

# VAT Notches, Voluntary Registration, and Bunching: Theory and UK Evidence

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# Introduction

- Tax notches relatively rare in major taxes: VAT registration thresholds probably one of the most important examples in OECD countries
- It is well-known that tax notches and kinks can produce bunching
  - Saez(2010): kinks
  - Kleven and Waseem (2013): notches
- But, uniquely among major taxes, firms also "volunteer" to pay the VAT (in our data-set, around 44%): voluntary registration, VR

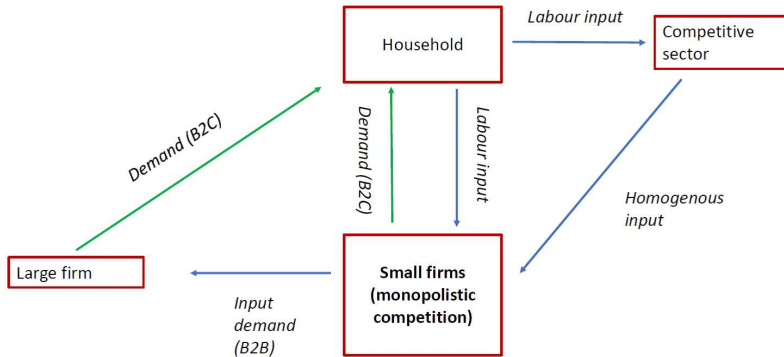
# This Paper: Main Contributions

- Presents a conceptual framework to explain *both VR and bunching*, building on Keen and Mintz (2004)
- Develops predictions on the determinants of VR and bunching
  - The impact of VAT on firm decision-making can be captured by a single sufficient statistic
  - The proportion of sales that are B2C, relative importance of intermediate inputs, and product market competition all affect VR and bunching
- Takes the predictions to a large administrative data-set for the UK
  - we find bunching as well as VR generally vary in the way predicted by the theory

# Bunching and Voluntary Registration

- *B2C sales* - sales to final consumers i.e. purchasers not registered for VAT (consumers)
- *B2B sales* - sales to businesses registered for VAT
- With *only* B2B sales, *all* firms will register voluntarily for VAT, as the purchaser can claim back VAT on inputs, so the seller can pass on all output VAT
- With *only* B2C sales, *no* firms will register for VAT, as the impact on profit of increased output tax liability exceeds any input VAT that can be claimed back (less obvious, but true for any downward-sloping or horizontal demand curve)
- So, need (i) both B2C and B2B sales, *and* (ii) a minimum of three stages of production

# Model Structure



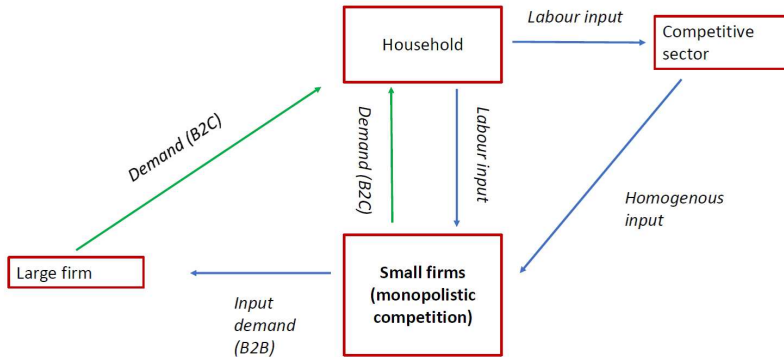
## Related Literature: Theory

- Keen and Mintz (2004); the first model of bunching at the VAT threshold
  - But their model only allows for firm sales to final consumers (B2C sales), and thus cannot explain voluntary registration.
- de Paula and Scheinkman (2010): a model where firms can choose between formal and informal production (e.g, register for VAT or not), and can also choose to buy inputs from formal or informal suppliers.
  - They allow for both B2C and B2B sales, but voluntary registration cannot occur in their model, as there are only two stages of production.
  - Also, comparative statics difficult in their model

