Stimulus Effect of a Value-added Tax Cut: Evidence from the UK Tax Returns Data

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Abstract

In response to the great recession of 2008, the UK government used a temporary value-added tax rate reduction as its main stimulus policy. From 1 December 2008 to 31 December 2009, the standard-rate of value-added tax was reduced from 17.5 to 15 percent while the existing zero-rate did not change. I use the universe of VAT returns between 2002q1 to 2010q4 to compare changes in sales growth for standard-rated traders to that of zero-rated traders (difference-in-differences). I find an insignificant small impact on sales growth once I allow for heterogeneous effects of the recession either by a) relying solely on post-recession observations or b) controlling for two-digit sector specific recession impacts. Subject to full pass through of the rate cut to consumer prices, a zero effect on sales growth is reflective of a proportionate increase in sales quantity (unit elasticity).

Keywords: fiscal stimulus, value-added tax, standard-rate cut, returns data
JEL Classification: H24, H32, E62

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1 Introduction

The great recession of 2008 has led to a variety of fiscal stimuli and unprecedented expansionary monetary policy around the world. Tax rebates, incentives for investment and consumption, and investment in infrastructure were common elements of stimulus packages. While a large body of literature studies the impact of fiscal policy, the debate about its effectiveness during recessions is far from settled (Auerbach et al. (2010)).

In the UK a temporary reduction of value-added tax (VAT) rate was the main element of the fiscal stimulus package. The VAT rate cut was heralded as timely, targeted, and reversible. The cut was estimated to cost £12.5 billion which amounts to approximately 15.5 percent reduction in VAT receipts or 2.2 percent fall in total tax revenue. VAT rates could be changed relatively quickly and are easy to reverse making them an interesting temporary instrument for cycle management. While many countries have value-added taxation little is known about the stimulus impact of a VAT rate cut. The main objective of this paper is to estimate the stimulus effect of the VAT rate cut using tax return data.

The theoretical impact of the cut depends on whether traders pass-on the cut to customers or take home the reduction in tax liability. The former case would result in income and substitution effects while the latter involves only an income effect. The consumption increase as a result of the income effect is not expected to be substantial due to the temporary nature of the cut unless individuals are credit constrained or myopic[1]. Two types of substitution effects could be present. First, demand for standard-rated items would increase as their price relative to zero-rated items is lower (intra-temporal). Second, price of consumption is lower during the cut and consumers would shift purchases to benefit from lower prices (inter-temporal). Since about one third of standard-rated items are durable goods in the UK, the inter-temporal substitution effect could be strong because consumers can stock up and consume these items later[2].

[1]Under permanent income hypothesis, unanticipated temporary increases in income would be spread over the life cycle and therefore should have little impact on current period consumption. Credit constrained consumers would, however, consume any marginal income. Interestingly, many recent studies of US tax rebates find substantial consumption responses right after the receipt of rebates (e.g. Johnson et al. (2006), Parker et al. (2013), and Agarwal et al. (2007)). Most of the rebate money is consumed within a few quarters after receipt. For a review of the empirical literature on marginal propensity to consume out of income shocks refer to Jappelli and Pistaferri (2010).

[2]The recession might moderate the inter-temporal substitution effect by tightening credit constraints and increasing income uncertainty. For a detailed discussion of the potential impact of the cut refer to Blundell (2009), Crossley et al. (2009), and Barrell and Weale (2009).

The key difference between the UK VAT cut and the US style tax rebates is that the former encourages consumption through price incentives while the latter works purely through an increase in after-tax income[3]. Absence of inter-temporal substitution effects for tax rebates could reduce their effectiveness as a stimulus policy. The same effect could also jeopardize nascent recovery if the economy has not returned to normal conditions after the expiry of the VAT cut[4].

A common issue to VAT cut and tax rebates is salience[5]. The VAT in the UK is quite complex, but targeted advertisement by retailers at the time of the cut increased its salience[6]. A related issue is the size of incentives. Small incentives might not be effective. Under full pass through the standard-rate cut would reduce prices by 2.1 percent which might be insignificant in the face of large income drops during the recession[7].

This paper is the first to use the universe VAT returns between 2002q1 and 2010q4 from HM Revenue and Customs (HMRC) to estimate the stimulus impact of the VAT standard-rate cut. Administrative VAT returns data is well suited for studying the impact of the cut because: a) there is very little measurement error; b) observing effective tax rates on sales allows identification of standard and zero-rated traders; and c) observing a large number of traders over a long time horizon (32 quarters) allows for a rich set of fixed effects (e.g. trader fixed effects and sector by date fixed effects).

I categorize traders to treatment and control based on pre-cut average effective output tax rates (ratio of sales VAT to sales). I compare sales growth for standard-rated traders to that of zero-rated traders before and during the cut period to estimate the impact of the cut. The key challenge for this difference-in-differences (DD) identification strategy is the great recession. Since most durable goods are standard-rated

[3]While price incentives are widely used to promote business investment (e.g. R&D and investment tax credits), use of price incentives was more limited in the US (except for Cash for Clunkers program of 2009 and First-time Home buyer Credit).

