How Distortive are Turnover Taxes? Evidence from Replacing Turnover Tax with VAT

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Abstract

In this paper, we investigate distortions created by turnover taxes. As a natural experiment, we explore a reform that replaced turnover taxes with value-added taxes for some service industries in China, while the taxation of manufacturing industries remained unchanged. The reform increased sales, R&D investment, and employment for affected service firms, which is primarily driven by outsourcing from downstream manufacturing firms. We document that smaller and less innovative manufacturing firms outsource more, and reallocation increases the quality of innovation for affected service firms. Our study provides new evidence on the negative impact of turnover taxes imposed on business inputs.[1]

JEL: H25, H26, O32, D25

Keywords: turnover tax, value-added tax, outsourcing, R&D investment

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1 Introduction

Turnover taxes are levied on revenues and do not allow for input deductions, resulting in tax cascading where final goods are taxed multiple times throughout production. While many developing countries adopt turnover taxes because they are harder to evade (Best et al., 2015; Naritomi, 2019; Pomeranz, 2015; Waseem, 2019), they are also gaining popularity in developed countries like the United States (Hansen et al., 2021; Phillips and Ibaid, 2019). In principle, turnover taxes distort business organizations to favor vertical integration, which depresses demand for upstream suppliers (Coase, 1937; Williamson, 1971). Such allocation inefficiency is potentially large, especially when turnover taxes are imposed on some, but not all, sectors (or regions) in the economy. In this paper, we examine how sector-specific turnover taxes distort business decisions, considering the perspectives of both upstream and downstream firms.

As a quasi-natural experiment, we explore a major tax reform in China which replaced the business tax (BT) on gross revenue with the value-added tax (VAT) for firms in service industries starting from 2012 (thereafter, the B2V reform). Before the B2V reform, Chinese service firms were subject to the BT, while manufacturing firms were subject to the VAT. As manufacturing firms could not claim input deductions when they purchased intermediate goods from BT-paying service firms, this dual tax system encouraged manufacturing firms to vertically integrate to avoid tax cascading. The reform effectively removed this distortion in the tax system and encouraged outsourcing. Since service firms mainly produce intangible goods, this effect is likely to be more pronounced for intangible inputs. We leverage the staggered implementation of the B2V reform across regions and time to identify its impact on firm sales, investment, R&D, and employment based on a sample of Chinese listed firms during 2009-2017.

For identification, we use a difference-in-differences approach and compare affected service firms with manufacturing firms that were unlikely to have been affected by the reform through their supply chains. Consistent with the hypothesis that removing turnover taxes should replace vertical integration with outsourcing, we find that treated service firms increased sales by 11.5% on average, relative to the control group. In response to the sales increase, treated firms experienced a significant increase in R&D investment and employment, of 9.9% and 6.6% respectively. Treated firms also increased capital expenditures, but the observed effect becomes insignificant with additional controls. We show that these results are driven by outsourcing from manufacturing firms, especially from the smaller and less innovative ones. Such outsourcing appears to benefit larger and less innovative treated service firms, as the treatment effects are more prominent for them. We further find that the B2V reform led to higher quality of R&D investment by the treated service firms, potentially reflecting technology catch-up by those that are less innovative.

We explore alternative explanations for the observed changes in sales, R&D investment and employment by treated firms. First, we show that our benchmark results are not driven by firms that were more financially constrained, or driven by changes in the cost of capital. Second, we show that the reform had limited impact on goods prices, thereby ruling out the reverse causality channel (Alfaro et al., 2016; Hansen et al., 2021; McGowan, 2017). Taken together, our results imply that sector-specific turnover taxes led to inefficient vertical integration (Gadenne et al., 2019), especially in the context of intangible inputs (Atalay et al., 2014), and their removal likely results in efficiency gains for the whole economy.

Our study contributes to the small body of empirical research on turnover taxes. Hansen et al. (2021) find that following the replacement of the gross receipt tax with a retail tax on Washington's cannabis industry, the share of vertically-integrated cannabis fell immediately while production increased, indicating large production inefficiency associated with the gross receipt tax. Smart and Bird (2009) find that replacing sales taxes with value-added taxes in several Canadian provinces led to significant increases in machinery and equipment investment. On the other hand, Best et al. (2015) emphasize that turnover taxes reduce evasion, which outweighs the associated production inefficiency. We show that turnover taxes depress the activities of the upstream suppliers, as downstream firms may choose to vertically integrate. Our findings also suggest that removing such tax distortion, as the country's tax capacity improves, is likely to benefit innovation and long-run economic growth (Balasubramanian and Sivadasan, 2011; Doraszelski and Jaumandreu, 2013; Griliches and Mairesse, 1991; Hall and Mairesse, 1995; Hasan and Tucci, 2010; Kogan et al., 2017; Mansfield, 1980).

Second, we add to the discussion on how government can influence private innovation via increasing private demand. The majority of the literature focuses on supply-side government policies (e.g., tax incentives) that change the cost of R&D investment (Agrawal et al., 2020; Akcigit et al., 2018; Bloom et al., 2002; Chen et al., 2021; Einiö, 2014; Guceri and Liu, 2019; Hall and Van Reenen, 2000; Lokshin and Mohnen, 2013; Rao, 2016), while less evidence exists on the effectiveness of policies affecting demand.[2] Based on our estimation results, we calculate the implied elasticity of R&D investment with respect to increase in sales to

[2]The importance of demand-side policies for innovation has long been recognized (Schmookler, 1962, 1966), but there is limited empirical evidence (Edler and Georghiou, 2007).

be between 0.86 - 1.05, depending on the specification. As a comparison, the estimated elasticity of R&D investment with respect to policy-induced changes in the tax component of the user cost of capital ranges from 0.14 in the short-run to 2.7 in the long-run (Bloom et al., 2002; Hall, 1993). Our estimated medium-run demand elasticity is large in comparison. This suggests that policies changing firms' demand conditions are just as effective as those changing the marginal cost of R&D investment.

This paper also has important policy implications. International organizations, such as the IMF, have been encouraging developing countries to move from turnover type taxes to VAT in the last few decades, notably, with Brazil switching in 2002 and 2003. However, turnover-type taxes remain popular, largely as they are easier to enforce than profit taxes.[3] In more developed economies, while the VAT has been widely adopted, features like VAT exemptions potentially impose similar problems as the Chinese dual tax system before the B2V reform (Ebrill et al., 2001). In the U.S., the state sales tax system also imposes a significant tax on business-to-business transactions (Phillips and Ibaid, 2019). We show that these distortions in the tax system alter firm decisions, and removing them can lead to more efficient allocation of business activities.

2 Policy background

2.1 The reform

China's economic growth traditionally depended on its manufacturing sector, but its service sector and, consequently, innovation driven growth is becoming increasingly important (Zilibotti, 2017). Since 2011, the aggregate annual output growth rate of the service sector outpaced that of the manufacturing sector and has remained at the double-digits level. By 2017, the service sector contributed to more than 50% of the country's GDP. Therefore, policies targeting growth of the service sector are likely a key for China's productivity and long-run economic performance.