## Related Literature: Empirics

- Onji (2009): effect of the introduction of a VAT threshold in Japan on the incentives for a large firm to split in order to stay below the threshold.
  - More recent papers: bunching of small firms at the VAT registration threshold in Finland (Harju (2016)) and Armenia (Peichl (2016))
  - Harju (2016) provide strong evidence of bunching below the VAT threshold in Finland, and argue that compliance costs are the main driver.
  - Neither paper studies voluntary registration in detail, or relates bunching to underlying determinants (input costs, B2C ratio, industry competition)
- Almunia (2014) finds strong bunching at a large taxpayers unit (LTU) threshold in Spain
  - They show that bunching is more pronounced in sectors with a *lower* fraction of B2C sales, which is the opposite of what we find.

# Model Structure Again





# Small Firms

- The unit cost function:  $c(I(a); a)$ , where  $I(a) = 1$  if registered and  $I(a) = 0$  otherwise:

$$c(1; a) = \frac{1}{a}, \quad c(0; a) = \frac{1 + \omega t}{a}$$

- $a, \omega$  measure productivity, and the firm's intensity of use of intermediate inputs
- The firm's profit is

$$\pi(p_C, p_B, I; a) = (p_C - c(I; a))x_C + ((p_B - c(I; a))x_B$$

$$x_C = \lambda A_C (p_C(1 + I.t))^{-e_C}, \quad x_B = (1 - \lambda) A_B (p_B)^{-e_B}$$

# The Registration Decision

- If registered, the firm solves:

$$\pi_R = \max_{p_C, p_B} \pi(p_C, p_B, 1; a)$$

- If not registered, the firm solves:

$$\pi_{NR} = \max_{p_C, p_B} \pi(p_C, p_B, 0; a) \text{ s.t. } p_C x_C + p_B x_B \leq s^*$$

- Then, the firm registers if:

$$\pi_{NR} \leq \pi_R$$

# The Sufficient Statistic

- Assume  $e_C = e_B = e$
- then a firm registers voluntarily iff  $T > 1$ , bunches if  $T < 1$ , where:

$$T = \underbrace{\frac{(\lambda + (1 - \lambda)A_B)}{(\lambda(1 + t)^e + (1 - \lambda)A_B)}}_{\text{output VAT burden from R, } < 1} \times \underbrace{(1 + \omega t)^{e-1}}_{\text{input VAT burden from NR, } > 1}$$

- where:
  - $t$  – Statutory rate of VAT
  - $\omega$  – weight of intermediate inputs in production
  - $\lambda$  – share of demand that is B2C
  - $A_B = \left(\frac{e-1}{e}\right)^e$

# Main Results

- The higher  $\omega$ , the higher is  $T$ , so:
  - the more likely the firm is to register voluntarily
  - the less likely the firm is to bunch
  - the *amount* of bunching overall (% of firms at the threshold) falls
- the higher  $\lambda$ , the lower is  $T$ , so:
  - The less likely the firm is to register voluntarily
  - the more likely the firm is to bunch
  - the *amount* of bunching overall (% of firms at the threshold) rises
- Special cases:
  - If no B2C sales i.e.  $\lambda = 0$ , then  $T = (1 + \omega t)^{e-1} > 1$ , so VR is always best
  - If no B2B sales i.e.  $\lambda = 1$ , then  $T = (1 + \omega t)^{e-1} / (1 + t)^e < 1$ , so VR is never best

