How Does the Substitution of VAT for GRT Affect Firms' Outsourcing Behavior and Production Efficiency: Evidence from China

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Abstract: The replacement of gross receipt tax (GRT) with value added tax (VAT) is an important phenomenon in the past half century. The conventional theory predicts that this kind of tax reform can reduce vertical integration, raise production efficiency, and potentially improve industrial structure. Yet there is surprisingly little empirical evidence for these predictions. This paper exploits the tax reform that replaced the GRT with VAT for service industry in China and apply difference-in-difference framework to estimate the causal effect of a GRT-to-VAT tax reform. We find evidence consistent with the predictions. First, the tax reform increase the probability and the intensity of outsourcing for both manufacturing firms and service firms. The more a given industry relies on the treated service industry in production, the more the industry outsources after the tax reform. Second, the reform increased total factor productivity of the manufacturing firms. Third, the tax reform boosted the sales of the service industry and allocated more resources to service industry, meaning that the tax reform promoted the growth of service industry that is underdeveloped in China.

Key Words: GRT to VAT reform; Outsourcing behavior; Vertical integration; Production efficiency; Industry structure.

1. Introduction

In the past half century, the value-added tax (VAT) has displaced other consumption taxes and became a major source of government revenue in more than 160 countries (Ufier, 2014; Adhikari, 2015). This phenomenon is considered as the most significant development in tax policy of recent decades (Keen and Lockwood 2010). The gross receipt tax (GRT), which taxes all business sales with no deductions or exemptions for the cost of intermediate inputs (i.e. business-to-business sales), was among the major classes of taxes being replaced by the VAT in the 1960s and 1970s (Ross, 2016). One motivation of the replacement comes from the well-understood shortcoming of GRT: the production distortion resulted from cascading (or pyramiding).[1] Specifically, cascading leads to different effective tax rates on final sales and the tax rate increases with the number of taxable production stages (Teata and Mattoon, 2007; Bird and Smart, 2008). It thus provides firms incentives to vertical integrate to reduce the number of stages subject to the tax, and it penalizes firms or industries whose intermediate input costs account for a large share of the final sales (McClure 2005; Pogue, 2007; Mikesell, 2007). In addition, the GRT creates a tax bias against firms that provide service or other inputs to other firms. In contrast, by taxing the difference between a firm's sales and its intermediate input costs, the VAT is essentially levied only on final consumption and thus avoid the cascading problem and its associated distortions.

Surprisingly, very few studies provide empirical estimates for the efficiency gain resulted from the elimination of cascading when an economy switched from GRT to VAT, particularly the gain from reducing vertical integration (Kopczuk and Slemrod, 2006). Although the GRT undoubtedly generates tax-rate differentials, it is not clear how much firms would respond to the distortion. The efficiency gain can be blurred by real-life complications. First, the tax rate under the broad-based GRT is generally much lower than the tax rate under the VAT. Second, the distortion of the GRT depends on how easily firms can substitute untaxed inputs, such as self-produced inputs, for the taxed intermediate inputs. Third, the VAT system is often not well-

[1] Conventional public economists believe that VAT and sales tax are superior to GRT. Other criticisms of GRT include: 1) the lack of transparency and fairness created by the cascading; 2) the discrimination against new investment and capital-intensive industries; 3) incompatibility with outward-oriented economic policy. Other argument for VAT include that the VAT can enhance efforts to mobilize tax revenue and improve tax administration and compliance.
The third-party reported paper trail improves enforcement and makes tax evasion more diffcult. See Pogue (2007) and Ross (2016) for a review of the pros and cons of GRT and VAT.

designed or well-enforced, as most countries exempt some firms (mostly small firms) and/or some sectors (such as service industries and informal sectors) from the VAT system, which leads to production distortion. Finally, VAT tends to increase tax evasion and informality because the cost of complying with a VAT is higher than that of a GRT, especially for small and medium firm (Hines, 2004; Coolidge, 2012). These real-life complications help explain why the GRT is still common nowadays, especially in low-income countries (Caprettini, 2014), and the GRT has surprisingly resurged in the US in recent years. Moreover, these complications indicate that the efficiency gain from the substitution of VAT for GRT is essentially an empirical issue.

This paper exploits the tax reform that gradually replaced GRT with VAT for service industries after 2012. We study how this tax reform affects firms' outsourcing or vertical integration behavior, resource misallocation, production efficiency, and industrial structure. The reform provides a case that the VAT tax system is extended from the downstream firms to upstream firms, and also a case that the VAT was newly implemented for the whole production chain. Specifically, before the tax reform, the manufacturing industry (typically the downstream firms) was subject to VAT while the service industry (can be both upstream and downstream firms) was subject to GRT. After the tax reform, both industries are subject to the VAT. Based on the predictions from the cascading story, we expect the service industry and manufacturing industries would respond differently to the reform. The available of the firm-level data helps us examine the changes in firm behavior and resource misallocation in both industries. We also examine productivity gains, especially TFP gains, for manufacturing industry, and industrial growth for service industry. Unfortunately, the estimation of TFP for service industry is not feasible.

Since the reform was first piloted in one province and seven service industries in 2012, and extended to other provinces and other service industries later on, we can apply the classical difference-in-difference (DD) framework to estimate the causal effect of the tax reform on service industry. In principle, all manufacturing firms are affected once some service industries become subject to VAT, because every manufacturing firm can purchase and deduct the cost of the service from the treated service industries. However, given that the production linkage between manufacturing industries and service industries are different, the intensity of the influence varies across manufacturing industries when the GRT of a given service industry is

displaced. Therefore, we use the production linkage calculated from the input-output table to proxy the treatment intensity for manufacturing firms and then apply the DD framework.

We find that the GRT-VAT reform significantly increased firms' outsourcing probability and intensity (as measured by the share of outsourcing cost out of sales) for both manufacturing and service industries. Taken transportation service as an example. For every 1 percent increase in the treatment intensity of manufacturing firms, i.e. the production reliance of manufacturing firms on the treated service industry, the GRT-VAT reform increased their outsourcing probability by up to 12 percent and raised the share of outsourcing out of sales by 0.26 percentage points. For service industry, compared with untreated service industries, the probability of outsourcing of the treated service industry increased by up to 15.8 percent and the share of outsourcing out of sales increased by 3.9 percentage points. Moreover, we find that manufacturing firms with higher treatment intensity showed a greater increase in TFP, suggesting that the GRS-VAT tax reform improved production efficiency. We also confirm that service industry experienced an expansion in sales, employment, and investment, due to the tax reform.

The event study results confirm there is no preexisting trend before the tax reform. In addition, the response in the first year of the tax reform is significant and substantial. Nevertheless, the dynamic of the effects varies across service industries. Heterogeneity analyses show that the effect on reducing vertical integration was larger for bigger firms. The tax reform effect on service industry also increased with the production linkage between treated industries and the industry we are interested in. Our robustness confirms that these main results are not driven by the reduction on tax burden, and survive the counterfactual tests (using small firms and the untreated service industries at the end of our sample period).

The finding in our paper is informative for other countries. Although China has experienced remarkable economic growth, the service industry has been lagged behind even when comparing with countries at a similar level of economic development (as shown in figure A.1). The GRT tax system has been considered as one hurdle for the development of service industry, which is one of the two main motivations of the tax reform. However, there was no empirical evidence on how the industry structure has been affected by the GRT, as there was little evidence of GRT on vertical integration. Our study provides the first estimate for the potential growth of service industry after a GRT-VAT reform. In addition, our estimates refer to the efficiency gain when an

incumbent VAT system is extended to cover more sectors. Given that more than 160 countries have adopted VAT in some sectors, the efficiency gain for this kind of reform is more relevant for these countries than all-around tax reform of adopting VAT.

Our study contributes to three lines of the literature. The first one includes the few studies that estimate the efficiency gains of adopting VAT. Most of these studies, such as Keen and Lockwood (2010), Ufier (2014), and Adhikari (2015), use cross-sectional country data to estimate the effect of VAT adoption on total efficiency or revenue gains. Besides the empirical issues of inferring causal effect, these papers do not distinguish the tax regime before the adoption, and only estimate the total efficiency gain that includes gains other than the one from elimination of cascading. The total efficiency gain is more or less a black box and may depend highly on underlying institutional background, such as the tax system before the policy change, tax enforcement capacity, and industrial structure. Therefore, it is worthwhile to focus on the efficiency gain related to vertical integration and resource misallocation because these are better understood theoretically and less attached to institution backgrounds. A few papers exploit policy changes to estimate the effect of adopting VAT. Smart and Bird (2009) and Ferede and Dahlby (2012) consider reforms replacing sales tax with VAT in Canada. Hansen, Miller, and Weber (2017) explores the tax reform that switched from GRT to RST in the marijuana industry in the US. They find that GRT induced vertical integration and the policy change improved efficiency. However, whether the findings for a reform on a small industry can be extend to a large scale reform like the one in China is questionable. Moreover, their reform changed the tax system for the whole chain of the production, which is different from our case of extending the VAT to the upstream industry. Whether a reform from GRT to RST has a similar effect as a GRT-VAT reform is not clear either.[2]

The second line is related to the misallocation of resources. Recent studies highlight that the misallocation of resources can lower aggregate total factor productivity (TFP) substantially in developing countries (Banerjee and Duflo, 2005; Hsieh and Klenow, 2009; Gancia and Zillibotti,

[2] Some studies use computable general equilibrium model (CGE) to estimate the production efficiency of adopting VAT (Gebresilasse and Sow, 2016, …). However, the results generally rely on some unrealistic assumptions. A preliminary working paper by Caprettini (2014) considers the effect of the tax reform that converted two GRTs into two VATs in two sectors on aggregate production of and resource allocation towards these two sectors. He does not consider firm outsourcing behavior, production efficiency, and the influence on other sectors.

2009; Durate and Restuccia, 2010). In China, although various reforms have been implemented to reduce distortions and stimulate rapid growth, resource misallocation is significant and reduces manufacturing TFP by as high as 30% in China (Hsieh and Klenow, 2009; Brandt and Zhu, 2010). In terms of the mechanisms for resource misallocation, the literature has focused on the frictions in factor market, including labor market regulations (Yuan and Xie, 2011; Dong and Xu, 2009) and financial market frictions (Brandt and Zhu, 2010; Song, Storesletten and Zilibotti, 2011). Few studies consider how the tax system affects resource misallocation and firm production efficiency in developing countries. Moreover, the misallocation literature focuses on within-industry misallocation, but the tax system often provides different tax treatment for different industry that result in across-industry misallocation. We complement this literature by considering how the design of the consumption tax system can affect resource misallocation, industry structure, and production efficiency.

The last line of the literature concerns the structural transformation and development of the service industry. Duarte and Restuccia (2010) highlight that structural transformation from manufacturing industry to service industry is essential for productivity growth. The delay in the development of the service industry is a big concern for China's productivity growth, but not well understood. Our study shed some light on this issue and argue that the tax reform from GRT to VAT can boost service industry substantially.

The remainder of this paper proceeds as follows. Section 2 introduces the institution background of the GRT-VAT tax reform in China. Section 3 briefly introduces our data and reports summary statistics for key variables. Section 4 presents empirical methodology and results for both manufacturing industries and service industries. Section 5 estimates the tax reform effect on production efficiency and industrial structure. Section 6 concludes.

2. Institutional Background

Although value-added tax has been the main tax revenue for Chinese government since the early 1990s, it was not introduced in China until 1980. Before 1980, the profit from state-owned enterprises and the industrial and commercial tax (a turnover tax) had been the main source of income of Chinese government. In 1980, the government started to levy VAT on machinery and farm equipment manufacturing industries in Xiangfan, Shanghai, Changsha, Xi'an and Liuzhou cities. In 1984, gross receipt tax, a turnover tax, was introduced to the service industry and VAT

was expanded to more industries.[3] It was not until 1994 that VAT was implemented for all primary and secondary industries and the wholesale and retail service industries. The VAT had been production-type before 2004, which means that firms' investment in fixed assets was not deductible from the tax base. The reform that changes the production-type VAT to the standard consumption-type VAT started a pilot in six manufacturing industries in three northeastern provinces in 2004 and was expanded to all provinces and all industries in 2009. Most service industries were still subject to the gross receipt tax, which does not allow deductions for any input until 2012. Now, similar to many other developing countries, Figure 1 shows that VAT and corporate income tax are the main source of tax revenue in China (Asatryan and Peichl, 2017), accounting for more than 50% of total tax revenue. Gross receipt tax accounts for about 15% of total tax revenue of government before the GRT-to-VAT reform.

