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The effects of China's VAT enlargement reform on the income redistribution of urban households

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Abstract

Background: China's former goods and service tax (GST) system subjects sale of goods to VAT and provision of services to business tax. The VAT enlargement reform launched in 2012 aimed to replace the business tax with VAT step by step. This paper is intended to explore the redistribution effects of this reform.

Methods: On basis of input-output model and statutory tax rates, this paper derives the measurement of full GST burden of households in China where both VAT and business tax are imposed. Using the 2012 urban household survey data, the redistribution effects of the VAT enlargement reform is estimated by comparing the Gini coefficient and general entropy indexes before and after the reform.

Results: The VAT enlargement reform has improved the redistribution effects of China's GST system mainly through lowering the average tax burden and reducing the inequality within the lowest-income group, though the inequality among different income groups was not reduced considerably.

Conclusions: Compared with overall rate reduction, greater relief to necessity items could improve the redistribution effects of the future VAT system more effectively.

Keywords: VAT enlargement, Redistribution effects, General entropy index, Input-output model

Background

China launched the pilot value-added tax (VAT) enlargement reform in Shanghai with the new rules taking effect in January 1, 2012, in transportation and some selected modern service industries and then quickly expanded to other regions and industries. It is planned that the switch from the current dual goods and service tax system, which levies VAT and business tax concurrently on sale of goods or provision of services, to a single GST system with only VAT levied will be finished by the end of 2015.

At present, most entities conducting various business operations in China shall pay GST for their sale or business revenue. In general, sale of goods is subject to VAT and provision of services is subject to business tax before the VAT enlargement reform. Therefore, the two taxes are both widely based and contribute considerably to the overall tax revenue in China. In 2013, the revenue from domestic VAT and business tax accounted for 26 and 16 % of China's overall tax revenue, respectively, which ranked No. 1 and No. 3

among all taxes levied.¹ With the implementation of the VAT enlargement reform, VAT has been levied in the pilot industries which are formerly subject to business tax. Since under China's VAT regime the final VAT payable is partly determined by the creditability of the VAT already paid on purchased inputs, the fact that a service or a good is liable to VAT or not will influence the tax burden of both its sellers and buyers. As such, the VAT enlargement reform will cause changes in the VAT and/or business tax (also referred to as "two taxes") burden² of nearly every industry in the economy and undoubtedly further influences which need thorough academic research.

This paper will mainly study the effects of the VAT enlargement reform on the income redistribution of China's urban households.

In theory, the GST is regarded as indirect tax levied on consumption. Since, for high-income households, the share of consumption expenditure in the overall income is relatively low, the GST burden of high-income households is typically lower than the low-income households, the redistribution effects of GST tend to be regressive. Based on this consideration, in order to improve the overall redistribution effects of China's taxation system, the ratio of indirect tax revenue to direct revenue shall be lowered. Actually, the VAT enlargement reform is part of China's structural tax-cut package, namely the tax burden of the trial and other related industries, and shall be lowered or at least remain the same; therefore, we may expect the redistribution effects of the two taxes to be improved by this reform.

However, it is easier to achieve the above conclusions under an ideal regime where various goods and services are subject to a single GST and there is only one applicable rate. But in China, different goods or services are subject to different GSTs (VAT or business tax) at different rates, and additional exemption or reduced rates are applied to selected necessities, so we cannot simply ascertain the regressivity of VAT and business tax as a whole. With the VAT enlargement reform, though more services are subject to VAT, several important industries including construction, real estate, banking and insurance, etc. are still liable to business tax, two additional reduced rates (11 and 6 %) are introduced, and the changes in tax burden vary drastically across industries; therefore, the exact influence of the VAT enlargement reform on China's household income redistribution can only be determined through empirical study.

Concerning the burden or redistribution effects of indirect taxes, there has been much study in the literature. The methods adopted by the author include micro simulation and general equilibrium analysis. Based on industry and household data, the micro simulation method is more suitable for figuring out the effects of the industry-related policy adjustments. In conducting research using this method, a key point is the estimation of the VAT and/or business tax included in the prices of the goods or services purchased by the households. Some studies directly take the statutory rates of VAT or business tax as the tax burden rates of the specific expenditure items of the households (Liu and Nie 2004; 2009), others determine the tax burden of the household expenditure items through measurement of the tax burden of various industries on the basis of input-output data and then match the industries in the input-output table with the household expenditure items. Considering the fact that China levies VAT or business tax on different goods or services, and the applicable rates and credit rules vary across different taxable items even within the VAT regime, the method based on input-output data can achieve more accurate results. However, in measuring the tax burden of each industry, earlier studies (Nie

and Liu 2009; 2010; Tamaoka 1994) considered only the tax burden at the last stage in supplying the relevant goods and services and ignored the taxes included in the prices of the inputs and shifted finally to the households. More recent studies (Scutella 1999; Nie and Yue 2013) made important progress by including the input taxes in overall tax burden, but since the analysis is based on the data of collected tax revenue and leads to results reflecting the combined effects of tax system and tax administration, their method is still problematic for evaluating the effects of tax reform.