Despite the growing importance of the service sector, until 2012 Chinese service firms were subject to a different tax treatment from that imposed on manufacturing firms. Before the B2V reform, supply of goods, and provisions of processing, repair, and replacement services were subject to the VAT. In contrast, other services and the transfer of intangible

[3]For example, Afghanistan, Ethiopia, Suriname, and Taiwan levy turnover taxes on all firms, while South Africa applies it to small businesses. For more information see `https://www.ibfd.org/sites/ibfd.org/files/content/pdf/ivm_2018_02_int_2.pdf`.

assets and immovable properties were subject to the BT. While the VAT broadly applied to the manufacturing sector, the BT broadly applied to the service sector excluding those in the retail and wholesale industries. Under the VAT, firms are taxed based on value added, and there is an "input-output" credit mechanism. That is, the buyer pays VAT on her input purchases and subsequently claims tax credit when she sells to downstream customers. In comparison, the BT was imposed on gross revenue and costs of factor inputs could not be deducted. As a result, VAT-paying firms could not claim tax credits on input purchased from the BT paying firms.

The rationale behind imposing a revenue-based tax on service firms is largely related to tax enforcement. In developing countries, it is difficult for the tax administrator to monitor firms, especially those with little tangible assets. That applies to most firms in the service sector. Compared with profit-based tax, it is more efficient to collect tax based on revenue for such firms. The drawback of the BT-VAT dual tax system is that it breaks the VAT chains in the economy and distorts production decisions. Ample anecdotes suggest that before the B2V reform, manufacturing firms were forced to become "big and comprehensive"—that is, to self-supply intermediate goods and internalize the costs, as outsourcing to service firms implied a higher tax burden.

Starting from 2012, the Chinese government gradually replaced the BT with the VAT.[4] The aim of the reform was to unify the tax treatment for the manufacturing and the service sectors, and to remove distortion and the inefficiency associated with the BT. The transition was made in a revenue-neutral way.[5] The pilot reform took place in Shanghai on January 1st, 2012 and affected transportation industry and six "modern services" (R&D and technical services, IT services, cultural and innovation services, logistics auxiliary services, attestation and consulting services, and tangible assets leasing services). The reform was then gradually rolled out to cover more industries and regions. By May 2016, the reform covered all service industries and effectively eliminated the BT from the Chinese tax system. The reform has been hailed as the most important tax reform in China since 1994, involving the countries' two most important taxes (Cui, 2014).

2.2 Mechanisms

There are three potential channels through which the Chinese BT, and the elimination of it, can affect the demand and investment decisions for the treated service firms. First, the BT

[4]Table A1 provides the time-line of the B2V reform.

[5]Table A2 lists the BT rates and the VAT rates for the treated industries.

induced manufacturing firms to substitute away from inputs produced by BT-paying service firms. At the extreme, this generated incentives for downstream manufacturing firms to vertically integrate their business and "self-supply". After the unification of the tax system, the demand for treated upstream service firms will increase directly, as manufacturing firms would have stronger incentives to outsource. We call this the "outsourcing effect". The increase in sales would likely drive up employment, wages and investment of treated service firms. Given that the affected service firms are R&D intensive, we also expect to observe a higher level of innovation activities after the reform.[6]

Second, as the VAT is imposed on a narrower base, the B2V reform may lower the tax burden for the affected service firms. While the VAT rates for treated service industries are set to be higher than the BT rates (Table A2), the government chose these rates to ensure their tax burden would not increase, in principle. If the reform resulted in a lower tax burden for treated firms, they may lower price of their products. Consequently, the quantity of goods sold would increase, if demand is elastic. We call this the "direct price effect". A lower tax burden may also relax treated service firms' financial constraints, leading to more investment and/or employment.

Third, the B2V reform lowered the tax burden of manufacturing firms already purchasing from service firms, since they can now deduct input costs. If a lower tax burden translates into a lower final consumer price, it can lead to a higher demand for products sold by the manufacturer. This may have a cascading effect on the demand for intermediate goods provided by service firms. We call this the "cascading price effect".[7] We explore each of those mechanisms in our analysis.

2.3 Contemporary policies

During the analyzed time period, the Chinese government enacted several other tax policies. First, there was a nationwide corporate tax rate cut for small and micro-profit enterprises (SMPEs) (Cui, Wei, Xie and Xing, 2021), which is unlikely to affect listed firms in our sample. Second, China introduced accelerated depreciation for selected manufacturing industries since 2014. However, existing study shows that this policy had rather low take-up

[6] Table A3 shows that treated firms are almost twice as R&D intensive as control firms, indicated by the ratio of R&D investment to total assets.

[7] The magnitude of this cascading effect will depend on the pass-through of the VAT to the final consumer. The empirical literature on this subject is mixed, ranging from full pass-through for food and chain restaurants, some pass-through for hairdressers and French restaurant consumers, to no pass-trough for small restaurants (Benzarti and Carloni, 2019; Gaarder, 2018; Harju et al., 2018; Kosonen, 2015).

and limited impact on firms' investment (Cui, Hicks and Xing, 2021).

More, there are tax incentives specifically targeting firms' R&D investment. For example, qualified high-tech firms enjoy a 15% corporate income tax rate, 10% lower than the main rate, that was in place before the B2V reform (Chen et al., 2021). There are also R&D super deductions and subsidies. Since such tax schemes existed well before the B2V reform and applied to firms in all sectors, they are unlikely to threaten our identification. Nevertheless, to address possible confounding effects of these tax incentives, we add firm and time-specific corporate tax rate and subsidies as control variables in our estimations.

3 Data and empirical strategy

We use a sample of all Chinese firms listed in Shanghai and Shenzhen Stock Market Exchanges during the period 2009-2017, which is provided by the database CSMAR. Our treated firms are from service industries that experienced the transition from the BT to the VAT by 2015, as shown in Table A1.[8] Our control group includes listed firms from the manufacturing industries that always paid the VAT. We select manufacturing firms that are less likely to be in the same production chain with the service firms to avoid capturing the indirect effect of the reform. Specifically, we exclude manufacturing firms from industries that purchase more than 50% of intermediate goods from, and sell more than 50% of their intermediate products to, the treated industries, based on the 2012 industry-level input–output tables published by the National Bureau of Statistics of China.[9] Overall, we obtain a balanced sample of 243 firms in the selected treatment group and 980 firms in the control group.[10]

We use the difference-in-differences approach to analyze the effect of the B2V reform on firms' performances. We use the following general specification:

$$Y_{i,t} = \alpha + \beta \times Treated_i \times Post_{i,t} + \delta \times X'_{i,t} + \eta_t + \psi_i + \epsilon_{i,t} \quad (1)$$

where $Y_{i,t}$ is a set of outcome variables at the firm level, which in the baseline specifications includes sales, capital expenditures, $R\&D$ expenditures, the number of employees and total wage bills (all in natural logarithms). $Treated_i$ is a dummy variable that equals to 1 when

[8] We exclude real estate, construction, finance and other service industries that were reformed in 2016 to allow for adequate post-reform time.

[9] We use the BEA industry-level input–output tables as an alternative and obtain similar results.

[10] We provide a complete list of all treated and control industries in Table A2, while Table A3 provides summary statistics for key outcome and control variables for the selected treatment and control groups.

a firm belongs to the treatment group, and 0 if it belongs to the control group. The B2V reform was implemented in different industries across provinces in different years (see Table A1). To allow for sufficient adjustment time, we set $Post_{i,t}$ to 1 since year t if the reform was implemented in the first half of year t, and to 1 since year $t+1$ if the reform occurred in the second half of year t. $X'_{i,t}$ is a set of firm-level control variables, including size, age, profitability, leverage, the amount of government subsidies and firm specific corporate tax rate; η_t is the time fixed effect, ψ_i is a firm-specific fixed effect and $\epsilon_{i,t}$ is the unobserved error term. We cluster standard errors at the firm level. The treatment effect is captured by the parameter β, which is the difference in the outcome variables averaged across all treated firms relative to the control group after the reform was implemented.

