Firm Response to VAT Policy: Evidence From Ethiopia*

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Abstract

The empirical evidence on the effects of VAT policy in developing countries is scarce. Using a detailed firm level census panel, we study the response of manufacturing firms to the adoption of VAT in Ethiopia. The VAT policy mandated firms with revenue higher than $22000 to register for VAT and the smaller firms to pay a lower turnover tax. First we provide suggestive evidence of firm bunching around the threshold. Second, applying a difference-in-differences strategy with big firms (revenue $>$ $22000) as treated and small firms as controls, and excluding potential bunching firms, we find that big firms experience increases in reported revenue, value added, revenue share of taxes paid, revenue share of raw materials, and firm productivity; formality increases relatively more for small firms. VAT increases both revenue efficiency and production efficiency for big firms. These results are driven by whether firms are in concentrated or competitive industries.

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1 Introduction

Fiscal capacity, the ability to generate revenue through taxation, is still very low in many developing countries (Besley and Persson (2013)). Fiscal constraints may hinder economic development in these countries by limiting the resources available for investments in infrastructure, education, and other growth enhancing projects. One of the major obstacles for robust revenue mobilization is the fact that tax authorities in developing countries do not have accurate information on transactions, which can be acutely lacking due to severe evasion. To deal with this information challenge, economists highlight the importance of third party information which would enable tax authorities to verify the reports of taxpayers against other sources, such as the reports of a firm's trading partners (Kopczuk and Slemrod (2006)); Gordon and Li (2009); Kleven et al. (2009)). Furthermore, it is also in the tax authority's interest that the tax systems allow full production efficiency even in second-best environments (Diamond and Mirrlees (1971)). The theoretical literature on the impact of VAT has shown that it is an efficient taxation system that facilitates tax compliance though a built in structure that generates third party paper trails. Hence, following the advice of economists and international organizations, over 140 countries have adopted value added taxation in the last few years in order to improve their fiscal capacities. Nonetheless, there have been limited empirical studies that examine the full effects of the adoption VAT policies in developing countries, particularly on firms' tax compliance and production decisions.

In this paper, using a detailed firm level census panel (1996-2009), we study the response of manufacturing firms to the adoption of VAT in Ethiopia in 2003. The VAT policy mandated firms with revenue higher than 500,000 Birr ($22000) to register for a 15% VAT while the smaller firms paid 2% or 10% turnover tax based on types of sale. First we provide suggestive evidence of firm bunching around the threshold where bunching firms lower reported revenue by 48,000 Birr ($2000) in order to avoid registration. Second, applying a difference in differences strategy with big firms (revenue $>$ 500,000 Birr) as treated and small firms as controls, and excluding potential bunching firms, we find that big firms experience increases in reported revenue, value added, revenue share of taxes paid, revenue share of raw materials, and firm productivity. On the other hand, formality increases relatively more for small firms. While these findings suggest that the adoption of VAT increased both revenue efficiency and production efficiency for the treated firm, most of the results are driven by whether the firms are in concentrated or competitive industries as measured by Herfindahl indices.

We use firm level panel data (1996-2009) from the Large and Medium Manufacturing Industries Survey conducted annually by Central Statistical Agency of Ethiopia; a data set that covers all regions of the country, and all manufacturing firms with at least 10 employees. Manufacturing is defined, according to International Standard Industrial Classification as the physical or chemical transformation of materials or components into new products, whether the work is driven by power driven machines or by hand, whether it is done in factory or in the worker's home, or whether the products are sold at wholesale or retail. VAT was introduced in Ethiopia on January 1st, 2003. Due to administrative feasibility considerations, the Ethiopian government set a threshold above which firms are required to register for VAT and below which firms pay a low flat tax (called turnover tax); the government implemented a 500,000 Birr turnover threshold level at which firms are obliged to register. The key features of this threshold are: all firms above this threshold pay a 15% tax rate on value added, and those firms below the threshold pay much lower 2% tax rate on turnover (revenue).

To examine firm bunching, we analyze the reported revenue response of firms to a VAT registration threshold. We follow the techniques from the bunching literature (Saez (2010); Chetty et al. (2011); Kleven and Waseem (2013); Almunia and Lopez Rodriguez (2014)). Thus we estimate the degree of bunching around this threshold. The basic bunching procedure to estimate the reaction of firms to the threshold relies on constructing a counterfactual distribution of reported revenue in the absence of a turnover VAT

threshold; we then compare it with the observed distribution to compute the excess mass. Therefore, we use the observed bunching to estimate the magnitude of evasion responses. The estimates found suggest[1] there is evidence of bunching: firms reduce their reported revenue by 48,000 Birr in response to the VAT registration threshold.