In this paper, using the 135-industry input-output table in 2007 published by the National Statistics Bureau of China, we try to estimate the burden of VAT and business tax for each industry according to statutory tax rates and with full consideration of input taxes. Then, on the basis of the results and the 2012 Urban Household Survey Data, we measure the VAT and business tax burden of sample urban households before and after the VAT enlargement reform and derive the redistribution effects of this tax reform. With regard to the measure of the redistribution effects of taxation, apart from adopting the traditional methods such as comparing the before-tax and after-tax burden and income shares of household groups of different income levels, comparing the before-tax and after-tax Gini coefficients, we also introduce the general entropy index with various sensitive parameters so as to disclose the structural influences of the VAT enlargement reform on household income redistribution. Since the whole estimation has been built on statutory tax rates, we finally simulated the redistribution effects of some typical VAT regimes, which may be helpful for the decision-making concerning future VAT reform.

Similar to the findings of other authors, our analysis also indicates the regressive effects of VAT and business tax as a whole. In addition to this, we find the VAT enlargement reform has improved the redistribution effects of the two taxes though lowering the average tax burden and narrowing the income gap “within” the low-income household group. Since this reform has not brought a considerable tax cut to the expenditure items which are particularly essential for the low-income households, the income gap “between” the household groups with different income levels is nearly unaffected. As such, the overall improvement of the redistribution effects is rather mild. Further simulation indicates the redistribution effects of VAT can be more effectively improved through lowering the tax burden on necessities.

The rest of this paper is arranged as follows: the “Methods” section introduces the methodology and data, the “Results and discussion” section presents the results of our estimation for the redistribution effects of the VAT enlargement and the simulation analysis for the redistribution effects of some typical VAT regimes, and the “Conclusions” section concludes the paper.

Methods

Measuring the VAT and business tax burden of the households

Households are the final consumers of various goods and services. Due to the complicated interaction of the industries in the economy, the output of every industry can be purchased by the households or become the intermediate input for producing the goods or services purchased by the households. Based on the assumption of forward tax shifting as frequently used in the literature, the taxes paid by the business operators of various industries finally shall be included in the prices of the goods or services purchased by the households. Therefore, in order to measure the VAT and business tax borne by the

households, we need to estimate the effective rate of VAT and business tax as a whole for each industry. Here, by effective tax rate, we mean the ratio of VAT and business tax included in the price of the output of an industry to the price of the output of that industry.

According to the structure of the input-output table, we have

$$p_j = \sum_{i=1}^n a_{ij}p_i + v_j, j = 1, 2, \dots, n \tag{1}$$

Where p_j denotes the price of the output of the j th industry, p_i denotes the price of the output of the i th industry, and a_{ij} is the direct consumption coefficient reflecting the consumed inputs from the i th industry per unit of the output of the j th industry; therefore, $\sum_{i=1}^n a_{ij}p_i$ represents the part of the output of the j th industry which is equivalent to the value of the intermediate inputs. In addition, v_j represents the value added per unit of the output of the j th industry. Since the output of each industry is equal to the sum of value added and the value of intermediate inputs, net production taxes (or the sum of VAT, business tax, consumption tax, and other indirect taxes) are just a component of the value added, and the inputs for each industry are just from the outputs of other industries; the value of the intermediate inputs of each industry shall include VAT and/or business tax as well. Therefore, the overall VAT and business tax included in the price of output of each industry shall be the sum of the two taxes directly paid by the sellers of the goods or services of that industry and the two taxes included in the prices of inputs of that industry. Let t_j denote direct effective tax rate or the ratio of directly paid VAT and business tax to price of output of the j th industry, τ_j denote indirect effective tax rate or the ratio of VAT and business tax included in the inputs to price of output of the j th industry, and T_j denote total effective tax rate which is the sum of direct effective tax rate and indirect effective tax rate; we can derive the three effective tax rates as follows.

On the basis of the VAT and business tax rules before and after the VAT enlargement tax reform, we can firstly get the direct effective tax rate for each industry. Let to_j denote the rate applied to the output of the j th industry; for the industries subject to business tax, we have

$$t_j = to_j \tag{2}$$

Where to_j is just the statutory rate; for the industries subject to VAT, in general, we have

$$t_j = to_j - \sum_{i=1}^n a_{ij}t_i - \sum_{i=1}^n k_{ij}t_i \tag{3}$$

Where a_{ij} is the direct consumption coefficient, and k_{ij} reflects the equipment investment from the i th industry per unit of the output of the j th industry. Since the tax base of VAT is a tax-exclusive price, to_j is changed to “statutory rate/(1+ statutory rate)”; t_i denotes the credit rate for the inputs from the i th industry, which is “statutory rate/(1+ statutory rate)” for inputs from industries subject to VAT, 13 % for primary agricultural products produced by farmers, 7 % for inputs from the transportation industry before the reform, and 0 % for inputs from other industries subject to business tax. t_{ji} is changed to 0 % if $t_j < 0$ or the output is subject to VAT but enjoys exemption and is changed to 3 % for the software industry before the reform and leasing industry (in case of tangible movable property leasing) after the reform³.