Our identification strategy is based on the assumption that the outcome variables for the treated and control groups would have evolved in parallel in the absence of treatment. We test this assumption using the event study methodology. We also use this method to evaluate the speed with which the reform affects our outcome variables. For this purpose, we estimate Equation 2:

$$Y_{i,t} = \alpha + \sum_{\kappa=-3}^{3} \beta_{i,\kappa} 1[t=\kappa] \times Treated_i + \delta \times X'_{i,t} + \eta_t + \psi_i + \epsilon_{i,t} \tag{2}$$

where $1[t=\kappa]$ is a set of dummy variables that equals to 1 in the κ years relative to the reform year for firm i. The coefficient on each of those dummies indicates the difference in each outcome variable between the two groups in that year relative to year t-1, which is the benchmark. The treatment indicators are binned at endpoints, such that t-3 indicates treatment in year t-3 and all previous years (Fuest et al., 2018; McCrary, 2007). We continue to control for firm-specific fixed effects and year fixed effects.

Finally, given the staggered nature of the DID estimation, one may be concerned that the estimated effects may be contaminated when "already-treated" observations act as control group, especially in the context of heterogeneous treatment effects across cohorts. These problems arise from negative weights in the computation of the average treatment effect. We do two things to address these issues. First, following Goodman-Bacon (2018), we decompose our estimator into its sources of variation. In Table A6 we show that our estimates rely almost exclusively on the comparison of treated with never-treated groups. Hence, variation in treatment timing is not a substantial issue in our setting. Second, to address the concerns about heterogeneous treatment effects in a staggered DID setting, when estimating the event study models with two-way fixed effects, we use alternative estimators to correct for this issue including those provided by de Chaisemartin and D'Haultfoeuille (2020), Sun and Abraham (2020), Callaway and Sant'Anna (2020), and Borusyak and Jaravel (2021).

4 Benchmark results

4.1 Impact on sales, investment and employment

Table 1 reports the estimated average treatment effect on different outcome variables based on Equation 1. In Panel A, we include only firm and year fixed effects in these estimations. We control for firm-level characteristics in Panel B. In both panels, the estimated treatment effect on sales is positive and highly significant (column 1). With firm-level controls, we find that treated firms experienced an 11.5% increase in sales, relative to the control group, since the B2V reform. Figure 1a plots the dynamic changes in sales for the treated group relative to the control group, using various estimators. Each dot in the sub-figure represents the point estimates, $\beta_{i,\kappa}$, from the dynamic difference-in-differences estimations based on Equation 2. The vertical lines represent the 95% confidence intervals associated with the corresponding point estimates. We show that the parallel pre-treatment trends for sales are largely satisfied, as the point estimates during the pre-treatment years are close to zero and not statistically different from it. These dynamic plots show a gradual increase in sales for the treated firms relative to the control firms since the B2V reform.

Next, we examine how treated firms' investment was affected by the reform. In column 2 in Table 1, we consider capital expenditures and in column 3, we consider R&D investment. We find that both capital and R&D expenditures increase substantially after the reform for treated firms when we do not include firm-level controls. Adding firm-level controls, however, only the effect on R&D investment remains statistically significant. In Figure 1b, we document a gradual and statistically significant increase in R&D investment with no discernible pre-trends.[11] It is not surprising that we observe a greater impact of the B2V reform on treated service firms' R&D expenditures, since they are rather R&D intensive with R&D expenditures consisting of 71.4% of all expenditures (Table A3). According to column 3 in Panel B, the treated service firms increase R&D investment by around 9.9%. Based on these results, we obtain an elasticity of 0.86 for R&D investment with respect to changes in sales (=9.9%/11.5% in Panel B).[12]

[11] Figure A1a in the Appendix demonstrates that capital expenditures only increase in year $t+2$, which is inconsistent with the timing of the B2V reform.

[12] Using results from Panel A , we obtain a similar elasticity of 1.05==30.7%/29.1%

Only a handful of firms in our sample report zero R&D investment. Nevertheless, Table A3 indicates that over 50% of firm-year observations report missing R&D investment. If missing R&D indicates zero R&D, we can analyze the effect of the B2V on treated firms' R&D investment at the extensive margin. Column 1 in Table A4 reports the probit estimation results where the dependent variable is a dummy indicating positive R&D and equals 0 otherwise. In this specification, we find a large and significantly positive effect of the reform on extensive margin of R&D investment.

In columns 4 and 5 in Panel A of Table 1, we show that following the B2V reform, both employment and wages in treated firms increased. The increase in employment remains large and statistically significant even when we control for firm-level characteristics. Figure 1c and Figure A1b show the dynamic treatment effects for these two variables. These results indicate that treated service firms increased employment to cope with higher market demand and R&D investment requirement.

One potential concern is the comparability between treated and control groups. Thus, as a robustness check, we match the treated and the control groups based on their observed firm characteristics in 2011 using propensity score matching. We describe the methodology in Appendix C, and columns 2-6 in Table A4 report the estimated treatment effects for our outcome variables based on the matched sample. We find qualitatively similar results to those in Table 1.

4.2 Reallocation?

From policy perspective, an important question is whether the reform spurred new activity or simply resulted in reallocation from manufacturing firms to service firms. If the BT led to inefficient vertical integration, downstream manufacturing firms may have an R&D-sales ratio that is higher than the optimal level without tax distortion. Reallocation indicates that manufacturing firms' R&D-sales ratio should decline after the B2V reform. Larger manufacturing firms may be more able to vertically integrate and avoid tax cascading. In contrast, smaller manufacturing firms may lack such capacity and have to bear the distortion caused by the turnover tax. As such, we expect to observe a more pronounced decline in R&D-sales ratio of larger manufacturing firms since the B2V reform.

In Figures 2a, we plot the evolution of R&D expenditures as a ratio to sales for treated service firms and all listed manufacturing firms, separately.[13] We cut the full sample of

[13]For comparability, in each line we remove firm fixed effects, subtract the group average in t-1 from each data point and add back the pooled mean from the sample period. This makes all the lines equal in t-1.

manufacturing firms into two types—large and small, based on the pre-reform sample median of total assets. Consistent with our hypothesis, there is a slowdown in R&D-sales ratio for both types of manufacturing firms since the reform, which is more pronounced for larger ones. Such slowdown is also accompanied by a relative increase for the treated service firms. This figure provides some evidence for reallocation of R&D investment from downstream manufacturing firms, especially the larger ones, to upstream service firms after the B2V reform.

Inefficient vertical integration may also result in poor quality of R&D investment. If such inefficiency is reflected by the quality of innovation before the reform, it is likely that less innovative manufacturing firms would increase outsourcing more than others. In Figures 2b, we split the full sample of manufacturing firms into two groups based on firms' pre-reform quality of innovation, proxied by the number of patents firms held before the B2V reform. There, we find that less innovative manufacturing firms did experience a more pronounced slow down in their R&D-sales ratio since the B2V reform. Taken together, these figures indicate that the B2V reform may have increased the overall efficiency of R&D investment in the economy via reallocation.