To estimate the effects of VAT adoption on revenue efficiency and production efficiency of firms, we use a difference in differences strategy using big firms as treatment and small firms as control. However, there is concern that firms around the VAT registration threshold may manipulate the reported revenue in order to evade the VAT and move to the lower turnover tax regime. If we include all firms in our analysis of the impact of VAT on outcomes of VAT firms, some of the results will be masked by the misspecification of size by some firms. The analysis of the bunching around the threshold informs us about the range around the threshold to exclude for the difference in differences estimation. We can define VAT firms (big firms) and non-VAT firms (small firms) relative to the VAT threshold excluding this range.

We find three sets of results from the difference in differences estimation, and these results show administrative, economic and market effects of VAT adoption on manufacturing firms. The first administrative effect is increased "formality", as defined by whether a firms keeps books of accounts or not: small firms relative to big firms increase "formality". The second administrative effect (also an economic effect) is that relative to small firms, big firms pay a higher revenue share of taxes paid. The first economic effects for big firms relative to small firms are: both reported revenue and value added increase while the share of value added in revenue does not increase; the revenue share of foreign raw materials in revenue increases even though the estimates are significant at 10% level only; firm productivity increases.

The market effect is that the results are driven by whether firms are in concentrated or non-concentrated industries as measured by Herfindahl indices. The market effect likely arises from unequal competition between VAT-registered and non-registered firms. VAT-registered firms in competitive industries in Ethiopia claim this "unfair" competition impacts of their ability to pass on VAT in full to consumers Abdella and Clifford (2010). More precisely, we find: revenue share of indirect and total taxes paid, and firm level productivity increase more for firms in concentrated industries than for firms in competitive industries; but revenue share of profit taxes paid decrease more for firms in competitive industries than for firms in concentrated industries. These results suggest that VAT policy improves both production and revenue efficiency and does so more effectively for firms in concentrated industries, which is consistent with the argument that VAT registered firms may suffer due to competition with other non-registered firms.

In this paper we contribute to the literature on the effects of VAT by examining how the implementation of VAT in Ethiopia affected the production and revenue efficiency of firms. The paper adds to the relatively new empirical literature on VAT and revenue mobilization in developing countries. In fact, empirical evidence on the effects of VAT policy on firm production and reporting decisions is scarce. With VAT, firms cannot easily hide a transaction involving a third party from the government (Tait (1972); Burgess and Stern (1993); Agha and Haughton (1996); Kopczuk and Slemrod (2006)). Pomeranz (2013) analyzes the role of third party information for VAT enforcement through randomized experiments and shows that announcing additional monitoring has less impact on transactions that are subject to a paper trail, indicating the paper trail's preventive deterrence effect. Therefore we should expect a VAT system to raise revenue mobilized from firms. VAT is also supposed to eliminate the cascading effect of output tax, and thus make production more efficient. Therefore tax systems should maintain full production efficiency even in second-best environments (Diamond and Mirrlees (1971)). This result implies governments should impose tax on consumption, wages and profits, but not on intermediate inputs, turnover and trade, which is one of the main reasons why VAT is so attractive to policy makers. There is suggestive evidence that most countries that have adopted a VAT

[1] Caveat: we are not using administrative data to estimate bunching. To be avoid potential behavioral response around VAT threshold, we exclude bunching firms in our DD estimation

seem to have gained a more effective tax instrument (Keen and Lockwood (2007)). Taking into account the effects shown in the above papers, we empirically examine firms' response to VAT policy.

This remainder of this paper is organized as follows. Section 2 gives a brief description of the VAT policy in Ethiopia; section 2.1 describes the firm level data and the main variables used; section 3 presents the empirical strategy for the difference in differences estimations; section 3.1 presents and discusses the results; and section 3.2 concludes.