Generally speaking, GRT increases firms' tax burden due to the cascading effect, encourages vertical integration, and distorts investment and production efficiency. As a result, VAT becomes more popular both in developed and developing countries (Ebrill et al. 2001; Smart and Bird, 2009; Bird, 2014). The Chinese government started to pilot the GRT to VAT reform in seven ("one+six") service industries in Shanghai in January 2012. The main purpose is to reduce the tax burden and stimulate the development of the service industry and promote specialization between manufacturing industries and service industries. Soon, the reform expanded to another eight provinces in the late of 2012 and to all other provinces in 2013, but it was still restricted to the same "one+six" industries. In 2013 and 2014, another three service industries were covered by the reform. And finally, in 2016, this reform was implemented nationally. As the reform deepened, the GRT-to-VAT reform ultimately was implemented in all the services industry and the national wide level in 2016.

Table 1 gives the details for the rollover of the reform before and after the reform. After the reform of GRT to VAT, service industries get refunds for input and service taxes paid on raw materials and intermediates, which eliminates price distortion and encourages vertical disintegration. Apart from service industries, manufacturing industries are also affected by this reform. Because after the reform, manufacturing industries can get VAT invoice from sellers

[3] More precisely, in 1984, the industrial and commercial tax was split into 4 different kinds of indirect tax: VAT, business tax, product tax, and salt tax. At the same time, profit payment to government was transformed into corporate income tax.

when purchasing service goods as intermediates, and it helps manufacturing industries to claim the same amount of tax return. Thus, it reduces the tax burden for manufacturing firms. Since service goods are not deductible before the reform, manufacturing would integrate some production of service goods in-house to avoid tax. Thus, we would also find more outsourcing inputs of manufacturing firms after the reform.

GRT-VAT make it possible for the deduction of service inputs at different deducted rates, while transportation service input can also be deducted at 7 percent before the reform and 11 percent after the reform against to the service value. Since the previous price is distorted and the deductible tax rate is smaller, it still induces repetitive taxing and vertical integration. Therefore, we should show that outsourcing probability and the ratio of transportation service are increased after the reform of GRT to VAT.

3. Data and Summary statistics

Our analysis is based on a sample data collected by the Chinese State Administration of Tax (CSAT). This data considers all industries and all types of firms. More specifically, the survey applies the stratified sampling based on the equal space sampling of sales. The data includes detailed information on firms' characteristics, such as location, sales, profits, assets, and the number of employees. It also provides detailed information on tax payment, including the VAT tax liability for outputs and VAT tax credit for inputs, the tax return from exporting, cooperate income tax, gross receipt tax, social insurance payment, and other local taxes.

Since the reform of GRT to VAT only affected VAT firms rather than small firms levied simplified VAT (similar to GRT), we drop small firms both in manufacturing and affected service industries and drop firms paid simplified GRT before and after the reform in unaffected service industries. This may lead to sample selection problems, and thus we only consider firms with sale greater than 5 million in the robustness checks. We also drop those whose tax is paid by their parent companies or who remitted tax for branches.

Table 2 presents summary statistic of key variables in this paper, including sale, asset, number of workers, age and value-added per worker in panel A and different chain relations in panel B. Value-added per worker is measured as the amount of value-added per worker, an alternative measurement of firms' productivity. Since it is hard to tell what the value-added for service industry is, we only provide summary statistics for manufacturing industry. Panel B of

table 2 reports ChainRelation_j measuring the reliance degree of industry j on input k.

$$ChainRelation_j = \sum_k DirectCons_{kj} * Treat_k$$

$\text{DirectCon}_{kj}$is the direct consumption coefficient from Chinese Input-Output table in 2007, and Treat_k is the affected service input in the change of GRT to VAT, including transportation input, R&D input and culture and et al. We assume that those that greatly depended on input k are heavily affected compared to those that slightly depend on input k.

The dependent variables are outsourcing probability and outsourcing ratio in this paper. Outsourcing probability is measured as whether firm purchases specific input from other companies, for example, the outsourcing probability of transportation for firm i equals one if it purchases transportation service from other companies, otherwise, the probability equals zero. Outsourcing ratio is measured as the ratio of purchased input normalized by sales. Table 3 reports the summary statistics of outsourcing probability and ratio. There is 25 percent of firms in our sample that outsourced transportation input and only 1 percent of firms purchasing tangible property leasing service from outside. Besides, the average ratio of outsourced transportation service to sale is 0.8 percent, which is 30 percent less than outsourced culture and creative service which is the greatest one. The outsourcing ratio of R&D is 0.17 percent.

4. Empirical methodology and Results

4.1. Manufacturing Industries

We first study the effect switching GRT to VAT on outsourcing behavior for manufacturing industry. Manufacturing firms are able to claim input tax credits on their non-service intermediates outsourcing from other manufacturing firms before and after the 2012 reform and could not claim input tax credits on any service inputs before 2012, but they were able to claim input tax credits on service intermediates of seven affected service industries operating in nine provinces in 2012 and in all provinces in August 2013. Thus the reform has a direct effect on the tax-inclusive cost of service inputs for these affected service industries but no direct effect on the tax-inclusive cost for non-service inputs. Besides, it would also have a greater effect on manufacturing industries that rely more heavily on service inputs compared to those that rely less on service inputs. In sum, the manufacturing firm has incentives to vertically integrate on service inputs to avoid repetitive tax before the reform, and we would expect vertical integration to be

reduced and increasing outsourcing after the reform because VAT eliminates repetitive cost that come from GRT. Since we have credible transaction input data measuring the cost of buying transportation service, research and development service and other service input from other companies, we exam how GRT to VAT affects outsourcing behavior for manufacturing industries.

Firstly, we use the manufacturing raw data to plot the time trend of the outsourcing rate of each affected service industry using manufacturing firms. As shown in Figure 2, the outsourcing rate of every service industry, measured by the ratio of outsourcing service input divided by sales of manufacturing firms, dramatically increases after the year when the GRT to VAT policy implements for VAT firm (the left graph of figure 2). Since the data of the year 2010 is only available for the transportation industry and R&D industry, we explore the time trend of the outsourcing rate from 2010 for these two industries but from 2011 for other service industries. Basically, it can reveal that after the GRT to VAT policy implements in 2012, the manufacturing firms tend to outsource more input. However, as we mentioned before that only the VAT firms are affected by the policy and small firms paying simplified VAT should not be affected, we also show the time trend graph for small firms in the right side of figure 2. We find that the outsourcing ratio did not increase in 2012 that consistent with our expectation.

Secondly, we consider studying the different input outsourcing reactions between high and low exposure (measured by the introduced variable of ChainRelation in above) to the reform. Since the manufacturing industry are affected simultaneously, we use the less exposure industry as our control group. In order to prove the validation of our specification, we should find the high exposure respond heavily than the less exposure group and Figure 3 shed light on it. We divide the manufacturing industry into high exposure industry and low exposure industry according to the variable of ChainRelation. If the value of ChainRelation for one industry is greater than the average ChainRelation across the whole sample, we divided it into high exposure group, otherwise, we divided it into less exposure group. We find that manufacturing industries with higher exposure to the reform show a greater transportation input outsourcing compared to those lower exposure manufacturing industries (as shown in Figure 3) both for transportation inputs and R&D inputs. These findings reveal that the manufacturing industries with higher exposure to the reform have the high incentive to outsource their service input after

the reform to get the benefits of the tax credit. Different provinces have implemented the reform in different month and year, thus we also plot the outsourcing ratio for different provinces. According to the reform stage, we separate the whole country into three groups: Shanghai Province, eight provinces affected after June in 2012, and other provinces affected in 2013. Graphs are shown on the right side of figure 3. Due to the outsourcing from other provinces, we find all three groups respond to the policy in 2012. Besides, we use the median value as the robust test and the conclusion is the same.

Considering the year 2010 data is not available for other service industries, for those industries, we only study the different total service input outsourcing reactions between high and low exposure to the reform using the same method from 2011 to 2015. The result is shown in Figure3, and we also find similar results with the above, which is that the higher total service input outsourcing rate for the manufacturing industries with higher exposure to the reform.

Baseline Regressions for manufacturing industries: Our empirical strategy compares changes in service input outsourcing between 2010 (or 2011) and 2015 across manufacturing firms that were differentially affected by the GRT-VAT reform. The dependent variable is input outsourcing probability or the ratio of the value of outsourcing input divided by the sales of the manufacturing firms per year:

$$Outsourcing_{it} = \beta_1 ChainRelation_j * Post_t + \mathrm{K}\, X_{it} + \delta_j + \eta_c + \rho_t + \varepsilon_{it} \quad (1)$$

Where $\mathrm{ChainRelation_j}$ is a vector of treatment variables, which is the sum of the direct consumption coefficient of the treated service industry k. And Post equals 1 for every year after 2012 that the treated service input industry starting to pay VAT. In our most basic specification, the control variable X includes the age of the manufacturing firms, number of workers (log), asset (log). The variable δ_j and η_c are the industry fixed effects and the city fixed effects, and ρ_t is the year fixed effects. The coefficient β_1 on the interaction term between ChainRelation and Post is the standard difference-indifferences estimator (e.g., Duflo 2001).

Since most of the outsourcing data are available from 2011 except outsourcing transportation and R&D which are available from 2010, we report regression results both during 2010-2015 and 2011-2015. We provide estimations for the outsourcing seven input and the top three important intermediates that are outsourcing of transportation, R&D, and culture and

creative industry.

Regression results reveal a high and statistically significant correlation between GRT-VAT reform and outsourcing probability in outsourcing input for manufacturing firms (Table 4). All the regressions have control variables listed in the equation (1) and the standard errors are clustered in city-industry pair level. We show the results of estimating equation (1) where the dependent variable is the outsourcing probability. Panel A, B, and C are the regression results with different fixed effect. In column 1 of this table, the dependent variable is outsourcing transportation and the estimation controls time fixed effect, city fixed effect and industry fixed effect respectively. The coefficient on the interaction term suggests that the outsourcing probability increases 2.46 percent for every 1 percent increase in the exposure. The interpretation of this coefficient that the outsourcing probability nearly increase 2.7 times compared to the average outsourcing probability for changing 1 standard deviation. The specification shown in column 1 of Panel B add city-year pair fixed effect instead of city and year fixed effects. Compared to the Panel A, the results are smaller but still positive, indicating city-year trend capture some effect of the effect. The specification reported in column 1 of Panel C control city-industry pair fixed effect, and the coefficient is significantly positive and the effect size is similar to Panel A, suggesting that the reform of GRT-VAT reform actually influence firms' decision on outsourcing or insourcing for intermediates.

The dependent variable is outsourcing probability of R&D for manufacturing industry of column (2) in table 4, and the coefficient is significantly positive, indicating the outsourcing probability of R&D increase 10 percent for every 1 percent increase in exposure after the reform. Panel B and C are based on the same regression equation with different fixed effect. The coefficients are changing little with different fixed effect, indicating there are no serious missing variable problems. The coefficients are much greater in column (2) than column (1), which suggest that intermediates of R&D are more sensitive to the reform of GRT to VAT and indicate more vertical integration and distortion before the reform comparing it for transportation intermediates.

In column 3 to 6, we report regression results using the sample from 2011 to 2015 for transportation, R&D, culture and creative industry, and seven intermediates. We see that the coefficients are significantly positive, which are consistent with the former results. For culture

and creative industry and seven intermediates, the outsourcing probability increases 0.84 percent and 0.631 percent respectively for every 1 percent increase in exposure. Different intermediates are affected differently, which may due to the capital intensity. We think that R&D and transportation are more capital intensive than culture and creative industry and other industries. Since the GRT-VAT reform makes the tax from purchasing capital goods deductible but not from labor, we would believe capital intensity industries are affected heavily comparing to the labor-intensive industry. These results are consistent with the literature on incomplete contract (Antras, 2003).

Because the classification of outsourcing intermediates is coarser, we can not know the change of outsourcing probability for a narrow defined intermediates and thus the estimation may be underestimated. For instance, a company provide water transportation by itself and outsource land transportation, but it purchases both water and land transportation from other companies after the reform. Since our data just have outsourcing probability of transportation, the change of outsourcing probability for water transportation could not be measured. Thus, our estimation would be underestimated. Besides, the increasing probability of outsourcing may be driven by scale expanding due to the declining tax burden for manufacturing firms.

To address these concerns, we use the outsourcing ratio measured by the ratio of outsourcing value to sale as our alternative dependent variable, examining whether outsourcing ratio increases after the reform of GRT-VAT. We present results in Table 5. Similar to Table 4, we report results with different fixed effects and different time period. The results of Table 5 reveal a high and statistically significant correlation between GRT-VAT reform and outsourcing ratio, which are consistent with those of the outsourcing probability, indicating that the reform of GRT-VAT increase outsourcing value. In column (1) and (2) of table 5, the dependent variables are outsourcing ratio of transportation and R&D and the coefficients are 0.132 and 0.257 respectively, suggesting that the outsourcing ratio increases 15.4 and 91.8 percent compared to the sample mean for every 1 standard error increase in the exposure respectively. For seven intermediates, the outsourcing ratio increases 0.045 percent for 1 percent increase in exposure and increase 7.9 percent comparing to the sample mean for increasing1 standard deviation in exposure.