4.3 Quality of innovation

When manufacturing firms outsource innovation activities that they do not specialize in to upstream service firms that are better at it, reallocation can lead to higher quality of innovation. Meanwhile, with a larger market, treated service firm may have stronger incentives to improve the quality of their innovation. In Table 2, we examine various proxies for firm innovation quality based on our benchmark specification. In columns 1-4, we examine the effect of the reform on the number and citations for firms' total patents. In columns 5-6, we examine the number and citations for new patents. The estimated treatment effects are positive across all columns, and we find a stronger effect for new patents. These results suggest that the reallocation of innovation activities may have enhanced the quality of innovation in the economy.

4.4 Which service firms benefit more?

Next, we ask which types of treated service firms benefit the most from B2V reform. In column 1 of Table 3, we show that the increase in sales, R&D investment and employment is positive and significant only for larger treated firms. This indicates that outsourcing spurred by the B2V reform mainly goes to larger treated firms, possibly due to their better business ties with downstream manufacturers and stronger market power.

In column 2, we differentiate between more and less innovative treated firms, based on their pre-reform quality of innovation. We find weak evidence that less innovative treated firms experienced a larger increase in sales, R&D investment and employment. Previously, we find that less innovative manufacturing firms tend to outsource more after the B2V. Evidence here suggests that such outsourcing is more likely to go to less innovative upstream service firms. As we also find an improvement in treated firms' innovation quality, this implies that the B2V reform may help the less innovative treated firms to catch up with the technological frontier.

As the B2V reform significantly increased sales for treated service firms, this, in principle, could enhance the liquidity of financially constrained firms. If so, we should observe stronger increase in R&D investment among constrained treated firms. To test this, we use two alternative proxies for financial constraints and conduct triple DID analysis: 1) dividend payout ratio, defined as dividend per share relative to net asset per share, averaged across years before the B2V reform; and 2) investment rating by financial analysts, averaged across years before reform. Presumably, firms with a higher dividend payout ratio are less likely to be constrained. Firms with a better investment rating by analysts may also find it easier to raise external financing by issuing new equity or borrowing. In columns 3 and 4 of Table 3, we report the triple DID estimation results using dummies classifying treated firms into constrained and unconstrained ones using the two proxies. In both columns, the estimated triple DID coefficients are statistically insignificant for all three outcome variables. Thus, there is no evidence that more financially constrained firms benefited more from outsourcing.

5 Alternative explanations

5.1 Changes in the cost of capital

The B2V reform could have potentially lowered the cost of capital for R&D investment for the treated firms. This is because before the reform, the treated service firms could not deduct input costs associated with R&D when calculating the BT, but can deduct those when calculating the VAT. However, if most of the R&D expenditures are in the form of wages, the reform should have limited impact on the cost of capital for R&D investment, since wages are not deductible when calculating either the BT or the VAT.[14] If the change in the cost of capital is important, however, we should observe a larger response among treated firms spending more on R&D related equipment and less on R&D personnel.

We hand-collect and calculate the ratio of R&D personnel wage to total R&D expenditures for each treated firm.[15] On average, more than 70% of R&D expenditures went into wage. This suggests that the majority of the R&D expenditures for a typical treated service firm was not deductible against the VAT after the B2V reform. In columns 1-3 in Table A5, we show that firms spending a larger proportion of their R&D expenditures on wages did not respond differently from those that spent less. Thus, changes in the cost of capital are unlikely to drive the observed increase in R&D investment.

5.2 Any price changes?

Higher demand may alternatively be caused by a lower price of intermediate goods produced by the treated firms, if the B2V reduced their tax burden and production costs. While the B2V is portrayed by the government as a tax reducing policy reform (Cui, 2014), it remains controversial whether firms' tax burden actually declined after the B2V.[16] In column 4 of Table A5, we calculate firms' tax burden as the natural logarithm of total BT and VAT paid. Alternatively, we scale the total amount of the two taxes by firms' total assets (column 5). We find no evidence that the treated firms experienced a significant reduction in their tax burden after the B2V reform, relative to the control group. Thus, our benchmark results are unlikely to be driven by this direct price effect.

On the other hand, manufacturing firms already purchasing intermediate goods from the treated service firms should experience a reduction in their tax burden after the B2V reform, since they now can claim deduction on such input purchases. This reduction in manufacturing firms' tax burden may lead to a lower price of the final product, possibly generating higher demand for both downstream manufacturing firms and upstream service firms. As a preliminary check, in column 6 in Table A5, we compare the producer price indices for manufacturing industries that were more affected by the B2V reform through their purchasing network with that of less affected manufacturing industries (i.e., our benchmark

[14] According to the Chinese accounting standard, R&D expenditures include both the wages of R&D related personnel and expenses on construction, use, maintenance, and depreciation of R&D-related fixed assets (Liu and Mao, 2019).

[15] Since Chinese listed firms were not required to disclose this data before 2015, we only managed to collect this information for years 2017 and 2018.

[16] Some firms reported increased tax burden after the reform, as illustrated by this media report: https://www.chinadaily.com.cn/bizchina/2014-07/30/content$_1$8207183.*htm*.

control group). There is no evidence that these price indices evolve differently by 2017, suggesting limited impact on producer prices within the few years since the reform. Hence, the cascading price channel is also unlikely to drive our benchmark results.

5.3 Relabeling

Firms could manipulate their financial statements, for example by relabeling, to qualify for certain tax benefits. Given the wide range of R&D tax incentives available during our sample period, the observed increase in treated firms' R&D investment may be caused by relabeling. However, there is little reason for the treated firms to engage in such manipulation more than control firms. The B2V reform is also unlikely to trigger R&D relabeling, since it does not target R&D investment per se. More, if treated firms did increase relabeling since the B2V reform for unknown reasons, we should find a significant reduction in their capital investment after the reform. As Table 1 shows, we actually find an increase in treated firms' capital expenditures. All of these suggest that the increase in R&D investment by treated service firms is unlikely to be caused by relabelling.

5.4 Placebo service firms

It is worth noting that our treated group firms mainly belong to the business-to-business (B2B) industries. For treated service firms in business-to-customers (B2C) industries, the outsourcing effect should be limited. Thus, we use only treated firms in B2C industries, based on the industry-level input-output table in 2012, as an alternative treatment group. This includes firms from the following industries: transportation services, culture and entertainment, and commercial services. In columns 7-9 in Table A5, we find that the B2V reform had little impact on these firms' sales, R&D investment, and employment. This placebo test strengthens our conclusion that the observed increase in sales, R&D and employment for treated firms are mainly caused by outsourcing.

6 Conclusions

Turnover taxes cause production distortions due to tax cascading. In particular, they lead to inefficient vertical integration and misallocation of resources. In this paper, we examine how the removal of turnover taxes affects firm performance, by investigating China's transition from the business tax to the value-added tax as a quasi-natural experiment. We find that service firms moving from business tax to the value-added tax significantly increased sales, R&D investment and employment, as downstream manufacturing firms increased outsourcing. Such reallocation increases economic efficiency and improves the quality of innovation.

This paper improves our understanding of the negative impact of turnover taxes imposed on business inputs, and contributes to the debate on future tax reforms. For example, in the U.S., the state sales tax system derives a large proportion of its revenue from taxing business purchases of intermediate goods and services.[17] There are also proposals to expand the state sales tax base to cover a wide range of services, since the overall proportion of services in the U.S. relative to the sales of tangible goods has been growing. Our study implies that such proposals would exacerbate distortions associated with sales tax, unless states can provide adequate exemptions for inputs purchased by businesses.

