Small Firm Growth and the VAT Threshold: Evidence for the UK

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Abstract

This paper studies the effect of the VAT threshold on firm growth in the UK, using exogenous variation over time in the threshold, combined with turnover bin fixed effects, for identification. We find robust evidence that annual growth in turnover slows by about 1 percentage point when firm turnover gets close to the threshold, with no evidence of higher growth when the threshold is passed. Growth in firm costs shows a similar pattern, indicating that the response to the threshold is likely to be a real response rather than an evasion response. Firms that habitually register even when their turnover is below the VAT threshold (voluntary registered firms) have growth that is unaffected by the threshold, whereas firms that select into the Flat-Rate Scheme have a less pronounced slowdown response than other firms. Similar patterns of turnover and cost growth around the threshold are also observed for non-incorporated businesses. Finally, simulation results clarify the relative contribution of "crossers" (firms who eventually register for VAT) and "non-crossers" (those who permanently stay below the threshold) in explaining our empirical findings.

JEL Classification: H22, H25, H26
Keywords: VAT, size-based threshold, firm growth

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1 Introduction

In this paper, we aim to understand the impact of the VAT registration threshold on small firm growth, using data from the UK. Generally, there are a number of reasons why the presence of the VAT threshold would affect small firm growth. First and foremost, crossing the threshold generally increases the VAT paid by the firm, as the firm must remit VAT on its sales, while claiming back VAT paid on inputs.[1] Second, there is a one-off compliance cost to initially registering for VAT, and then a periodic compliance cost of completing a VAT return. In the UK, the compliance costs are relatively low by international standards, but are not negligible.[2] Third, registration for VAT may make a tax audit more likely, because it gives the tax authorities more information.[3]

The UK case is of particular interest for several reasons. First, it has the highest threshold in the OECD, currently at £85,000, so it is feasible for many businesses to operate below this threshold for long periods of time.[4] Second, the threshold is very salient, for two reasons. The rate of VAT in the UK, currently 20%, is high. Moreover, there are no other changes in business taxation in the region of the threshold. So, it is quite plausible that firms will deliberately attempt to stay below the threshold either temporarily or permanently. Of course, such growth suppression may have a social cost, and be in conflict with other UK government initiatives deigned to stimulate small firm growth.[5] So, it is important to investigate whether growth suppression occurs, and whether some types of firms are more affected than others.

As all firms in the UK are subject to the same VAT regime, there is no obvious control group that one can use to identify the effect of the threshold. So, the first challenge is to develop an empirical strategy for identifying the effect of the threshold. In this paper, we use

[1] Of course, a non-registered firm generally pays the so-called "embedded" VAT on its inputs, but this will usually be less than the VAT charged on sales.

[2] A survey by the Federation of Small Businesses indicates an average time spent by a small business on VAT compliance of 45 hours per year, the highest time compliance cost of all taxes (https://www.fsb.org.uk/docs/default-source/fsb-org-uk/fsb-tax-report—taxing-times-final.pdf). A recent HMRC report (HMRC (2015)) finds that VAT compliance is particularly burdensome for micro- and nano-businesses (businesses with one to nine and zero employees respectively), which are very likely to be around the threshold.

[3] For example, in the UK, claims for VAT refunds may trigger an audit (https://www.gov.uk/guidance/hmrc-compliance-checks-help-and-support)

[4] Thresholds for OECD and other countries are shown in Figure A.1 in the Appendix.

[5] The UK government has a wide variety of initiatives to support small business growth, from loans to technical advice: see for example, https://thepitch.uk/government-support-for-small-businesses

exogenous changes in the threshold over time to do this. To distinguish the effect on growth of distance to the threshold from the effect on growth as a firm's turnover varies, we divide turnover into bins, and use bin fixed effects in our regressions. Then, we can distinguish the effect on growth of an increase in the threshold from a fall in the turnover of a firm, as explained in more detail in Section 5.[6]

Using this approach, we investigate the effect of the threshold using administrative data from UK corporate, VAT and income tax returns. Our main data-set consists of incorporated firms. Using corporate and VAT tax returns for these businesses, we can measure the reported turnover, input costs, and VAT registration status for each firm in the sample. We find robust evidence that annual growth in turnover starts to slow when the firm turnover gets within about £20,000 of the threshold, and slows by up to 2 percentage points when firms get close to the threshold. As the average growth rate in the sample is 8 percent, this implies a slowdown of up to 25 percent in the growth rate. There is no evidence of compensating acceleration in growth once a firm crosses the threshold. When a firm passes the threshold, growth in firm costs shows a similar pattern, indicating that the response to the threshold is likely to be a real response rather than an evasion response.

We also report simulation results showing how firm growth is affected by different values of the threshold, ranging from £40,000 to £120,000. The size of the firm can be up to 8% smaller than in the absence of the threshold, although the long-run fall in firm size is only 0.5-1.0%. The reduction in long-run firm size (relative to no threshold) is minimised at £80,000, close to the current VAT threshold in the UK.

We then turn to consider heterogeneous responses. We first distinguish between firms that habitually register even when their turnover is below the VAT threshold (voluntary registered firms) and firms that do not (non-voluntary registered firms). A firm is defined as voluntary registered if (i) it is currently below the threshold and registered, *and* (ii) it was also below the threshold and registered in the previous year. In this way, we are less likely to include firms that just remain registered through inertia. We would expect voluntary registered firms not to respond to the threshold, as they have already decided to pay the compliance costs of VAT registration for other reasons e.g. to reclaim VAT on inputs. Confirming this conjecture, we find a sharp difference between these two types of

[6]In the data, the growth rates of firms decline sharply with the level of turnover, so a move away from the threshold due to a fall in turnover for some other reason will generally increase growth. If we do not control for this, it could give a "false positive" effect of distance to the threshold on growth.

firms as they approach the threshold; non-voluntary registered firms slow down sharply, with growth falling 3-4 percentage points, whereas voluntary registered firms do not slow down at all. This result is robust to concerns about bias from selection into voluntary registration. Specifically, building on the findings of Liu et al. (2021), we also instrument the choice of voluntary registration by the industry share of business-to-consumer (B2C) sales, and we find similar results.

We then distinguish between firms that join the flat rate scheme (FRS), a simplified VAT scheme for small businesses in the UK that is explicitly designed to reduce compliance costs, and those that do not. A firm's VAT liability in the FRS is a single rate of tax times the total turnover of the business. As a result, the FRS is effectively a turnover tax, and only requires businesses to keep track of total turnover rather than a separate record of each purchase and sale, and should be less burdensome than regular VAT. In our sample, the FRS is widely used; 40% of the VAT registered firms are in the FRS. We find that firms that register for VAT via the FRS slow down less before the VAT threshold than those that do not, so, the FRS does appear to mitigate the effect of the threshold, as might be expected. This result is robust to concerns about bias from selection into voluntary registration. Specifically, we also instrument the choice of voluntary registration by the industry input cost ratio, and we find similar results.

A final kind of heterogeneity we consider is between "crossers" and "non-crossers". A recent survey of over 2000 UK firms conducted by IPSOS for HMRC found that while most firms started planning for registration when their turnover approached the threshold, "Overall, 20% of unregistered borderline businesses admit to having taken some action to remain under the threshold and outside the VAT system."[7]

Clearly, the behaviour of such firms ("non-crossers") might be contributing significantly to the slowdown that we observe in the data. We look at this issue by studying just the behaviour of firms we call "crossers", which are firms that initially start below the VAT threshold and eventually expand to have turnover above the VAT threshold. We observe that for these firms, there appears to be *no* slowdown in turnover or cost growth as the firms approach the threshold. So, it would appear that the effect of the VAT threshold is

[7]The HMRC report found: "Businesses restricted their turnover in several different ways (sometimes illegally), with the most common being closing the business or stopping advertising (47% of those restricting turnover admitted this), refusing or turning down work (21%), asking customers to purchase materials (16%), reducing prices of products to ensure the VAT threshold is not reached or splitting the business by operating as a separate legal entity or artificially separating the business by product or service (both 10%)."

primarily to create a group of "non-crossers" who deliberately stay out of the VAT system, and that this is the source of our slowdown results. However, as we explain in more detail in Section 7.3, one has to be cautious in drawing this conclusion, as selection effects lead unambiguously to *underestimation* of the effect of the threshold on the crossers.

Finally, we also analyse a second data-set of non-incorporated businesses. In the UK, unincorporated businesses, i.e. sole traders, partnerships, and unincorporated associations, are also subject to VAT. In terms of numbers, this form of organization is more important than incorporated firms, with over twice as many non-incorporated as incorporated businesses.[8] Here, the graphical and regression analysis shows the same pattern of slow-down in both turnover and cost growth near the VAT threhold as in the case of incorporated firms. In fact, the quantitative slowdown is between 1 and 2 percentage points, as in the case of incorporated firms.

While our empirical evidence is UK-specific, the methodology we develop in this paper is of course applicable to the effect of any size-based threshold on firm growth. Also, our substantive results show that a relatively high VAT threshold, such as the UK's, may have a substantial effect on firm growth, and also on the size of the firm for up to a decade or so, relative to a counter-factual situation of no threshold. Our results are also the first, to our knowledge, to demonstrate the role of a simplified VAT scheme in mitigating the growth effects of the threshold.

Literature There is now a growing literature on the effects of tax thresholds and kinks on the *levels* of indicators of firm activity such as turnover, investment, etc (Almunia and Lopez-Rodriguez (2018), Harju et al. (2019), Chen et al. (2021)). For example, Almunia and Lopez-Rodriguez (2018) studies the effect of a Large Taxpayers Unit (LTU) in Spain on firm behavior: they find that firms strategically bunch below the eligibility threshold of 6 million Euro in order to avoid stricter tax enforcement. The response is stronger in sectors where transactions leave more paper trail, suggesting that monitoring effort and the traceability of information reported by firms are complements.[9]

However, almost without exception, these studies do not study the effects of tax thresholds

[8]For example, the Department for Business, Energy and Industrial Strategy estimated that in 2016, there were 3.3 million sole proprietorships (60 percent of the total), 1.8 million companies (32 percent), and 421,000 ordinary partnerships (8 percent).