We can draw the conclusion that the reform of GRT to VAT increases the outsourcing

probability and outsourcing value of service intermediates for manufacturing industry, which is consistent with the tax theory that GRT lead to vertical integration. Tax system affect firms' production structure and give the government incentives to use tax instrument to enhance economy.

Event study for manufacturing industries: The above approach compares the outsourcing probability and ratio after the reform with the outsourcing probability and ratio before the reform. Therefore, unobserved characteristics after the reform in a city and industry that are fixed over time will not affect our results. However, a potential challenge to our estimation strategy is that the differential effects among industries with different reliance on service input may be driven by the preexisting difference in the time trend of outsourcing probability and ratio. To address this issue, we use event study allowing $\beta_1$to vary across industries with different reliance on service input to assess the concern by showing the time trend before and after the reform, using the first year before adopting the reform as the baseline.

$$Outsourcing_{it} = \sum_{t=-2}^{3} \beta_t Chain\,\mathrm{Re}lation_j * year_t + \kappa X_{it} + \delta_{j'} + \eta_c + \rho_t + \grave{o}_{it} \qquad (2)$$

Figure 4 and 5 are graphs of time trend of β_t for different outsourced industries, and the dependent variables are outsourcing probability and ratio respectively. The y-axis is the coefficients of $ChainRelation_j * \mathrm{year}_t$, measured the treatment effect before and after the adoption of GRT to VAT reform. The x-axis is the time relative to the implementation of the GRT to VAT. The dashed line corresponds to the 95 confidence interval of the coefficient estimates. The figures show that industries with different reliance on service input have a similar pattern on outsourcing probability and ratio before the reform, but outsourcing probability and ratio of the high reliance group are remarkable larger after the adoption. Manufacturing industries respond differently to outsourcing behavior between transportation input and R&D input. For outsourcing behavior of transportation input, manufacturing firms respond much in the first year and the effect is decreasing after the first year, but for outsourcing of R&D input, firms respond heavily in the first year and the effect is increasing after the first year.

4.2 Service Industry

As we mentioned above, manufacturing and service industries are affected differently both in theoretical prediction and empirical specification. In this part, we study the effect switching

from GRT to VAT on outsourcing for service industries. Firstly, we provide evidence of different time trends of outsourcing probability and ratio for both control and treated group. Then we use empirical methods to identify the effect of switching from GRT to VAT on outsourcing probability and ratio.

Importantly, before the change, firms in the service industry paid the GRT for every transaction implying firms paid the tax-inclusive price and cannot claim tax return on input; but after the reform firms remitted VAT and they were able to get credit on intermediates and service inputs. Repetitive taxation of GRT lead to vertical integration, thus we would expect the affected firms have a greater outsourcing probability and outsourcing value after the reform. Because service industries were affected differently across the sample period, those industries that affected by the reform before 2015 are considered as the treated group, and those affected in 2016 are considered as control group. seven industries in Shanghai and other eight provinces are treated in 2012, and seven industries in remaining provinces are treated in 2013. Since the provinces are affected in different time, we can plot the graph of different provinces to show the different responses.

Figure 6 presents the graphs of time trend of outsourcing ratio for service industries. Since different groups are affected in different time, we treat the affected year as time zero, the year before the affected year as -1 and so on. Graphs on the left side of figure 6 separate the service industries into treated group and control group, and we find the outsourcing ratio of transportation and R&D for the treated group increased sharply in the first year that affected by the reform. The pattern is not clear of outsourcing ratio of seven due to the missing value problem probably. On the right side of figure 6, we limited the sample to seven industries and study the different response when different provinces are affected in different time. We separate seven industries into three groups: Shanghai group treated in Jan. 2012, eight provinces group treated in the second half of 2012 and remaining provinces treated in 2013. Graphs on the right side of figure 6 find that Shanghai group started to respond in 2012 and the other two groups started to respond in 2013, which consistent with our expectation.

Baseline regression for service industries: Our empirical strategy compares changes in outsourcing probability and outsourcing ratio between 2010 and 2015 across service industries that were differently affected by the reform of GRT to VAT. The dependent variable

($\text{Outsourcing}_{\text{it}}$) includes outsourcing probability and ratio:

$$Outsourcing_{it} = \beta_1 Treat_{jc} * Post_t + \beta_2 Treat_j + \kappa X_{it} + \delta_{j'} + \eta_c + \rho_t + \grave{o}_{it} \quad (3)$$

Where i indexes each service firm, j indexes 4-digital industry, j' indexes 3-digital industry, c indexes city and t indexes year. $Treat_{jc} = 1$ if the industry j in city c is affected by the reform before 2015 which are listed in table 2. Similarly, $Post_t = 1$ if the firm was affected in year t. X_{it} are control variables including asset, number of workers and age. δ_j, are 3-digital industry fixed effects, and η_c are city fixed effects, $\rho_t$are the year fixed effects, and ϵ_{it} is the error term. The coefficient β_1 on the interaction term between $\text{Treat}_{\text{jc}}$and Post_{t} is the standard different-in-different estimator.

Regression results show a high and statistically significant correlation between tax reform of GRT to VAT and outsourcing probability (Table 6). Taken outsourcing probability of transportation as an example, GRT to VAT reform increase outsourcing probability by 12.9 percent compared to the unaffected firms. Treatment effect for R&D is smaller than transportation but still, account for 7.8 percent increase in outsourcing probability. Due to the data limitation, we report regression results between 2011 and 2015 and the coefficients are significant and robust. Standard errors are clustered at city-industry pair level. Coefficients stay highly significant and consistent when adding different fixed effect. Similarly, GRT to VAT reform has a significant effect on outsourcing ratio for service industries (Table 7). The ratio of transportation input to sale for affected firms increases 2.1 percent and the ratio of R&D input increase 0.6 percent after the reform comparing with the unaffected firms. Results are robust when we limit data from 2011 to 2015 and adding different fixed effect. Therefore, we conclude that GRT to VAT reform increase outsourcing probability and outsourcing ratio for affected firms.

Event study for service industries: A potential challenge to the difference-in-difference strategy is that the differential effects between treated and untreated group may be driven by the preexisting difference in the time trend of outsourcing probability and ratio. To address this issue, we use event study allowing $\beta_1$to vary across treated and untreated to show the time trend before and after the reform, using the first year before adopting the reform as the baseline.

$$Outsourcing_{it} = \sum_{t=-4}^{3} \beta_t Treat_{jc} * year_t + \alpha Treat_j + \kappa X_{it} + \delta_{j'} + \eta_c + \rho_t + \grave{o}_{it} \quad (4)$$

Figure 7 and 8 are graphs of time trend of β_t for different outsourced industries. The y-axis is the coefficients of $Treat_{jc} * year_t$, measured the treatment effect before and after the adoption of GRT to VAT reform. The x-axis is the time relative to the implementation of the GRT to VAT. The dashed line corresponds to the 95 confidence interval of the coefficient estimates. The graphics show that the difference between the treated group and untreated group on outsourcing probability and ratio are not significant before the adoption, but outsourcing probability and outsourcing ratio of the treated group are remarkable larger than untreated group after the adoption.

4.3 Robustness checks

The results may be attributed to some other reasons such as tax deduction caused by the GRT to VAT reform; measurement error of the used weight, general effect, treated year problem and sample selection bias. In this part, we provide robust checks to further explore the effect of GRT to VAT on outsourcing behavior.

Declining tax burden and scale expanding: Our results may be driven by scale expanding because the reform also reduces the tax burden on firms which accelerated firms to expand the scale and increased firms' probability in outsourcing. We assess this problem in two ways. First, the ratio of outsourcing input to sale is our alternative dependent variable which should not respond to the scale expanding. But we still find a significant positive effect of the reform on outsourcing ratio, implying that our main results are not driven by scale expanding. Second, we control tax burden measured by the ratio of the sum of value-added tax and gross receipt tax to sales. Results are shown in table 8, which are consistent with our conclusion. Literature shows that financial constraints are also an important factor in affecting firms' decisions on outsourcing. The financial constraint may affect the time of the government of adopting the policy, thus we should control the inner financial constrain measured by the interest fee to sales. The results are presented in table 9 which consistent with our baseline estimations.

Endogenous of the control variables: People may worry about the endogenous of the control variables because the reform of GRT to VAT may affect firms' decision on investment and firm scale, thus affect the amount of asset and the number of workers. This would happen if

a firm in a high-exposure group or in treated group invests more after the reform, then the control variable of the asset is endogenous which would bias the estimators. In response to this concern, we respectively divide control variables of asset and worker into five groups and control these group dummies instead of controlling asset and workers to mitigate the endogenous problem. The estimation results are presented in table 10, which are significantly positive in both manufacturing and service industry. Thus the endogenous problem does not influence our estimations.

Weights problem: In the main specification, we weight statistics and regressions by stratified sampling weight in order to provide whole economic relevant estimates. There may be measurement error in calculating the sampling weight. Table 11 presents regressions with no weights using both key investigation firms and survey firms. Unweighted regression lead to modestly larger estimates both for manufacturing industry and service industry in outsourcing probability and outsourcing ratio. The results are robust when adding different fixed effect and we only present results with time fixed effect and city-industry pair fixed effects in table 11.

General equilibrium effect: we have not considered potential general equilibrium effects in our main specification, which are subsumed into time fixed effect. Data from NBS shows that the aggregate price index of transportation was slight declining after the reform possibly due to the increasing new enters lead to tough competition and relatively lower price. This may bias our results. In response to the concern, it is comforting that the control group in service industry presents constant outsourcing ratio during the sample periods instead of declining or increasing outsourcing ratio after the reform, which would indicate that the declining price would not heavily change the outsourcing behavior of control group and thus the biased effect is likely small. In addition, the declining price would not affect the results with dependent variables of outsourcing probability. For the results of outsourcing ratio, this effect may bias our results in downward because the outsourcing value is underestimated due to the declining price. This strength our results on the other side. Therefore, general equilibrium effect would not quantitatively important and our estimations are likely an underestimate of the true effects.

Alternative definition of the treated year: As an alternative way to define actual treated time for treatment group, we assume the treated time is in the next year if the industry is affected in the second half of the year. As graphs on the right side of figure 6 show that seven industries

in eight provinces respond in 2013 rather than in 2012. Table 12 is the regression results with year fixed effect and city-industry fixed effect. Outsourcing probability and ratio results are shown in the panel A and B respectively. Standard errors are clustered at city-industry level. Results are positive and robust.

Bunching problem of small firms: One potential problem with baseline regression is that firm choose to pay VAT voluntarily when sales is less than a threshold that may cause sample selection problem. Besides, we drop small firms paid simplified VAT after the reform, but we cannot drop small firms that have a high probability to pay simplified VAT before the reform. Then our results may be biased. In order to solve the problem, we drop firms with sales less than 5 million for manufacturing firms and 50 million for service firms that are the VAT threshold for them. Table 13 reports the regression results. The estimation are consistent.

4.4 Placebo test

Small firm: As we mentioned above, only the VAT firms are affected by the reform that both manufacturing firms and service firms paid VAT are able to claim tax return on service input after the reform, but small firms paid simplified VAT still cannot credit input tax. Thus, we can use small firms to test the different of outsourcing probability and outsourcing ratio between treated industries and control industries after the reform, and we expected the coefficient of the interaction is insignificant. Table 14 and 15 are the results for small firms in manufacturing industries and service industries respectively. Almost all the coefficients are insignificant and implying that our results are not owning to other policy change that happened in the same year.

Constructive labor service: Constructive labor service industries don't implement the reform of GRT to VAT until 2016, thus as a placebo test we can explore the difference of outsourcing probability and the ratio of constructive labor industries between treated and control group by assuming the policy time is in 2012, 2013 or 2014. We expect the coefficients of the interaction term are insignificant. Results are presented in table 16 and 17, which are insignificant consistent with our expectation.

4.5 Heterogeneous effects

In the previous section, we have identified the significant positive relationship between the GRT to VAT reform and outsourcing. In this part, we present some further evidence to shed light on the heterogeneous effect that who outsource more after the reform. We provide evidence form

firm size and exposure intensity for service industry.