Secondly, on the basis of the direct effective tax rates and direct consumption coefficients of inputs, we can derive the amount of VAT and business tax included in the

prices of inputs directly consumed by each industry per unit of output of that industry. Since these inputs are produced in turn by consuming the inputs from various industries, according to similar logic, we can further derive the amount of the two taxes included in the prices of inputs indirectly consumed. Let \mathbf{A} denote the matrix of direct consumption coefficients; then the matrix of the first indirect consumption coefficients is $\mathbf{A} \times \mathbf{A}$, the matrix of the second indirect consumption coefficients is $\mathbf{A} \times \mathbf{A}^2$, and the matrix of the k th indirect consumption coefficients is $\mathbf{A} \times \mathbf{A}^k$. Assume $\mathbf{t} = (t_1, t_2, \dots, t_n)^\top$, which is the matrix of direct effective tax rates, and assume $\boldsymbol{\tau} = (\tau_1, \tau_2, \dots, \tau_n)^\top$, which is the matrix of indirect effective tax rates, then we have (see Additional file 1 for the derivation of Eq. (4))

$$\boldsymbol{\tau} = \mathbf{A}^\top \cdot \mathbf{t} + (\mathbf{A} \times \mathbf{A})^\top \cdot \mathbf{t} + (\mathbf{A} \times \mathbf{A}^2)^\top \cdot \mathbf{t} + \dots + (\mathbf{A} \times \mathbf{A}^k)^\top \cdot \mathbf{t} \quad (4)$$

Also, assume $\mathbf{T} = T_1, T_2, \dots, T_n)^\top$, which is the matrix of total effective tax rates; then, according to its definition, we have

$$\mathbf{T} = \mathbf{t} + \boldsymbol{\tau} = \left(\mathbf{I} + \mathbf{A} + \mathbf{A} \times \mathbf{A} + \mathbf{A} \times \mathbf{A}^2 + \dots + \mathbf{A} \times \mathbf{A}^k \right)^\top \cdot \mathbf{t} \quad (5)$$

For $k \rightarrow \infty$, we can get the limit of \mathbf{T} as

$$\mathbf{T} = (\mathbf{I} - \mathbf{A})^{-1} \cdot \mathbf{t} \quad (6)$$

On the basis of the results above, by matching the input-output industries with the expenditure items of the households, we can get the effective tax rates of the items purchased by the households and then calculate the burden of VAT and business tax according to the actual expenditure of households.

Measuring the effects of VAT enlargement reform on income redistribution of households

We will evaluate the income redistribution effects of VAT and business tax by comparing the values of some inequality measures for household income before and after the levying of these two taxes. Here the household income means the annual per capita income of the sample households and the inequality measures include Gini coefficient and generalized entropy indexes.

The indicator of redistribution effects of taxation based on Gini coefficient is also called the MT index, as it was initially put forward by Musgrave and Thin, two American scholars, and could be expressed by the following formula:

$$MT = G_x - G_y \quad (7)$$

where G_x is the Gini coefficient for before-tax income, G_y is the Gini coefficient for after-tax income, and a higher MT index means stronger redistribution effects. By decomposing the MT index, we can further analyze the horizontal equity effects and vertical equity effects of taxation and the influences of progressivity and the average tax burden on the redistribution effects.

According to Kakwani (1984),

$$MT = (C_y - G_y) - tK/(1 - t) \quad (8)$$

Where C_y is the concentration index for after-tax income ranked by before-tax income. Since G_y , the coefficient of after-tax income, is equivalent to the concentration index for after-tax income ranked by after-tax income, $C_y - G_y$ reflects the impact of re-ranking of the household income due to taxation and is referred to as the horizontal equity effect.

The second term in Eq. (8) measures the vertical equity effects, where t is the average tax burden and K is the progressivity index put forward by Kakwani, which can be calculated by using the following formula:

$$K = C_t - G_x \quad (9)$$

Where C_t is the concentration index for tax payable ranked by before-tax income. Since G_x , the coefficient of before-tax income, is equivalent to the concentration index for before-tax income ranked by before-tax income, $C_t - G_x$ reflects the relative inequality of tax payable in comparison to the before-tax income.

Although the Gini coefficient is frequently used as an inequality index that measures the income gap, it is not perfect. Supposing there is a pair of income distributions, \mathbf{x} and \mathbf{y} , \mathbf{x} is more equitable than \mathbf{y} only when \mathbf{x} exceeds \mathbf{y} in every point of the Lorenz Curve, so inequality indexes that are sensitive to the bottom, middle, and top of the distribution curve should be considered together, rather than just the Gini coefficients of \mathbf{x} and \mathbf{y} .