[4]For the cash for clunker program in the US, Mian and Sufi (2012) find substantial demand shifting. They estimate that the two months program has led to 370,000 more car purchases but car purchases were lower for a period of 10 months after the program expiry.

[5]For example if posted prices are tax exclusive (as in Chetty et al. (2009)) or the tax cut is applied at the till, consumers might fail to notice the price reduction. For tax rebates Sahm et al. (2012) find that a tax cut delivered through reduced withholding has half of the effect of a similar one-off tax rebate.

[6]Big retailers like Tesco heavily advertised the VAT cut and showed calculations of extra savings on their websites.

[7]In the context of US tax rebates Parker et al. (2013) find significant impacts on durable consumption for the larger 2008 rebates while Johnson et al. (2006) does not find a significant impact on durable goods from 2002 rebates. Both studies, however, find significant impacts on non-durable consumption.

in the UK and these are likely to receive a greater impact from the recession, it is unlikely for the identification assumption of the simple DD strategy to hold.

I use two main strategies to control for heterogeneous recession effects. First, I allow average growth rates to differ for standard and zero-rated traders during the recession period (2008q1-2010q4). The estimated magnitudes reflect the differential change in average growth rate of standard-rated traders during the cut period relative to recessionary quarters. This strategy deliver unbiased estimates when the heterogeneous recession effects are time invariant[8]. Second, I allow heterogeneous recession effects for two-digit sectors by including sector by recession interactions in the regression. To the extent that recessionary effects are on average the same for standard and zero-rated traders within the same two-digit sector, the DD estimates from this specification would deliver unbiased estimates[9].

Once I employ either of the above strategies to deal with heterogeneous recession effects, the magnitude of the estimated effect on sales growth becomes small and insignificant. Several robustness checks confirm the stability of this result. A zero effect on gross sales is suggestive of a proportionate increase in quantity demanded in response to tax induced price reductions. Under full pass through, the 2.5 percentage points reduction in the standard-rate would translate to a 2.1 percent price reduction. This price reduction would unambiguously lead to an increase in quantity demanded. But unless the price elasticity of demand is greater than 1, the resulting change in gross sales would be negative. Therefore, under full pass through a zero effect on gross sales suggests a proportional change in quantity demanded.

Several studies try to give ex ante evaluations of the VAT cut impact on consumer spending. Crossley et al. (2009) and Blundell (2009) predict changes in consumption as a result of the VAT cut. These papers suggest the inter-temporal elasticity of substitution is around 1 which is consistent with my finding that gross sales did not change in response to the rate cut. Barrell and Weale (2009) uses aggregate consumption data for six European countries with VAT rate changes (2 rate reductions and 7 rate increases) and concludes that the consumption would be increased by less than 1 percent while GDP will increase by less than half a percent[10].

[8]The common recession effect could vary over time. This assumption only requires the differential impact of the recession to remain constant.

[9]The first and second methods deal with different concerns and therefore it might be difficult to select one as the preferred method. The first method allows for a differential recession response for standard and zero-rated categories while the second method controls for two-digit sector specific recession effects. Since there is not a perfect correlation between two-digit sectors and standard-rated categories, the two measures control for different potential confounders.

[10]Fernandez-de Cordoba and Torres (2011) get somewhat similar results using a calibrated general equilibrium model.

Two survey based studies during the cut find little positive impacts. The Guardian reports the results of a PWC survey that shows 88 percent of consumers "said that the VAT cut had not prompted them to spend more on goods or services". In a second study that interviewed 2005 VAT registered businesses during May and June 2009, 78 percent stated that they passed on the VAT cut to consumers while 15 percent did not[11]. 46 percent of businesses, however, disagreed that the cut had a positive effect on their sales while 26 percent agreed there was a positive effect (ORC International (2010)).

The only ex post studies of the VAT cut are Crossley et al. (2014) and Crossley et al. (2013). Crossley et al. (2014) is the most comprehensive study. Using a difference-in-differences strategy they conclude that a) prices declined almost one-to-one, and b) retail sales increased by 1 percent while aggregate consumption did not change in response to the rate cut. Crossley et al. (2013) use UK Economic Accounts and Living Costs and Food Survey (LCFS) to consumption behavior through three recessions of 1980, 1990, and 2008. They find that real durable consumption fell more than non-durable consumption during recessions. However, in the current recession, the initial fall in durable purchases mimics that of earlier recessions, but from 2009q1 until 2009q4 durable purchases start to rise while non-durable purchases are flat. This period coincides with the VAT rate cut and the car scrappage scheme. The increase in durable purchases is reversed after 2009q4 and durable purchases start to decline further which could be consistent with inter-temporal shifting of durable demand. Obviously, the correspondence between VAT rates and durable consumption is not clear cut and national accounts are not clearly comparable to returns data.