[17] According to Phillips and Ibaid (2019), over 41% of state and local sales tax revenues came from those on business inputs in 2017.

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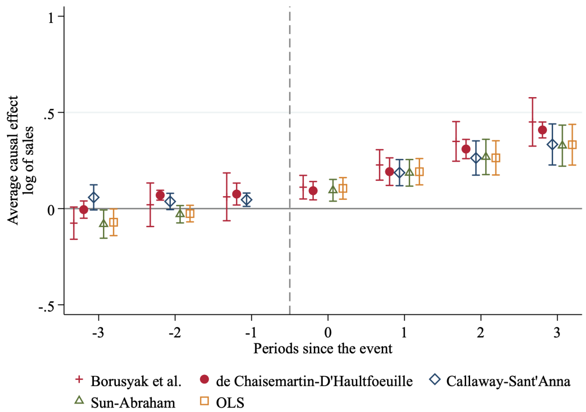
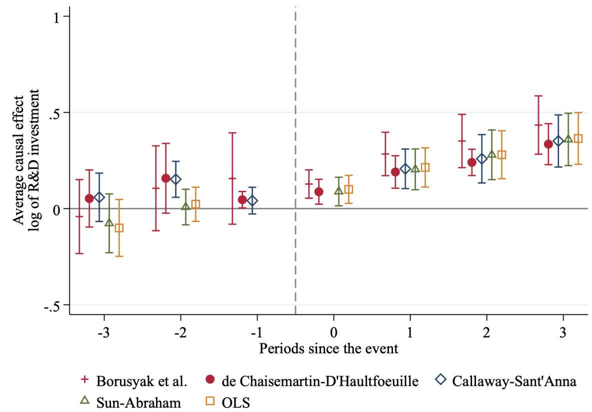
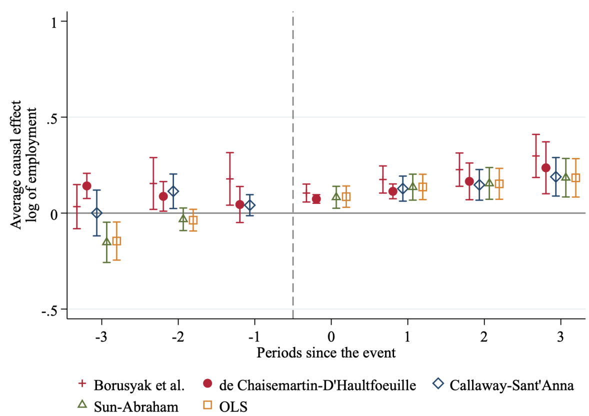
Figure 1: Dynamic effects of the B2V reform on sales and R&D investment: firm-level evidence



a Sales (in logs)



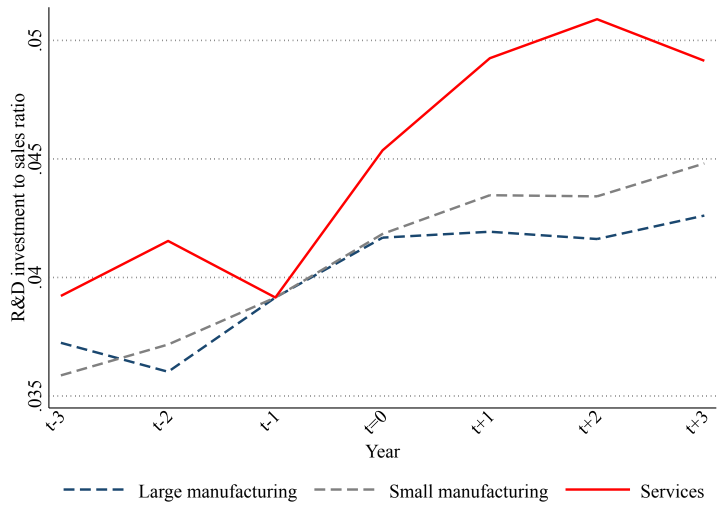
b R&D investment (in logs)



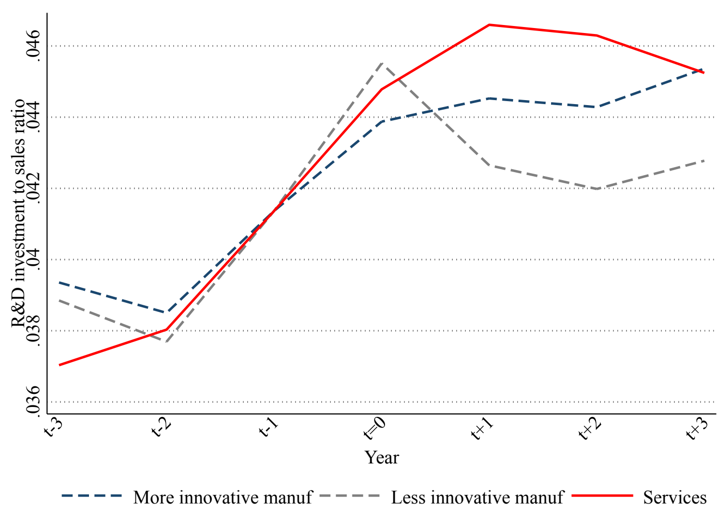
c Employment (in logs)

Note: This figure reports the dynamic effects of the reform on sales (panel a), R&D expenditures (panel b), and number of employees (panel c). All panels include the event study coefficient plots for treated firms relative to those in the control group from 3 years before the B2V reform year to 3 or more years after the B2V reform year. Each dot represents the coefficient estimate using different difference in difference methodology, while each vertical line represents the 95% confidence interval. We control for year and firm-level fixed effects when estimating these differences. Each colored line represents a different methodological correction to difference-in-differences to account for heterogeneous staggered implementation of the reform. The treated group consists of listed firms in service industries moving from BT to VAT by 2015, as outlined in Table A2. The control group consists of manufacturing firms with weak links to the treated service industries. Standard errors are robust and clustered at the firm level.

Figure 2: Evidence for outsourcing



a Large versus small manufacturing firms



b More innovative versus less innovative manufacturing firms

Note: These figures plot the evolution of the R&D expenditures to sales ratio for treated service firms and manufacturing firms. For comparability, each line is constructed such that we remove firm fixed effects, subtract the group average in period t-1 from each data point and add back the pooled mean from the sample period. This makes all the lines equal in t-1. In Panel A, we split the full sample of manufacturing firms into two groups, based on their pre-reform size (proxied by the natural logarithm of total assets). In Panel B, we split the manufacturing firms into less and more innovative using median number of valid patents that they had before the reform. The red line indicates treated service firms. Standard errors are robust and clustered at the firm level.