[9]Amirapu and Gechter (2020), in a related paper, study distortions in size distribution of Indian firms induced by labour regulations.

and kinks on *growth* of the firm.[10] This may be because there is an established method for identifying the causal effect of the kink or threshold on the level of activity (calculation of so-called excess mass) and also estimation of various elasticities from the excess mass, both methods due to the seminal paper of Saez (2010). So, the first contribution of this paper is methodological i.e. to propose a rather different method for identifying the causal effects of a threshold or kink on growth.

From a methodological point of view, a related paper is Marx (2018), which proposes a new bunching estimation strategy for panel data which avoids biases due to serial dependence of the choice variable and extensive-margin responses. Specifically, the probability of bunching in the current year, both below and above the notch, is conditioned on the growth rate of the choice variable from the previous year. Our method differs in that we directly examine the effect of the threshold/notch on the turnover growth rate, by controlling for bin fixed effects, and is thus free of the issues in standard bunching methods discussed in Marx (2018). Also, we do not impose functional form (polynomial) assumptions on how turnover growth rate varies with lagged turnover by exploiting the threshold changes.

To our knowledge, there are only two papers which study the effect of the VAT threshold on firm growth Harju et al. (2019) and Muthitacharoen et al. (2021). Harju et al. (2019) provides some graphical evidence for Finland that turnover growth slows below the VAT threshold, by comparing growth rates for similar firms in Sweden. However, during the period analysed, the Finnish VAT threshold was only 7500 Euro, and so entities below the threshold were largely the self-employed, rather than small or even micro-firms. Moreover, the growth effects of the threshold are not the main focus of attention of this paper, which is to compare the relative effects of the VAT and compliance costs on bunching.

Muthitacharoen et al. (2021) does have a regression analysis of the effect of the VAT threshold on growth for firms in Thailand. Their regression specification allows firm growth to depend on time and firm fixed effects, plus dummy indicator variables for two years prior to registration, the year of registration, and the year after. There are two problems with this specification. First, these indicator variables are by definition, endogenous to the decision whether to register. Second, this specification cannot separately identify the effects of a change in the position of the threshold from the effect of the level of turnover

[10] In the working paper version of Almunia and Lopez-Rodriguez (2018), there was some graphical analysis of firm growth around the LTU threshold. Our Figure 2 is based on Figure 6 of their paper.

on growth.[11] Our identification strategy solves both these problems, as the effect on firm growth is identified by exogenous variation in the position of the threshold.

Second, there is a huge literature on the determinants of small firm growth (a recent survey of the literature on developing countries is Nichter and Goldmark (2009)). Much of this is descriptive, identifying characteristics that are correlated with high growth. These are under the general headings of owner characteristics (education, gender etc.), firm characteristics such as age and access to finance, and finally the state of the macro-economy. In our administrative data, we only observe firm age, which we include as a regressor, but in our analysis, many of these other variables are proxied by firm and year fixed effects. Virtually all of this literature does not consider the effect of taxes on growth. Exceptions include Carroll et al. (2001), which finds that for a sample of US firms, individual income taxes exert a significant negative influence on firm growth rates, and Gale et al. (2015), which finds that income taxes have no effect on broader growth measures at the US state level. However, none of this literature, to our knowledge, considers the effect of VAT. Overall then, our paper fills a gap at the intersection of these two literatures.

Finally, our results on the FRS also relate to the literature on presumptive taxes. As it is assessed on the basis of turnover, the FRS is an example of a presumptive tax, which is a simplified tax that uses proxies such as turnover or gross receipts instead of the actual tax base to assess the tax liability, in order to reduce compliance costs for very small firms. Presumptive tax regimes are more prevalent in developing countries, due to limited tax administration capacity, and the FRS is the only example - to our knowledge - of a presumptive VAT in an OECD country.

So, our results showing some limited effect of the FRS on mitigating growth slowdown relate to an empirical literature on presumptive taxes, recently surveyed by Bucci (2020). For example, following the introduction of a business tax reduction and simplification scheme (SIMPLES) for small unincorporated businesses in 1996 to replace several federal taxes and social security contributions in Brazil, the empirical evidence points to significant increases in firm registration and their tax payments (Fajnzylber et al., 2011).

[11] They find a huge increase in growth in the year that the firm is registered for VAT, which is rather different to our finding of no catch-up. This may be due to the endogeneity of the indicator variables.

2 Institutional Background

The value-added tax in the UK is remitted by approximately 2 million registered businesses in each fiscal year.[12] It is UK's third largest source of government revenue following income tax and national insurance contributions. In 2015/16, VAT raised 16.7 percent of total government revenue in the UK, making it the third largest source of revenue after to income taxes, which raised 25.4 percent, and National Insurance contributions, which raised 17.7 percent (Pope and Waters, 2016).

VAT is levied on most domestic goods and services, and on imported goods and some services.[13] All businesses must register for VAT if their taxable turnover is above a given threshold, and can choose to register voluntarily if their taxable turnover is below the threshold.[14] The current registration threshold is £85,000 in 2019/20, and the thresholds over the period of our study are shown in Table 1 below. The threshold in the UK has risen generally in line with inflation. The UK currently sets the highest registration threshold in the EU, which is perceived as a way for the government to reduce the compliance costs of small businesses not wishing to register for VAT (Figure A.1).[15]

If registered, a business pays VAT on its purchases–known as input tax, and charges VAT on the full sale price of the taxable supplies–known as output tax. Businesses can choose to register voluntarily with a turnover below the threshold in order to recover the input taxes, and many firms do this, as discussed further below. The default VAT rate is the standard rate, which is shown in Table 1 over the period of our study, 2004-2015. Note in particular that there was a temporary reduction in the main rate of VAT from 17.5 to 15 percent between December 1, 2008 and January 1, 2010, which was the main part of a fiscal stimulus package to counter the recession. Then, in January 4 2011, the main rate of VAT was raised to 20 percent, where it has remained. A small number of goods and services are charged at a reduced rate of 5 percent and there are also goods and services that are charged at a zero rate or exempt from VAT altogether. Note also that there is considerable variation in the threshold over time, a feature that is key to identification of our effects.

[12] Authors' estimates based on the universe of UK VAT records between 2004/05 and 2014/15.

[13] There are complex regulations for goods and services imported from within the EU.

[14] VAT taxable turnover includes the value of any goods or services a business supplies within the UK, unless they are exempt from VAT. Any supplies that would be zero-rated for VAT are included as part of the taxable turnover.

[15] See http://www.oecd.org/tax/tax-policy/tax-database.htmvat. In countries with no VAT threshold, all businesses are required to register unless exempt otherwise.

Table 1. Value-Added Tax System in the UK

Fiscal Year	Registration Threshold (£)	Deregistration Threshold (£)	Standard Rate (%)	Flat-Rate Scheme Threshold (£)
2004-05	58,000	56,000	17.5	150,000
2005-06	60,000	58,000	17.5	150,000
2006-07	61,000	59,000	17.5	150,000
2007-08	64,000	62,000	17.5	150,000
Apr 1, 2008-Nov 30, 2008	67,000	65,000	17.5	150,000
Dec 1, 2008-Mar 30, 2009	67,000	65,000	15.0	150,000
Apr 1, 2009-Dec 31, 2009	68,000	66,000	15.0	150,000
Jan 1, 2010-Mar 30, 2010	68,000	66,000	17.5	150,000
Apr 1, 2010-Jan 3, 2011	70,000	68,000	17.5	150,000
Jan 4, 2011-Apr 1, 2012	70,000	68,000	20.0	150,000
2011-2012	73,000	71,000	20.0	150,000
2012-2013	77,000	75,000	20.0	150,000
2013-2014	79,000	77,000	20.0	150,000
2014-2015	81,000	79,000	20.0	150,000

Notes: The table shows changes in the registration threshold, deregistration threshold, Flat-Rate scheme threshold, and VAT standard rate over recent fiscal years. For more information on the UK VAT tax system, see `http://www.hmrc.gov.uk/vat/forms-rates/rates/rates-thresholds.htm`.

There are two rules governing registration, a forward-looking rule and a backward-looking one. First, a firm must register for VAT if either the VAT taxable turnover of the firm may go over the threshold in the next 30 days alone, or the firm takes over a VAT-registered business as a going concern. Second, a firm must register for VAT if its VAT-taxable turnover for the previous 12 months was more than the threshold. In our sample, among firms that register for the first time, around 68 percent of them have turnover in the previous year lower than the VAT threshold. This suggests that the forward-looking decision is more important.

3 Data

We construct our dataset by linking the universe of VAT returns to the universe of corporation tax records in the UK. The first data set provides VAT tax information for businesses in different legal forms including sole traders, partnerships, and companies but only for those who are registered. To obtain information on non-VAT registered businesses, we link the VAT records to the population of corporation tax records based on a common anonymised taxpayer reference number. The linked dataset allows us to identify VAT registers and non-registers for the population of UK companies, and contains rich information on VAT and corporation tax for each company and year.[16]

We take the following steps to refine the sample to better study the VAT registration decisions of individual companies. First, we eliminate companies which are part of a larger VAT group and focus only on stand-alone independent companies. This is because companies under common control–for example subsidiaries of a parent company–can register as a VAT group and submit only one VAT return for all companies in a VAT group. Second, because the registration decision can be based on turnover in the previous 12 months, we drop all observations with partial-year corporation tax records.

A final refinement is the following. We might worry about firms that provide mainly zero-rated or exempt goods and services, because the VAT threshold is not such an obstacle to growth for such firms. Specifically, a firm supplying only exempt goods has no requirement to register and nothing to be gained from registering, and a firm selling mainly zero-rated

[16]We further merge the linked tax dataset with annual company accounts from the FAME (Financial Analysis Made Easy) database for additional firm characteristics and accounting information. This gives us additional information about firms e.g. number of employees, which we report below, but we do not use the FAME data in our statistical analysis.

goods has an unambiguous tax advantage from registering, although they will still face administrative costs in doing so. In our data, we have a 4-digit SIC code recording the sector of the main business activity of the firm. This allows us to identify firms that are mainly supplying zero-rated or exempt goods and services [17]. So, we drop firms in these sectors from our data-set. In addition, as exports are zero-rated, we eliminate companies that mainly engage in overseas activities based on the HMRC trade classification. Our justification for doing so is Figure A.2 in the Appendix which shows the histogram of turnover for growing and shrinking firms in these sectors only. It is clear from panel A of Figure A.2 that bunching is much less sharp here than bunching of growing firms in the sample of remaining firms, as shown in panel A of Figure 2.