A few papers study the impact of VAT reductions in other countries. Misch and Seymen (2013) compares changes in sales after the tax cuts in Turkey for firms selling treated goods with unaffected firms. The Turkish tax cuts were implemented with short notice and happened between March and September 2009 (less than 7 months). The paper estimates sales growth increased by 39 percentage points. Harju and Kosonen (2013) consider the reduction of VAT rate for restaurant meals in Finland from 22 to 13 percent in 2010. They carry out a difference-in-differences estimation using hotels and restaurants in neighboring countries as control groups for restaurants in Finland. The results show a low pass-through of 25 percent and they are unable to find a significant effect on sales.

In the next section, I briefly describe the VAT rate cut in the UK. Section 3 dis-

[11] Chirakijja et al. (2009) uses consumer price data together with a difference-in-difference estimation strategy to find a pass through of 71 percent. Although given large standard errors full pass through cannot be rejected.

cusses VAT returns data and presents summary statistics. In section 4 I explain the empirical strategy and discuss various specifications. Section 5 presents graphical and regression evidence on the impact of the cut. A final section concludes.

2 The VAT rate cut in the UK

Businesses with annual taxable turnover above a threshold (£67,000 during 2008 financial year) must register for VAT in the UK. There are three VAT rates in the UK (Table 1). The standard rate applies to household goods, most business services, and everything not listed in other categories. From April 1991 to December 2008 the standard rate was 17.5 percent. The second VAT rate applicable to food, books, children clothes, exports, and other items listed in column (2) of table 1 is zero. Selling these creates no VAT liability but VAT paid on inputs used in the production process can be reclaimed. The third VAT rate (column (3)) is a reduced-rate which was set at 5 percent during my sample. There are very few traders in this category.

In the wake of the great recession 2008 the standard rate was cut to 15 percent from 1 Dec 2008 to 31 Dec 2009. The cut was announced quite unexpectedly on 24 Nov 2008[12] leaving little room for real behavioral responses before the cut[13]. This policy was the main fiscal stimulus adopted in the UK and was heralded as the best and fairest approach to boost the economy by "giving back" 12.5 GBP billion of tax to consumers. The Chancellor of the Exchequer argued that by rapid implementation of a fiscal measure that targets purchasing decisions of firms and individuals, the demand could be boosted. Furthermore, the temporary nature of the cut made it more appealing both by encouraging consumers to bring forward their spending and by minimizing the budgetary impact of the stimulus (Seely (2009)).

3 Data

The data used in this paper is the universe of all value-added tax returns between 2002q1 and 2010q4. Administrative VAT returns data is well suited for studying the impact of the cut because: a) there is very little measurement error; b) observing

[12]It seems the first speculative report was by The Telegraph on 22 November 2008.

[13]There might be pure reporting responses due to the timing of returns submission. Returns are submitted with one month (and 7 days if online) delay. For example, returns relating to transactions between 1 August and 31 October 2008 are submitted on 30 November 2008. Therefore, these returns are submitted when the cut was in place. I am, however, unable to identify any impact on average growth rates before the cut.

Table 1: Good and services under different VAT rates

Standard-rated	Zero-rated	Reduced-rated
(1)	(2)	(3)
household goods, and durables	Exports	Mobility aids for elderly
legal, accounting, consultancy services	Food	Energy saving and new energy items
catering, taxis, and	Books, newspapers and magazines	Domestic fuel and power
everything not in other	Passenger transport	Women's sanitary products
categories	Supplies to disabled and	Contraceptives
	charities, Domestic water	Children's car seats
	or sewerage services,	Smoking cessation products
	Construction and sale of	Residential conversions
	new domestic buildings,	and renovations
	Children clothing, Cycle	
	helmets, etc.	

Notes: Some sales are exempt from VAT. Traders solely involved in sale of exempt items do not register for VAT and hence are out of my sample. The list of exempt items is as follows: Rent on domestic dwellings, Supplies of commercial property, Private education and Health services, Postal services, Burial and cremation, Finance and insurance, Betting, gaming and lottery, Cultural admission charges. I drop sectors that qualify for exemptions from my analysis.

effective tax rates on sales allows identification of standard and zero-rated traders; and c) observing a large number of traders over a long time horizon (32 quarters) allows for a rich set of fixed effects (e.g. trader fixed effects and sector by date fixed effects). The caveat, however, is that I do not observe quantities and prices separately.

I start from a total number of 66,375,762 returns between 2002q1 and 2010q4 and drop around 26 million observations (40 percent) in the following steps: a) returns with zero reported sales ($\approx$10 million), b) returns corresponding to majority exempt sectors (health, education, finance), alcohol, fuel, and tobacco related sectors, and sectors relating to wholesale and retail of cars[14] ($\approx$6 million), c) returns for traders with forms of ownership other than sole proprietors, partnerships, and incorporations ($\approx$2 million), d) flat rate scheme traders ($\approx$4 million), and e) observations that could not be matched to a trader characteristics dataset ($\approx$ 4 million).