## Main Results 2

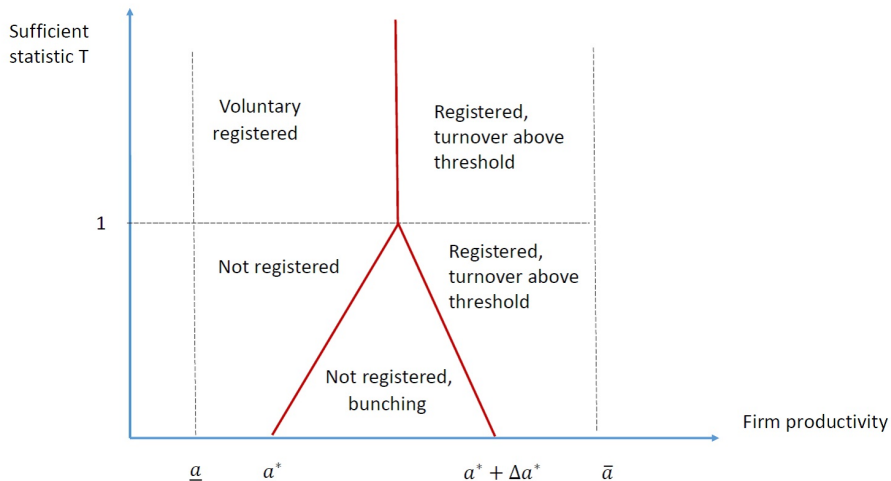
- An increase in  $e$  has two opposite effects on  $T$ :
  - *First*, the input VAT burden from **non-registration** rises with  $e$ , because the higher cost (due to embedded VAT) is harder to pass on to both B2C and B2B consumers when demand becomes more elastic
  - *Second*, the output VAT burden from **registration** rises with  $e$ , because the tax on output is harder to pass on to B2C consumers when demand becomes more elastic
- Theoretically, either of these can dominate
- Possible to show that second effect dominates as  $e \rightarrow \infty$

# The Effect of $e$ on $T$

**Table:** The Effect of Competition on the Sufficient Statistic  $T$

$e$	2	5	10	20	50	100
$\omega = 0.9, \lambda = 0.1$	1.039	1.408	1.967	2.361	1.564	0.678
$\omega = 0.9, \lambda = 0.9$	0.826	0.796	0.739	0.629	0.381	0.164
$\omega = 0.1, \lambda = 0.1$	0.898	0.786	0.530	0.148	0.001	0.000
$\omega = 0.1, \lambda = 0.9$	0.714	0.444	0.199	0.039	0.000	0.000

# Model Overview



# VAT in the UK

Date Range	Standard Rate (%)	Registration Threshold (\$)
1 Apr 2004 - 30 Mar 2005	17.5	58,000
1 Apr 2005 - 30 Mar 2006	17.5	60,000
1 Apr 2006 - 30 Mar 2007	17.5	61,000
1 Apr 2007 - 30 Mar 2008	17.5	64,000
1 Apr 2008 - 30 Nov 2008	17.5	67,000
1 Dec 2008 - 30 Dec 2009	15.0	67,000
1 Jan 2010 - 30 Mar 2011	17.5	68,000



# Data

- Administrative data on VAT returns
  - Contains VAT registration number, value of sales, etc. But *only* for VAT-registered firms
- Administrative data on corporate tax returns (CT 600)
  - Contains taxpayer reference number and value of total sales, cost of inputs including wages
  - We must use CT600 data on sales, value of inputs, to get coverage both above and below the VAT threshold
- Company accounts from FAME
  - Contains additional firm characteristics including input costs and wages *separately*, and number of employees (coverage varying by firm size)
- ONS sectoral-level data on the share of sales to final consumers
- Final data-set contains 714,571 observations for 257,373 unique companies between April 1 2004 and March 30 2010

# Empirical Measurement of Key Variables

- The **input cost ratio**  $\omega$  is measured by the ratio of intermediate inputs plus labour costs to sales (CT600) or just ratio of intermediate inputs to sales (FAME)
- The **B2C ratio**  $\lambda$  is measured *at the industry level* (2-digit) and by year, by the share of sales to final consumers of the industry where the firm is located
- We measure the **level of competition** at the industry level by the *Lerner index*, which is one minus the average ratio of trading profit to value of sales for firms in that industry
  - If demand is iso-elastic at  $e$  for all firms in an industry the Lerner index is simply  $(e - 1)/e$ .