Firm size: Firm size is one of the important factor that affects firms' decision on outsourcing Generally, firms with large size are more likely to be productive firms and can manage entry cost and bring economic scale, thus have great probability in outsourcing. We conduct exercises both for manufacturing and service industry. We use the triple difference method and the estimation are listed in table 18. Panel A of table 18 are the regression results for manufacturing industry with different fixed effects. It is found that the interaction term of firm size and chain relation index and post is significant positive both for outsourcing transportation and R&D service, suggesting that larger firms are more sensitive to this reform. But the estimation of column 3 is not significant. Panel B of table 18 is the estimation for the service industry, and we have the similar results.

Exposure intensity: Since we have treated industry and control industry that are not be affected before 2015, we can use the exposure to estimate the heterogeneous effect. Using the DDD specification method, we test whether the high exposure industries response more. The estimations are presented in table 19. The coefficients of the interaction terms are significantly positive, implying those with high exposure are more likely to outsourcing.

5. Production Efficiency and Industrial Upgrading

5.1 Production Efficiency

We have found that the manufacturing firms tend to outsource more input after the GRT to VAT reform. Considering the productivity improvement is the natural results of this kind of outsourcing for the manufacturing firms and it is also the reform target for the government. Then, we will explore the influence of the GRT to VAT reform on the manufacturing firms.

Firstly, we study the differences of time trend of manufacturing firms' TFP between high exposure and low exposure to total service input. We use the estimated production coefficients from Brandt et al. (2017) and using the TFP estimation method introduced by Ackerberg et al. (2016), we calculate the TFP for firms in manufacturing industries. From the figure 9, we can see clearly that the manufacturing firms with the high exposure possess the higher TFP in every year compared with the low exposure group, which is consistent with what we predict.

Secondly, based on the result of the differences between the two groups, we consider on

conducting the regression to investigate the influence of GRT to VAT policy on the productivity for the manufacturing firms. Since the reform also affects firms' tax burden, we control the tax liability of each firm to alleviate the concerns. We find the distribution of value added in 2015 is totally different from other years which lead us to doubt the validity, thus the specification only uses the data from 2009 to 2014 in this part which provide us more data to check the time trend before reform. As a robust check, we use the labor productivity measured by the ratio of value-added to number of workers as a complementary variable for TFP. The Firm-level regressions indicate that both TFP and labor productivity of the manufacturing firms have improved significantly much more in the industries heavily rely on the service input (Table 20). The estimated coefficients imply that the reform of GRT-VAT increases TFP by 2.134 percent as 1 percent increase in exposure. To be consistent with the above period, we also report the sample from the year 2010. The interaction coefficient indicates that the TFP of the manufacturing firms is increased after the implementing of GRT to VAT policy. Results are robust with different fixed effects.

One of the concerns is that the production parameters that we borrowed from Brandt et al. (2017) which are estimated by using the data from 1998 to 2007, while the time of our estimation is from 2009 to 2014. There would be measurement error when the technology changes along the time. In order to assess this concern, we provide estimation with labor productivity as an alternative dependent variable. The results of the labor productivity test are similar but much bigger than the results of TFP, which indicates that the influences of GRT to VAT policy on the labor productivity of the manufacturing firms are significantly positive and much greater than the influences of the TFP.

5.2 Industrial Upgrading

The former results show that the reform of GRT to VAT promote specialization and enhance production efficiency both for manufacturing and service industries, which implies the development of the service industry after the reform. In this part, we provide evidence to show that the service industry has expanded after the reform, which has great meaning for other countries by adopting better tax system to upgrade industrial structure.

We first check whether the sales of service firm increased after the reform comparing to the unaffected firms. Based on DD regression, the results reveal a high and statistically significant

correlation between GRT-VAT reform and the sales of service firms. Column 1-3 of table 21control different fixed effects and the standard errors are clustered at city and industrial pair level. One of the potential problems is that the scale expanding of the service industries would be affected by the reduced tax burden. Therefore, in column 4, we control the tax burden of each firm, and the result is also significant positive which is consistent.

In addition to the firm sale, we further check whether the reform improves the industrial structure by increasing the ratio of service sale to GDP in the experimental cities. We use the data from 2009 to 2012 in order to take the advantage of the stage change. We assume that the reform would increase the ratio of service output in GDP comparing to the unaffected control group. The estimation equation is:

$$\left(\frac{sales\ of\ six+one}{total\ sales}\right)_{ct} = \beta Treat_{c,2012} * Post_t + \gamma X_{ct} + \eta_c + \rho_t + e_{ct} \qquad (5)$$

Where c represent city, and t is time. $\frac{sales\ of\ six+one}{total\ sales}$ measures the ratio of sales seven intermediates to total sales of city c in year t. $Treat_{c,2012}$ is the treated city, and we have three measurements for it. The other variables are the same as the former regression equation.

The estimations are shown in table 22. In column (1), the treated group is those provinces that affected in 2012 and the control group that those affected in 2013. The coefficient is not significant which may due to that some province are affected after October. But firms need time to adjust, the treated group may not respond in 2012. In column 2 of table 22, the treated groups are those that affected before October, and the control groups are those affected in 2013. We find that the reform of GRT-VAT has a positive effect on the ratio of seven intermediates to total sales. The treated province in column 3 is Shanghai province and the control group are those affected in 2013, and the estimation is also significantly positive, suggesting that the GRT to VAT improve the industrial structure in China.

6. Conclusions

Tax type plays an important role in determining production structure and efficiency. Most developed and developing countries have adopted VAT recently except that almost all states in America adopted retail tax, while some developing countries still collect GRT from firms. Literature reach consensus that GRT lead to repetitive tax and distortion, but there is little

empirical evidence to prove it. This paper has used the reform switching from GRT and VAT as a natural experiment to exam the effect of the reform on outsourcing behavior for manufacturing and service industries and further explore the effect on production efficiency. Data from Chinese Tax Administrative indicate that replacing GRT with VAT has a strong and significant effect on outsourcing probability and outsourcing ratio. Taken transportation service input as an example, GRT-VAT reform increases outsourcing probability by up to 12.02 percent for every 1 percent increase in exposure for manufacturing firms and 15.8 percent for affected service firms comparing to unaffected service firms, and boosts the share of outsourcing out of sales amount by up to 0.26 percent for every 1 percent increase in exposure for manufacturing firms and 3.9 percent for affected service firms comparing to unaffected service firms respectively These results suggest that the reform of switching GRT to VAT encourages specialization and improves production efficiency and industrial structure.

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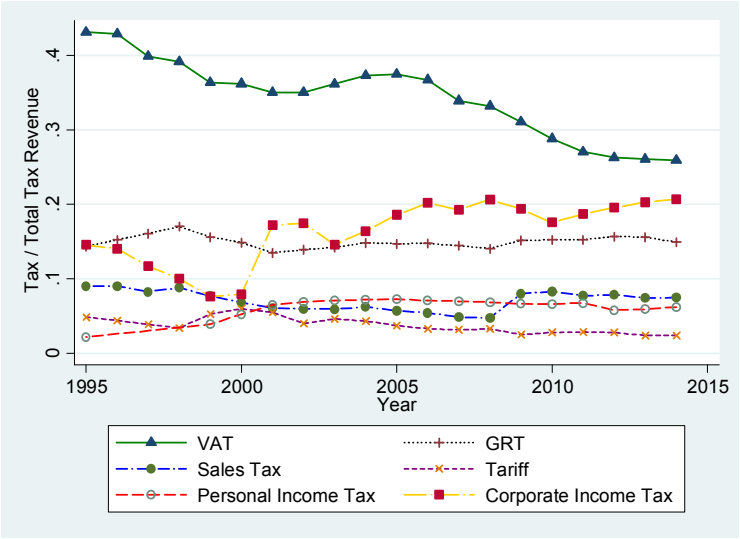
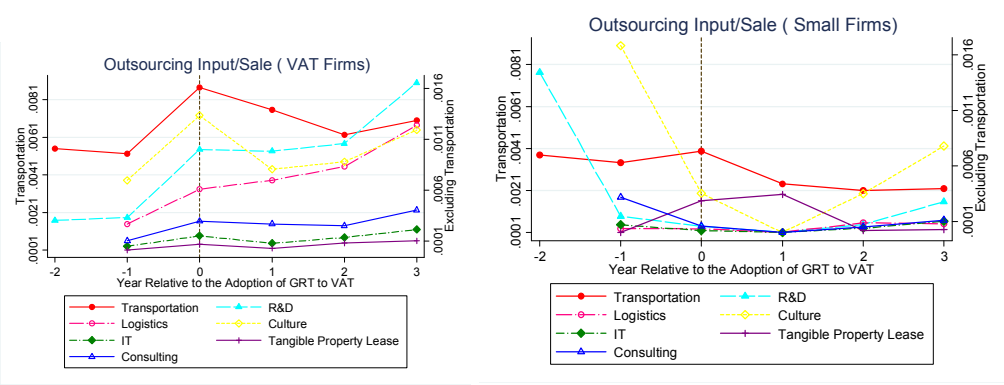
Figure 1: Time Trend of Different Tax Ratio in China



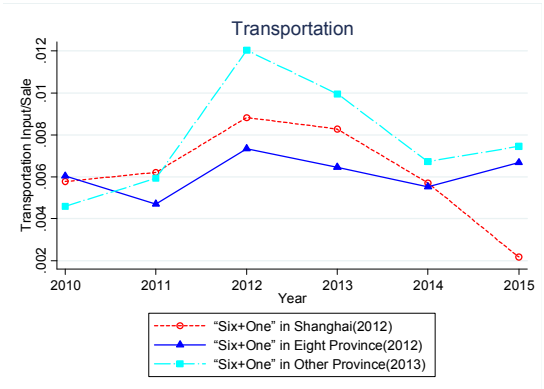
Note: Data is from NBS including all province in china from 1995 to 2015 and separate into 6 types according to the tax type: VAT, GRT, Sale tax, tariff, personal income tax and corporate income tax. For example, VAT share is measured as the ratio of VAT income to total tax income.

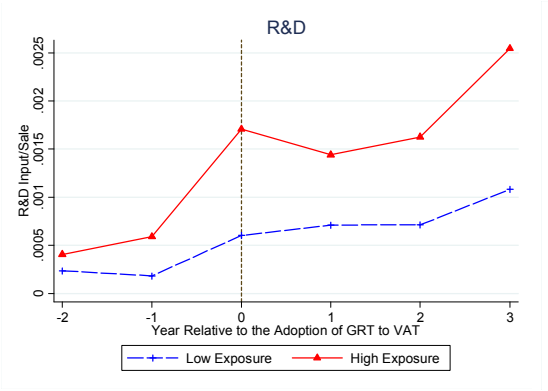
Figure 2. Manufacturing: Time Trend of Different Outsourcing Input /Sales

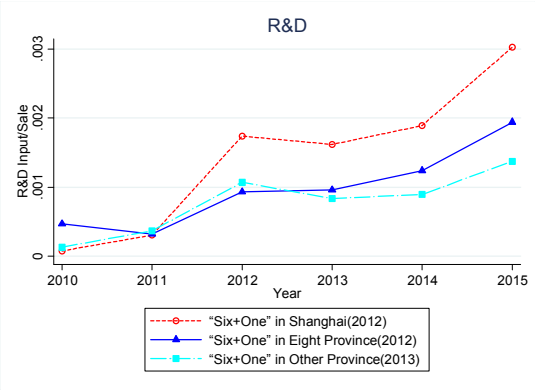


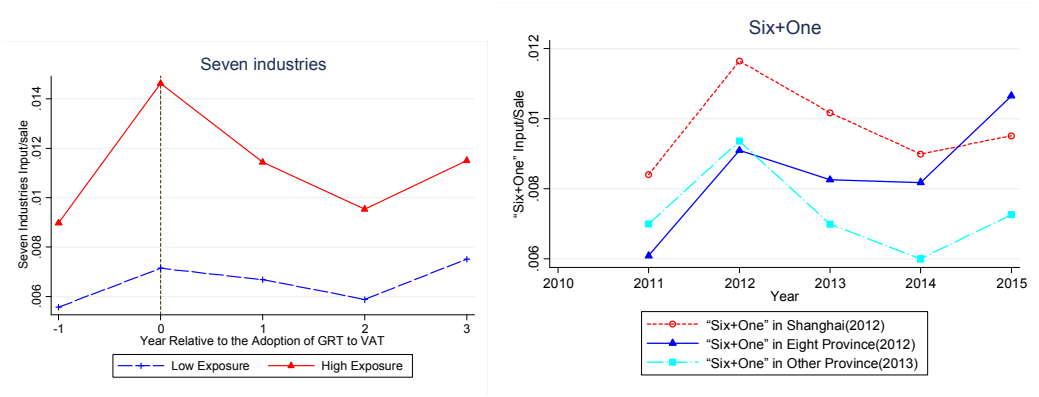
Notes: This graph shows a plot of the mean value of outsourcing ratio against time from 2010 to 2015 for manufacturing industries including: transportation service, R&D service, logistics service, culture and creative service, information and technology service, tangible property leasing service and consulting service.