Majority of VAT traders submit quarterly returns on a staggered timeline over the three months in a quarter. 38 percent of traders submit returns corresponding to calendar quarters (end of March, June, September, and December). For traders submitting returns that does not correspond to a full calendar quarter, I assume transactions are equally spread over three months covered and take a weighted aver-

[14]To offset the effect of the standard-rate cut on price of alcohol, tobacco, and fuel, the government raised the excise duties on these items. Therefore, these products are essentially unaffected. The government also implemented a generous car scrappage scheme from May 2009 until March 2010 offering £2000 cash toward the purchase of a new car when an old one was scrapped.

age of the two returns that have an overlap with the calendar quarter. For example, for returns in February, I use an average of February and May returns with weights of 2/3 and 1/3 to arrive at adjusted returns for the first calendar quarter[15][16].

Traders report net of tax sales, purchases, and VAT on sales and purchases. I use gross sales (sales + sales VAT) (hereafter I drop the gross prefix) as the main variable of interest. To remove seasonality and trend I rely on changes in sales relative to the same quarter a year earlier. $\Delta_4 \ln S_{it} \triangleq \ln S_{it} - \ln S_{it-4}$ is defined to as sales growth, where S_{it} is the level of sales (in Pounds) for trader i at date t[17]. Table 2 reports summary statistics for the variables of interest. Average sales and purchases are £627,955 and £482,127 respectively with very large standard deviations. The mean and standard deviation of log sales is 10.71 and 1.73. Average sales growth is 0.3 percent during the sample period with 75.1 percent standard deviation.

I define effective output tax rate, τ_o, to be the ratio of reported sales VAT to net sales (in percents). Average effective output tax rate ($\overline{\tau}_o$) during 2007q4 to 2008q3 is used to assign traders in to treatment and control groups. Treated traders have $\bar{\tau}_o \in [14, 18]$ and control traders have $\bar{\tau}_o \in [0, 4]$[18]. The large spikes around standard and zero-rate in the distribution of τ_o suggest that the bands used for treatment definition are unimportant (figure 1)[19]. 55 and 14 percent of observations are respectively assigned to traders with standard and zero-rated sales (table 2). About 31 percent of observations are left unassigned either because the trader is not in the data between 2007q4 and 2008q3 or because $\bar{\tau}_o$ lies outside designated bands. Standard-rated traders are on average smaller and have lower growth rates compared to zero-rated ones. Average growth rate of sales is respectively 1 and 2.1 percent for standard and zero-rated traders. Standard-rated group is dominated by incorporated businesses whereas zero-rated traders are equally split between various forms of ownership.

One potential concern with the treatment definition is changes in composition of sales

[15]The results with no adjustment or solely focusing on those with a perfect overlap with calendar quarters are very similar.

[16]A very small number of traders submit monthly or annual returns. The former group are often larger traders while the latter are smaller traders. I drop annual traders but keep monthly traders. To make them comparable to quarterly traders, I add up the value of three monthly returns in a calendar quarter.

[17]Notice the change in logs is equivalent to percent change in level variable only when the change is small. If the log change is $\beta = \Delta_4 \ln y_{it} = \ln y_{it} - \ln y_{it-4}$, then percent change in level variable is $\%\Delta_4 y_{it} = e^{\beta} - 1$ which is equal to β if β is small.

[18]In principle, I could use VAT law and relate 5-digit SIC codes to activities listed under different VAT rates. Certain zero-ratings cross the border of 5-digit SIC codes and hence identification of zero and standard-rated sectors is impossible.

[19]I have experimented with bands of [0,1] and [17,18] or [0,8] and [14,18] for zero and standard-rated assignment and the results are essentially unchanged.

Table 2: Summary statistics

Variable	All traders			Standard-rated sales			Zero-rated sales		
	Obs.	Mean	S.D.	% Obs.	Mean	S.D.	% Obs.	Mean	S.D.
Sales (£)	38,952,778	627,955	6x10^7	55	445,605	2x10^7	14	867,202	6x10^7
ln(sales)	38,952,778	10.71	1.73	55	10.82	1.63	14	10.51	1.94
Δ_4 ln(sales)	32,450,522	0.0036	0.751	57	0.0100	0.664	15	0.0210	0.850
Purchases (£)	38,952,778	482,127	5x10^7	55	329,702	3x10^7	14	718,846	7x10^7
Value added (£)	38,952,778	150,133	5x10^7	55	119,768	4x10^7	14	151,218	5x10^7
% incorporated	38,952,778	0.52		53	0.55		14	0.33	
% sole proprietor	38,952,778	0.29		53	0.29		14	0.32	
% partnership	38,952,778	0.19		53	0.16		14	0.35	

Notes: Summary statistics for level variables are calculated using observations between 2002q1 and 2010q4. Value added, sales, and purchases are all gross, i.e. they include VAT. Standard-rated and zero-rated traders are those with average effective output tax rates $\overline{\tau}_o \in [14, 18]$ and $\bar{\tau}_o \in [0, 4]$ respectively. The average is calculated over a period of four quarters from 2007q4 to 2008q3. Effective output tax rate is the ratio of sales VAT to net sales (in percents).