The generalized entropy index put forward by Cowell (in 2011) is an inequality measure that contains a sensitivity parameter θ . When θ is given different values, the generalized entropy index is sensitive to the bottom, middle, and top of the distribution curve. So in this paper, we will try to refer to the idea of the MT index to make further calculation of the income redistribution effects of taxation on the basis of the generalized entropy index. RE, the income redistribution effect based on the generalized entropy index, can be calculated as:

$$RE = GE_\theta^x - GE_\theta^y \quad (10)$$

where GE_θ^x is the generalized entropy index for before-tax income and GE_θ^y is that for after-tax income. A larger value of RE indicates stronger redistribution effects of taxation, which is similar to the MT index. Four important values, -1 , 0 , 1 , and 2 of θ are applied in the calculation in this paper. If the value of RE is larger when $\theta = 2$, it indicates that the taxation is more effective in narrowing the income gap within the high-income group; on the contrary, if the value of RE is larger when $\theta = -1$, the taxation is more effective in narrowing the income gap within the low-income group.

By decomposing the generalized entropy index, we can easily decompose the redistribution effects into the between-group effects and within-group effects and obtain more structural information.

The data

The input-output data is from the 135-industry input-output table in 2007 published by the National Statistics Bureau of China. This table provides the most detailed input-output information with regard to industries, but according to the rules of VAT and business tax, there are still some cases where the products of a specific industry may be subject to different tax treatment. For instance, in the industry of “liquid milk and dairy products manufacturing,” the applicable VAT rate for “liquid milk” shall be 13 % and for “dairy products” shall be 17 %; and in the industry of agriculture, the self-produced products by the farmers shall be exempt from the output VAT and credited at the rate of 10 % if purchased by other VAT payers, while other agricultural products shall be taxed and credited both at the rate of 13 %, etc. In order to make our estimation more accurate, we

break down some of the industries in the current input-output table so as to achieve a new 149-industry input-output table (see Additional file 2 for detailed information).

The household income and expenditure data is from the 2012 Urban Household Survey Data provided by the National Statistics Bureau. The sample includes 11,271 households from China's Liaoning, Sichuan, and Guangdong provinces and Shanghai Municipality. The household consumption in the data is divided into eight categories such as food, clothing, residence, household facilities and articles, health, traffic and communications, education, culture and recreation, and other goods and services. Each category is further broken down into several sub-items. We try to match the input-output industry with the consumption items according to the Urban Household Survey Manual and Category of products for Statistics published by the National Statistics Bureau. However, since a specific consumption item in the Urban Household Survey Data may involve products from more than one industry, we have to break down some of the consumption items and allocate the consumption amounts among the related industries according to the nature of the goods or services involved (see Additional file 3 for detailed information).

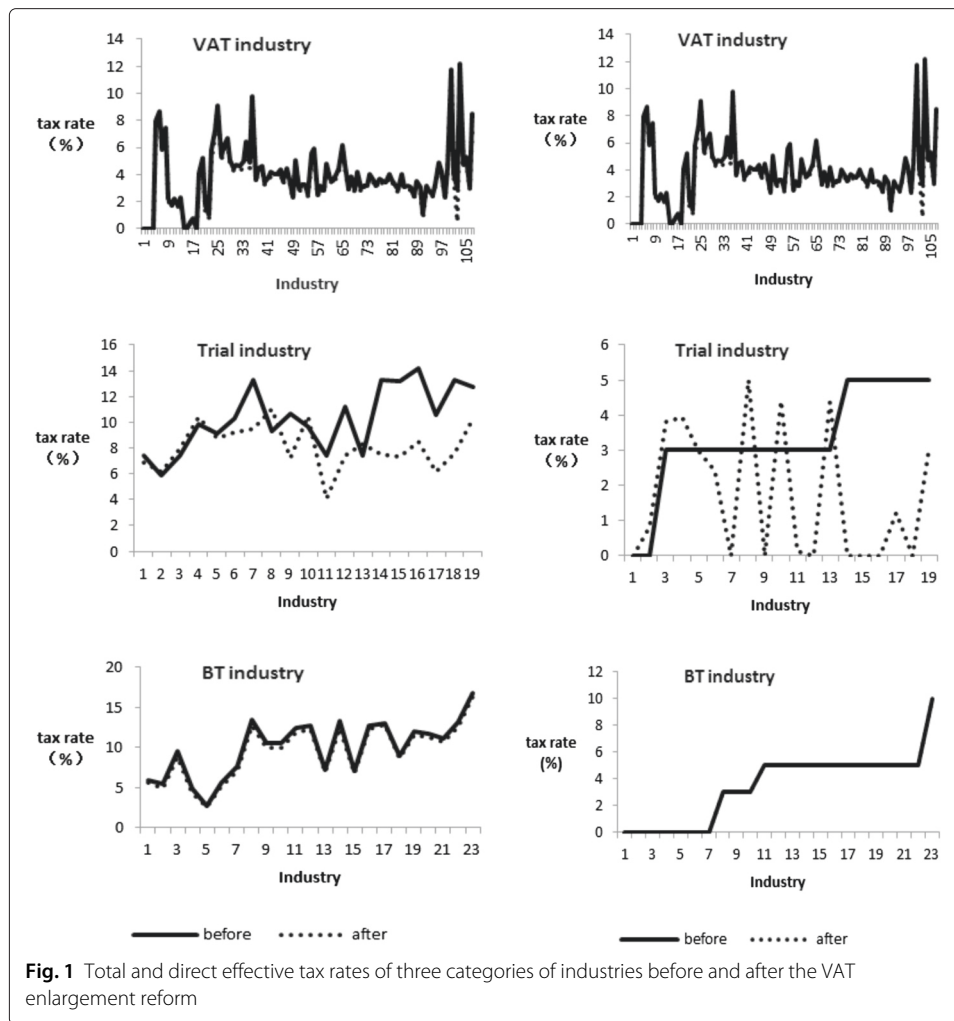
Besides, in order to estimate the direct effective rate for each industry liable to VAT, we need the information about the equipment investment from other industries per unit of output of that industry, namely the k_{ij} in Eq. (3). Our data source for the equipment investment of each industry is the 2008 Fixed Assets Investment Yearbook (again adjusted according to the allocation rates in Additional file 2). We assume the equipment investment of the industry of "agriculture, forestry, husbandry, and fishing" is from the industry of "agriculture, forestry, husbandry, and fishing special equipment manufacturing" (the credit rate is 13 %), and the equipment investment of other industries is from the industry of other special equipment manufacturing (the credit rate is 17 %).