# Summary Statistics

Summary statistics for firms around the threshold (turnover between \$10,000 and \$200,000):

**Table:** Summary Statistics

Variable	Mean	St.Dev.	p10	p50	p90	Observations
Total Turnover	73.735	48.979	19.541	60.761	151.509	714,571
Trading Profit	20.986	25.942	0.000	11.547	56.454	714,571
Total Input Costs (CT600)	52.749	44.742	11.576	36.205	124.354	714,571
Intermediate Input Costs (FAME)	30.768	33.444	2.000	17.000	81.000	80,682
Input-Cost Ratio (CT600)	0.71	0.27	0.29	0.77	1.00	714,571
Input-Cost Ratio (FAME)	0.38	0.25	0.05	0.37	0.72	80,682
Share of B2C Sales	0.46	0.26	0.10	0.43	0.88	714,571
Lerner Index	0.76	0.10	0.61	0.78	0.90	714,571

*Notes:* this table shows the mean, standard deviation, the 10th, 50th (median) and 90th percentiles, and the number of nonmissing observations of the key variables used in the empirical analysis. The top four variables are expressed in thousands of pounds (GBP). The rest of variables are defined to be in the interval  $[0, 1]$ . Note that we only have data on salary-exclusive input costs for a subset of companies from the FAME dataset. The share of B2C sales denotes the proportion of turnover that comes from sales to final consumers, as opposed to sales to other VAT-registered businesses.

# Evidence on Voluntary Registration 1

- Around 44% of firms with a turnover below the VAT notch are voluntarily registered for VAT
- By quartiles of input cost ratio and B2C sales

Ratio of B2C Sales (%)	Ratio of Input Costs (%)			
	Q1	Q2	Q3	Q4
Q1	47.05	47.52	45.99	46.98
Q2	56.35	51.80	52.01	55.43
Q3	24.11	29.01	32.87	36.70
Q4	32.93	34.28	36.04	46.77

# Evidence on Voluntary Registration 2

Table: Determinants of Voluntary VAT Registration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of B2C Sales	-0.137*** (0.005)			-0.016*** (0.006)	0.001 (0.004)	0.000 (0.004)	-0.041** (0.016)	-0.041** (0.016)
Input-Cost Ratio		0.023*** (0.004)		0.073*** (0.004)	0.006*** (0.002)	0.044*** (0.002)	0.025*** (0.009)	0.036*** (0.009)
Lerner Index			-0.557*** (0.014)	-0.579*** (0.017)	-0.116*** (0.026)	-0.130*** (0.026)	-0.156* (0.088)	-0.164* (0.088)
Distance to Threshold						-0.002*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Observations	478,973	478,973	474,339	474,339	474,339	474,339	53,455	53,455
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-FE	No	No	No	No	Yes	Yes	Yes	Yes
Cost-Ratio Source	n/a	CT600	n/a	CT600	CT600	CT600	FAME	CT600

Columns (1)-(4) present results from the linear probability model without firm-fixed effects, and columns (5)-(8) present results by adding firm-fixed and additional firm-level control variables, such as distance to the registration threshold. \*, \*\*, \*\*\* denotes significance at 10%, 5% and 1%, respectively. Standard errors are clustered at firm level.

# The Dynamics of Voluntary Registration

- Considerable amount of persistence in firm registration status; concern that VR may be mainly due to this

$$R_{it} = \gamma_0 + \gamma_1 R_{i,t-1} + \gamma_2 (1 - R_{i,t-1}) IR_{it} + \gamma_3 R_{i,t-1} ID_{it} + \gamma_4 B2C_{it}^j + \gamma_5 ICR_{it} + \gamma_6 L_{it}^j + \gamma_7 D_{it} + \rho_t + \phi_i + \nu_{it}$$

- $R_{it}$  is a dummy indicator for registration
- $IR_{it}, ID_{it}$  are dummy indicators for whether turnover  $Y_{it}$  is above the registration and deregistration thresholds  $Z_t, Z'_t$  respectively at time  $t$
- $IR_{it} = \begin{cases} 1, & Y_{it} \geq Z_t \\ 0, & Y_{it} < Z_t \end{cases}, ID_{it} = \begin{cases} 1, & Y_{it} \geq Z'_t \\ 0, & Y_{it} < Z'_t \end{cases}$ ,