Table 3: Transition probabilities between bands of τ_o prior to VAT cut

Effective output tax rate		$\tau_o[t]$					
		[0,4)	**[4,6)**	**[6,15)**	**[15,17)**	**[17,18)**	**[18,20)**
$\tau_o[t-1]$	**[0,4)**	**86.3**	4.05	5.5	0.9	2.84	0.4
	[4,6)	29.86	**35.21**	27.67	2.17	4.21	0.89
	[6,15)	6.54	4.61	**64.62**	9.91	12.76	1.57
	[15,17)	1.78	0.57	16.43	**45.82**	32.85	2.54
	[17,18)	0.91	0.19	3.35	4.97	**88.57**	2.01
	[18,20)	2.8	0.81	8.75	8.76	49.79	**29.09**

Notes: the cells show probability that a trader with effective output tax rate within a given band switches to another band in the next quarter. Diagonal elements show probability of remaining in the same band.

in response to the cut. A rise in demand for standard-rated items firms shift their output mix in favor of such items. The gray line in figure 1 shows the distribution of τ_o during the cut. There is essentially no change in fraction of zero-rated traders but the fraction of traders right around the new standard-rate is 10 percentage points lower than before. Closer inspection shows the reduction in mass of purely standard-rated traders is due to transitions in and out of the temporary rate. The temporary nature of the cut also reduces the possibility of a VAT induced product line switching.

To further shed light on the stability of effective tax rates, table 3 shows transition probabilities for bands of τ_o prior to the rate cut. On average traders with τ_o within [0,4) remain in the same interval with 86 percent probability. Similarly traders with effective output tax rates within [17,18) continue to be in the interval with 88 percent probability.

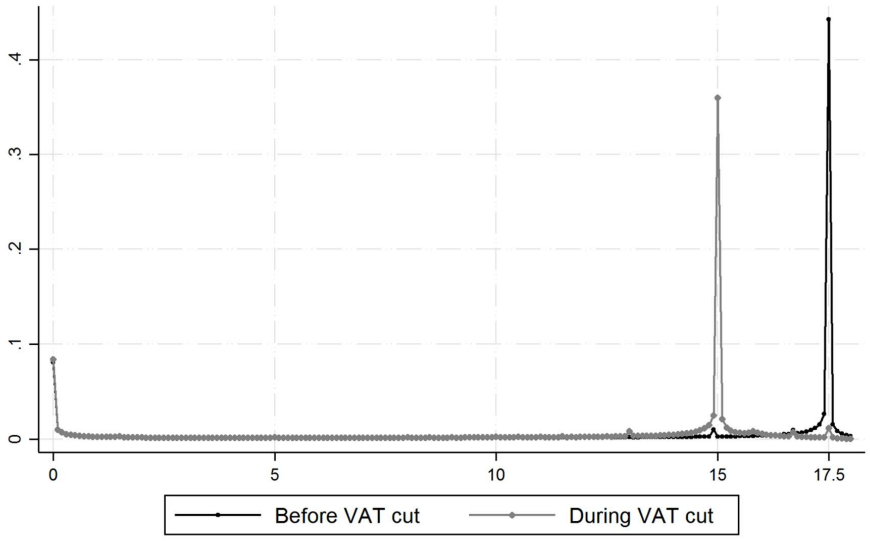

Figure 1: Distribution of effective output tax rate before and during the VAT rate cut

Notes: The bin width for distribution plots is 0.1 percentage point and the mass shows fraction of observations that fall in an interval centered around the indicated bin. Before period is from 2002q1 until 2008q3 and the during period is from 2008q4 until 2010q1. Effective output tax rate is calculated as the ratio of sales VAT to net sales. I am excluding observations between 2010q2 and 2010q4 from these graphs but their inclusion does not change the shape of distributions.

4 Empirical Strategy

The main empirical strategy used in this paper is difference-in-differences (DD) using zero-rated traders as a control group for standard-rated ones. I compare the average change in sales growth for standard-rated traders during the cut period to the average change for zero-rated traders to estimate the stimulus effect. This strategy could be implemented in a regression as follows:

$$\Delta_4 \ln S_{ist} = \alpha_i + \beta_t + \gamma \text{SRated}_{is} \times \text{Cut}_t + \epsilon_{ist} \tag{1}$$

where $\Delta_4 \ln S_{ist}$ is the change in log of sales for trader i operating in sector s at date t relative to four quarters earlier, α_i and β_t represent trader and date fixed effects, SRated_{is} is equal to one if trader i in sector s is classified as standard-rated ($\overline{\tau}_o \in [14, 18]$) and zero otherwise, and Cut_t is equal to one during the quarters that the standard-rate was reduced and zero otherwise[20]. The coefficient of interest is γ and shows the differential change in growth rates for standard-rated traders during the cut period. Trader fixed effects control for anything that is constant over time

[20]This is from 2008q4 to 2010q1. A maximum of one month in 2008q4 returns and a maximum of two months in 2010q1 returns cover the cut period.

and has an influence on growth rate of sales. For example, larger traders might have slower but more stable growth rates on average. Time fixed effects control for any event that affect standard and zero-rated traders to the same extent.