2 VAT Policy in Ethiopia

Ethiopia's tax policy has gone through substantial changes throughout its tumultuous political history, especially in the past 60 years. The Coordinating Committee of the Armed Forces, Police, and Territorial Army (commonly referred to as DERG), which is a socialist government that was in power until 1991, established a tax regime that was aligned with its ideology: high tax rates that suppressed the private sector and promoted the collective public sector. When the Ethiopian Peoples' Revolutionary Democratic Front (EPRDF) came to power in May 1991, it reversed these policies in favor of lower taxes and a large private sector. Since the coming to power of the EPRDF, tax reform has gone through several stages and it ultimately led to the the introduction of VAT in 2003. The government has implemented broadly two sets of reforms in order to improve revenue mobilization. The first set of reforms introduced new taxes so to broaden the domestic tax base while the second types of reforms were designed to improve the administrative capacity of the tax authority. The second type of reform led ultimately to the introduction of VAT policy.

The main reason for VAT implementation in Ethiopia is stated in the VAT proclamation No. 285/2002: "The VAT minimizes the damage that may be causes by attempts to avoid and evade the tax and helps to ascertain the profit obtained by the taxpayers; the tax enhances saving and investment as it is a consumption tax and does not tax capital; the replacement of the current sales tax by value added tax enhances economic growth and improves the ration relationship between GDP and Government Revenue." About 140 countries in the world have adopted VAT, which is a tax on consumption. Most these countries introduced VAT as a replacement for sales tax. Sales tax is charged only to the final consumer, but VAT is levied at all stages in the value chain of production. So in theory, a business itself pays no tax (only value added taxes) but collects the tax on behalf of the government. This mechanism is one of the main reason why VAT is an attractive system. One of the shortcoming of VAT is that in practice, in competitive markets or where there are many non-VAT-registered competitors, a business may not be able to pass on all of the VAT to customers and thus part of the cost of the VAT may be borne by the business rather than its customers (Abdella and Clifford (2010)).

The government of Ethiopia introduced VAT on January 1, 2003 to replace sales taxes. In a effort to follow the global trend toward indirect taxation, and improved fiscal capacity, Ethiopia introduced VAT with a 15% rate. VAT is levied on locally produced goods at the manufacturing level or on imported goods. There is a refund for input taxes paid on raw materials used in the production of local goods, except for pure alcohol used as raw material. The tax is payable monthly and is due no later than the end of the following month. Some taxable supplies of goods or rendering of services are exempted. A few transactions are zero rated but these are very limited: exports; international transport; supply of gold to the National Bank; or sale of a business as a going concern. All other goods and services are liable to VAT at a rate of 15 percent.This rate applies to all firms with a turnover of more than 500000 Birr. For firms with less than the turnover threshold of 500000 Birr, a much lower flat rate is applied. For goods sold locally, a 2% is applied; for services rendered locally the rate is 2%; and for other services the rate is 10%. It is intended to be equivalent to VAT for non-VAT-registered entities.

The purpose of the VAT is to only tax value-added, eliminate the cascading effect of sales taxes, and

hence improve production efficiency. Thus, a VAT-registered business pays VAT on the goods and services it purchases as inputs and charges VAT on the output it sells. The difference between the input and output VAT charges is the tax on the value added by the business and this tax is paid over to the government. Therefore, VAT eliminates the distortionary effect of sales tax on production since firms are no longer taxed twice. Moreover, the VAT introduces a paper trail effect because at the intermediate level proper reporting increases substantially. Thus governments are expected to increase tax revenue from VAT.

In Ethiopia, VAT policy has a heterogenous incidence on manufacturing firms. An important portion of manufacturing firms are impacted by VAT as their size qualifies them to register for VAT, and they do pay value-added taxes (see data section). Other manufacturing firms pay the 2% turnover tax but not the 10% turnover tax as they are not service firms. VAT exemption affect manufacturing factors that are exporters as exports are zero rated. However this exemption concerns exporters of "processed" goods as opposed to animal skins for example. Finally, for many manufacturing firms VAT might play a big role in production decisions because they have raw materials as a big share of their total inputs.

2.1 Data

Our analysis in this paper is based on firm level panel data from Ethiopia covering all regions of the country from 1996 to 2009. More precisely, the data is from Large and Medium Manufacturing Industries Survey (LMMIS) conducted annually by Central Statistical Agency of Ethiopia. Manufacturing is defined, according to International Standard Industrial Classification as "the physical or chemical transformation of materials or components into new products, whether the work is driven by power driven machines or by hand, whether it is done in factory or in the worker's home, or whether the products are sold at wholesale or retail. The assembly of the components parts of manufacturing products is also considered as manufacturing activities." The scope of the LMMIS is confined to those manufacturing establishments which engage ten persons or above, use power driven machinery, and covers both private and public industries in all regions of the country, where establishments under the scope of the survey are found.