The final dataset contains 1,942,656 observations between April 1, 2004 and April 5, 2015. In this data-set, the key variables are turnover and cost, and an indicator variable recording whether the firm was VAT-registered or not. Turnover is VAT-exclusive turnover taken from the corporate tax records, and whether it is registered for VAT. We use the turnover from the CT600 returns, rather than from the VAT returns, for the obvious reason that we want to study the behavior of firms not registered for VAT, as well as those that are, and turnover data for the former group of firms is only available from the CT600 returns.[18] The data for cost are also from CT600, and include the cost of intermediate inputs and labour.

We further refine the data-set in order to study growth around the VAT threshold. We first drop all companies with turnover lower than £10,000 or greater than £200,000. Then, we drop firms with only one turnover observation, as we cannot calculate a growth rate for such firms. Then, we drop firms with three successive years or more of negative turnover growth, as such firms are likely to be naturally declining and not affected by the threshold. We remove outliers by first, dropping firms whose minimum or maximum annual growth rate

[17] We classify the following sectors as zero rated: agriculture (1), publishing (22), water/sewage supply (41) Health (85), where the 2003 SIC codes are in brackets. Exempt sectors are: financial services (65,66) and education (80).

[18] An additional reason for using the CT600 measure is that it may be more salient to firms. It is possible that firms that are not registered for VAT are more likely to base their registration decision on the overall amount of turnover, instead of computing a separate measure of turnover that is subject to VAT. To see whether this is true, in Liu and Lockwood (2015), we predict (out-of-sample) the amount of turnover liable for VAT for unregistered firms, by regressing the amount of turnover liable for VAT on the amount of total turnover and a full set of industry and year dummies. We then plot a similar histogram of turnover based on actual/predicted turnover liable for VAT for registered/unregistered firm. Bunching below the VAT notch is still present, but much more noisy and imprecise comparing to bunching based on total turnover reported in CT600. The empirical differences suggest that for unregistered firms, they are more likely to rely on the overall turnover figure for their VAT registration decisions.

over the sample period is in the top or bottom 1 percent of growth rates. Then, we perform the same elimination of outliers for the growth rate over the whole sample period.[19]

Table 2 provides summary statistics for basic firm characteristics and also the key variables used in empirical analysis. We note the following from Table 2. The median firm in the sample is six years old, has two employees, has a turnover of around £66,000, costs of £38,000, and trading profit of £14,000. All these variables have a skewed distribution, so that the mean is larger than the median in all cases. For VAT registered firms, the effective VAT rate - that is, net VAT remitted over turnover- for the median firm is 10.0 percent.

Table 2. Summary Statistics

Variable	Mean	p25	p50	p75	S.D.	N
Turnover(£1,000)	77.89	38.75	65.35	110.16	48.46	1,942,656
Cost (£1,000)	53.40	20.42	36.89	74.00	44.07	1,942,656
Trading Profit (£1,000)	24.50	2.49	14.84	36.08	28.34	1,942,656
Age (years since incorporation)	8.65	4.00	6.00	10.00	8.98	1,942,656
Number of Employees	7.02	1.00	2.00	2.00	205.63	17,263
Net VAT-turnover (%)	0.12	0.07	0.12	0.15	0.38	1,364,784
Turnover growth rate (%)	0.07	-0.14	0.00	0.16	0.62	1,510,528
Cost growth (%)	0.10	-0.12	0.01	0.18	0.69	1,414,806

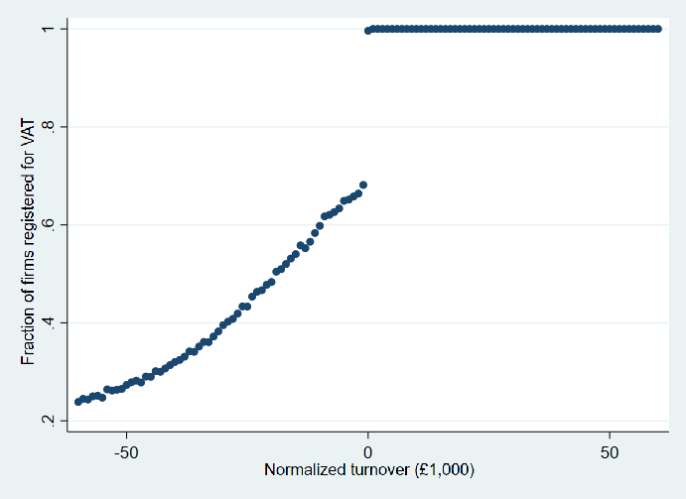
Notes: The small number observations on employment is due to the fact that reporting of this information in FAME is not mandatory for small and medium-sized firms.

Turning to the growth variables that are the focus of this study, both the turnover and cost growth rates are highly skewed, due to a small number of firms which grow very fast, so the mean and median turnover growth rates are 8.0% and 1.0%, for example. Costs grow at roughly the same rate as turnover, as we would expect. So, the median firm grows relatively slowly. Note that we lose over $500,000$ observations when we calculate growth rates because we drop all observations in the initial year, 2004.

Finally, to illustrate two other key features of our data set, we plot the proportion of firms registered by turnover in Figure 1. This plot illustrates two things. First, it shows that compliance with VAT is very high in the data, in the sense that virtually all firms that report turnover above the threshold on their CT600 return are registered for VAT. So, in this sense, we can be sure that VAT registration is a genuine administrative requirement facing

[19]Specifically, we drop the companies with (maximum turnover-minimum turnover)/(minimum turnover) higher than 99th percentile or lower than the 1st percentile of the distribution of this variable.

Figure 1. VAT Registration by Turnover Relative to Threshold



Notes: The figure plots the proportion of firms registered for VAT by their turnover relative to the threshold in the same year. Sample include CT600 firms.

firms. The second feature is that even well below the threshold, the proportion of firms that are registered is quite high. This is consistent with *voluntary registration*, where firms below the threshold register in order to claim back VAT on inputs. This is an issue that we return to in Section 7.1.

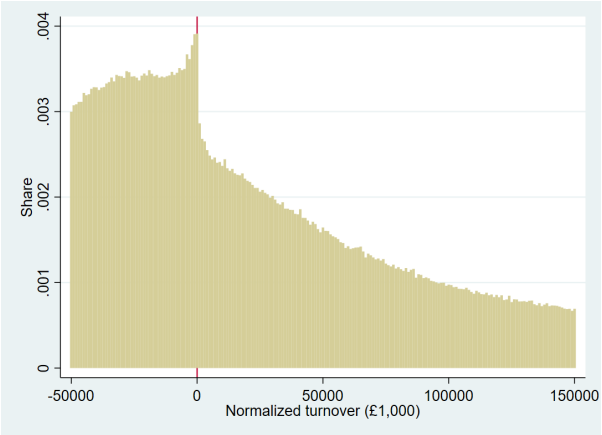
4 Graphical Analysis

We begin by presenting evidence on the deterrence effect of the VAT threshold on firm growth in Figure 2, which pools all data over the sample period and presents a histogram of normalized turnover (net of current-year VAT threshold) for growing and shrinking companies in Panels A and B, respectively. It is evident that many firms with positive growth rate nevertheless choose to stay below the threshold, which creates the excess mass just below the threshold in Panel A. By contrast, there is no evidence of bunching for firms that are declining. These patterns suggest that as small firms grow and approach the threshold, many of them slow down their growth to avoid crossing the threshold for registration.

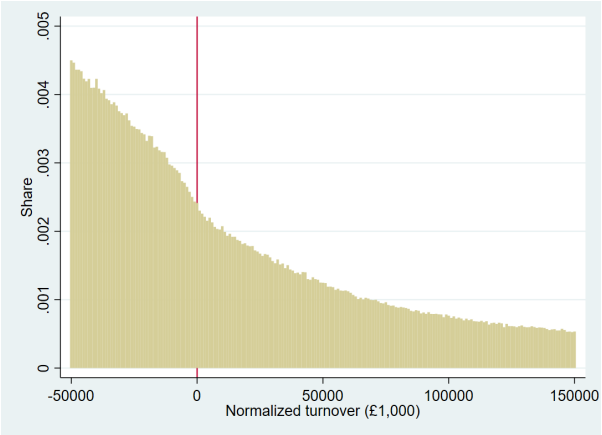
We now turn to address the key question of the effect of the VAT threshold on firm growth rates. We do this in Figure 3 (a) by plotting the rate of growth of turnover in year t, defined as the change in turnover between year t and $t-1$ divided by turnover in period

Figure 2. Turnover Bunching at the VAT Threshold

(a) Growing Firms



(b) Shrinking Firms



Notes: The figure shows the histogram of growing companies (firm-years with positive growth rate) within the neighbourhood of normalized VAT threshold during 2004/05-2014/15 in the top panel and the histogram of declining companies (firm-years with non-positive growth rate) in the bottom panel. The bin width is £1,000 and the vertical line denotes the normalized VAT threshold of zero.

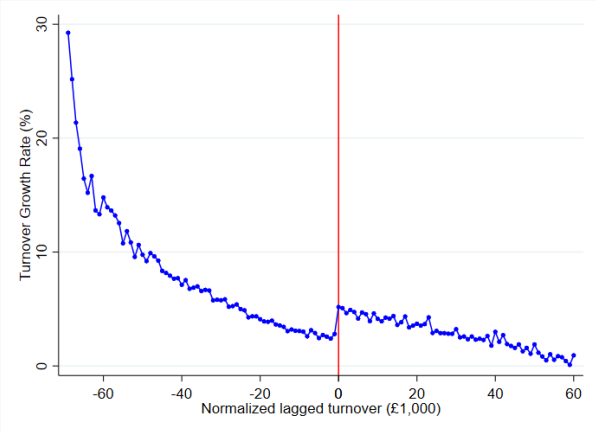
$t-1$, against the distance of last year's turnover to the VAT threshold for that year. On the horizontal axis, we have the difference between actual turnover in $t-1$ and the VAT threshold in that year, *normalized turnover*, and on the vertical, we have the annual turnover growth rate. Each point is the mean value of the growth rate for firms in a £1,000 bin of normalized lagged turnover. Each bin x is defined as comprising all firms in the normalized turnover range $[x, x+1000)$, so in particular, the bin at zero comprises all firms exactly at the threshold and up to £1,000 above.