Figure 3. Manufacturing: Heterogeneous Response on Outsourcing Ratio



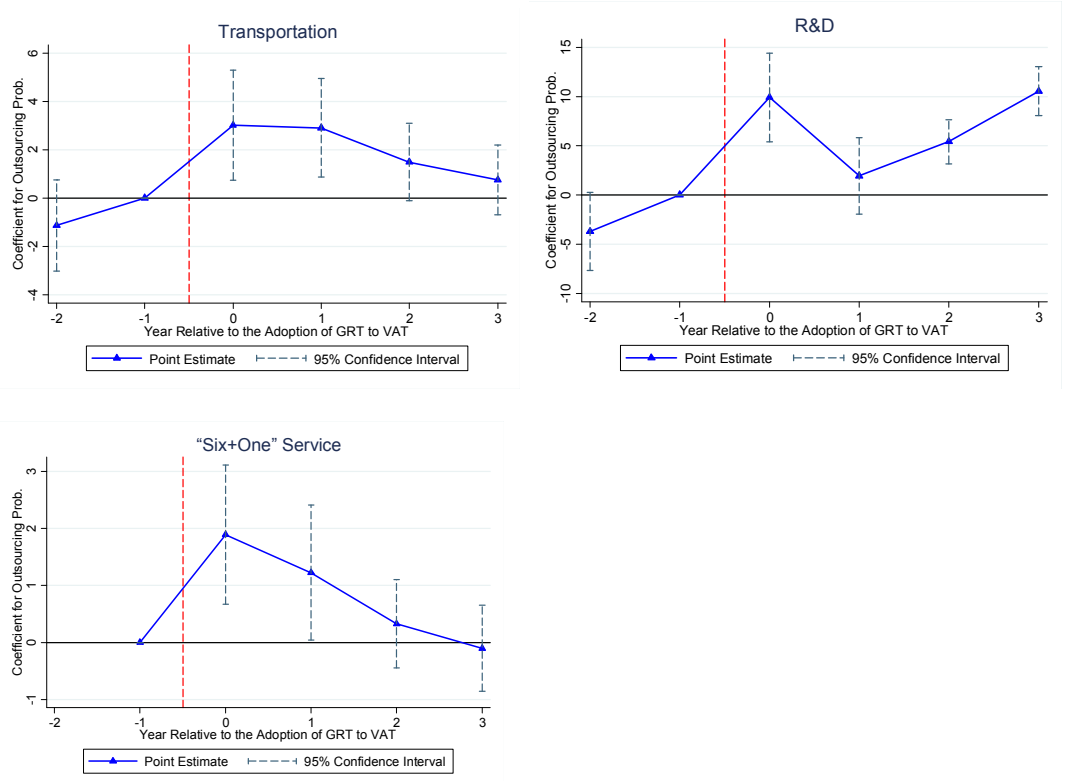






Note: This graph shows a plot of the mean value of outsourcing ratio against time from 2010 to 2015 for high exposure and low exposure groups. The "High Exposure" group relies heavily on specific service input and a "Low Exposure" group slightly rely on specific service input. The vertical black line is the policy year for manufacturing firms. y axis is outsourcing input over sales. There are three types of service input: 1) outsourced transportation ratio; 2) outsourced R&D ratio; 3) outsourced seven input ratio.

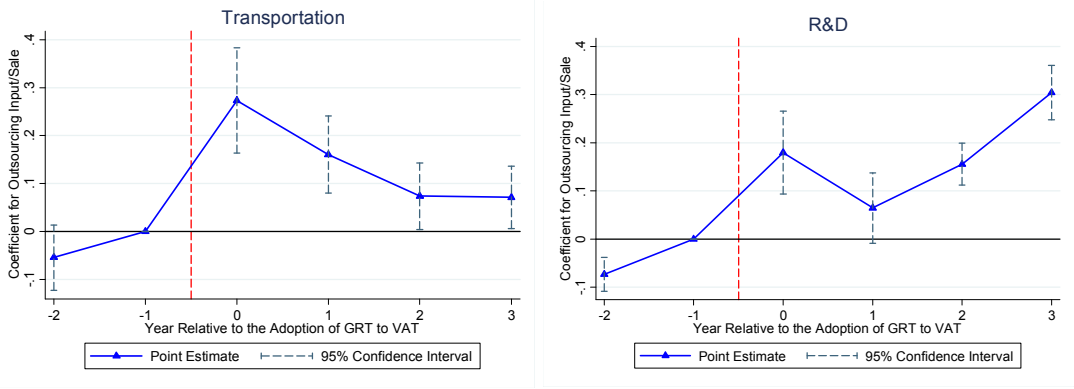
Figure 4. Manufacturing: Event Study Results on Outsourcing Probability

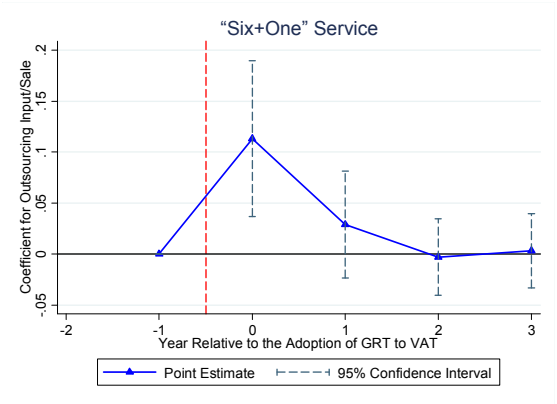


Note: This graph shows a plot of coefficient of outsourcing probability against time (year) from 2010 to 2015 for manufacturing industries. This is a conditional plot after running the event regression specification. Based on Autor, Donohue and Schwab(2006) and Serfling(2016), we regress outsourcing probability on dummy variables indicting the year relative to the reform get the relation between the adoption of GRT to VAT on outsourcing probability. The detailed estimation equation is in the following:

$$Outsourcing_{it} = \sum_{t=-2}^{3} \beta_t Chain\,\mathrm{Re}lation_j * year_t + \kappa X_{it} + \delta_j + \eta_c + \rho_t + \grave{o}_{it}$$

Figure 5. Manufacturing: Event Study Results on Outsourcing Ratio

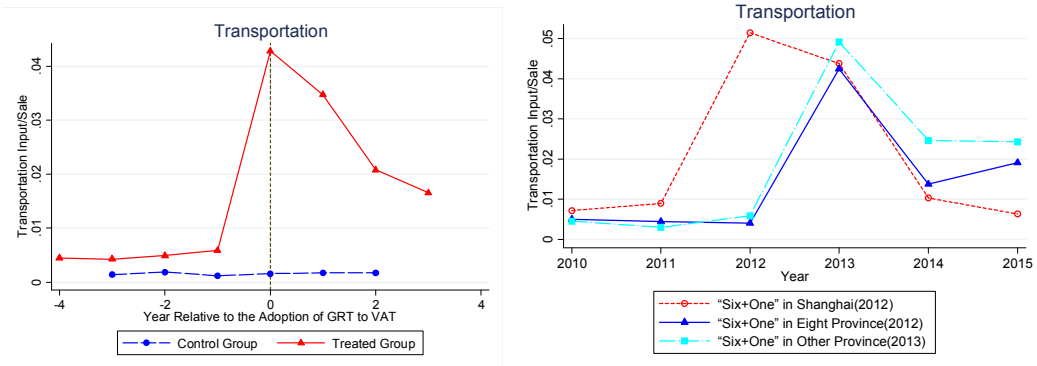


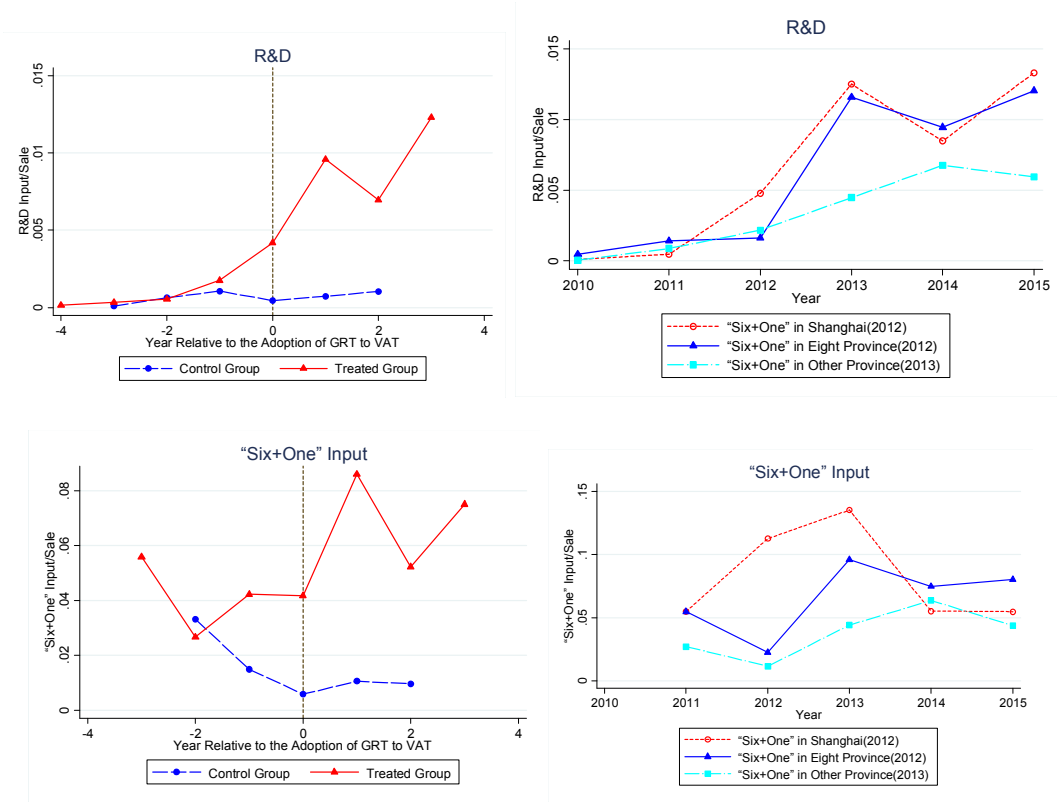


Note: This graph shows a plot of coefficient of outsourcing ratio against time (year) from 2010 to 2015 for manufacturing industries. This is a conditional plot after running the event regression specification. Based on Autor, Donohue and Schwab(2006) and Serfling(2016), we regress outsourcing ratio on dummy variables indicting the year relative to the reform get the relation between the adoption of GRT to VAT on outsourcing probability. The detailed estimation equation is in the following:

$$Outsourcing_{it} = \sum_{t=-2}^{3} \beta_t Chain\,\mathrm{Re}lation_j * year_t + \kappa X_{it} + \delta_{j'} + \eta_c + \rho_t + \grave{o}_{it}$$

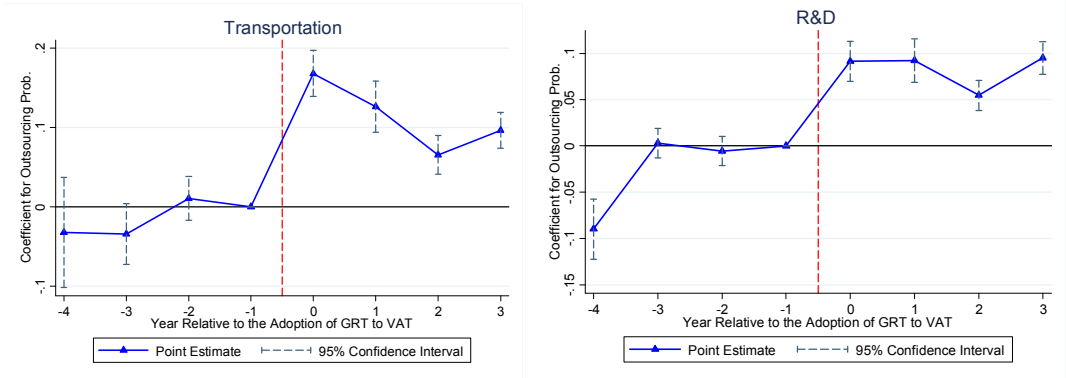
Figure 6. Service Industries: Time Trend of Outsourcing Ratio

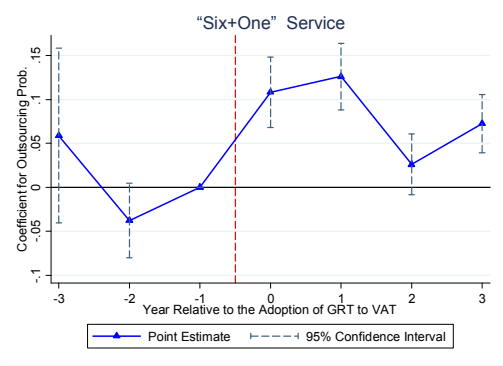




Note: This graph shows a plot of the mean value of outsourcing ratio against time from 2010 to 2015 for treated and control for service industries. The vertical black line is the policy year for service firms. y axis is outsourcing input over sales. There are three types of service input: 1) outsourced transportation ratio; 2) outsourced R&D ratio; 3) outsourced seven input ratio. Graphs in the left side separate the sample into treated and control group. Graphs in the right side separate seven industries into three groups: Shanghai group treated in Jan. 2012, eight provinces group treated in the second half of 2012 and remaining provinces treated in 2013.