Table 1: Baseline result: Impact of the B2V reform on firm performances

	(1) Ln(Sales)	(2) Ln(Capex)	(3) Ln(R&D)	(4) Ln(Empl)	(5) Ln(Wage)
Panel A: No controls					
$\text{Treated}_i \times \text{Post}_{i,t}$	0.291***	0.259***	0.307***	0.241***	0.158***
	(0.047)	(0.092)	(0.058)	(0.046)	(0.041)
Observations	11109	8183	8465	11100	11084
# firms	1549	1872	1770	1551	1551
Mean	21.155	18.426	17.697	7.606	18.932
Panel B: Including controls					
$\text{Treated}_i \times \text{Post}_{i,t}$	0.115***	0.052	0.099*	0.066**	0.005
	(0.025)	(0.085)	(0.050)	(0.030)	(0.024)
Observations	10564	7808	8137	10554	10543
# firms	1526	1854	1717	1529	1528
Mean	21.169	18.433	17.690	7.621	18.951
Year FE	✓	✓	✓	✓	✓
Firm FEs	✓	✓	✓	✓	✓

Note: This table reports the estimated effects of the reform on sales (column 1), capital expenditures (column 2), R&D expenditures (column 3), number of employees (column 4) and wages (column 5). The treated group consists of listed firms in treated service industries. The control group are manufacturing firms with weak links to the treated service industries. In Panel A, we present results with firm and year fixed effects, and in Panel B, we add firm control variables. Firm controls include size, age, returns on assets (ROA), leverage, subsidy and firm-specific and time-varying nominal corporate income tax rate. We define each of those variables in Appendix A. Standard errors are robust and clustered at the firm level.

Table 2: Quality of innovation

	(1)	(2)	(3)	(4)	(5)	(6)
	Total patents				New patents	
	No. of patents	Citations	Weighted patents	5-year citations	No. of patents	5-year citations
$\text{Treated}_i \times \text{Post}_{i,t}$	0.234***	0.072	0.150***	0.192	0.267**	0.556***
	(0.081)	(0.106)	(0.038)	(0.120)	(0.125)	(0.152)
Observations	7966	8162	6971	8162	8176	7873
# firms	1382	1425	1603	1425	1411	1482
Mean	4.085	3.123	0.880	3.419	3.012	2.810
Year FE	✓	✓	✓	✓	✓	✓
Firm FEs	✓	✓	✓	✓	✓	✓

Note: This table reports the estimated effects of the B2V reform on treated firms' innovation quality. In Columns 1-4 we consider total patents owned by firms and in columns 5-6 we consider new patent applications. The outcome variable is the number of patents in columns 1 and 5, the number of citations in column 2, the weighted patents in column 3, and the number of citations during the first 5 years since a patent is granted in columns 4 and 6. All outcome variables are in natural logarithms. The treated group consists of listed firms in treated service industries. The control group are manufacturing firms with weak links to the treated service industries. Standard errors are robust and clustered at the firm level.

Table 3: Which service firms benefit more?

Split based on:	(1) Size	(2) Quality of innovation	(3) Dividend payout ratio	(4) Investment rating
Panel A: Ln(Sales)				
$\text{Treated}_i \times \text{Post}_{i,t}$	-0.037	0.514***	0.291***	0.304***
	(0.083)	(0.111)	(0.081)	(0.073)
$\text{Treated}_i \times \text{Post}_{i,t} \times \text{Above}_i$	0.473***	-0.205*	0.089	0.075
	(0.096)	(0.122)	(0.098)	(0.094)
Panel B: Ln(R&D expenditures)				
$\text{Treated}_i \times \text{Post}_{i,t}$	-0.008	0.415***	0.226**	0.235**
	(0.092)	(0.123)	(0.091)	(0.101)
$\text{Treated}_i \times \text{Post}_{i,t} \times \text{Above}_i$	0.381***	-0.139	0.148	0.101
	(0.107)	(0.134)	(0.109)	(0.117)
Panel C: Ln(Employment)				
$\text{Treated}_i \times \text{Post}_{i,t}$	-0.038	0.243**	0.194***	0.144**
	(0.083)	(0.098)	(0.065)	(0.072)
$\text{Treated}_i \times \text{Post}_{i,t} \times \text{Above}_i$	0.327***	-0.013	0.036	0.137
	(0.091)	(0.106)	(0.080)	(0.084)
Observations	8465	8465	6307	6931
# firms	1442	1442	1442	1442
Mean	17.697	17.697	17.826	17.775
Year FE	✓	✓	✓	✓
Firm FEs	✓	✓	✓	✓

Note: This table reports the estimated effects of the reform for different types of treated firms on sales (Panel A), R&D expenditures (Panel B), and number of employees (Panel C). The treated group consists of listed firms in treated service industries. The control group are manufacturing firms with weak links to the service industries. Each column presents triple DID result where we interact $Treated_i \times Post_{i,t}$ with a dummy, $Above_i$, that indicates treated firms being above a certain threshold. In column 1, $Above_i$ equals 1 if the treated firm's total assets before the reform (in logs) is above the sample median. In column 2, $Above_i$ equals 1 if the treated firm's pre-reform quality of innovation is above the sample median. In column 3, $Above_i$ equals 1 if the treated firm's dividend payout ratio before the reform is above the sample median. In column 4, $Above_i$ equals 1 if the treated firm's investment rating before the reform is above the sample median. Standard errors are robust and clustered at the firm level.

Appendices

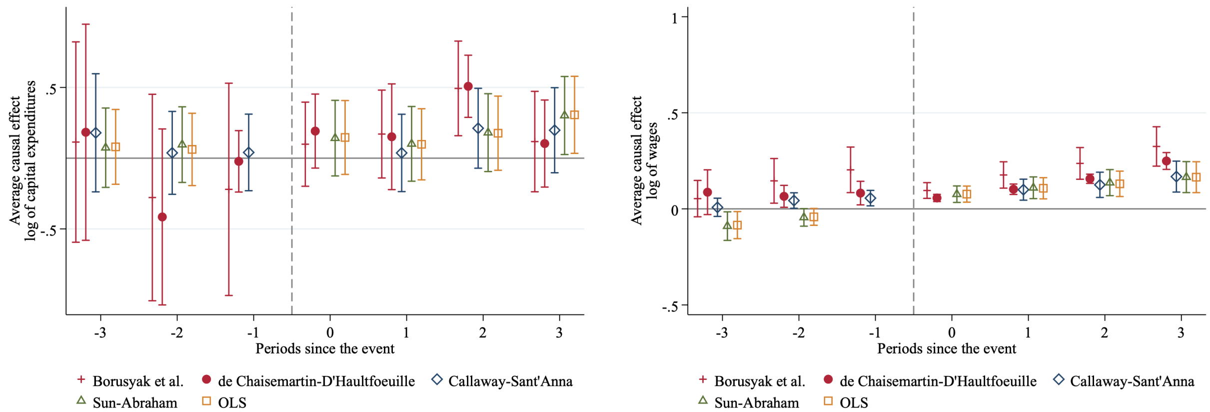
A Variable definitions

Sales: firms' sales. Under the BT regime, we subtract the amount of the business tax from sales since the amount of business tax paid was included in the sales figure.
Capex: net increase in fixed assets
R&D: firm-level R&D expenditures.
R&D dummy: a dummy that equals to 1 when RD investment is positive, and 0 otherwise.
Employment: firm-level annual total employment.
Wages: firm-level annual total wages.
Number of patents (total patents): Number of total patents that a firm owns.
Number of patents (new patents): Number of new patents that a firm apply for in a certain year.
Citations (total patents): The cumulative number of citations over all previous years for a firm's total patents
Weighted patents: Total number of patents that a firm holds weighted by the number of citations that these patents receive.
5-year citations (total patents): Number of citations received in 5 years after application for all patents that a firm owns.
5-year citations (new patents): Number of citations received in 5 years after application for new patents that a firm owns.
Size: the natural logarithm of firms' total assets.
Age: current year minus the year of firm establishment.
ROA: net profit divided by total assets.
Leverage: total debt divided by total assets.
Subsidy: the natural logarithm of all subsidies received from the government.
CIT: firm and year-specific nominal corporate income tax rate.
Tax: the sum of annual business tax and value-added tax paid by the firm. As Chinese listed firms do not disclose VAT, we follow Fang et al. (2017) to calculate the sum of the two taxes as follows. We first calculate the total turnover tax which is the sum of BT, VAT, and consumption tax paid. We then subtract the amount of disclosed consumption tax paid from the total turnover tax. Total turnover tax is not directly disclosed. However, additional tax and fees are calculated based on the amount of turnover tax paid. Specifically, the education