We see that there is a noticeable slow-down in growth as firms approach the threshold, and equally noticeable catch-up when firms pass the threshold. The difference in growth rates at the threshold is very sharp; the rate almost doubles once the threshold is crossed. This is suggestive evidence that firms do suppress their growth to avoid hitting the registration threshold. Of course, as noted in the introduction, this can happen in two ways. Firms may slow down but eventually cross the threshold ("crossers") or make an explicit decision to stay permanently below the threshold ("non-crossers"). This is an issue we return to in Section 7.3 below.

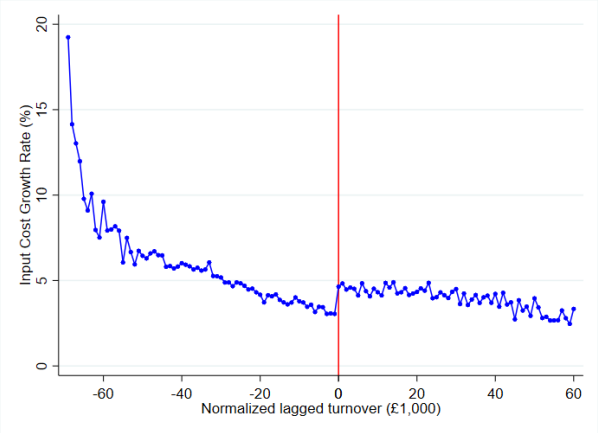
An important question is to ask how firms are achieving this growth suppression. One

Figure 3. Firm Growth and the VAT Threshold

(a) Turnover growth



(b) Cost growth



Notes: The figure shows the average growth rate of firms by bins of £1,000 with one-period lagged turnover within the neighbourhood of normalized VAT threshold during 2004/05-2014/15. The vertical line at zero denotes the normalized VAT threshold.

possibility is that it is *real* response, i.e. firms reduce the growth in their scale of operations. The other is that it is via evasion. In particular, it is known that for the UK, a major form of evasion is for firms to under-report sales and/or over-report purchases of inputs. To get some insight into these mechanisms, we graph the growth of input costs against normalized turnover in Figure 3(b) below. The construction of the Figure is exactly the same as for Figure 3 (a), except that on the vertical axis, we record the growth rate in input costs.

Figure 3 (b) shows that there is a gradual slow-down in input cost growth as the VAT threshold is approached, with a catch-up in growth above the threshold. Qualitatively, this is very similar to the picture in Figure 3 (a). There are two interpretations of this. The first is that firms have a real response to the threshold, i.e. they suppress growth in their real activities. The second is that firms are evading by reducing both reported turnover and reported input purchases and labour cost growth proportionally, in order for reported turnover to stay below the threshold, while real turnover might be above. The second scenario is possible but quite unlikely in the UK, as it would require quite a lot of co-ordination between different firms in the production chain, and between firms and their employees, to achieve this.[20]

[20]We are not claiming here that costs on the VAT return requires more coordination than understating sales, but that understating both at once requires considerable coordination.

5 Regression Analysis

5.1 Regression Specification

In this section, we propose a method of identifying the effect of the VAT threshold on firm growth via changes in the threshold over time, which are clearly exogenous to individual firms' decisions. Our identification strategy is based on the the following regression:

$$g_{it} = \sum_{j=1}^{W} \alpha_j A_{it}^j + \sum_{j=1}^{W} \beta_j B_{it}^j + age_{i,t} + f_i + \tau_t + b_{i,k} + \varepsilon_{it} \tag{1}$$

where here, g_{it} is the growth rate in turnover (or cost) of firm i at time t. We allow ε_{it} to be clustered at the firm level. The A_{it}^j and B_{it}^j are dummies recording how close the firm i is to the VAT threshold at time t. Specifically, bins A^j are bins above the threshold of width £2,000 so $y_{i,t-1} \in A^1$ if $y_{i,t-1}$ is between £0 and £2,000 above the VAT threshold, $y_{i,t-1} \in A^2$ if $y_{i,t-1}$ is between £2,001 and £4,000 above the VAT threshold, etc. Similarly, bins B^j are bins below the threshold of width £2,000, so $y_{i,t-1} \in B^1$ if $y_{i,t-1}$ is between £0 and £2,000 below the VAT threshold, so $y_{i,t-1} \in B^2$ if $y_{i,t-1}$ is between £2,001 and £4,000 below the VAT threshold, etc. This means that we are allowing for a reaction to the VAT threshold by firms whose lagged turnover is in a "window" of between $£2,000 \times W$ below and $£2,000 \times W$ above the threshold. We allow the number of bins W to be determined by the data, as discussed below.

The idea is that exogenous variation in threshold causes exogenous variation in the A_{it}^j and B_{it}^j. For this to yield credible estimates of the effects, however, we need to control adequately for all other factors that might explain the growth rate of the firm. To do this, we include firm and year fixed effects f_i, τ_t and firm age fixed effect $age_{i,t}$. Firm fixed effects capture all time-invariant heterogeneity in growth rates due to unobserved firm characteristics. Year fixed effects capture common macroeconomic shocks, such as the financial crisis, which clearly affect the growth rate of all firms. Finally, firm age fixed effects capture the effect of firm age s on the growth rate if firm i is of age s at time t.

However, inspection of Figures 3 (a), (b) make it clear that there is a marked slowdown in growth rates as turnover and costs rise, even far away from the threshold. We capture this by including a bin fixed effects; $b_{i,k}$ takes on the value 1 if firm i has turnover in bin k at $t-1$. Bin fixed effects allow the growth rate to respond in a very flexible i.e. non-parametric

way to lagged turnover.

These bin fixed effects are key for credible identification. To see this, note that there are two ways in which a firm could move farther away from the threshold. One is because the threshold exogenously increases, as it does in practice. The other is that for some other reason, the firm's turnover falls. In the second scenario, we will likely observe an increase in the firm's growth rate as the distance to the threshold increases, but this will have nothing to do with growth suppression due to the threshold. This is clearly a confounding factor that might cause us to overestimate any growth slowdown from being below but close to the threshold. Bin fixed effects clearly allow us to control for this possible confounder. But, note that our identification strategy requires the assumption that the unobserved differences between firms in different turnover bins, in the absence of treatment, are stable over time.[21]

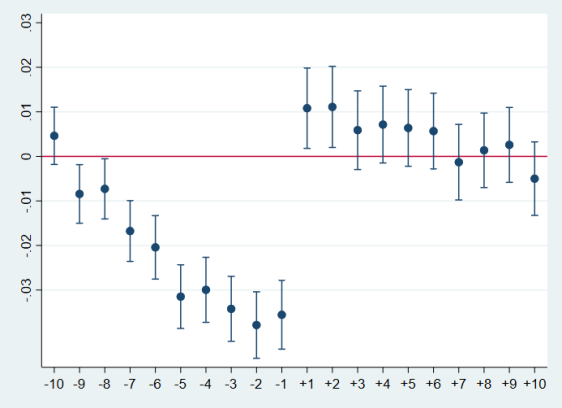
So, the coefficients β_j (α_j) therefore identify the treatment effect of being below (above) the threshold, under the assumptions that (i) firms outside of window W are not affected by the threshold; and (ii) unobserved differences between firms with different levels of turnover (in the absence of treatment) are stable over time. It is in general not possible to test for (ii) as we do not observe the counterfactual growth rate in the absence of treatment by threshold.

However, we provide evidence on (i) by increasing W until β_W is insignificant; that is, until firms at the lower end of the lagged turnover window do not appear to react to being close to the threshold. This occurs at $W = 10$, so that firms appear to start reacting to the threshold when their turnover is about £20,000 below the threshold. The estimates of β_j, α_j from this exercise are shown in Figure 4 below. We show the results first without and then with bin fixed effects. As expected, the estimates of β_j, α_j with bin fixed effects are generally smaller in magnitude than that without, but for both specifications, the value of W suggested by the data is the same. It is also important to note that while there is a small catch-up effect of growth being faster just above the threshold, this is insignificant when bin fixed effects are included.

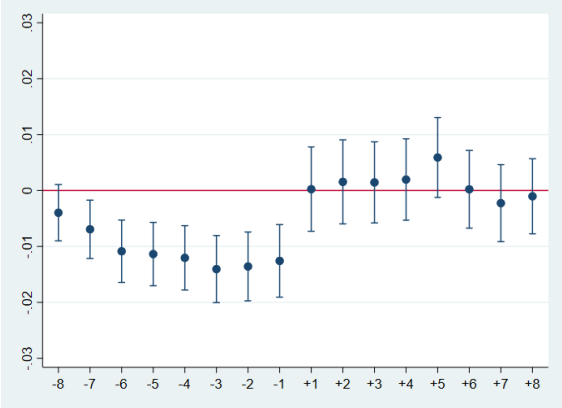
[21] That is, we do not allow the $b_{i,k}$ also to vary with the year: allowing this would clearly make identification impossible.

Figure 4. Turnover Regression Results: Choice of Window W

(a) Turnover



(b) Turnover- Bin FE



Notes: The figure shows the coefficients β_j, α_j and their 95% confidence intervals. To lighten notation, coefficients $\beta_1, ..\beta_{10}$ are denoted by $-1, .. -10$ and coefficients $\alpha_1, ..\alpha_{10}$ are denoted by $+1, .. +10$. In panel (b) we control for bin fixed effects and firm age fixed effects.

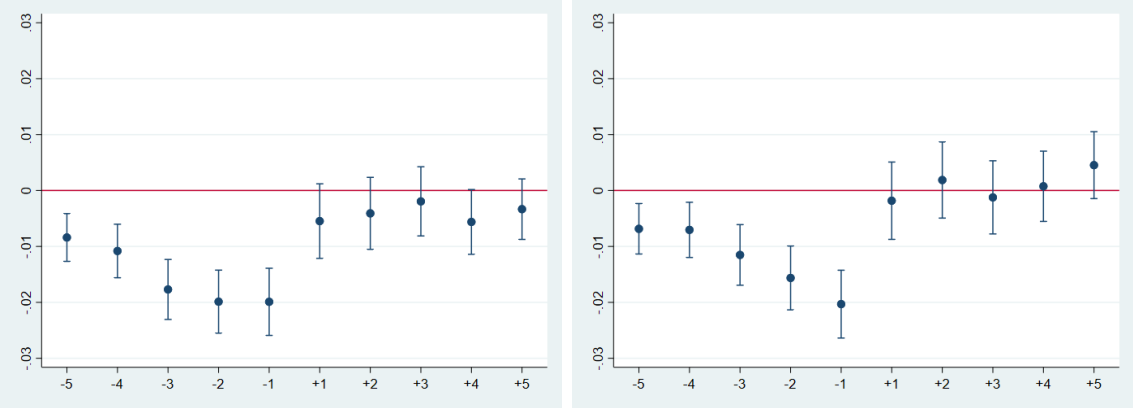
5.2 Main Results

In what follows, we double the width of the bins to £4,000 to avoid loss of precision from having to estimate too many coefficients. So, to keep the size of the window around the threshold the same size, we allow for five bins i.e. W=5. The results of estimating equation (1) for turnover and cost growth are then shown in Figure 5. As we can see, for turnover growth, there is clear evidence of slow-down ($\beta_j < 0$) as a firm approaches the VAT threshold. Quantitatively, this effect is up to 2 p.p. As average growth in the sample is around 8 p.p., this is a 25% slowdown as the firm comes close to the threshold. Once the threshold is past, there is no evidence of accelerating growth ($\alpha_j > 0$). The slow-down and catch-up coefficients for cost growth show a similar pattern; it is clear from Figure 5 that cost growth slows below the threshold.