Figure 7. Service Industry: Event Study Results on Outsourcing Probability

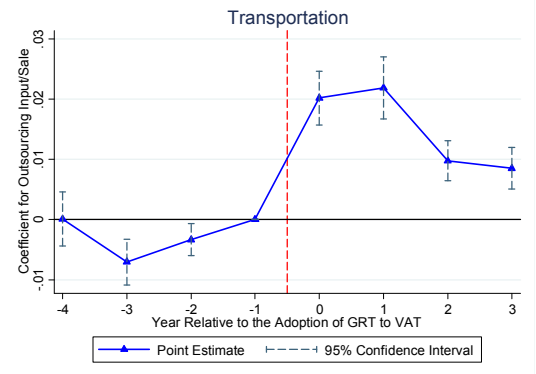


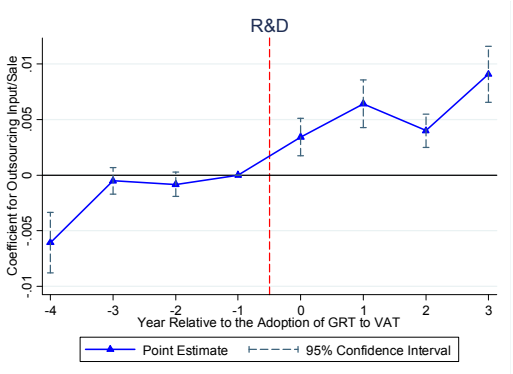


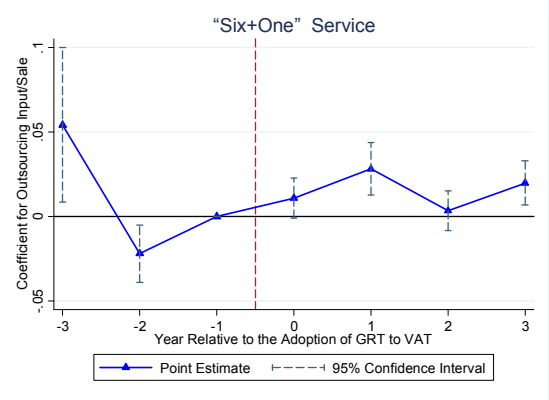
Note: This graph shows a plot of coefficient of outsourcing probability against time (year) from 2010 to 2015 for service industries. This is a conditional plot after running the event regression specification. Based on Autor, Donohue and Schwab(2006) and Serfling(2016), we regress outsourcing probability on dummy variables indicting the year relative to the reform get the relation between the adoption of GRT to VAT on outsourcing probability. The detailed estimation equation is in the following:

$$Outsourcing_{it} = \sum_{t=-4}^{3} \beta_t Treat_{jc} * year_t + \alpha Treat_j + \kappa X_{it} + \delta_{j'} + \eta_c + \rho_t + \grave{\upsilon}_{it}$$

Figure 8. Service Industry: Event Study Results on Outsourcing Ratio







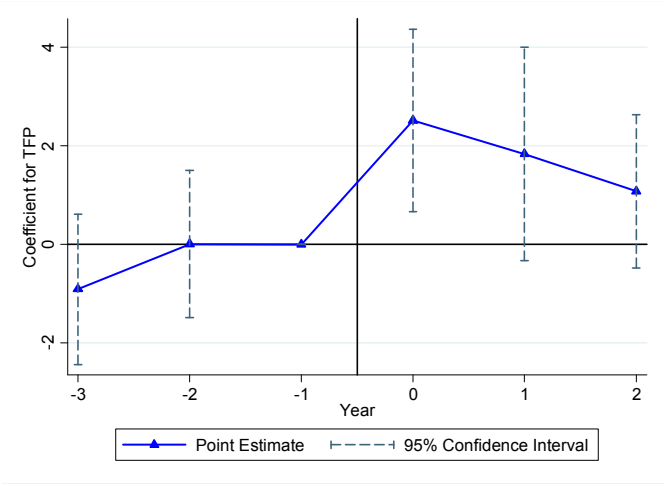
Note: This graph shows a plot of coefficient of outsourcing ratio against time (year) from 2010 to 2015 for service industries. This is a conditional plot after running the event regression specification. Based on Autor, Donohue and Schwab(2006) and Serfling(2016), we regress outsourcing ratio on dummy variables indicting the year relative to the reform get the relation between the adoption of GRT to VAT on outsourcing ratio. The detailed estimation equation is in the following:

$$Outsourcing_{it} = \sum_{t=-4}^{3} \beta_t Treat_{jc} * year_t + \alpha Treat_j + \kappa X_{it} + \delta_{j'} + \eta_c + \rho_t + \grave{o}_{it}$$

Figure 9. Manufacturing: Time Trend of Production efficiency

Note: This graph shows a plot of the mean value of production efficiency against time from 2009 to 2014 for high exposure and low exposure groups. The "High Exposure" group relies heavily on specific service input and a "Low Exposure" group slightly rely on specific service input. The vertical black line is the policy year for manufacturing firms in 2012. y axis is TFP.

Figure 10. Manufacturing: Event study of Production efficiency



Note: This graph shows a plot of coefficient of TFP against time (year) from 2010 to 2015 for manufacturing industries. This is a conditional plot after running the event regression specification. Based on Autor, Donohue and Schwab(2006) and Serfling(2016), we regress TFP on dummy variables indicting the year relative to the reform get the relation between the adoption of GRT to VAT on outsourcing ratio. The detailed estimation equation is in the following: $TFP_{it} = \sum_{t=-4}^{3} \beta_t Treat_{jc} * year_t + \alpha Treat_j + \kappa X_{it} + \delta_{j'} + \eta_c + \rho_t + \grave{o}_{it}$

Table 1. The Timetable of GRT-to-VAT Reform

Start time	Industries	Province	Being treated (Baseline)
Jan.2012	one+six industries	Shanghai	t>=2012
Sep.2012	one+six industries	Beijing	t>=2012
Oct.2012	one+six industries	Jiangsu, Anhui	t>=2012
Nov.2012	one+six industries	Fujian, Guangdong	t>=2012
Dec.2012	one+six industries	Tianjin, Hubei, zhejiang	t>=2012
Aug.2013	one+six industries	All province	t>=2013
Aug.2013	Radio, film and television services	All province	t>=2013
Jan.2014	Railway transportation; Postal services	All province	t>=2014
June.2014	Telecom services	All province	t>=2014
May.2016	Construction; Real estate; Finance; Lifestyle services	All province	t>=2016

Note: In the term of "one+six," one refers to Land, water, air and pipeline transportation industry and six refers to six modern service industries, including R&D and technical services, IT (information technology) services, Cultural & innovation services, Logistics auxiliary services, Tangible asset leasing services, and Consulting and attestation services.

Table 2. Summary Statistic for Key Variables

	N	mean	sd	p50
Sale(100 million)	649,163	0.29	5.93	0.02
Number of Worker	649,163	57.98	6,342.32	14.50
Asset(100 million)	649,163	1.43	71.35	0.04
Age	649,163	7.36	6.03	6.00
Valueadd per Woker of Manufacturing (Thousand)	249,648	53.51	130.32	16.65
Tax rate	638,305	0.040	0.031	0.037
Financial Constraints	410,819	0.016	0.070	0.000
ChainRelation of Transportation input	135	0.028	0.022	0.022
ChainRelation of R&D input	135	0.005	0.007	0.003
ChainRelation of Seven input	135	0.047	0.032	0.036
ChainRelation of Constructive Labor Input	135	0.0025	0.0055	0.0003

Note: Data are collected by Chinese Tax Administrative from 2010 to 2015. Sampling weights are used to summarize the mean, standard error and median in panel A. ChainRelation data are calculated from Chinese input-output table in 2007.

Table 3. Summary of Outsourcing Probability and Ratio

		Outsourcing Prob.		Outsourcing Input/Sale	
	N	mean	sd	mean	sd
Transportation Input	403,719	0.2495	0.4327	0.0080	0.0427
R&D Input	339,823	0.0635	0.2438	0.0017	0.0175
Seven Input	269,173	0.2844	0.4511	0.0234	0.1100
Culture and Creative Input	303,174	0.1425	0.3496	0.0116	0.0940
Logistics Input	285,283	0.0729	0.2600	0.0048	0.0455
Consulting Input	291,482	0.1017	0.3023	0.0017	0.0170
Information Technology Input	281,278	0.0589	0.2354	0.0005	0.0055
Tangible Property Leasing Input	270,816	0.0225	0.1482	0.0004	0.0051
Constructive Labor Input	333,355	0.0989	0.2985	0.0493	0.9557

Note: Data are collected by Chinese Tax Administrative from 2010 to 2015. Sampling weights are used to summarize the mean, standard error and median. Outsourcing probability equals one if firm outsource specific service input from outside, otherwise outsourcing probability equals zero. Outsourcing ratio is measured as the ratio of the amount of outsourced input over sales. Since constructive labor service industry is affected in 2016, we use it as a placebo test in the following.

Table 4. Manufacturing: GRT to VAT Reform on Outsourcing Probability

Panel A: Year FE +City FE +Industry FE						
	2010-2015		2011-2015			
	Transportation Prob.	R&D Prob.	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.
	(1)	(2)	(3)	(4)	(5)	(6)
ChainRelation*Post	2.468***	10.277***	1.884***	7.271***	0.840**	0.631*
	(0.740)	(1.687)	(0.675)	(1.015)	(0.363)	(0.348)
R-squared	0.207	0.109	0.245	0.135	0.154	0.216
Panel B: City-year FE +Industry FE						
ChainRelation*Post	0.162	8.122***	1.171*	7.155***	0.768**	0.680**
	(0.577)	(1.064)	(0.628)	(0.918)	(0.344)	(0.346)
R-squared	0.283	0.228	0.278	0.159	0.177	0.240
Panel C: Year FE +City-Industry FE						
ChainRelation*Post	2.273**	12.020***	1.593*	7.487***	0.400	0.440
	(0.966)	(2.311)	(0.824)	(1.363)	(0.455)	(0.442)
Log(#Worker)	0.095***	0.024***	0.111***	0.041***	0.054***	0.113***
	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)
Log(Age)	-0.011***	-0.007***	-0.001	-0.002	-0.010***	-0.009**
	(0.004)	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)
Log(Asset)	0.030***	0.011***	0.032***	0.016***	0.023***	0.032***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
R-squared	0.384	0.274	0.384	0.295	0.325	0.367
Observations	263,888	209,158	231,035	179,693	181,194	167,498
b*sd(CR)	0.016	0.030	0.012	0.017	0.004	0.006
b*sd(CR)/mean(y)	2.646	0.379	0.028	0.207	0.029	0.017

Note: The dependent variables are outsourcing probability of different service inputs for manufacturing industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A adds year, city and industry fixed effects. Panel B adds city-year and industry fixed effects. Panel C adds year and city-industry fixed effects.

Table 5. Manufacturing: GRT to VAT Reform on Outsourcing input/sale

Panel A: Year FE +City FE +Industry FE						
	2010-2015		2011-2015			
	Transportation Input/sale	R&D Input/sale	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
	(1)	(2)	(3)	(4)	(5)	(6)
ChainRelation*Post	0.151***	0.259***	0.112***	0.201***	0.021**	0.037**
	(0.031)	(0.018)	(0.029)	(0.020)	(0.010)	(0.017)
R-squared	0.093	0.048	0.104	0.059	0.064	0.092
Panel B: City-year FE +Industry FE						
ChainRelation*Post	0.097***	0.242***	0.080***	0.190***	0.017*	0.037**
	(0.026)	(0.017)	(0.026)	(0.019)	(0.009)	(0.017)
R-squared	0.138	0.068	0.143	0.073	0.088	0.129
Panel C: Year FE +City-Industry FE						
ChainRelation*Post	0.132***	0.257***	0.102***	0.220***	0.019	0.045**
	(0.043)	(0.024)	(0.035)	(0.027)	(0.013)	(0.021)
Log(#Worker)	0.001***	0.000***	0.001***	0.001***	0.000***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Age)	-0.000**	-0.000***	-0.000***	-0.000***	-0.000***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Asset)	0.000***	0.000***	0.000***	0.000***	0.000***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.336	0.197	0.322	0.225	0.298	0.310
Observations	263,888	209,158	231,035	179,693	181,194	167,498
b*sd(CR)	0.001	0.001	0.001	0.001	0.000	0.001
b*sd(CR)/mean(y)	0.154	0.918	0.113	0.460	0.173	0.079

Note: The dependent variables are outsourcing ratio of different service inputs for manufacturing industries. Standard error are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A adds year, city and industry fixed effects. Panel B adds city-year and industry fixed effects. Panel C adds year and city-industry fixed effects.