The dataset contains an unbalanced panel of manufacturing firms at the SIC 4 four-digit level. About 70% of firms are located in the 3 biggest regions of Ethiopia (the biggest being Addis Abeba). The data covers 44 industries with an average of 1000 firms per year with 623 in 1996 and 1,948 in 2009. The level of observation is at the firm level. For the difference in differences regressions, only firms present before and after the adoption of VAT policy are used. To reduce the influence of outliers, we "winsorize" the firm-level variables within each year by setting values below the 1st percentile to the value at the 1st percentile and values above the 99th percentile to the value at the 99th percentile.

The main variables used in our regressions are described in the summary statistics Table 1. Revenue is total sales value. Indirected taxes are equal to sales tax for all firms before the VAT policy; after the policy indirect taxes are equal to value added tax for VAT registered firms and turnover tax for non-registered VAT firms. Profit taxes are income taxes paid on firm profit. Thus total taxes are equal to the sum of all taxes paid. Wage bill is total wages paid to all employees, which is represented by the variable workers. Local raw materials and foreign raw materials used are non-processed material inputs from Ethiopia and abroad, respectively. As part of controls in the difference in differences regression, we use age of firm and type of ownership. Age of firm is computed from the variable "year firm was started". Type of ownership is a dummy indicating whether a firm is publicly or privately owned. Finally, Keepbook is a dummy indicating whether a firm keeps books of accounts or not. See table 2 for the summary statistics of these variables.

While we use the manufacturing census data for the bunching estimation, the procedure has shortcomings[2]. First, it is difficult to observe bunching in survey data due to small sizes and measurement error

[2]In an ongoing project, we are using administrative tax data from Ethiopia.

(Kleven (2016)); which is the reason why the bunching literature took off when economists started to have access to administrative data. Second the data comprises of manufacturing firms with at least 10 employees. So we are missing smaller firms and firms in all other sectors. Thus, our bunching estimation results are only illustrative.

3 Empirical Strategy

We present a difference in differences empirical specification to estimate the impact of VAT policy on big firms (our treatment) relative to small firms (our control). To do so we use our bunching estimates; (obtained from the bunching analysis in Appendix **A**). These estimates allow us to create an exclusion range which consists of firms we believe might be manipulating their VAT eligibility (change revenue to revenue below the threshold in order to be VAT ineligible). Using this range we can define VAT firms (big firms) and non-VAT firms (small firms).

Before looking at the regression specification, Figures 3, 5, 6, 7, 8, 9 plot the raw data over time for the variables of interest. These are conditional plot after running the corresponding regression specifications.These plots show that the pre-2003 trends are similar across the treated and control firms, only diverging (mostly) after 2003. The pre-treatment trends look parallel and provide visual support to the use of difference-in-differences (DID) strategy in this context to estimate the causal effect of VAT policy.

To estimate the impact of VAT policy on big firms (our treatment group) relative to small firms (our control groups), we use the following main specification:

$$Y_{it} = \alpha + \beta_1 Treatment_i + \beta_2 Post_t + \beta_3 Treament_i \times Post_t + \mu_i + \nu_r + \delta_t + \rho t + \gamma X_{it} + \epsilon_{it} \quad (1)$$

where Y_{it} is our outcome of interest, $Treatment_i$ is a dummy whether a firm's revenue greater than the 500000 threshold (or VAT eligible). $Post_t$ is a dummy for whether year is greater than 2002; and X_{it} is a vector of controls such as firm age, firm ownership type, and lag of log sale to control for firm size trends; μ_i is firm fixed effect, δ_t is year fixed effect, ν_r is region fixed effect, and ρt is time trend.

Because of potential bunching of some firms around the threshold, we define VAT eligibility by excluding all firms with revenue within 58,000 (48,000 the bunching interval$\pm$10,000) of the threshold, a range obtained from the bunching estimates. The interval can vary for different specifications.

We also run regression specification (1) for firms in concentrated industries only and for firms in competitive industries only. We define these industries using the Herfindhal index; which is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them (see Rhoades (1993) for a formal definition). We use an index of 20% as a cut-off above which an industry is concentrated.