Overall, these results are consistent with Figure 3. In particular, both the figures and the estimation results display significant slowdown below the threshold. The main difference is that the Figures also suggest some acceleration once the firm above the threshold, whereas we do not find this in the regression results. The reason for this could be that in the regressions, we allow for firm fixed effects on growth. Mechanically, abstracting from these - as in the Figures- means that firms that are faster-growing for other reasons are also more likely to

Figure 5. Turnover and Cost Growth Regression Results

(a) Turnover (b) Cost



Notes: The figure shows the coefficients β_j, α_j and their 95% confidence intervals. To lighten notation, coefficients $\beta_1, ..\beta_5$ are denoted by $-1, .. -5$, and coefficients $\alpha_1, ..\alpha_5$ are denoted by $+1, .. +5$. . In both panel (a) and (b) we control for bin fixed effects and firm age fixed effects.

be above the threshold, and so the apparent acceleration could be due to this selection bias.

One concern might be that the estimates of bin fixed effects on growth might be misspecified because both lagged turnover and growth are measured in nominal terms. Specifically, real turnover growth may be determined by the lagged level of real turnover. As nominal turnover growth is equal to real turnover growth plus inflation, to some extent this problem is already mitigated as we include year dummies which proxy for inflation. However, as a robustness check, we rerun regression (1), where we divide both turnover and cost variables by the fiscal year GDP deflator, with baseline value of 100 in 2014-2015. We use the GDP deflator as it is a producer rather than a consumer price index. The results are shown in Figure A.3: they are very similar to our baseline results, and for this reason, in what follows, we continue to measure turnover and growth in nominal values.

6 The Effects of Different Thresholds on Firm Size

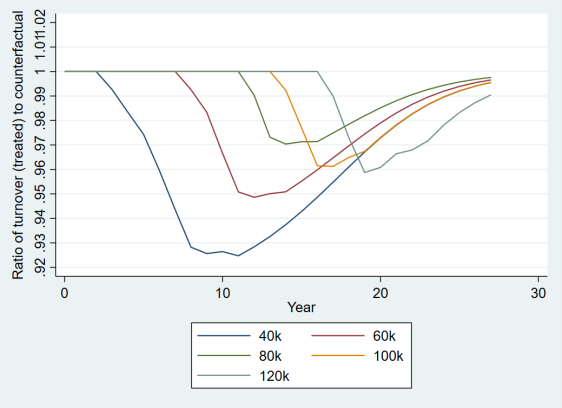
To understand the implications of our results, we use our estimates of α_j, β_j to calculate how the growth path and firm size of a typical firm is affected by the VAT threshold. In fact, we go further than this, to compare the long-run size of the firm for differnt possible values of

the VAT threshold.

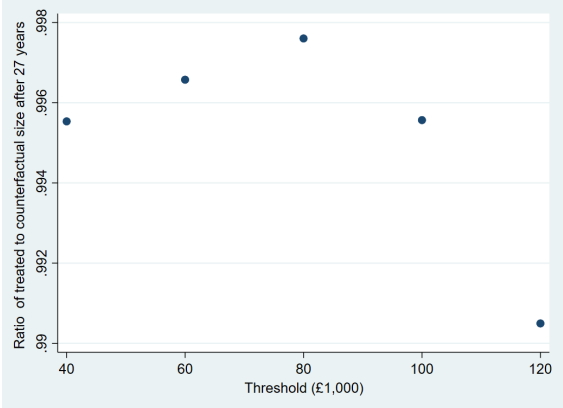
To do this, we first use our estimates of bin fixed effects to calculate the *counterfactual* growth path of an average firm, starting at an initial turnover of £16,000, that did not exhibit any slowdown/catch-up effect around the threshold i.e. we set $\alpha_j = \beta_j = 0$. We then calculate the "actual" growth path for the average firm, again starting at £16,000, taking into account our estimates of α_j, β_j, for different values of the VAT threshold.[22] For each possible VAT threshold, we then calculate ratio of the actual to counterfactual turnover. These ratios are shown in Figure 6 (a) below.[23]

Figure 6. The Effects of Different VAT Thresholds on Firm Size

(a) Time Path of Turnover



(b) Long-Run Firm Sizes



Notes: Figure (a) plots the ratio of turnover for a firm facing different VAT thresholds to with the counterfactual firm that does not face any VAT threshold. In year 0, the initial turnover is assumed to be £16,000. To simplify the calculations, we estimate a version of equation (1) without year, age, and firm fixed effects, and we also smooth the bins by taking a quadratic approximation to the relationship between turnover bin and growth. The growth rate of the counterfactual firm is then calculated by setting $A_{ij}^t = B_{ij}^t = 0$, and the growth rate for the treated firm firm is calculated using estimates α_j, β_j from the estimation of the full version of (1). Figure (b) plots the ratio of turnover for a firm facing VAT threshold to the counterfactual firm in the long-run (after 27 years).

The findings are quite striking. First, looking at panel (a), we see that depending on the level of the VAT threshold, actual and counterfactual growth are the same until the point at which turnover enters the window of £20,000 around the threshold, at which point the firm

[22]This initial value is chosen to be the largest one such that the initial turnover of the firm is not affected by the smallest VAT threshold in our simulations.

[23]Note that we only simulate turnover ratios up to 27 years because at this point, the size of the firm for some thresholds approaches the maximum turnover in the sample of £200,000.

starts to slow down. With a £40,000 threshold, the firm is nearly 8% smaller than it would have been without the threshold after 10 years, at which point the slightly lower growth of the counterfactual firm causes this ratio to rise. Other higher thresholds have similar but less dramatic effects on the time path of turnover. In panel (b), we show the effects of different thresholds on the long-run size of the firm. Interestingly, the lowest threshold does *not* have the biggest long-run effect on firm size; rather, that is due to the largest threshold. This reflects a trade-off: a low threshold restricts the growth of the firm when it is small and growing fast, but a high threshold restricts the growth of the firm when it is large. There is thus a trade-off in setting the threshold in our framework. In fact, panel (b) suggests that if the objective is to maximise long-run firm size, the best threshold is intermediate at £80,000.[24]

7 Firm Heterogeneity

7.1 Voluntarily Registered v.s. Non-Voluntary Registered Firms

As we already noted from Figure 1, there is some evidence that some firms might be registering voluntarily for VAT i.e. choosing to register whilst below the threshold to take advantage of VAT refunds. It is plausible that such firms will suppress their growth by less, or not at all, in response to approaching the threshold. We now refine the analysis to see if firms that register voluntarily are less affected by the threshold.

In our data, 44 percent of firms below the threshold are voluntarily registered, by the definition that they are currently registered and also have a current turnover below the threshold.[25] However, to rule out firms that through inertia, drop below the threshold and do not de-register, we adopt a more stringent definition. A firm is defined as voluntary registered (VR) at time t if (i) it is currently below the threshold and registered, *and* (ii) it was also below the threshold and registered in the previous year, $t-1$. If a firm is not VR, we say it is not voluntary registered (NVR).

We compare the growth behavior of VR and NVR firms below the threshold by running

[24]This trade-off is different to the more conventional one, studied in Keen and Mintz (2004), between revenue and collection costs, and is thus complementary to their analysis.

[25]This is not UK-specific. In Australia, for example, 37 percent of businesses fell below the VAT threshold while 92 percent of all business were registered for VAT. In South Africa, 50 percent of businesses that were not required to be registered for VAT were registered nevertheless (Smulders and Evans, 2017).

a "diff-in-diff" variant of the regression (1) of the form:

$$g_{it} = \sum_{j=1}^{5} \beta_j B_{it}^j + \lambda NVR_{it} + \sum_{j=1}^{5} \gamma_j (B_{it}^j \times NVR_{it}) + age_{i,t} + \tau_t + b_{i,t} + \varepsilon_{it} \tag{2}$$

Here, all variables are defined as before, except for NVR_{it} which is a dummy recording whether in a given year, a firm was not voluntarily registered.[26] In this exercise, we omit firm fixed effects, in order to obtain precise estimates. We also only estimate this equation for firms below the threshold, as NVR_{it} is only defined for firms below the threshold. We would expect $\gamma_j < 0$, as firms that have a reason to stay below the threshold will suppress growth more as they approach it.

One issue with estimating (2) as it stands is that NVR_{it} is endogenous to firm decision-making. So, as a robustness check, we instrument NVR_{it} by the yearly average industry B2C ratio. The rationale for this instrument comes from Liu et al. (2021), which shows that voluntary registration by UK firms is well-predicted by the industry B2C ratio. In particular, the higher is this ratio, the more difficult is it for firms to pass on output VAT to purchasers (because the VAT cannot be reclaimed by final consumers), and so the lower is voluntary registration. Thus, a high industry B2C ratio will be positively correlated with NVR_{it} with all of age, year and bin effects. Table A.1 in the Appendix shows the first stage of the IV; the F-statistic on the instrument is very high.

The results for turnover growth are as follows. First, the OLS estimates of (2) are shown in panel (a) of Figure 7. Here, we see that for turnover growth, all the $\gamma_j < 0$; that is, as conjectured, firms that have a reason to stay below the threshold will suppress growth more as they approach it. Also, we note that the coefficients β_j are now slightly positive; in other words, the VR firms appear not to slow down at all as they approach the threshold. When we instrument NVR_{it} with the yearly average industry B2C ratio, the coefficients are less precisely estimated, but they show the same qualitative pattern.