Results and discussion

The direct effective tax rates and total effective tax rates

We divide all the 149 industries into three categories, namely the industry which is subject to VAT both before and after the VAT enlargement reform (VAT industry), the industry which is subject to business tax both before and after the VAT enlargement reform (BT industry), and the industry which is subject to business tax before the reform and VAT after the reform (Trial industry). Figure 1 illustrates the direct effective tax rates and total effective tax rates calculated according to the statutory rates of VAT and business tax before and after the reform, respectively, where the industries are ranked according to the statutory rates before the reform.

Obviously, there exists a gap between the direct effective tax rates and total effective tax rates so that the amount of the two taxes included in the inputs constitutes an important component of the overall burden of the two taxes included in the prices of various goods or services. The VAT enlargement reform has brought a tax cut to all three categories of industries, especially in terms of the total effective tax rates. As for the difference among the industries, the tax burden of the "trial industry" changes more significantly and the tax burden of the "VAT industry" drops slightly more than the "BT industry." As for the differences within each category, the extents of tax cut both within the "BT industry" and within the "VAT industry" are similar. But the extents of tax cut within the "Trial industry" vary dramatically, as the direct effective tax rates of some modern service industries



dropped to 0 and those of post and some transportation industries are even higher after the tax reform.

In general, since the burden of VAT and business tax is lowered in most industries due to the tax reform, the tax burden borne by the consumers of various goods and services shall be lower as well. Therefore, it is likely that the VAT enlargement reform can help to improve the redistribution effects of the two taxes. However, the tax cut in most industries is only marginal, which may bring some doubts on this possible positive effect. Meanwhile, the variance in the total effective tax rates among industries is widened by the reform, which may make the burden of VAT and business tax depend more on the structure of consumption of the households. As such, the exact impact of the VAT enlargement reform on the income redistribution effects of the two taxes is rather unclear and shall be determined by further serious analysis.

The effective tax rates of the household consumption on various goods and services

Table 1 reports the effective tax rates of major household consumption items before and after the VAT enlargement reform. For each major consumption item, we adopt the weighted average of the effective tax rates of its sub-items. Actually, the effective tax rates

Table 1 The effective tax rate of major consumption items before and after the reform (%)

Item	Effective tax rate		% of decline in tax rate
	Before reform	After reform	
Food	11.5	11.0	4.4
Clothing	14.6	13.9	5.3
Housing	11.6	11.0	4.8
Household facilities and articles	14.3	13.4	6.4
Health	12.9	11.9	7.7
Traffic and communications	11.0	10.1	8.1
Education, culture, and recreation	10.6	10.0	5.6
Other goods and services	13.6	12.7	6.0

for all the major consumption items have dropped after the reform with the tax reduction rate for “transportation and communications” highest and the tax reduction rate for “food” lowest. In terms of the absolute value of effective tax rate after reform, the lowest burden is for the “education, culture, and entertainment services” and the highest burden is for the “household equipment and devices.”

However, with regard to the consumption structure of the sample households, “food” and “residence” constitute more important consumption items for low-income households, while “household facilities and articles,” “traffic and communications,” and “education, culture, and recreation” constitute more important consumption items for high-income households (see Fig. 2). This means the direction of tax cut caused by the VAT enlargement reform is not fully consistent to the improvement of the redistribution effects of the two taxes.