3.1 Results

We present the difference in differences estimates: how firm outcomes change for VAT (big) firms relative to non-VAT(small) firms. These outcomes are grouped into administrative, economic and market effects of VAT adoption on manufacturing firms. In all tables, robust standard errors, in parenthesis, are clustered at the industry level. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are 58,000 Birr away from the turnover threshold. In all regression, we include firm fixed effects, region fixed effects, and year time trend. All graphs show plots of outcome variables against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification. VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program

binscatter (Stepner (2014)).

The first finding (administrative effect) is that, after the adoption of VAT policy, there is a higher increase in the number of small firms keeping books of accounts relative to big firms (see Table 3). Note that there are some big firms that start to keep books when the policy is introduced (see Figure 2). The coefficient on the variable keepbook, which is whether a firm keeps book or not, is -0.215. In the difference in differences framework, this value indicates that the increase in book keeping among small firms is about 20% larger than that among big firms. Formality is hard to measure but it is highly plausible that a firm that starts keeping books of accounts is providing more information to the government: so the firm is more formal (at least at the intensive margin). The structure of the VAT policy in Ethiopia can explain why small firms increase formalization relative to big firms after the adoption of the policy. Small firms are not required to register for VAT, and face low turnover tax (sale tax); and so to take advantage of this differential tax treatment they start keeping books to qualify for turnover tax. But it is more likely that small firms are dealing (such as supplying inputs) with VAT firms and hence have to keep books.

The second main finding (administrative and economic effects) is reported revenue and value added for big firms increase by 12%, and 15% relative to small firms. Table 4, and Table 5 show estimates of 0.119 and 0.150 for revenue and value added, and their coefficient values are significant at the 1%, and 5% level respectively. The increase in revenue and value added, where value added equals revenue minus inputs, may be driven by both reporting and economic effects. The reporting effect may be due to the increase in information of firm transactions created by the VAT whereas the economic effect may be due to firms increasing their production efficiency as only value added is taxed. Value added, which is the difference between a firm's revenue and its purchases of inputs from other firms, has increased for big firms relative to small firms, which seems to suggest evidence of increased production efficiency. But we need to analyze further the use of inputs to determine whether the increase in value added is at least partly due to production efficiency benefits of VAT. We should note, however, the increase in reported revenue is much higher with firms in concentrated industries than firms in competitive industries: estimates are respectively 0.184 and 0.094 (see Table 4). These results might stem from market effects as well, which arise from unequal competition between VAT-registered and non-registered firms. VAT-registered firms in competitive industries in Ethiopia claim this "unfair" competition impacts of their ability to pass on VAT in full to consumers (Abdella and Clifford (2010)).

The third finding (administrative effect) is that relative to small firms, big firms pay a higher revenue share of taxes paid. Revenue share of indirect and total taxes paid by big firms increase by about 46% and 40%, respectively, relative to small firms(see Table 7 and Table 9). But the revenue share of profit taxes paid fall by 42%, (see Table 8) which is mainly driven by firms in competitive industries. The increase in taxes paid suggests the effectiveness of VAT in raising revenue from VAT eligible firms because of its ability to facilitate enforcement through a built-in incentive structure that generates a third-party reported paper trail on transactions between firms. More specifically, VAT should raise firms reported revenue.

The fourth finding (economic effect) suggest use of foreign raw materials and total factor productivity increase. Big firms increase the use of of foreign raw materials relative to small firms by 16% but the results are only significant at the 10% level (see Table 10). These big firms might be more likely to use higher quality inputs (Kugler and Verhoogen (2012)), which are mostly imported from foreign markets; this is especially true under a VAT system in which inputs are not taxed. This result suggest production efficiency increased. Finally, firm productivity as measured by total factor productivity (measured under the methodology of Levinsohn and Petrin (2003)) increases by 10%. This productivity increase might arise from the fact the firm now can choose inputs in a more optimal environment given taxes are only levied on output and not inputs.

We interpret these results as follows. First, VAT improves the intensive margin of compliance from big

firms by bringing more of their revenue under the VAT "net", which likely due to the paper trail effect. Therefore, it is also likely that small firms find it worthwhile to prove they are VAT ineligible, and so they become "formal" by keeping books of accounts. Second, production appear to have improved considerably as revenue share of taxes paid in increases. Third, because relative to small firms big firms revenue share of foreign raw materials use and total factor productivity increased, production efficiency appears to have improved. Finally, these results might stem from market effects as well, which arise from unequal competition between VAT-registered and non-registered firms. VAT-registered firms in competitive industries in Ethiopia claim this "unfair" competition impacts of their ability to pass on VAT in full to consumers. Tax authorities should thus be more wary with this group of firms as outside competition can dramatically change their response to VAT policy.