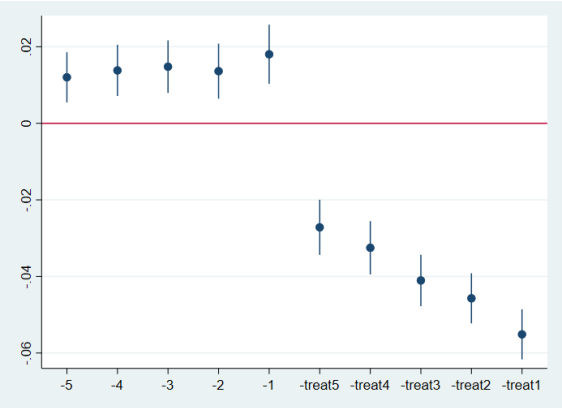
7.2 The Flat-Rate Scheme

The flat rate scheme (FRS) is a simplified VAT scheme for small businesses in the UK that is explicitly designed to reduce compliance costs. A firm's VAT liability in the FRS is a

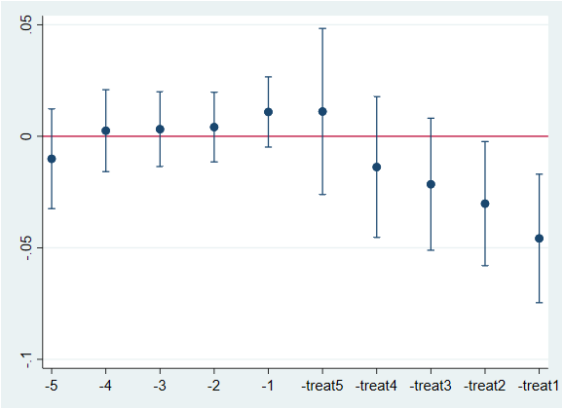
[26] By definition, $NVR_{it} = 1 - VR_{it}$, where VR_{it} takes the value of 1 if firm i is voluntarily registered in both year t and $t-1$ following our stringent definition of voluntary registration.

Figure 7. Turnover Growth of Voluntary Registered vs. Non-Voluntary Registered Firms

(a) Turnover



(b) Turnover IV



Notes: Figure (a) shows the coefficients β_j, γ_j and their 95% confidence intervals. To lighten notation, coefficients $\beta_1, ..\beta_5$ are denoted by $-1, .. - 5$, and the treatment coefficients $\gamma_1, ..\gamma_5$ are denoted by $-treat1, .. - treat5$. Specification control for firm age and turnover bin fixed effects. In Figure (b), NVR is instrumented with share of B2C ratio at industry-year level.

single rate of tax times the total turnover of the business. As a result, the FRS is effectively a turnover tax, and only requires businesses to keep track of total turnover rather than a separate record of each purchase and sale, and should be less burdensome than regular VAT. HMRC sets flat rates by sector so the average trader in each sector is indifferent between FRS and regular VAT. As a result, a trader may also gain in terms of a lower VAT liability from opting for FRS if its input costs are below average for the sector.

The FRS was introduced in 2002. Currently, a firm is eligible for FRS if its VAT-taxable turnover is below a threshold, which has been fixed at £150,000 since 2011, and was £100,000 prior to that. A firm must leave the FRS if its turnover including VAT exceeds a higher threshold, which as been set at £230,000 since 2011. So, given that turnover in our sample is capped at £200,000, many of the firms in our sample were eligible for the FRS, and indeed, of the firms that in our sample that were registered for VAT, 40% opted for the FRS.

The relevance of all this is that the FRS reduces compliance costs and also possibly the tax cost of registration, so it is a plausible hypothesis that firms who opted for the FRS during our sample period had less of a growth slowdown than firms who did not. We test for this heterogenous response by estimating the following equation:

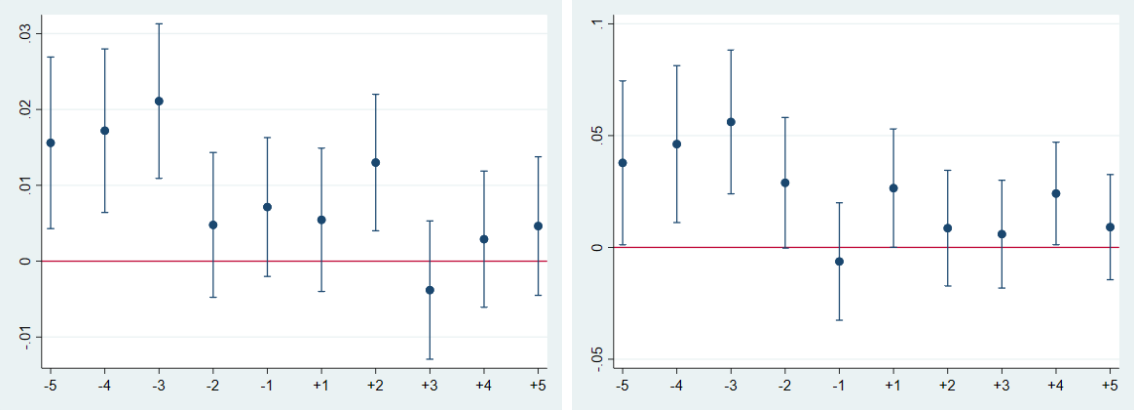
$$g_{it} = \sum_{j=1}^{5} \beta_j B_{it}^j + \sum_{j=1}^{5} \alpha_j A_{it}^j + \lambda FRS_{it} + \sum_{j=1}^{5} \delta_j (B_{it}^j \times FRS_{it}) + \sum_{j=1}^{5} \gamma_j (A_{it}^j \times FRS_{it}) + age_{i,t} + \tau_t + b_{i,t} + \varepsilon_{it} \quad (3)$$

Here, FRS_{it} is a dummy variable equal to 1 if firm i is in the FRS at time t. So, in (3), we are allowing for membership of the FRS to affect growth in flexible way around the threshold.

One obvious issue here is that there may be bias from selection into the FRS. To deal with this, we instrument FRS_{it} with the industry input cost ratio. We expect this to have a negative effect on FRS_{it} as the higher this ratio, other things equal, the higher is the tax rate on turnover in the FRS, and so the less attractive the FRS is for a firm with a given input cost ratio. This is indeed the case as our first-stage regression shows; in Table A.2, the F-statistic is very high. The results are shown in Figure 8 below. Both the OLS and IV estimations show quite clearly that membership of the FRS scheme appears to have no additional effect on slowdown or catch-up.

Figure 8. Turnover Growth of FRS vs. Non-FRS Firms

(a) Turnover (b) Turnover IV



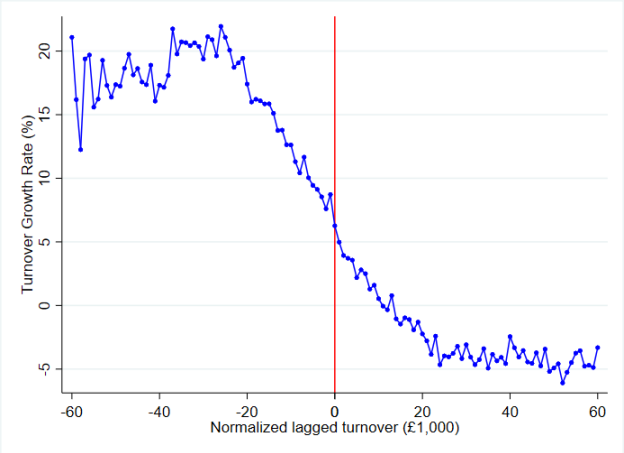
Notes: Figure (a) shows the coefficients γ_j, δ_j and their 95% confidence intervals. To lighten notation, coefficients $\gamma_1, ..\gamma_5$ are denoted by $+1, ..+5$, and the coefficients $\delta_1, ..\delta_5$ are denoted by $-1, ..-5$. The specification controls for firm age, year, and turnover bin fixed effects. In Figure (b), FRS is instrumented with the input-cost ratio at industry-year level.

7.3 Crossers and Non-Crossers

As noted in the introduction, in order to fully understand how firms behave at the threshold, it is important to distinguish between two types of firms. The first are firms that never cross the threshold, and firms that eventually do cross the threshold. So, the question is: do the aggregate results which show slow-down and then some (but incomplete) catch-up accurately describe the behaviour of the "crossers" around the threshold?

First, we look at the turnover growth of crossers. We define these as firms who had turnover both below the minimum VAT threshold and the maximum VAT threshold in the sample period. We see from Figure 9 that there does not appear to be any slowdown in growth as firms get close to the threshold. How can this be reconciled with the sharp effect on turnover growth we see in Figure 3? There are two possible explanations. One is that, as already noted, about 20% of the firms are non-crossers who do restrict their growth just below the threshold, and in Figure 9, these firms are excluded.

Figure 9. Growth Rates for Firms that Cross the Threshold



Notes: The figure shows turnover growth against lagged turnover, only for firms whose lowest (highest) turnover was below the minimum (above the maximum) VAT threshold during the sample period.

But, there is also a less obvious, selection effect. To illustrate, think of the turnover growth of the crossers as being generated by a process where growth depends on lagged turnover (possibly non-linearly) and a firm-specific stochastic shock. Suppose also that on top of this, firms do adjust their growth downwards as they approach the VAT threshold

from below. Nevertheless, if we consider the pattern of turnover growth in the crossers, this slowdown will be attenuated or even eliminated by selection effects.

First, crossers include firms initially below the threshold that had a sequence of positive shocks in previous periods and thus are growing faster than average below and near the threshold. Second, crossers include firms initially above the threshold that had a sequence of negative shocks in previous periods and thus are growing slower than average above and near the threshold. Combined, these two effects tend to increase (reduce) observed growth below (above) the threshold, resulting in a smoothing out of the slowdown.

We can illustrate this by a simple example. We simulated a firm-year data-set with 100,000 firms with 10 years of turnover growth data. Initial turnover for each firm was a random draw from a uniform distribution between £10,000 and £80,000. The VAT threshold was set at £50,000. Growth from year t to year $t-1$, expressed in percentage terms, is $g_{it} = 100 \times \Delta ln y_{it}$ and is generated by the following process;

$$g_{it} = 10 - 0.1 y_{i,t-1} + 0.0005 y_{i,t-1}^2 - 2.5(y_{t-1}/50) I[y_{t-1} < 50] + \epsilon_{it} \tag{4}$$

where $y_{i,t-1}$ is lagged turnover, and $\epsilon_{it} \sim N(0, 10)$ is the random shock for firm i in year t. Finally, $I[y_{t-1} < 50]$ is an indicator that takes on the value 1 only lagged turnover is below the threshold, so the term in this indicator models a slowdown in growth as $y_{i,t-1}$ approaches the threshold from below.