Table 6. Service: GRT to VAT Reform on Outsourcing probability

Panel A: Year FE +City FE +Industry FE						
	2010-2015		2011-2015			
	Transportation Prob.	R&D Prob.	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.
	(1)	(2)	(3)	(4)	(5)	(6)
Treat*post	0.118***	0.077***	0.113***	0.076***	0.095***	0.140***
	(0.011)	(0.005)	(0.009)	(0.007)	(0.012)	(0.013)
R-squared	0.181	0.086	0.206	0.093	0.143	0.133
Panel B: City-year FE +Industry FE						
Treat*post	0.123***	0.077***	0.115***	0.075***	0.096***	0.140***
	(0.011)	(0.006)	(0.009)	(0.007)	(0.011)	(0.012)
R-squared	0.226	0.123	0.237	0.128	0.188	0.173
Panel C: Year FE +City-Industry FE						
Treat*post	0.129***	0.078***	0.126***	0.082***	0.097***	0.158***
	(0.013)	(0.007)	(0.011)	(0.009)	(0.015)	(0.015)
Treat	0.036	0.010	-0.001	0.010	0.037	-0.023
	(0.025)	(0.011)	(0.031)	(0.013)	(0.041)	(0.060)
Log(#Worker)	0.027***	0.015***	0.032***	0.020***	0.047***	0.054***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)
Log(Age)	0.010***	0.005***	0.012***	0.007***	-0.008**	0.001
	(0.003)	(0.002)	(0.003)	(0.002)	(0.004)	(0.004)
Log(Asset)	0.005***	0.001	0.006***	0.001	0.013***	0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
R-squared	0.337	0.232	0.342	0.243	0.299	0.288
Observations	139,794	130,631	120,583	111,690	121,962	101,658
b/mean(y)	0.979	1.761	0.821	1.353	0.637	0.670

Note: The dependent variables are outsourcing probability of different service inputs for service industries. Standard error are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A adds year, city and industry fixed effects. Panel B adds city-year and industry fixed effects. Panel C adds year and city-industry fixed effects.

Table 7. Service: GRT to VAT Reform on Outsourcing Input/Sale

Panel A: Year FE +City FE +Industry FE						
	2010-2015		2011-2015			
	Transportation Input/sale	R&D Input/sale	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
	(1)	(2)	(3)	(4)	(5)	(6)
Treat*post	0.019***	0.006***	0.015***	0.005***	0.035***	0.036***
	(0.002)	(0.000)	(0.001)	(0.001)	(0.008)	(0.005)
R-squared	0.134	0.046	0.146	0.051	0.066	0.088
Panel B: City-year FE +Industry FE						
Treat*post	0.020***	0.005***	0.014***	0.005***	0.033***	0.034***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.007)	(0.005)
R-squared	0.159	0.061	0.168	0.064	0.139	0.129
Panel C: Year FE +City-Industry FE						
Treat*post	0.021***	0.006***	0.017***	0.005***	0.037***	0.039***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.011)	(0.007)
Treat	-0.007*	0.000	-0.009	0.001	0.000	-0.008
	(0.004)	(0.001)	(0.006)	(0.001)	(0.007)	(0.022)
Log(#Worker)	0.000	0.001***	0.000	0.001***	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Log(Age)	0.001*	0.000	0.001*	0.000	-0.002	-0.003**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.002)
Log(Asset)	0.000*	-0.000	0.000**	0.000	0.001	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
R-squared	0.223	0.156	0.229	0.171	0.186	0.220
Observations	139,794	130,631	120,583	111,690	121,962	101,658
b/mean(y)	2.442	2.857	1.466	1.613	2.056	1.200

Note: The dependent variables are outsourcing ratio of different service inputs for service industries. Standard error are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A adds year, city and industry fixed effects. Panel B adds city-year and industry fixed effects. Panel C adds year and city-industry fixed effects.

Table 8: Controlling Tax Reduction channel

Panel A: Manufacturing Firms								
	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ChainRelationr*Post	2.336**	12.141***	0.286	0.390	0.134***	0.256***	0.018	0.041**
	(0.972)	(2.322)	(0.469)	(0.448)	(0.044)	(0.024)	(0.013)	(0.021)
Tax rate	-0.055	0.114**	-0.116**	-0.441***	0.014***	0.004***	0.002**	0.006
	(0.117)	(0.050)	(0.046)	(0.071)	(0.004)	(0.001)	(0.001)	(0.004)
Observations	260,388	206,422	178,910	165,408	260,388	206,422	178,910	165,408
R-squared	0.384	0.275	0.327	0.368	0.336	0.200	0.305	0.312
Panel B: Service Firms								
Treat*Post	0.127***	0.075***	0.093***	0.157***	0.021***	0.005***	0.028***	0.034***
	(0.013)	(0.007)	(0.014)	(0.015)	(0.002)	(0.001)	(0.010)	(0.006)
Tax rate	-0.088***	-0.038***	0.012	-0.134***	-0.007**	0.000	0.013	-0.022*
	(0.023)	(0.009)	(0.026)	(0.031)	(0.003)	(0.001)	(0.016)	(0.012)
Observations	137,967	128,744	120,395	100,438	137,967	128,744	120,395	100,438
R-squared	0.337	0.234	0.306	0.292	0.223	0.160	0.156	0.213
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y	Y	Y

Note: The dependent variables are outsourcing ratio and outsourcing probability of different service inputs for manufacturing and service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A are the regressions for manufacturing industry. Panel B are the regressions for service industry.

Table 9: Controlling Financial Constraints Channel

Panel A: Manufacturing Firms								
	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ChainRelation*Post	2.018**	11.711***	-0.116	0.654	0.126***	0.220***	0.015	0.044**
	(0.965)	(2.315)	(0.454)	(0.452)	(0.032)	(0.022)	(0.011)	(0.020)
Tax rate	-0.083	0.077	-0.133***	-0.459***	-0.088***	-0.038***	0.012	-0.134***
	(0.134)	(0.051)	(0.042)	(0.075)	(0.023)	(0.009)	(0.026)	(0.031)
FinCons	0.545***	0.093**	0.328***	0.294***	-0.052***	-0.056***	-0.112***	-0.031
	(0.062)	(0.046)	(0.048)	(0.064)	(0.014)	(0.009)	(0.022)	(0.030)
Observations	137,967	128,744	120,395	100,438	137,967	128,744	120,395	100,438
R-squared	0.223	0.160	0.156	0.213	0.337	0.234	0.306	0.292
Panel A: Service Firms								
Treat*Post	0.090***	0.049***	0.066***	0.160***	0.017***	0.004***	0.010***	0.035***
	(0.012)	(0.006)	(0.011)	(0.016)	(0.002)	(0.001)	(0.003)	(0.006)
Tax rate	-0.081***	-0.031***	0.008	-0.152***	-0.007**	0.000	0.019	-0.028**
	(0.021)	(0.008)	(0.023)	(0.033)	(0.003)	(0.002)	(0.014)	(0.013)
FinCons	0.041**	-0.001	0.071***	0.039	0.007	-0.000	0.026**	0.015*
	(0.016)	(0.004)	(0.015)	(0.024)	(0.004)	(0.000)	(0.012)	(0.008)
Observations	117,583	112,602	99,032	90,580	117,583	112,602	99,032	90,580
R-squared	0.308	0.217	0.302	0.306	0.216	0.159	0.152	0.223
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y	Y	Y

Note: The dependent variables are outsourcing ratio and outsourcing probability of different service inputs for manufacturing and service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A are the regressions for manufacturing industry. Panel B are the regressions for service industry.

Table 10: Endogeneity of the Control Variables

Panel A: Manufacturing Firms								
	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ChainRelation*Post	2.214**	11.860***	0.218	0.347	0.131***	0.252***	0.019	0.041*
	(0.954)	(2.295)	(0.446)	(0.439)	(0.043)	(0.024)	(0.013)	(0.021)
Observations	263,888	209,158	181,194	167,498	263,888	209,158	181,194	167,498
R-squared	0.375	0.278	0.323	0.352	0.335	0.203	0.297	0.308
Panel B: Service Firms								
Treat*Post	0.127***	0.079***	0.111***	0.166***	0.021***	0.006***	0.039***	0.041***
	(0.012)	(0.007)	(0.016)	(0.015)	(0.002)	(0.001)	(0.011)	(0.007)
Observations	139,794	130,631	121,962	101,658	139,794	130,631	121,962	101,658
R-squared	0.337	0.232	0.297	0.286	0.223	0.157	0.187	0.220
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y	Y	Y

Note: The dependent variables are outsourcing ratio and outsourcing probability of different service inputs for manufacturing and service industries. The control variables of worker and asset are separated into five groups by the size respectively, and we control five dummies of each control variable instead of controlling the variable. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A are the regressions for manufacturing industry. Panel B are the regressions for service industry.

Table 11: Using the Full Sample with no Weights

Panel A: Manufacturing Firms								
	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ChainRelation*Post	2.945***	13.510***	1.396***	0.057	0.254***	0.394***	0.054***	0.013*
	(0.447)	(1.427)	(0.198)	(0.142)	(0.014)	(0.022)	(0.004)	(0.007)
Observations	1,050,187	849,769	601,274	544,690	1,050,187	849,769	601,274	544,690
R-squared	0.304	0.211	0.250	0.279	0.195	0.129	0.188	0.182
Panel A: Service Firms								
Treat*Post	0.176***	0.086***	0.057***	0.159***	0.029***	0.006***	0.008***	0.024***
	(0.009)	(0.005)	(0.008)	(0.010)	(0.002)	(0.000)	(0.001)	(0.002)
Observations	423,210	405,952	326,725	272,793	423,210	405,952	326,725	272,793
R-squared	0.227	0.165	0.289	0.195	0.187	0.141	0.100	0.160
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y	Y	Y

Note: The dependent variables are outsourcing ratio and outsourcing probability of different service inputs for manufacturing and service industries. We use the main investigation firms and survey firms in Table 11 to assess the potential weight problem. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A are the regressions for manufacturing industry. Panel B are the regressions for service industry.

Table 12. Service: Robustness Check Using Alternative Method to Define Treated Time

Panel A: Outsourcing Probability						
	2010-2015		2011-2015			
	Transportation Prob.	R&D Prob.	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.
	(1)	(2)	(3)	(4)	(5)	(6)
Treat*Post	0.042***	0.046***	0.014	0.033***	0.035***	0.083***
	(0.012)	(0.008)	(0.013)	(0.010)	(0.013)	(0.014)
R-squared	0.332	0.229	0.339	0.240	0.297	0.285
panel B： Outsourcing Input/Sale						
	Transportation Input/sale	R&D Input/sale	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
Treat*Post	0.011***	0.004***	0.006***	0.004***	0.022***	0.028***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.007)	(0.005)
R-squared	0.219	0.156	0.227	0.170	0.185	0.220
Observations	139,794	130,631	120,583	111,690	121,962	101,658
Year FE	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y

Note: We change the definition of treated time and assume the treated time is in the next year if the industry is affected in the second half of the year. The dependent variables are outsourcing probability and ratio of different service inputs for service industries. Standard error are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table 13: Dropping Firms with Sale Less Than 0.5 Million

Panel A: Manufacturing Firms								
	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ChainRelation*Post	2.849***	13.041***	0.251	0.228	0.172***	0.276***	0.015	0.050**
	(0.997)	(2.411)	(0.495)	(0.482)	(0.045)	(0.024)	(0.014)	(0.022)
Observations	251,612	197,437	170,166	156,733	251,612	197,437	170,166	156,733
R-squared	0.375	0.279	0.328	0.351	0.345	0.206	0.320	0.307
Panel B: Service Firms								
Treat*Post	0.142***	0.087***	0.106***	0.177***	0.031***	0.006***	0.017**	0.029**
	(0.024)	(0.013)	(0.024)	(0.029)	(0.004)	(0.001)	(0.007)	(0.012)
Observations	89,736	82,386	77,376	60,885	89,736	82,386	77,376	60,885
R-squared	0.384	0.290	0.370	0.310	0.255	0.193	0.173	0.246
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y	Y	Y