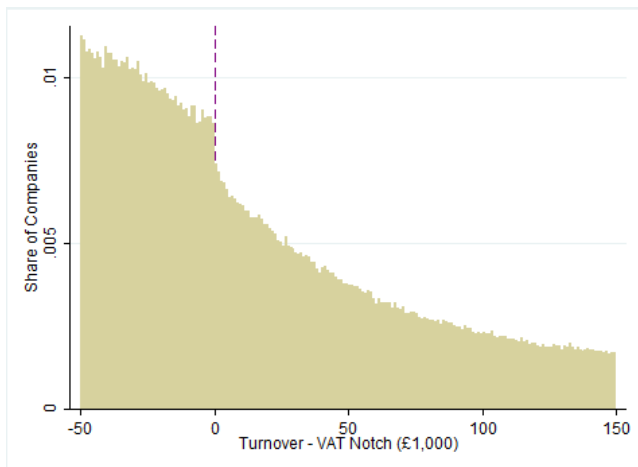
# Dynamic Estimation: Marginal Results

**Table:** Determinants of VAT Voluntary Registration: Average Partial Effects

Evaluated at:		Mean $\Pr(\widehat{R}_t = 1)$ (1)	Average Partial Effect (2)
$R_{t-1} = 1$	$ID_t = 1$	0.984	
$R_{t-1} = 1$	$ID_t = 0$	0.934	0.050***
$R_{t-1} = 0$	$IR_t = 1$	0.993	
$R_{t-1} = 0$	$IR_t = 0$	0.289	0.704***
Average in the sample:		0.646	
$B2C + \sigma_{B2C}$		0.645	-0.001**
$ICR + \sigma_{ICR}$		0.646	0.000
$Lerner + \sigma_{Lerner}$		0.620	-0.025***

Notes: this table presents the partial effects of the key variables of interest from the dynamic estimation of VAT registration.

# Bunching: All Firms





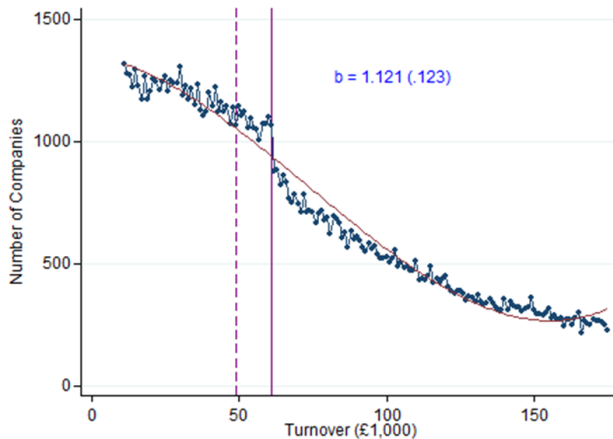
# Bunching Estimates: Introduction

- Our empirical measure of bunching,  $b$  is:

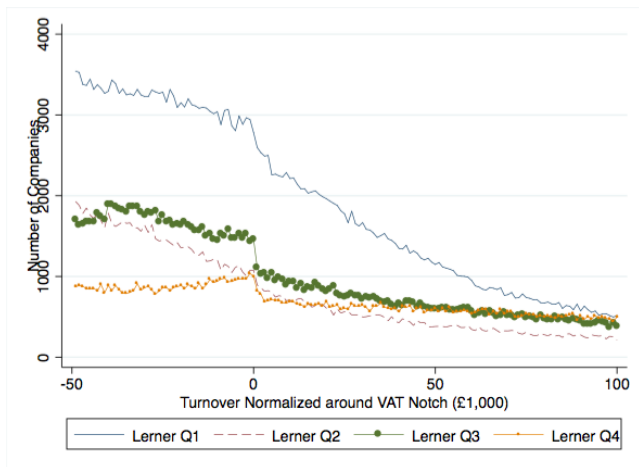
$$b = \frac{\sum_{j=s_{-}^{*}}^{s^{*}} (c_j - \hat{c}_j)}{\frac{1}{J} \sum_{j=s_{-}^{*}}^{s^{*}} \hat{c}_j}.$$