The first panel of Figure 10 shows the average growth rate in each £1000 bin of lagged turnover for *all* firms. As expected, it shows a discontinuity at the threshold due to the slowdown effect that is built into (4). The second panel of Figure 10 disaggregates the firms into three groups. First, the blue distribution shows firms who have a sequence of negative growth draws and never cross the threshold. The red distribution shows the firms that had an initially high turnover and a sequence of positive growth draws and thus always stay about the threshold. Finally, the green distribution shows firms who cross the threshold, both from below to above and vice versa. For the parameter values we have chosen in (4), the two selection effects just described jointly completely offset the "real" slowdown in the growth process and so there appears to be no slowdown in growth, consistently with Figure 10.

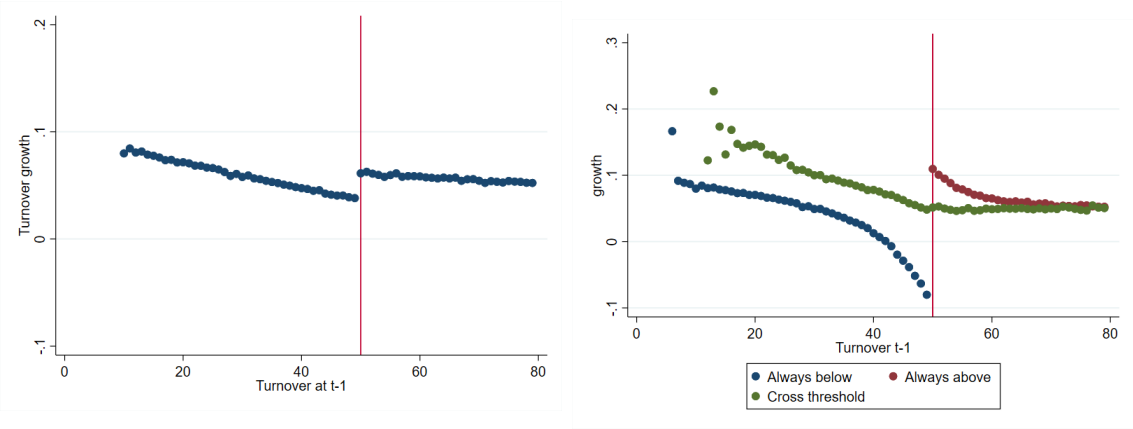
This all raises the question of which set of firms we should be studying. In the example, the "true" data-generating process has a slowdown, which shows up in the whole data-set

but not when we restrict attention to the crossers, and so clearly we should be studying all firms together. Things become more complex when we also have a set of firms that behave differently by taking action never to cross the threshold. Ideally, we would like to separate out these firms in our data and study them separately. Unfortunately, we cannot distinguish these firms from other firms that intend to cross the threshold, but for some reason, have slow or negative growth during the sample period.

Figure 10. Simulated Data: Turnover Growth

(a) Whole sample

(b) Sample disaggregated by behavior relative to the threshold



Notes: The figure shows the turnover growth against lagged turnover with a simulated dataset with 100,000 firms with 10 years of growth data. Panel (a) plots the "true" turnover growth with respect to lagged turnover in the data; panel (b) plots the turnover growth with respect to lagged turnover for three sub-sample of the simulated data: 1) Firms that are never above the threshold; 2) Firms that are always above the threshold; 3) Firms that cross the threshold.

8 Non-Incorporated Businesses

In the UK, unincorporated businesses, i.e. sole traders, partnerships, and unincorporated associations, are also subject to VAT. In terms of numbers, this form of organization is more important than incorporated firms. For example, the Department for Business, Energy and Industrial Strategy estimated that in 2016, there were 3.3 million sole proprietorships (60 percent of the total), 1.8 million companies (32 percent), and 421,000 ordinary partnerships (8 percent).[27]

Moreover, most unincorporated businesses are very small, and so are more likely to be impacted by the VAT threshold than companies. So, it is important to study the growth of this sector around the VAT threshold. To do this, we use data from self-assessment (SA) tax returns from 2004-05 to 2013-14. All sole traders and members of partnerships are obliged to submit a SA tax return. These returns have a box where turnover is reported. These individuals can also report the costs of goods used or bought for resale, as well as other costs such as rent, rates, utilities, professional fees and so on. We are interested in a measure of cost that is variable with output, and so use the cost of goods used or bought for resale as our measure.

A further issue here is that unincorporated businesses with turnover below the VAT threshold can opt to file a simplified SA tax return without having to report a detailed cost breakdown. For such businesses, their cost of goods is recorded as a zero in our data set. Moreover, the SA tax return of a business in the UK cannot be directly linked to its VAT return. So, we cannot identify the filers of simplified returns and (for example) drop them when we analyse cost growth.

Bearing in mind this caveat, Table 3 reports the summary statistics for turnover, cost and their growth rates for non-incorporated businesses. Note in particular that the median business reports only £1,400 of spent on goods, reflecting the fact just noted that in many cases, this will be reported as zero even though it may be positive.

Finally, as SA tax returns cannot be directly linked to their VAT returns, so we do not know whether a particular e.g. sole trader is registered for VAT or not. This means that we cannot determine if unincorporated businesses are voluntarily registered or not. This in turn means that we cannot analyse voluntary registered vs. non voluntary registered traders

[27] See www.gov.uk/government/statistics/business-population-estimates-2016.

Table 3. Summary Statistics, Non-Incorporated Taxpayers

Variable	Mean	p25	p50	p75	S.D.	N
Turnover (£1,000)	42.15	22.35	32.53	51.17	30.06	6,575,873
Cost (£1,000)	9.59	0.00	1.40	11.26	42.09	6,575,873
Turnover growth rate (%)	0.07	-0.10	0.01	0.15	0.42	4,902,236
Cost growth rate (%)	0.97	-0.41	-0.04	0.22	90.29	3,018,240

in the same way that we did for incorporated firms.

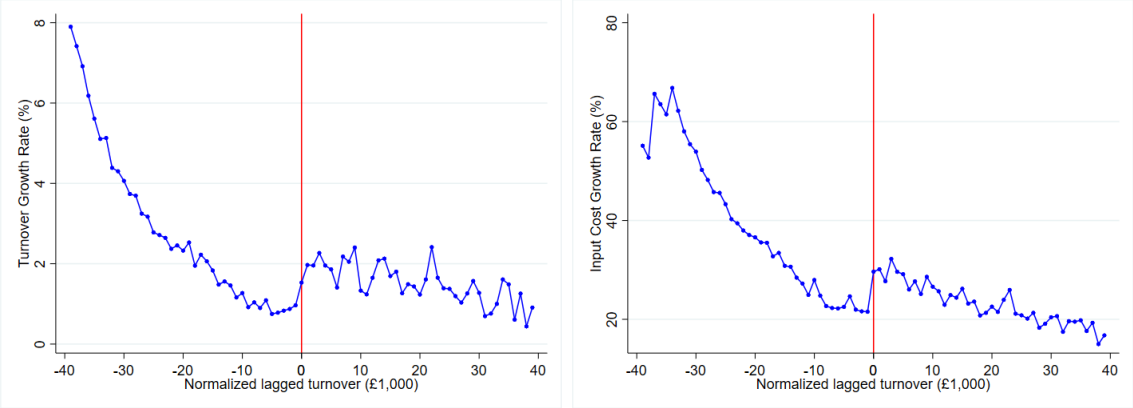
Graphical Evidence We begin by graphing the rates of growth of turnover and cost in year t, against the distance of last year's turnover to the VAT threshold for that year, for all non-incorporated businesses in Figure 11. The figure has the same interpretation as Figure 3: on the horizontal axes, we have the difference between actual turnover in $t-1$ and the VAT threshold in that year, *normalized turnover*, and on the vertical, we have the turnover and cost growth rates. Each point is the mean value of the growth rate for unincorporated businesses in a £1,000 bin of normalized lagged turnover.[28] We see that there is slowdown in growth of both turnover and cost below the threshold. This means that as in the case of companies, some of the growth suppression is achieved by gradual slow-down in the input cost growth prior to reaching the VAT threshold.

Regression Analysis We now turn to regression analysis to further study turnover and cost growth. We first run the regression based on equation (1) for turnover growth and the results are reported below in Figure 12, panel (a). We see a pattern very similar to that for incorporated businesses; there is significant slowdown just below the threshold, and some weaker evidence of catch-up after the threshold. Panel (b) summarizes the regression results based on equation (1) where the dependent variable is cost growth. The pattern is somewhat similar: cost growth slows below the threshold, but there is only weak evidence of catch-up above.

[28] As in the case of Figure 3, bin x is defined as comprising all firms in the normalized turnover range $[x, x+1000)$, so in particular, the bin at zero comprises all unincorporated businesses exactly at the threshold and up to £1,000 above.

Figure 11. Growth of Unincorporated Businesses and the VAT Threshold

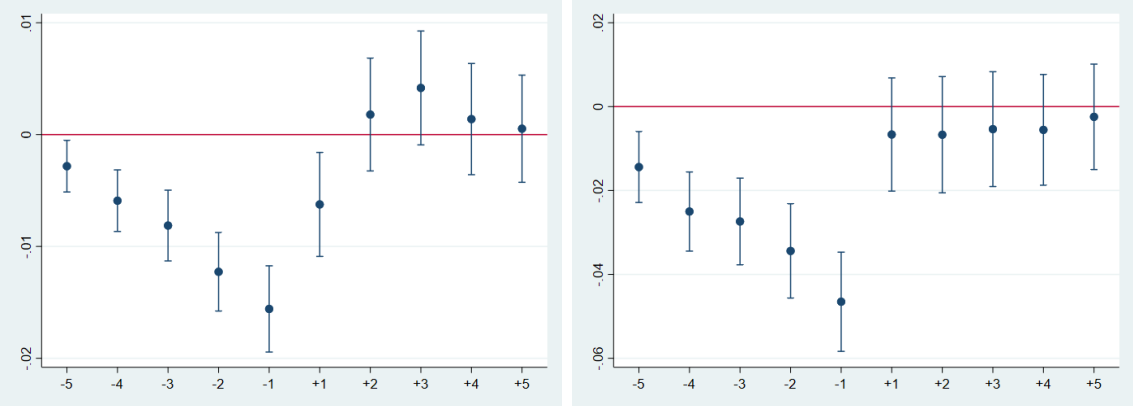
(a) Turnover (b) Cost



Notes: The figure shows the average growth rate of unincorporated businesses by bins of £1,000 with one-period lagged turnover within the neighbourhood of normalized VAT threshold during 2004/05-2014/15. Panel (a) shows the average turnover growth rate, and panel (b) shows the average growth rate in labor-inclusive input costs. The vertical line at zero denotes the normalized VAT threshold.