3.2 Conclusion

The wide adoption of VAT in developing countries in recent years has been facilitated by the long held belief that VAT create an enforcement through a built-in incentive structure that generates a third-party reported paper trail on transactions between firms, and therefore generates more tax revenue. Furthermore, by eliminating the cascading effect of output taxes, it should improve production efficiency which is economically desirable. In this paper, we study the impact of VAT on firms by exploiting the adoption of VAT in Ethiopia in 2003, and using a panel data of manufacturing firm (1996-2009). By law, a firm is required to register for VAT if it is big (its revenue is higher than 500,000 Birr); otherwise the firm is small and faces a much lower turnover tax rate. Using difference in differences with big firms as a treatment and small firms as control, we find for big firms relative to small firms: formality (as measured by whether a firm keeps book or not) increases less; both reported revenue and value added increase increase while the share of value added in revenue does not increase; share of indirect taxes and total taxes paid out of revenue increase while the share of profit taxes fall; share of foreign raw materials in revenue increases (even though estimates on this variable is significant at 10% level only); finally firm productivity increases. However some of these results are driven by whether firms are in concentrated or non-concentrated industries as measured by Herfindahl indices.

VAT improves the intensive margin of compliance from big firms by bringing more of their revenue under the VAT "net", which likely due to the paper trail effect. Therefore, it is also likely that small firms find it worthwhile to prove they are VAT ineligible, and so they become "formal" by keeping books of accounts. Production appear to have improved considerably as revenue share of taxes paid in increases. Because relative to small firms big firms revenue share of foreign raw materials use and total factor productivity increased, production efficiency appears to have improved. Finally, these results might stem from market effects as well, which arise from unequal competition between VAT-registered and non-registered firms. VAT-registered firms in competitive industries in Ethiopia claim this "unfair" competition impacts of their ability to pass on VAT in full to consumers. Tax authorities should thus be more wary with this group of firms as outside competition can dramatically change their response to VAT policy.

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Table 1: Summary Statistics for sales, taxes, and raw materials

	Firms	Time Period	Observations	Mean	Std Dev
Total sales value	Big	Pre-2003	1835	16081.53	34976.47
	Small	Pre-2003	1642	194.61	130.48
	Big	Post-2003	6054	17622.84	39196.78
	Small	Post-2003	4209	208.88	131.19
Indirect taxes payments	Big	Pre-2003	1742	2758.58	11637.21
	Small	Pre-2003	1439	11.74	15.48
	Big	Post-2003	1378	1803.74	6687.9
	Small	Post-2003	1560	8.92	12.89
Income tax paid on profit	Big	Pre-2003	1737	554.86	1877.54
	Small	Pre-2003	1438	2.44	5.59
	Big	Post-2003	3500	563.26	1933.98
	Small	Post-2003	2099	4.68	28.33
Total taxes paid	Big	Pre-2003	1740	2903.47	8765.73
	Small	Pre-2003	1439	14.18	17.23
	Big	Post-2003	5511	3041.69	8575.63
	Small	Post-2003	3114	14.66	28.46
Value of Imported raw materials	Big	Pre-2003	1847	3363.18	9239.33
	Small	Pre-2003	1632	32.47	66.47
	Big	Post-2003	6218	4179.77	11213.29
	Small	Post-2003	4180	31.6	93.02
Value of local raw materials	Big	Pre-2003	1851	4134.59	8308.17
	Small	Pre-2003	1633	83.57	94.91
	Big	Post-2003	6218	4083.14	9753.85
	Small	Post-2003	4180	89.77	119.44

Notes: Monetary values in thousands of Ethiopian Birr. Big refer to a firm with revenue greater than the 500000 threshold; otherwise the firm is considered Small.