To claim that γ is an unbiased estimate of the stimulus effect, I need to assume that in the absence of the cut the change in growth rates would have been the same for standard and zero-rated traders. This is obviously a contentious assumption given the fact that the cut was in response to the great recession. Some of the zero-rated activities relate to necessities like food while some standard-rated traders are involved in sales of durable goods. The recession might have a stronger impact on standard-rated traders because of more elastic demand. Therefore, the confounding recessionary effect could induce a downward bias on the estimates of γ from the basic specification in (1).

I experiment with four extensions of the basic specification to control for the recession effect. The recession started to impact aggregate variables from 2008q1. Therefore, in the first extension I introduce a second interaction term that allows for a heterogeneous impact of the recession on standard-rated traders from 2008q1 onward:

$$\Delta_4 \ln y_{ist} = \alpha_i + \beta_t + \gamma \text{SRated}_{is} \times \text{Cut}_t + \delta \text{SRated}_{is} \times \text{Rec}_t + \epsilon_{ist} \tag{2}$$

where Rec_t is a dummy that is switched on from 2008q1 onward. Effectively, this specification relies on three quarters before the start of the VAT cut and three quarters after the end of the cut to identify the recession effect[21]. Under the assumption that the differential recession effect remains the same during and outside the cut period, estimates of γ from (2) would give causal impact of the cut. If, however, the differential impact of the recession is changing over time the estimates are still biased.

In the second extension, I allow two-digit sectors to receive heterogeneous impacts from the recession by including interactions of two-digit sector dummies with the recession dummy.

$$\Delta_4 \ln y_{ist} = \alpha_i + \beta_t + \gamma_1 \text{SRated}_{is} \times \text{Cut}_t + \delta_s \times \text{Rec}_t + \epsilon_{ist} \tag{3}$$

where δ_s is a set of 66 two-digit sector dummies. The potential factors controlled in

[21] The estimated magnitude of γ from this regression is identical to a regression based on equation (1) where the sample is restricted to the post recession dates (other coefficient estimates would be different).

this specification are slightly different from (2). As far as standard and zero-rated traders within the same two-digit sector are subject to the same recession effect, the remaining within sector differences between the two groups capture the causal effect of the cut. If however, sectors with majority standard-rated traders experience a greater recession impact right in the middle of the cut period, this specification would fail to give the causal estimates of the cut.

In the third extension I categorize two-digit sectors to quintiles based on the share of standard-rated traders in the sector. Allowing for date by quintile fixed effects is another way I could control for heterogeneous recession effects. In the final extension I rely on business-to-business traders as another control group and run a DDD regression.

5 Results

5.1 Graphical evidence

Figure 2 shows average growth rate of sales for standard-rated (black line) and zero-rated (gray line) traders over time. Although the average growth rate of zero-rated traders is much more volatile[22], before the recession the growth rates are similar. From 2007q3 growth rates for standard-rated traders start to decline and turns negative from 2008q3. After the start of the VAT cut (first vertical line) average growth of sales continues to fall and the decline only stops after 2009q2. By the end of the VAT cut (second vertical line) sales growth is -3 percent and right after the end of the cut, when you expect to see a backlash in standard-rate activities, it jumps to 2 percent and remains there for the following quarters. Average growth rate for zero-rated traders starts to fall approximately around 2008q4 but the decline in growth rates seem to be smaller. It seems during the recession standard-rated traders experienced lower growth rates. However, after the cut and towards the end of the recession the two series converge. Overall the convergence of the two series right after the recession and the absence of a set-back period supports a zero impact on sales[23].

[22] Average per quarter observations for zero-rated traders is around 76,000 while for standard-rated traders it is 441,000.

[23] One could argue that the recession induced gap could have been larger had there not been the VAT cut. In the regressions I build more complex counterfactuals to respond to such concerns.