supplementary tax is 3% of the turnover tax, the local education supplementary tax is 2% of the turnover tax, and the urban construction tax is 5% or 7% of the turnover tax for firms in the urban areas. We follow the following three steps to obtain turnover tax paid: 1) for companies disclosing the federal education supplementary tax, we set the turnover tax to be the federal education supplementary tax divided by 3%; 2) for companies only disclosing the local education supplementary tax, we set the turnover tax to be the local education supplementary tax divided by 2%; and 3) for other companies, we use the urban construction tax divided by 6% to calculate the amount of the turnover tax.

B Additional figures and tables

Figure A1: Dynamic effects of the B2V reform on additional outcome variables



a Ln(Capex) b Ln(Wage)

Note: This figure reports the dynamic effects of the reform on capital expenditures (Panel a) and wages (Panel b), both in logs. We include the event study coefficient plots for treated firms relative to those in the control group from 3 years before the B2V reform year to 3 or more years after the B2V reform year. Each dot represents the coefficient estimate using different difference in difference methodology, while each vertical line represents the 95% confidence interval. We control for year and firm-level fixed effects when estimating the differences. Each colored line represents a different methodological correction to difference-in-differences estimations to account for heterogeneous staggered implementation of the reform. The treated group consists of listed firms in all treated industries, as outlined in Table A2. The control group are manufacturing firms with weak links to the service industries. Standard errors are robust and clustered at the firm level.

Table A1: Timeline of the B2V reform.

Reformed industries	Regions	Implementation date
Transportation and six service industries (R&D and technical services, IT services, cultural and innovation services, logistics auxiliary services, attestation and consulting services, and tangible assets leasing services)	Shanghai	2012.01.01
	Beijing	2012.09.01
	Jiangsu	2012.10.01
	Anhui	2012.10.01
	Fujian	2012.11.01
	Guangdong	2012.11.01
	Hubei	2012.12.01
	Tianjin	2012.12.01
	Zhejiang	2012.12.01
	Nationwide	2013.08.01
Postal service, rail transportation	Nationwide	2014.01.01
Telecommunication	Nationwide	2014.06.01
Real estate, construction, finance, and other services	Nationwide	2016.05.01

Note: This table outlines the waves of the B2V reform across different industries and regions.

Table A2: Sample distributions across treated and control industries.

Panel A: Treated industries

Industry name	Industry code	No. of firms	BT rate	VAT rate[18]
Railway transportation	G53	3	3%	11%
Road transportation	G54	28	3%	11%
Water transportation	G55	26	3%	11%
Air transportation	G56	11	3%	11%
Portage and transportation agency	G58	1	3%	6%
Warehousing	G59	5	5%	6%
Telecomms, broadcast TV and satellite transmission services	I63	10	5%	6%
Internet services	I64	12	5%	6%
Software and information technology services	I65	96	5%	6%
Leasing	L71	1	5%	11% or 17%[19]
Business services	L72	18	5%	6%
Research and experimental development	M73	1	5%	6%
Professional technical services	M74	9	5%	6%
News and publication	R85	13	5%	6%
Radio, television, film and recording production	R86	7	5%	6%
Culture and art	R87	2	5%	6%
Total		**243**		

Panel B: Control industries

Industry name	Industry code	No. of firms		
Agricultural and sideline food processing	C13	35		13% or 17%[20]
Food manufacturing	C14	23		13%
Textile	C17	36		17%
Leather, fur, feathers and their products and shoemaking	C19	5		17%
Furniture manufacturing	C21	4		17%
Petroleum processing, coking and nuclear fuel processing	C25	12		13%
Chemical raw materials and chemical products manufacturing	C26	163		17%
Chemical fiber manufacturing	C28	21		17%
Non-metallic mineral products	C30	67		17%
Ferrous metal smelting and rolling processing	C31	29		17%
Metal products	C33	36		17%
General equipment manufacturing	C34	86		17%
Special equipment manufacturing	C35	118		17%
Electrical machinery and equipment manufacturing	C38	146		17%
Computer, comms and other electronic equipment manuf.	C39	198		17%
Comprehensive utilization of waste resources	C42	1		17%
Total		**980**		

Note: This table reports the distribution of firm-year observations in our sample across different industries, based on the China Securities Regulatory Commission's industry classification system. The B2V reform provides a general guide for industries that are subject to the reform (as in A1). We therefore match industries in the sample of listed firms with those outlined by the B2V reform policy.

[18] These were VAT rates applicable by June 1st, 2017. The VAT rates were reduced for certain industries in later years.

[19] The VAT rate is 17% for movable property leasing and 11% for immovable property leasing.

[20] 13% for general agriculture products, and 17% for deep processed agriculture products.

Table A3: Descriptive statistics of key variables.

	(1) All	(2) Control	(3) Treated	(4) diff	(5) t-test
Ln(Sales)	21.020	21.078	20.782	0.296***	2.722
Ln(Capex)	18.388	18.447	18.135	0.312*	1.699
Ln(R&D)	17.221	17.225	17.197	0.027	0.246
R&D intensity	0.026	0.024	0.039	-0.015***	-4.857
R&D investment in all investment	0.435	0.390	0.714	-0.324***	-6.044
Ln(Empl)	7.485	7.539	7.268	0.271***	2.665
Ln(Wage)	18.656	18.627	18.773	-0.146	-1.632
Patents owned	3.257	3.421	2.166	1.255***	9.802
Nb of citations	1.764	1.889	1.150	0.739***	5.326
Cit weighted nb patents	0.685	0.674	0.776	-0.102*	-1.832
Pat owned: 5 year citation count	2.227	2.375	1.500	0.875***	5.311
Nb of patent applications	2.802	2.990	1.875	1.115***	6.785
Pat appl: 5 year citation count	3.679	3.925	2.512	1.413***	6.481
Non-missing R&D	0.471	0.473	0.459	0.014	0.330
Ln(Tax)	17.672	17.701	17.552	0.149	1.459
Tax/ total assets	0.028	0.029	0.022	0.007***	5.301
Age	12.317	12.339	12.226	0.114	0.297
Size	21.601	21.579	21.689	-0.110	-1.082
ROA	0.049	0.045	0.065	-0.019***	-5.382
Leverage	0.388	0.397	0.348	0.050***	2.950
Subsidy	15.949	15.962	15.894	0.068	0.521
CIT	0.178	0.174	0.193	-0.019***	-5.043

Note: This table reports summary statistics of key variables for the control group and the treated group for a period before the reform 2009 - 2011. Full sample includes both treated and control groups. For each variable, we conduct the t-test on the null hypothesis that the mean values are equal between the treated and the control groups. The associated T-statistics is reported in the last column. R&D intensity is measured by the ratio of R&D expenditures to total assets. All investment is the sum of R&D expenditures and capital expenditures. All other variable are defined in Appendix A.

