transfer payment to form a comprehensive tax preference system resulting in residents' tax reductions and fee cuts and thus improved welfare. However, this study has some shortcomings. A future direction for this research could be the use of a dynamic CGE model.

Notes

1. Website of the Central People's Government of the PRC http://www.gov.cn/xinwen/2018-01/18/content_5257720.htm
2. Output tax and input tax are assumed to be charged at the same rate for each sector.
3. The average tax rate is the ratio of residents' total indirect tax to their total income.

References

- Akram, T., Lei, S., Haider, M. J., & Hussain, S. T. (2020). The impact of organizational justice on employee innovative work behavior: Mediating role of knowledge sharing. *Journal of Innovation & Knowledge*, 5(2), 117–129. <https://doi.org/10.1016/j.jik.2019.10.001>
- Chang, G. H. (2017). *Principles of computable general equilibrium (CGE) modeling and programming*, 2e(M). Truth & Wisdom Press.

- Du, L. (2015). The effects of China's VAT enlargement reform on the income redistribution of urban households. *China Finance & Economic Review*, 3(1), 1–15.
- Fan, J., Yang, Z. W., & Zhao, T. (2010). Compilation of China's macro social accounting matrix. *World Economic Papers*, 04, 103–119.
- Ge, Y. Y., Tian, Z. W., & Hu, Y. J. (2015). On the income distribution effect of replacing business tax with VAT: From the double perspectives of income and consumption. *Contemporary Finance & Economics*, 04, 23–33.
- Gil-Alana, L. A., Škare, M., & Claudio-Quiroga, G. (2020). Innovation and knowledge as drivers of the “great decoupling” in China: Using long memory methods. *Journal of Innovation & Knowledge*, 5(4), 266–278. <https://doi.org/10.1016/j.jik.2020.08.003>
- Kakwani, N. C. (1984). On the measurement of tax progressivity and redistributive effect of taxes with applications to horizontal and vertical equity. *Advances in Econometrics*, 3, 149–168.
- Lecuna, A. (2020). Income inequality and entrepreneurship. *Economic Research-Ekonomska Istraživanja*, 33(1), 2269–2285. <https://doi.org/10.1080/1331677X.2019.1663545>
- Liu, H. T., & He, Q. Y. (2019). The effect of basic public service on urban–rural income inequality: A Sys-GMM approach. *Economic Research-Ekonomska Istraživanja*, 32(1), 3211–3229. <https://doi.org/10.1080/1331677X.2019.1661005>
- Liu, Q. Z., & Luo, C. (2019). Will tax cuts in enterprises exacerbate income inequality? - Research based on the VAT reform quasi-natural experiment. *Journal of Zhongnan University of Economics & Law*, 23(5), 87–95, 123.
- Musgrave, R. A., & Thin, T. (1948). Income tax progression, 1929–48. *Journal of Political Economy*, 56(6), 498–514. <https://doi.org/10.1086/256742>
- Ni, H. F., Gong, L. T., & Wang, Q. M. (2016). Price effect and income distribution effect of the reform of replacing business tax for VAT. *China Industrial Economics*, 12, 23–39.
- Nie, H. F., & Liu, Y. (2010). An estimate of the indirect tax incidence in urban households. *Economic Research Journal*, 45(7), 3–42.
- Su, Z. F., Chen, C. N., & Lan, J. J. (2021). Business tax replaced with VAT reform and labor share: Evidence from Chinese listed companies. *Finance & Trade Economics*, 42(1), 44–61.
- Tian, Z. W., & Hu, Y. J. (2014). Dynamic effect of replacing business tax with VAT on fiscal revenues and the economy: Analysis bases on CGE model. *Journal of Finance & Economics*, 40(02), 4–18.
- Veselinović, L., Mangafić, J., & Turulja, L. (2020). The effect of education-job mismatch on net income: Evidence from a developing country. *Economic Research-Ekonomska Istraživanja*, 33(1), 2648–2669. <https://doi.org/10.1080/1331677X.2020.1723427>
- Wang, H. (2016). Income distribution effect of tax cut after “turning business tax into value added tax”. *Public Finance Research*, 10, 85–100.
- Wang, J. F., & Fan, M. T. (2012). The value-added tax and its influential mechanism on CGE model price system in China. *The Journal of Quantitative & Technical Economics*, 29(12), 112–123.
- Yang, Y. P., & Guo, X. D. (2017). How does replacing business tax with VAT affect household indirect tax burden and income redistribution? *Finance & Trade Economics*, 38(08), 5–19, 97.
- Zhai, F., & Hertel, T. (2005). *Impacts of the Doha development agenda on China: The role of labor markets and complementary education reforms*. Policy Research Working Paper Series 3702, The World Bank.
- Zhan, Q. L., Zeng, X. H., Wang, Z. A., & Mu, X. Z. (2020). The influence of minimum wage regulation on labor income share and overwork: Evidence from China. *Economic Research-Ekonomska Istraživanja*, 33(1), 1729–1749. <https://doi.org/10.1080/1331677X.2020.1762104>
- Zhao, Y., & Wang, J. F. (2008). *CGE model and its applications in economic analysis*. Economic Press China.
- Zheng, Y. X., & Fan, M. T. (1999). *CGE model and policy analysis in China*. Social Sciences Academic Press.