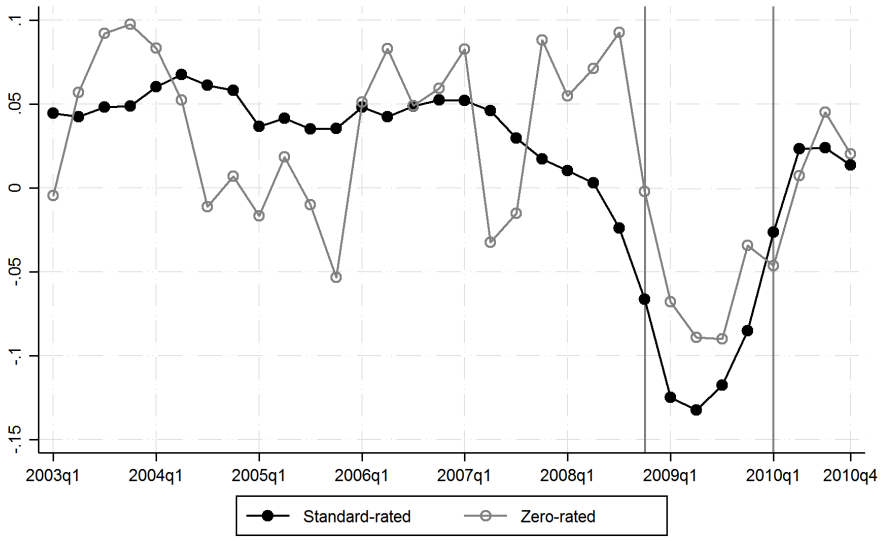

Figure 2: Change in log sales for standard and zero-rated traders

Notes: Figure shows average change in log of sales for standard and zero-rated traders over quarters. Standard-rated and zero-rated traders are those with average effective output tax rates $\bar{\tau}_o \in [14, 18]$ and $\bar{\tau}_o \in [0, 4]$ respectively. The average is calculated over a period of four quarters from 2007q4 to 2008q3. Effective output tax rate is the ratio of sales VAT to net sales (in percents). The first and second vertical lines mark 2008q4 and 2010q1 corresponding to the first and final quarter were the VAT cut has any effect.

5.2 Regression evidence

Table 4 shows the main estimation results. Columns (1) to (3) report DD estimates in the absence of recession controls. Column (1) uses a basic DD specification and confirms the conclusion from figure 2. Standard-rated traders had 3.7 percentage points lower growth rates during the cut period. Controlling for trader and date fixed effects in columns (2) and (3) makes the estimated magnitudes larger and even more significant.

I control for heterogeneous recession effects in columns (4) to (6) using three different strategies. In all cases the coefficient of interest becomes very small and insignificant. Column (4) includes the interaction of recession dummy with the standard-rated dummy. This specification would fix the identification problem if the recession had a time invariant heterogeneous impact on standard-rated traders. Column (5) controls for sector specific recession effects by including interactions of two digit sectors and the recession dummy[24]. Column (6) controls for time varying recession effects. Here I created dummies for quintiles of share of standard-rated traders in each two digit sector and included interactions of these dummies and date fixed effects[25].

[24] Almost all two digit sectors have both standard and zero-rated traders.

[25] In an additional specification I controlled for two digit sector by date fixed effects. This specification allows sectors to evolve freely in each quarter, effectively estimating stimulus effect from within sector-date differences between standard and zero-rated traders. The results of this specifi-

In table 5 I carry out several robustness checks. Column (1) reproduces the coefficient from the preferred specification from table 4, column (5). Column (2) estimates the cut impact using data collapsed to group-quarter observations. I control for recession effects by including the interaction of standard-rated dummy and recession dummy. The estimate is very small and insignificant.

Column (3) collapses the data to group-quarter observations but uses a DDD strategy to control for recession effects. Traders in sectors that deal with final customers receive a direct impact from the cut induced demand boost. While traders dealing with other businesses might be less sensitive to VAT rate changes because the buying side can reclaim VAT paid on purchases. Therefore, I use Input-Output tables from the Office of National Statistics for year 2007 and classify sectors into business-to-customer (B2C) if the share of final demand is greater than 50 percent[26]. Other sectors are classified as business-to-business (B2B). Under the assumption that the recession induced change in sales growth is similar across B2B and B2C sectors, I could use the former as a control group for the latter. The triple interaction term in column (3) shows that the rate cut did not affect standard-rated traders in B2C sectors differently relative to zero-rated traders and to standard-rated traders in B2B sectors.

Column (4) of table 5 restricts the sample to B2C sectors and estimates a DD specification similar to column (1). The estimated cut effect is still insignificant but much larger than column (1). In column (5) I restrict the sample to large traders with an average quarterly sales of more than £100,000. Larger firms could increase the salience of the cut through advertising. Therefore, there might be a larger impact for bigger traders. The estimated effect, however, remains insignificant. Column (6) restricts the sample to traders that had an average effective input tax rate, $\overline{\tau}_i$, of 14 to 18 percent[27]. This is meant to control for potential confounding effects on sales growth from the heterogeneity along the input tax rate. The estimated effect remains insignificant.

5.3 Discussion

Tables 4 and 5 show that after controlling for recession effects the VAT cut did not have a significant effect on sales of standard-rated traders. I need to relate this to

cation still showed an insignificant effect.

[26]IO tables provide data on 110 sectors. This relates to two or three-digit SIC2007 codes. About 59 out of 110 sectors are identified to have a greater than 50 percent share of final demand.

[27]Effective input tax rate is defined as input VAT over net input purchases. Averaging is taken on the four quarters preceding the VAT rate cut: 2007q4-2008q3.