The redistribution effects of VAT and business tax and the influence of the reform

Table 2 reports the calculated redistribution effects of VAT and business tax before and after the reform. In general, the redistribution effects of the two taxes are regressive both

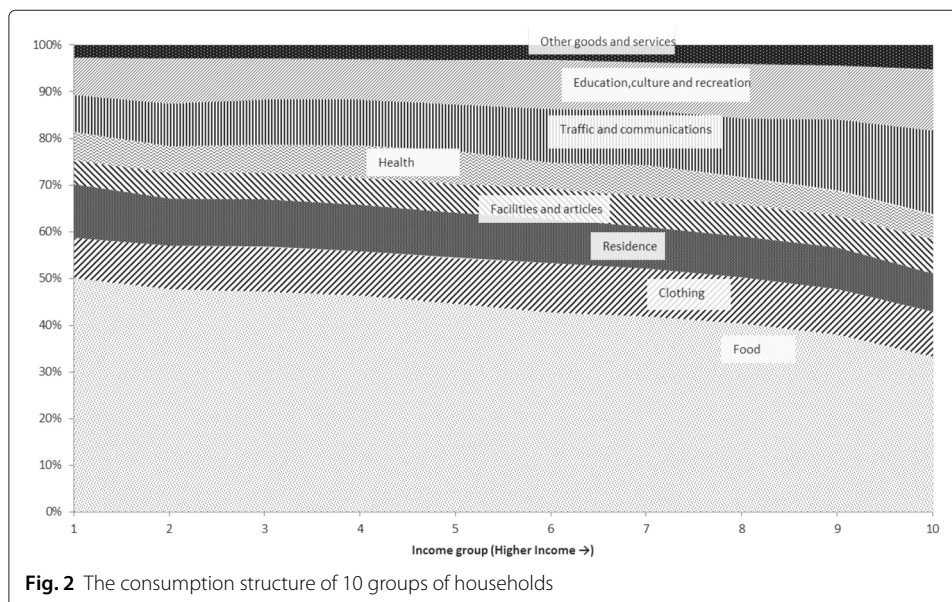


Table 2 Redistribution effects of VAT and business tax before and after the reform

Equity measure	Before the reform			After the reform			% of decline in RE
	Pre-tax	Post-tax	RE	Pre-tax	Post-tax	RE	
GE ₂	0.2605	0.2666	-0.0061	0.2605	0.2660	-0.0056	8.20
GE ₁	0.1951	0.1991	-0.0040	0.1951	0.1987	-0.0036	10.00
GE ₀	0.1904	0.1943	-0.0039	0.1904	0.1939	-0.0035	10.30
GE ₋₁	0.2535	0.2507	0.0028	0.2535	0.2492	0.0044	57.10
Gini	0.3331	0.3367	-0.0035	0.3331	0.3364	-0.0032	8.60

before and after the reform. But the reform has improved the redistribution effects of the two taxes by lowering the attitude of the regressivity.

However, when measuring on the basis of different inequality measures, we achieve quite different results for the impact of the reform on the redistribution effects of the two taxes. In particular, if we choose the generalized entropy index with θ equal to -1 as the inequality measure, the redistribution effects of the two taxes become progressive both before and after the reform and the improvement of redistribution effects caused by the reform seems rather considerable. Therefore, we will try to make further analysis by decomposing the results in Table 2.

We firstly decompose the results achieved on the basis of the Gini coefficient. As indicated in Table 3, in terms of both horizontal equity and vertical equity, the income gap of the sample households is widened by the “two taxes” but narrowed by the VAT enlargement reform. As for the vertical equity, since the percentage of reduction of the average tax rate is more than that of the regressivity, we can derive the reform improved the redistribution effects of the two taxes mainly through lowering the overall tax burden instead of lowering the tax burden of the low-income households.

Secondly, we decompose the results achieved on the basis of generalized entropy index. Table 4 presents the decomposing of the before-tax income inequality of sample households and the redistribution effects of the two taxes on the basis of GE₂ and GE₋₁ with G1 to G5 standing for five groups with household income from low to high. With regard to within-group effects, when measured on the basis of GE₂, the redistribution effects of the two taxes are regressive for all the five groups and the reform just slightly reduces the regressivity, but when measured on the basis of GE₋₁, the redistribution effects become progressive for two low-income groups (G1 and G3) and the reform significantly increases the progressivity. With regard to between-group effects, the redistribution effects of the two taxes are regressive on the basis of both GE₂ and GE₋₁ and the reform slightly reduces the regressivity. As a smaller value of θ gives more weight to low-income groups, the overall redistribution effects of the two taxes are progressive when measured by GE₋₁ and the reform significantly increases the progressivity.

Table 3 Decomposition of the MT index for VAT and business tax before and after the reform

Tax regime	MT index	Horizontal equity	Vertical equity	Progressivity	Average tax rate
(1)	(2)	(3)	(4)	(5)	(6)
Before reform	-0.00352	-0.00133	-0.0022	-0.02562	0.08571
After reform	-0.00318	-0.00117	-0.00201	-0.02506	0.08029
% of change	9.70	12.00	8.60	2.20	6.30

$$(2) = (3) + (4), (4) = (5) \times (6)$$

Table 4 Breakdown of the redistribution effects before and after the reform based on GE_2 and GE_{-1}