Figure 12. Turnover and Cost Growth Regression Results: Non-Incorporated Businesses

(a) Turnover - bin FE (b) Cost - bin FE



Notes: The figure shows the coefficients β_j, γ_j and their 95% confidence intervals. To lighten notation, coefficients $\beta_1, ..\beta_5$ are denoted by $-1, .. -5$, and coefficients $\gamma_1, ..\gamma_5$ are denoted by $+1, .. +5$. . In panel (b) we control for bin fixed effects and firm age fixed effects.

9 Conclusions

This paper has studied the effect of the VAT threshold on firm growth in the UK, using exogenous variation over time in the threshold for identification. We have found robust evidence that annual growth in turnover slows by around one percentage point when firm turnover gets close to the threshold, but no evidence of higher growth just above the threshold is passed. Growth in firm costs shows a similar pattern, indicating that the response to the threshold is likely to be a real response rather than an evasion response. Firms that habitually register even when their turnover is below the VAT threshold (voluntary registered firms) have turnover and cost growth that is unaffected by the threshold. Also, firms that opt for the FRS seem to be affected by the threshold, but slow down less than other firms just below it. We have also discussed a possible additional dimension of heterogeneous response i.e. crossers vs. non-crossers ; selection effects make it hard to obtain an unbiased estimate of the effect of the threshold on crossers. Similar patterns of turnover and cost growth around the threshold are also observed for non-incorporated businesses.

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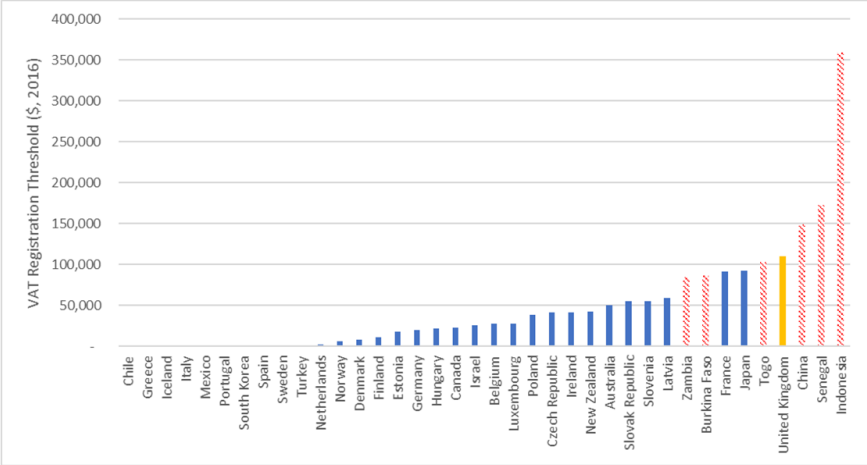
Appendix: Supplementary Tables and Figures

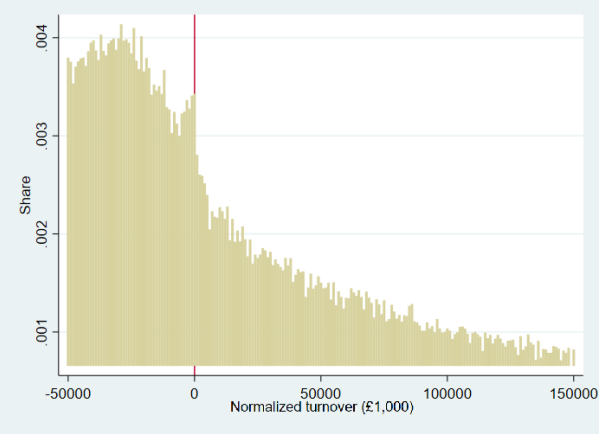
Figure A.1. VAT Thresholds in Selected Countries, 2016



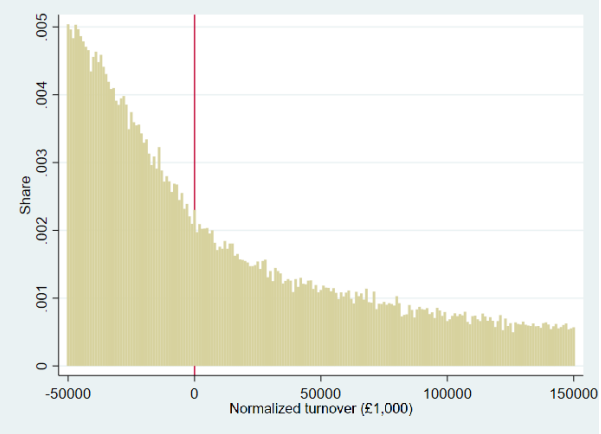
Notes: The figure shows the VAT registration threshold in OECD and other selected countries in 2016.

Figure A.2. Turnover Bunching at the VAT Threshold - Firms in Zero-rated & Exempt Sectors Only

(a) Growing Firms



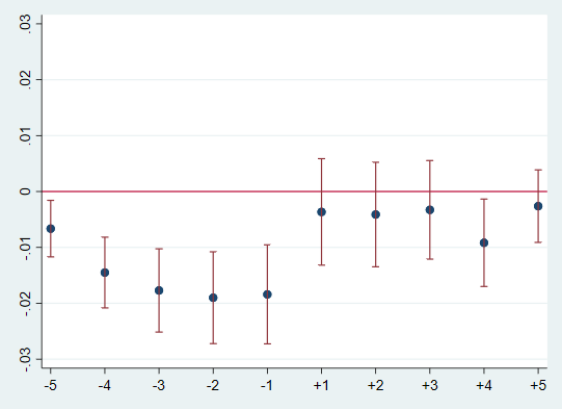
(b) Shrinking Firms



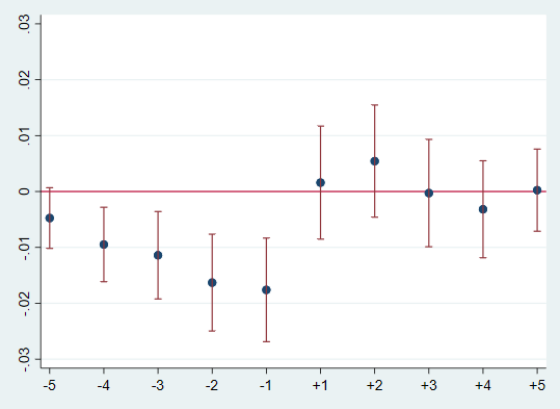
Notes: The figure shows the histogram of growing companies within the neighbourhood of normalized VAT threshold during 2004/05-2014/15 in the top panel and the histogram of declining companies in the bottom panel. The bin width is £1,000 and the dashed line denotes the normalized VAT threshold. The sample includes only firms in zero-rated and exempt sectors.

Figure A.3. Real Turnover and Real Cost Growth Regression Results

(a) Turnover



(b) Cost



Notes: The figure shows the coefficients β_j, α_j and their 95% confidence intervals. To lighten notation, coefficients $\beta_1, ..\beta_5$ are denoted by $-1, .. - 5$, and coefficients $\alpha_1, ..\alpha_5$ are denoted by $+1, .. + 5$. . In both panel (a) and (b) we control for bin fixed effects and firm age fixed effects. Turnover and cost variables are divided by the 2014-2015 fiscal year GDP deflator.

Table A.1. Growth of voluntary registered vs non-voluntary registered - first stage for IV estimation

	(1) NVR (treated)	(2) NVR (treated)
Share of B2C	0.353***	0.250***
	(0.00828)	(0.00925)
N	206390	206390
F-stat	1820.9	328.9
F-stat (all first stage equations)		122.5
Year FE	Y	Y
Bin FE	Y	Y
Indicators for above/below the thresholds and interaction terms	N	Y

Notes: The table present the estimates of the first stage for the IV estimation. The outcome variable is an indicator of the firm voluntarily registered in year t. The explanatory variable is the share of B2C in industry-year level. Controls include year fixed effect, lagged turnover-bin fixed effects (£2,000) and firm age fixed effects. Column (2) in addition control for other exogenous variables (indicators for below the thresholds) and their interaction terms with share of B2C. The reported F-statistics is for share of B2C in col (1) and also its interaction with above/below threshold indicators in col (2). The F-stat for all first stage equations is the Kleibergen-Paap statistics for all excluded instruments (share of B2C and its interaction with the above/below threshold indicators) on the instrumented variables (NVR and its interaction with the above/below threshold indicators).

Table A.2. Growth of flat-rate scheme vs non-flat rate scheme firms - first stage for IV estimation

	(1) FRS	(2) FRS
Input-cost ratio	-1.182***	-1.131***
	(0.0124)	(0.0140)
N	266985	266985
F-stat	9065.0	826.0
F-stat (all first stage equations)		138.9
Year FE	Y	Y
Bin FE	Y	Y
Indicators for below the thresholds and interaction terms	N	Y

Notes: The table present the estimates of the first stage for the IV estimation. The outcome variable is an indicator of the firm in the flat-rate scheme in year t. The explanatory variable is the input cost ratio in industry-year level. Controls include year fixed effect, lagged turnover-bin fixed effects (£2,000) and firm age fixed effects. Column (2) in addition control for other exogenous variables (indicators for below and above the thresholds) and their interaction terms with input-cost ratio. The reported F-statistics is for input-cost ratio in col (1) and also its interaction with above/below threshold indicators in col (2). The F-stat for all first stage equations is the Kleibergen-Paap statistics for all excluded instruments (input-cost ratio and its interaction with the above/below threshold indicators) on the instrumented variables (FRS and its interaction with the above/below threshold indicators).