Note: We drop firms with sales less than 5 million. The dependent variables are outsourcing probability and ratio of different service inputs for manufacturing and service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table14. Manufacturing: Placebo Test Using Small Firms

Panel A: Outsourcing Probability						
	2010-2015		2011-2015			
	Transportation Prob.	R&D Prob.	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.
	(1)	(2)	(3)	(4)	(5)	(6)
ChainRelation*Post	6.010	-14.093	13.543	-1.565	3.541	0.566
	(6.033)	(20.594)	(10.320)	(2.572)	(3.687)	(1.960)
Observations	9,058	8,697	8,445	8,100	8,013	7,862
R-squared	0.761	0.890	0.552	0.645	0.506	0.533
Panel B： Outsourcing Input/Sale						
	Transportation Input/sale	R&D Input/sale	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
ChainRelation*Post	0.021	-0.062	0.066	-0.033	0.086	0.047
	(0.158)	(0.216)	(0.156)	(0.045)	(0.101)	(0.097)
Observations	9,058	8,697	8,445	8,100	8,013	7,862
R-squared	0.784	0.957	0.525	0.684	0.461	0.399
Year FE	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y

Note: we limit our data to small firms that pay simplified VAT before and after the reform in manufacturing industries. The dependent variables are outsourcing probability and ratio of different service inputs for service industries. Standard error are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table15. Service: Placebo Test Using Small Firms

Panel A: Outsourcing Probability						
	2010-2015		2011-2015			
	Transportation Prob.	R&D Prob.	Transportation Prob.	R&D Prob.	Culture and Creative Prob.	seven Input Prob.
	(1)	(2)	(3)	(4)	(5)	(6)
Treat*Post	-0.019	0.004	-0.005	0.005	0.030**	-0.004
	(0.012)	(0.005)	(0.007)	(0.006)	(0.015)	(0.016)
Observations	65,091	64,036	60,067	59,087	60,503	56,094
R-squared	0.314	0.238	0.290	0.233	0.322	0.279
Panel B： Outsourcing Input/Sale						
	Transportation Input/sale	R&D Input/sale	Transportation Input/sale	R&D Input/sale	Culture and Creative Input/sale	seven Input/sale
Treat*Post	-0.003	0.001*	-0.000	0.001	2.821***	0.209**
	(0.002)	(0.000)	(0.001)	(0.001)	(0.948)	(0.082)
Observations	65,091	64,036	60,067	59,087	60,503	56,094
R-squared	0.340	0.179	0.293	0.205	0.239	0.306
Year FE	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y

Note: we limit our data to small firms that pay simplified VAT after the reform for treat group and those with sales less than 5 million for untreated group in service industries. The dependent variables are outsourcing probability and ratio of different service inputs for service industries. Standard error are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table 16. Manufacturing: Placebo Test Using Constructive Labor Input

	Construction Prob.			Construction Input/sale		
	Policy in 2012	Policy in 2013	Policy in 2014	Policy in 2012	Policy in 2013	Policy in 2014
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
ChainRelation*Post	75.801*	57.392	41.762	-0.316	0.080	0.539
	(45.257)	(38.771)	(33.473)	(1.104)	(0.887)	(0.720)
Observations	198,265	198,265	198,265	198,265	198,265	198,265
R-squared	0.301	0.301	0.300	0.262	0.262	0.262
Year FE	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y

Note: The dependent variables are outsourcing probability and ratio of constructive labor service inputs for manufacturing industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table 17. Service Industry: Placebo Test Using Constructive Labor Input

VARIABLES	(1) Construction Prob.	(2) Construction/sale
Treat*Post	0.006	0.019
	(0.010)	(0.012)
Treat	-0.030	-0.022
	(0.035)	(0.015)
R-squared	0.310	0.097
Observations	162,019	162,019
Year FE	Y	Y
City-industry FE	Y	Y

Note: The dependent variables are outsourcing probability and ratio of constructive labor service inputs for service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table 18: Who is outsourcing: firm size

Panel A: Manufacturing Industry						
	TransProb.	R&D Prob.	CultureProb.	TransRatio	RDRatio	CultureRatio
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
ChainRelation*Post*logworker	0.517	5.320***	-0.173	0.052***	0.151***	-0.005
	(0.463)	(0.873)	(0.252)	(0.018)	(0.013)	(0.006)
Observations	263,888	209,158	181,194	263,888	209,158	181,194
R-squared	0.388	0.282	0.326	0.339	0.206	0.300
Panel B: Service Industry						
Treat*Post*logworker	0.037***	0.036***	0.042***	0.003***	0.002***	-0.000
	(0.005)	(0.005)	(0.007)	(0.001)	(0.001)	(0.002)
Observations	139,794	130,631	121,962	139,794	130,631	121,962
R-squared	0.339	0.238	0.300	0.223	0.158	0.186
Year FE	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y

Note: The dependent variables are outsourcing ratio and outsourcing probability of different service inputs for manufacturing and service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. Panel A are the regressions for manufacturing industry. Panel B are the regressions for service industry.

Table 19: Who is outsourcing: Chain Effect of service industry

	TransProb.	R&D Prob.	CultureProb.	TransRatio	RDRatio	CultureRatio
VARIABLES	(1).	(2)	(3)	(4)	(5)	(6)
Treat*post*ChainRelation	2.365***	0.062	4.406***	0.865***	0.234***	1.992***
	(0.510)	(0.640)	(0.797)	(0.061)	(0.063)	(0.341)
Treat*post	0.021	0.072***	0.008	-0.016***	0.004***	-0.003
	(0.018)	(0.007)	(0.014)	(0.002)	(0.001)	(0.003)
Treat*ChainRelation	-0.582	-115.850*	-0.734	-0.082	-2.56	-0.549
	(1.386)	(59.966)	(2.537)	(0.174)	(6.042)	(0.429)
Year FE	Y	Y	Y	Y	Y	Y
City-industry FE	Y	Y	Y	Y	Y	Y
Observations	136,525	127,421	119,130	136,525	127,421	119,130
R-squared	0.185	0.09	0.142	0.145	0.052	0.067
b*sd(CR)	0.066	0.001	0.055	0.024	0.002	0.025
b*sd(CR)/mean(y)	0.501	0.014	0.359	2.806	1.081	1.372

Note: The dependent variables are outsourcing probability and ratio of constructive labor service inputs for service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table 20. Manufacturing: GRT to VAT on Production efficiency

	TFP					Value-added/worker				
	2009-2014			2010-2014	Drop Small Firms	2009-2014			2010-2014	Drop Small Firms
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ChainRelation *Post	2.134***	2.167***	2.137***	2.133***	1.646***	3.456**	3.550**	3.217	4.378**	2.577
	(0.674)	(0.673)	(0.820)	(0.786)	(0.637)	(1.643)	(1.668)	(1.996)	(1.844)	(2.176)
logworker	0.018**	0.018**	0.014*	0.007	-0.017**	0.080***	0.079***	0.063***	0.018	-0.100***
	(0.009)	(0.009)	(0.008)	(0.007)	(0.007)	(0.016)	(0.016)	(0.018)	(0.018)	(0.026)
logage	-0.033***	-0.032***	-0.032***	-0.047***	-0.060***	-0.02	-0.018	-0.02	-0.036*	-0.056**
	(0.011)	(0.011)	(0.011)	(0.010)	(0.012)	(0.018)	(0.018)	(0.019)	(0.020)	(0.026)
logasset	0.018***	0.019***	0.016***	0.020***	0.011**	0.250***	0.259***	0.247***	0.298***	0.285***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.010)	(0.010)	(0.013)	(0.012)	(0.018)
taxrate	0.461**	0.464**	0.412	0.273	0.606**	-0.724*	-0.720*	-0.843**	-0.286	1.023*
	(0.225)	(0.224)	(0.278)	(0.258)	(0.273)	(0.426)	(0.427)	(0.420)	(0.436)	(0.590)
FinCons	0.257	0.243	0.476	0.059	-0.043	-0.768**	-0.905***	-0.518	-1.219***	-2.015***
	(0.398)	(0.397)	(0.516)	(0.200)	(0.205)	(0.302)	(0.303)	(0.329)	(0.318)	(0.453)
Constant	-1.625***	4.187**	0.555***	0.600***	0.806***	0.693	1.413	-0.193***	0.04	0.352***
	(0.477)	(1.688)	(0.036)	(0.034)	(0.040)	(0.712)	(1.141)	(0.072)	(0.075)	(0.119)
Year FE	Y		Y	Y	Y	Y		Y	Y	Y
Industry FE	Y	Y				Y	Y			
City FE	Y					Y				
City-year FE		Y					Y			
City-Industry FE			Y	Y	Y			Y	Y	Y
Observations	189,931	189,931	189,931	157,468	152,623	189,556	189,556	189,556	157,165	152,248
R-squared	0.087	0.087	0.319	0.315	0.386	0.257	0.25	0.454	0.484	0.430

Note: The dependent variables are TFP and value-added per worker for service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level. We add year and city-industry fixed effects.

Table 21: Scale expanding of service industry

Logsale				
VARIABLES	(1)	(2)	(3)	(4)
treatpost2	0.679***	0.664***	0.681***	0.625***
	(0.059)	(0.060)	(0.063)	(0.061)
taxrate				-2.588***
				(0.248)
Constant	3.450***	2.721***	2.845***	2.888***
	(0.690)	(0.836)	(0.120)	(0.123)
Year FE	Y		Y	Y
Industry FE	Y	Y		
City FE	Y			
City-year FE		Y		
City-industry FE			Y	Y
Observations	270,223	270,223	270,223	265,044
R-squared	0.439	0.467	0.534	0.622

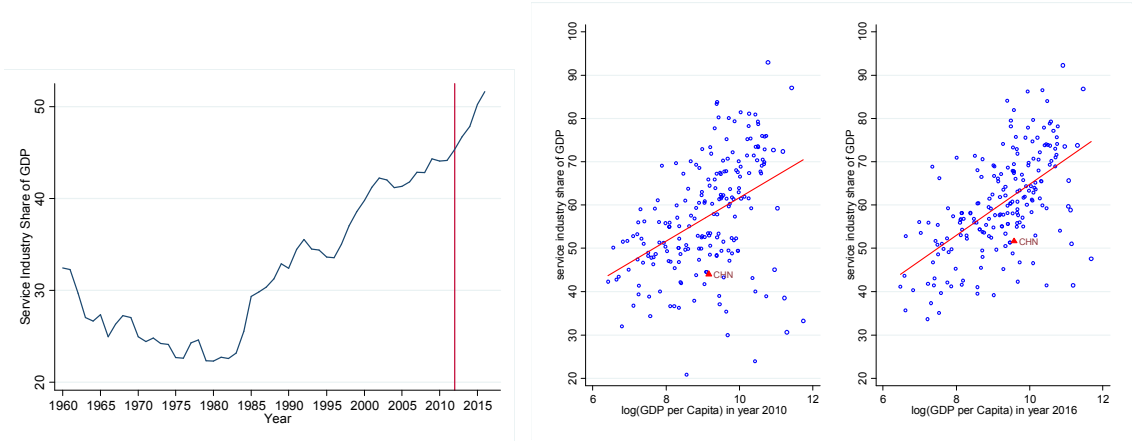
Note: The dependent variables are Logsale for service industries. Standard errors are clustered at city-industry pair level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level.

Table 22: Industrial Structure

	seven service sale/Total sale		
VARIABLES	(1)	(2)	(3)
Treat*Post	-0.001		
	(0.008)		
Treat2*Post		0.024***	
		(0.008)	
Treat3*Post			0.009**
			(0.003)
Number of Firms	-0.005***	-0.004**	-0.003**
	(0.001)	(0.001)	(0.001)
Average Asset	-0.006***	-0.007***	-0.006***
	(0.001)	(0.002)	(0.001)
Average Worker	-0.004*	-0.002	-0.001
	(0.002)	(0.002)	(0.002)
Average Age	0.004	0.002	0.001
	(0.004)	(0.004)	(0.004)
Constant	0.135***	0.132***	0.117***
	(0.020)	(0.023)	(0.021)
Year FE	Y	Y	Y
City FE	Y	Y	Y
Observations	13,024	10,885	9,739
R-squared	0.095	0.100	0.097

Note: The dependent variables are sales of seven to total sale in each city. The sample period is from 2010 to 2013. Standard errors are clustered at province level in parentheses. ***significant at the 1 percent level, ** significant at the 5 percent level and *significant at the 10 percent level.

Figure A 1. The development of industry in China



Note: The left side graph plots the time trend of the importance of service industry to the whole economy by using the NBS data. The right side graph plots the importance of service industry for every county in the world where the data come from the World Bank. The size of the circle measures the importance of the country in the world economy.