Group	Inequality before tax			RE	
	$GE_2^%$	Weight	Contribution	Before reform	After reform
(1)	(2)	(3)	(4)	(5)	(6)
GE_2					
G1	0.0394	0.1407	0.0043	-0.0021	-0.0019
G2	0.0043	0.3779	0.0013	-0.0013	-0.0011
G3	0.0036	0.6878	0.0019	-0.0015	-0.0014
G4	0.0049	1.273	0.0048	-0.0013	-0.0012
G5	0.1044	4.2148	0.3377	-0.0035	-0.0031
Between	0.1694	.	0.6501	-0.002	-0.0019
Total	0.2605	.	1	-0.0061	-0.0056
GE_{-1}					
G1	0.1078	2.6663	0.227	0.0149	0.0159
G2	0.0044	1.6268	0.0056	-0.002	-0.0017
G3	0.0036	1.2057	0.0034	0.0008	0.0029
G4	0.0049	0.8863	0.0034	-0.0017	-0.0015
G5	0.0566	0.4871	0.0217	-0.0047	-0.0039
Between	0.1873	.	0.7389	-0.0034	-0.0032
Total	0.2535	.	1	0.0028	0.0044

(4) = (2) × (3) × 100 %, (9) = (7) × (8) × 100 %, where (3) and (8) represent the weights assigned to each group. Assume the average income of the i th group is \bar{y}_i , the overall average income is \bar{y} , the ratio of the population of the i th group to the overall population is m_i , and the weight is W_i , then $w_i = m_i \left(\frac{\bar{y}_i}{\bar{y}}\right)^\theta$

Therefore, the above inconsistency in the estimation of the redistribution effects of the two taxes is just due to the different sensitivities of different inequality measures to the structural features of income distribution. We can summarize the results in Table 4 as follows: (1) The “two taxes” has narrowed the income gap within the low-income groups but has not helped to narrow the income gap within the high-income groups and between the high-income and low-income groups. (2) The VAT enlargement reform further narrowed the income gap within the low-income groups but has not helped much in narrowing the income gap between household groups of different income levels.

We also show the average burden of the “two taxes” of household groups of different income levels before and after the reform in Table 5. It is clear that the reform has lowered the tax burden of the household groups of all income levels, and the lower-income groups got more tax reduction. But apart from the household group with the lowest income level, most household groups got a similar tax reduction. This is consistent to the above structural features of the impact of the reform on the redistribution effects of the two taxes.

Table 5 The average tax burden of 10 groups of households before and after the reform

Group	Before	After	Tax cut	Group	Before	Before	Tax cut
1	9.86	10.44	-0.58	6	7.52	7.96	-0.44
2	8.02	8.48	-0.47	7	7.32	7.75	-0.43
3	7.95	8.42	-0.47	8	7.26	7.69	-0.42
4	7.79	8.25	-0.46	9	7.49	7.92	-0.44
5	7.69	8.14	-0.46	10	7.11	7.53	-0.41

Tax burden = VAT and business tax burden/Household income

Simulation of the redistribution effects of different VAT regimes

So far, our analysis indicates the positive impact of VAT and business tax on narrowing the income gap within low-income groups. But since this positive impact is quite limited, in general, the redistribution effects of VAT and business tax are still regressive when measured on the basis of the Gini coefficient and several other inequality measures. Meanwhile, the VAT enlargement reform has improved the redistribution effects of the two taxes, but the improvement is quite limited as well. According to China's 12th 5-year plan, the VAT enlargement reform will continue and finally subject all the goods and services to VAT, but the rules for several industries which currently are still liable to business tax are still under discussion, and the overall VAT system needs to be streamlined after the reform. Therefore, we will try to estimate the desirable VAT statutory rates for the industries subject to business tax at present (or future trial industries) and further simulate the redistribution effects of several alternative VAT regimes so as to provide references for the future VAT adjustments.

For the purpose of tax neutrality, the statutory VAT rates shall be as few as possible. So the VAT rates applicable to the future trial industries shall be selected just from 17, 13, 11, and 6 % which are the current VAT statutory rates for general taxpayers. Since the VAT enlargement reform requires "stable tax cut" for the trial industries, we just calculate the direct effective tax rates for the future trial industries on the basis of each of the four possible statutory VAT rates, and for each industry, we choose the rate which leads to the lowest positive tax cut as the desirable statutory rate (see Table 6). Apart from the traditional tax-exempt industries such as education and health, our desirable statutory rates for the industries such as banking, securities, and real estate are 6 %; for other industries are 11, 13, or even 17 %; and can get tax reduction rate of as high as 20 % for most industries.

Based on the above desirable statutory VAT rates for the future trial industries, we give the measure of the redistribution effects of the new VAT regime. Meanwhile, we also examined four alternative regimes which are likely to improve the redistribution effects of VAT, namely (1) VAT with overall rate reduction. Under this regime, the statutory rates of all items (excluding those exempt under former VAT and business tax rules) are reduced to 13 or 11 %. (2) VAT with selected rate reduction. Under this regime, the necessities (or the items currently subject to VAT at the rate of 13 % and accounting for more proportion in the consumption of low-income households) are taxed at a lower statutory rate of 6 % or exempt.

As indicated in Table 7, given the stable tax cut for the future trial industries, finally, the VAT enlargement reform will only slightly improve the redistribution effects of the two taxes. As for future VAT adjustments, in comparison to overall tax reduction, granting greater tax relief to necessity items will improve the redistribution effects of VAT more effectively.