- $c_j$  -the actual number of firms in each \$100 turnover bin
- $\hat{c}_j$  is the counter-factual bin counts without the notch:
- $s_{-}^{*}$  is the bin below the notch where bunching starts

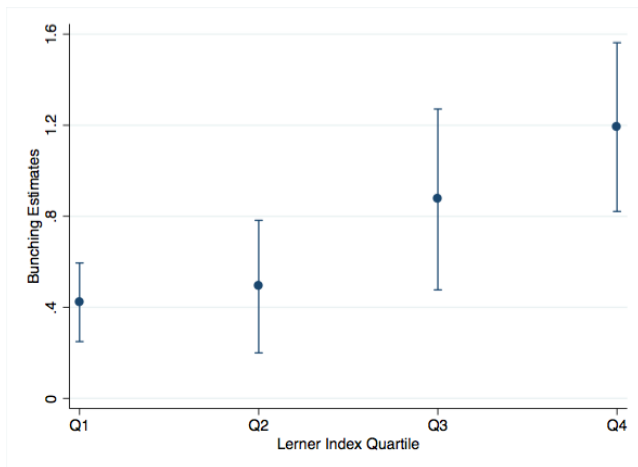
# Bunching Estimates: An Example (2006-7)



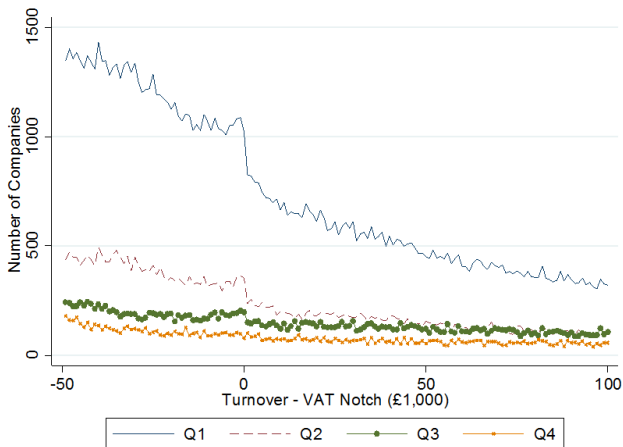
# Bunching across Quartiles of the Lerner Index 1



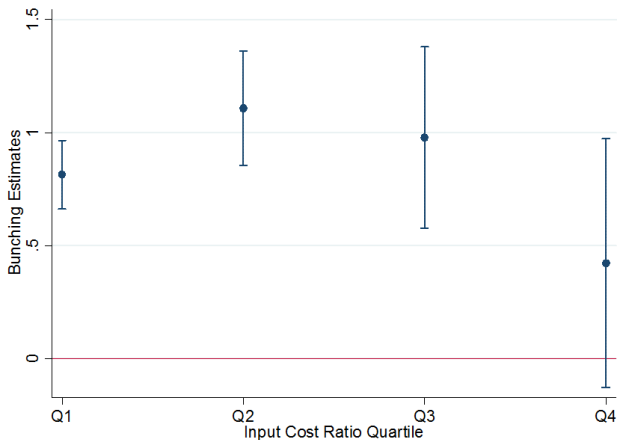
## Bunching across Quartiles of the Lerner Index 2



# Bunching across Quartiles of the Input Cost Ratio 1



# Bunching across Quartiles of the Input Cost Ratio 2



# Conclusions

- We have developed a model that can explain the simultaneous existence of voluntary registration and bunching, and we also developed testable predictions
  - The impact of VAT on firm decision-making can be captured by a single sufficient statistic
  - The B2C sales ratio, relative importance of intermediate inputs, and product market competition can all affect VR and bunching
- Taking the predictions to a large administrative data-set for the UK, we find some empirical support
- Some empirical results are weak, possibly due to measurement error