Table A4: Additional results

	Full sample	Matched sample				
	(1)R&D dummy	(2) Ln(Sales)	(3) Ln(Capex)	(4) Ln(R&D)	(5) Ln(Empl)	(6) Ln(Wage)
Panel A: No controls						
$\text{Treated}_i \times \text{Post}_{i,t}$	0.740***	0.236***	0.217**	0.246***	0.190***	0.111***
	(0.155)	(0.043)	(0.092)	(0.065)	(0.040)	(0.038)
Observations	10301	9427	7277	7008	9416	9409
# firms	1626	1113	1363	1030	1114	1114
Mean	0.817	21.266	18.457	17.757	7.701	7.701
Panel B: Including controls						
$\text{Treated}_i \times \text{Post}_{i,t}$	0.377*	0.110***	0.064	0.082	0.080***	0.008
	(0.194)	(0.025)	(0.085)	(0.058)	(0.029)	(0.024)
Observations	9848	9098	7047	6783	9088	9081
# firms	1595	1112	1368	1028	1112	1116
Mean	0.821	21.267	18.458	17.751	7.706	7.706
Year FE	✓	✓	✓	✓	✓	✓
Firm FEs	✓	✓	✓	✓	✓	✓

Note: This table reports the estimated effects of the reform on extensive margin of R&D investment (column 1) and in columns 2-6 on sales, capital expenditures, R&D investment, employment and wage in a matched sample. In Column 1, the outcome variable is a dummy equal to 1 when R&D investment is positive, and 0 otherwise. We use a probit model to estimate the effect of the reform on the extensive margin of R&D investment. In columns 2-6, we use kernel propensity score matching to match firms based on firm-level information as in 2011. For matching properties and methodology, see Appendix C. In Panel A, we present results with firm and year fixed effects, and in Panel B, we add firm control variables. Firm controls include size, age, returns on assets (ROA), leverage, subsidy and firm-specific and time-varying nominal corporate income tax rate. Standard errors are robust and clustered at the firm level.

Table A5: Alternative channels

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sample		Cost of capital			Price effect			B2C firms	
Dep. var.	Ln(R&D)	Ln(Sales)	Ln(Empl)	Ln(Tax)	Tax/Assets	Ln(Price)	Ln(Sales)	Ln(R&D)	Ln(Empl)
$\text{Treated}_i \times \text{Post}_{i,t}$	0.109***	0.095	0.045	-0.067	-0.000	-0.008	0.155	0.000	-0.080
	(0.029)	(0.058)	(0.035)	(0.049)	(0.001)	(0.020)	(0.103)	(0.176)	(0.118)
$\text{Treated}_i \times \text{Post}_{i,t}$	0.023	0.009	0.083						
$\times$ High labor ratio_i	(0.052)	(0.093)	(0.060)						
Year FE	✓	✓	✓	✓	✓		✓	✓	✓
Firm FEs	✓	✓	✓	✓	✓		✓	✓	✓
Observations	10564	8137	10554	7921	7925	20	6140	6140	6135
# firms	1709	1926	1711	1409	1409		976	976	976
Mean	21.169	17.690	7.621	17.921	0.029		21.267	17.668	7.699

Note: In this table, we analyze alternative explanations for the effects of the B2V reform. In columns 1-3, we examine the effect of changes in the cost of capital for sales, R&D investment, and employment, respectively. We interact $Treated_i \times Post_{i,t}$ with a dummy $Highlabor$, which equals 1 if the ratio of R&D personnel wage to R&D expenditures is above the median level of all treated firms. In columns 4-5, we examine changes in treated firms' tax burden. In column 4, the dependent variable is the log of tax paid, where tax is the sum of BT and VAT. In column 5 the dependent variable is the ratio of tax paid to total assets. In column 6, we examine changes in industry-level price indices (in logs) for manufacturing firms that are exposed to the B2V reform to different degrees. Treated dummy in column 6 is 1 when a firm is in a manufacturing industry that has high purchasing ratio from service firms. In columns 7-9, we examine the effect of the B2V reform on a sub-sample of treated firms in B2C industries including transportation services, culture and entertainment, and commercial services. Standard errors are robust and clustered at the firm level.

Table A6: Goodman Bacon decomposition

Dep Var.		Timing groups	Never treated	Overall coefficient
Ln(Sales)	Coefficient	0.078	0.279	0.275***
	Weights	0.019	0.981	
Ln(Capex)	Coefficient	-0.025	0.143	0.14
	Weights	0.017	0.983	
Ln(R&D)	Coefficient	-0.028	0.221	0.216***
	Weights	0.015	0.981	
Ln(Employment)	Coefficient	0.068	0.204	0.201***
	Weights	0.018	0.982	
Ln(Wage)	Coefficient	0.036	0.018	0.16***
	Weights	0.162	0.982	

Note: This table decomposes the overall effect of the reform using the Goodman Bacon decomposition, based on a balanced data during 2009-2016. This limits the number of observations, relative to the benchmark results, but is necessary to perform the decomposition. We report the estimated effects of the reform on sales, capital expenditures, R&D, employment and wages. Treated group consist of firms in treated service industries. We use manufacturing firms with weak links to the treated service industries as the control group. In the decomposition, we include year fixed effect, but no controls. Standard errors are robust and clustered at the firm level.

C Propensity score matching

We use propensity score-matching to construct the alternative treated and control groups, based on the observed firm-level characteristics including firm size, age, ROA, leverage, the level of subsidies received from the government (in logs), and individual firm-level corporate income tax rate. All these covariates are measured in 2011 before the implementation of the B2V reform. First, we estimate the following probit model:

$$Treated_i = \alpha_0 + \alpha_1 \times X_i' + \epsilon_i \tag{3}$$

where $Treated_i$ equals 1 if firm i belongs to the selected service industry treatment group and 0 when it is a selected manufacturing firm with weak links to service industry. X_i' is a vector of firm-level characteristics. ϵ_i is the error term. The predicted probabilities from this regression — propensity scores — are used to construct the matched sample of service and manufacturing firms. We use kernel matching, which assigns inverse probability weights to control group observations. Table A7 reports the means of key variables for the treatment and the control groups before and after our matching procedure together with a pairwise t-test and the bias reduction that results from matching.

Table A7: Matching properties

Variable	Group	Treated	Control	t-test	% bias	% bias reduction
Size	Unmatched	21.689	21.579	1.23	8.5	
	Matched	21.678	21.667	0.09	0.9	90
Age	Unmatched	12.226	12.339	-0.3	-2.2	
	Matched	12.175	12.239	-0.12	-1.2	43.6
ROA	Unmatched	0.0647	0.04532	4.92***	38.2	
	Matched	0.06626	0.06771	-0.32	-2.8	92.5
Leverage	Unmatched	0.34764	0.39731	-2.93	-21.8	
	Matched	0.3446	0.34677	-0.1	-1	95.6
Ln(Subsidy)	Unmatched	15.894	15.962	-0.56	-4.1	
	Matched	15.894	15.943	-0.29	-3	27.9
Firm-level tax rate	Unmatched	0.19327	0.17445	5.71***	39.7	
	Matched	0.19156	0.18888	0.55	5.7	85.8

Note: This table reports the matching properties for the list of matching variables we use. % bias reduction is calculated as (% bias of unmatched sample-% bias of matched sample)/(% bias of unmatched sample). For variable definitions, see Appendix A.