Conclusions

On basis of the input-output table and Urban Household Survey Data, this paper studied the impact of China's recent VAT enlargement reform on the redistribution effects of VAT and business tax as a whole.

We derive the method to measure the full burden of VAT and business tax included in the prices of goods and services purchased by households on the basis of the statutory rates of the two taxes. It is found that the reform only slightly lowered the tax burden for

Table 6 The desirable statutory VAT rates for future trial industries (%)

Industry	VAT rate	Direct effective tax rate		Tax-cut rate
		Before reform	After reform	
Entertainment	17	10	7.5	25.2
Leasing (other than movable property)	13	5	3.2	35.9
Hoteling	13	5	4.1	17.8
Catering	13	5	3.6	28.1
Insurance	11	5	3	40.8
Tourism	13	5	3.9	22
Real estate	6	5	3.5	30
Environmental management	13	5	3.1	37.4
Public facilities management	13	5	2.8	44.7
Banking, securities, and other financial activities	6	5	3.8	23.6
Water conservancy management	11	5	4.7	5.3
Household services	11	5	4.1	17.8
Other services	13	5	3.5	30.7
Culture and arts (non-exempt item)	11	3	2.5	16.4
Sports	11	3	1.6	45.2
Construction	13	3	1.2	59.5
Education	0	0	0	-
Health	0	0	0	-
Social security	0	0	0	-
Social welfare	0	0	0	-
Agricultural services	0	0	0	-
Public management and social organizations	0	0	0	-
Culture and arts(exempt item)	0	0	0	-

purchasing the goods and services from most industries and has not brought more tax cut for such items as “food” which are more important in the consumption structure of low-income households. This reflects the fact that narrowing income gap is not the main and direct purpose of the reform.

But the reform still influences the income distribution of the urban households. The analysis based on most inequality measures indicates the reform has improved the redistribution effects of VAT and business tax. In contrast, according to several authors, though having taken the narrowing of income gap as the main target, China’s adjustments of the individual income tax system in 2011 just weakened the redistribution effects of that tax. So the positive effects of VAT enlargement reform on income redistribution are worthy of due attention.

Table 7 Simulated redistribution effects of typical GST regimes

Inequality measure	Current VAT/BT	Post-reform VAT	VAT/overall reduction		VAT/selected reduction	
			13 %	11 %	6 %	0 %
GE ₂	-0.0056	-0.0054	-0.0037	-0.0032	-0.0029	-0.0024
GE ₁	-0.0036	-0.0035	-0.0024	-0.0022	-0.0019	-0.0015
GE ₀	-0.0035	-0.0033	-0.0023	-0.002	-0.0017	-0.0013
GE ₋₁	0.0044	0.0043	0.0075	0.0081	0.0083	0.0088
Gini	-0.0032	-0.003	-0.0022	-0.002	-0.0017	-0.0014

According to further decomposing analysis, instead of lowering the tax burden of low-income households, the VAT enlargement reform has actually improved the redistribution effects of the “two taxes” through reducing the tax burden of all the households. Moreover, the reform has narrowed the income gap within the low-income groups but failed to narrow the income gap between groups of different income levels. This means there is still considerable space for strengthening the income redistribution through future adjustments of the VAT system.

In order to find the VAT regime that has stronger redistribution effects, we estimate the desirable statutory VAT rates for future trial industries and simulate the redistribution effects of various VAT regimes; the results suggest the regime granting greater tax relief to necessity items will improve the redistribution effects of VAT more effectively.

Endnotes

¹Source:http://yss.mof.gov.cn/2013qgczjs/201407/t20140711_1111970.html.

²This paper mainly considers the total tax burden of VAT and business tax or the sum of the VAT burden and business tax burden.

³The statutory rate for the software industry before reform and tangible movable property leasing after reform is changed to 3 % because the part of VAT that makes the actual burden exceed 3 % can be refunded upon collection.

Additional files

Additional file 1: Derivation of the formula for indirect effective rate. The indirect effective tax rate of a specific industry is the VAT and business tax included in the prices of inputs directly and indirectly consumed per unit of output of that industry. (DOCX 17.3 kb)

Additional file 2: Industries in the input-output table and their statutory tax rates. In order to make our estimation more accurate in this paper, we break down some of the industries in the current input-output table so as to achieve a new 149-industry input-output table. (DOCX 30.5 kb)

Additional file 3: Matching of the consumption items with industries. Since a specific consumption item in the Urban Household Survey Data may involve products from more than one industry, we have to break down some of the consumption items and allocate the consumption amounts among the related industries according to the nature of the goods or services involved. (DOCX 40.4 kb)

Abbreviations

BT, business tax; GST, goods and service tax; MT index, Musgrave–Thin index; RE, income redistribution effect based on the generalized entropy index; VAT, value-added tax.

Competing interests

The author has no competing interests.

Authors' contributions

LD designed the study, performed the analysis, prepared the figures and tables, drafted the manuscript, and submitted the manuscript online.

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