Table 4: Regression results for the whole sample

	Basic	Fixed Effects		Recession		
Dep. Var. $\Delta_4 \ln$ (Sales)	(1)	(2)	(3)	(4)	(5)	(6)
SRated × Cut	-0.0373*	-0.0528**	-0.0573**	-0.0003	-0.0011	0.0179
	(0.0165)	(0.0188)	(0.0192)	(0.0125)	(0.0119)	(0.0111)
SRated × Rec				-0.0813**		
				(0.0196)		
Cut	-0.0910**	-0.107**				
	(0.0162)	(0.0183)				
SRated	-0.00141					
	(0.00326)					
Trader FE	N	Y	Y	Y	Y	Y
Date FE	N	N	Y	Y	Y	N
SIC2d×Rec	N	N	N	N	Y	N
quintile %SR × Date FE	N	N	N	N	N	Y
R^2	0.005	0.007	0.010	0.010	0.011	0.011

Notes: Table shows coefficient estimates and standard errors from estimation of six specifications. The dependent variable is $\Delta_4 \ln$ (Sales), growth rate of sales. All specifications have 21,598,298 observations (991,690 traders). Column (1) estimates a basic DD specification with SRated dummy, Cut dummy, and their interaction. SRated equals one for traders with average effective output tax rates $\overline{\tau}_o \in [14, 18]$. The average is calculated over a period of four quarters from 2007q4 to 2008q3. Effective output tax rate is the ratio of sales VAT to net sales (in percents). SRated is equal to zero if $\overline{\tau}_o \in [0, 4]$ during the same period. Cut is equal to 1 for dates between 2008q4 and 2010q1 (6 quarters). Column (2) adds trader fixed effects. Column (3) adds date fixed effects. In columns (4) - (6) I control for recession heterogeneity. Column (4) adds the interaction of Rec dummy by the SRated dummy. Rec is equal to 1 for dates on and after 2008q1. Column (5) includes interactions of 65 two-digit sector dummies with the recession dummy as in specification 3. Column (6) creates dummies for quintiles of share of standard-rated traders in two-digit sectors and include quintile by date dummies in the regression. All standard errors are clustered at 5-digit SIC2007 codes (around 570 clusters).* and ** show coefficient estimates are significant at 5 and 1 percent respectively.

Table 5: Robustness regression results

	Main	Collapsed		B2C	Large	$\overline{\tau}_i \in [14, 18]$
Dep. Var. Δ_4 ln (Sales)	(1)	(2)	(3)	(4)	(5)	(6)
SRated× Cut	-0.0011	0.0003	0.0053	0.0287	0.0231	0.0142
	(0.0119)	(0.0204)	(0.0133)	(0.0162)	(0.0173)	(0.0203)
SRated× B2C×Cut			-0.0171			
			(0.0257)			
Trader FE	Y	N	N	Y	Y	Y
Date FE	Y	Y	Y	Y	Y	Y
SIC2d×Rec	Y	N	N	Y	Y	Y
Obs	21,598,298	64	128	9,038,558	6,635,677	10,972,917
R^2	0.011	0.8706	0.7873	0.006	0.020	0.014
Traders	991,690	-	-	411,277	270,172	506,776

Notes: Table shows coefficient estimates and standard errors from estimation of six specifications. The dependent variable is Δ_4 ln (Sales). Column (1) reproduces column (5) of table 4. Columns (2) and (3) run regressions on collapsed data. Column (2) collapses the data based on SRated dummy over quarters. Column (3) collapses based on SRated and business-to-customer status dummies. Columns (4) to (6) run the same specification as Column (1) but on different samples. Column (4) looks only at business-to-customer sectors, defined as those with a higher than 50 percent share of final demand from input-output tables. Column (5) restricts to traders with quarterly sales greater than £100,000. Column (6) restricts to traders that have standard-rated effective input tax rates. This is defined as the ratio of input VAT to net inputs. All standard errors are clustered at 5-digit SIC2007 codes (around 570 clusters).* and ** show coefficient estimates are significant at 5 and 1 percent confidence levels respectively.

quantity of sales to evaluate the impact of the VAT cut on the real economy. If traders fully pass the rate cut to consumer prices and nothing else changes, the cut would mechanically lower gross sales for standard-rated traders by 2.1 percent[28]. Therefore a zero impact on gross sales suggests quantity demanded has increased by 2.1 percent. In other words, the price elasticity of demand for standard-rated products is -1.

The difference-in-differences methodology is unable to detect across the board effects. For example, the cut reduces prices and frees up income to be spent on any item (income effect). If consumers decide to spend this on both zero and standard-rated products DD would not be able to pick up any effect while the overall impact of the cut is positive.

6 Conclusions

In this paper, I used a difference-in-difference (DD) estimation strategy to identify the stimulus impact of 2008 VAT rate cut in the UK. Graphical evidence suggests the recession had a stronger impact on standard-rated traders. Therefore a simple DD

[28]Since standard VAT rate was reduced from 17.5 to 15 percent, it implies a 2.1= 0.025/(1+0.175) percent decline in sales.

strategy would confound the recession effect with potentially positive effects of the VAT cut. Regression results confirm this intuition. While simple DD estimates of the impact of the rate cut on sales growth are negative, controlling for the recession makes the estimates insignificant. This suggests the cut has boosted sales quantity for standard-rated traders just to compensate for the mechanical reduction in sales due to the price fall (assuming some degree of pass through). While these findings suggest the temporary standard-rate cut was effective in boosting real activity of standard-rated traders, it is not obvious whether it came at the expense of a decline in sales of other traders (intra-temporal substitution between goods).

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