Table 2: Summary Statistics for firm age, ownership and books of accounts

	Firm	Time Period	Observations	Mean	Std Dev
Age of Firm	Big	Pre-2003	1865	18.05	34.87
	Small	Pre-2003	1639	11.79	34.2
	Big	Post-2003	6169	15.7	17.55
	Small	Post-2003	4194	9.98	13.12
Type of ownership	Big	Pre-2003	1867	1.37	0.49
	Small	Pre-2003	1642	1.02	0.15
	Big	Post-2003	5923	1.19	0.45
	Small	Post-2003	3635	1.02	0.16
Keep books of accounts	Big	Pre-2003	1867	0.77	0.42
	Small	Pre-2003	1641	0.24	0.43
	Big	Post-2003	6269	0.91	0.29
	Small	Post-2003	4209	0.58	0.49

Type of ownership is a dummy which takes a value of 1 if the firm is private, and 0 if public. Keep book of accounts is a dummy which takes a value of 1 if the firm keeps book, and zero if not.

Table 3: Effect of VAT Policy on Whether Firm Keeps Books of Accounts

	Keep Books of Account		
	(1)	(2)	(3)
PostBig	-0.215***	-0.196***	-0.204***
	(0.0260)	(0.0557)	(0.0280)
Big	0.240***	0.112***	0.255***
	(0.0295)	(0.0360)	(0.0344)
ageFirm	-0.0000251	-0.000674	0.00000289
	(0.000115)	(0.000877)	(0.0000982)
Type of ownership	0.0361***	0.0340	0.0336**
	(0.0122)	(0.0217)	(0.0162)
LagLogSale	0.00977**	0.0144**	0.00790
	(0.00445)	(0.00702)	(0.00544)
Observations	8938	2373	6565
R^2	0.120	0.070	0.137
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is a dummy variable indicating whether the firm keeps books of account or not. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 4: Effect of VAT Policy on Revenue

	Revenue (in Logs)		
	(1)	(2)	(3)
PostBig	0.119***	0.184*	0.0949*
	(0.0430)	(0.0985)	(0.0505)
Big	1.380***	1.489***	1.346***
	(0.0731)	(0.142)	(0.0695)
ageFirm	-0.000611***	-0.0000515	-0.000680***
	(0.000219)	(0.00219)	(0.000191)
Type of ownership	0.0452	0.00350	0.0808**
	(0.0366)	(0.0632)	(0.0354)
LagLogSale	0.279***	0.218***	0.276***
	(0.0329)	(0.0537)	(0.0412)
Observations	8889	2357	6532
R^2	0.506	0.501	0.495
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is revenue (in logs). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only . *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 5: Effect of VAT Policy on Value Added

	Value Added (in Logs)		
	(1)	(2)	(3)
PostBig	0.150**	0.221	0.149*
	(0.0630)	(0.144)	(0.0763)
Big	1.242***	1.358***	1.195***
	(0.0821)	(0.192)	(0.0845)
ageFirm	-0.000575**	-0.00408	-0.000474**
	(0.000258)	(0.00322)	(0.000215)
Type of ownership	0.0805	-0.00210	0.143**
	(0.0686)	(0.124)	(0.0577)
LagLogSale	0.270***	0.181***	0.271***
	(0.0308)	(0.0487)	(0.0401)
Observations	8788	2324	6464
R^2	0.235	0.256	0.219
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is value added (in logs). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 6: Effect of VAT Policy on Revenue Share of Value Added

	Ratio of Value Added to Revenue (in Logs)		
	(1)	(2)	(3)
PostBig	0.0259	0.0464	0.0451
	(0.0439)	(0.0742)	(0.0529)
Big	-0.133**	-0.136	-0.141**
	(0.0548)	(0.103)	(0.0640)
ageFirm	0.000122	-0.00254	0.000210
	(0.000161)	(0.00203)	(0.000128)
Type of ownership	0.0370	-0.00228	0.0651
	(0.0478)	(0.0800)	(0.0419)
LagLogSale	-0.0109	-0.0352	-0.00852
	(0.0119)	(0.0347)	(0.0118)
Observations	8784	2323	6461
R^2	0.006	0.017	0.007
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is revenue share of value added (in logs). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 7: Effect of VAT Policy on Revenue Share of Indirect Taxes

	Ratio of Indirect Taxes to Revenue (in Logs)		
	(1)	(2)	(3)
PostBig	0.459***	0.405*	0.507***
	(0.0791)	(0.214)	(0.0849)
Big	-0.280***	-0.374*	-0.323***
	(0.0889)	(0.205)	(0.0998)
ageFirm	-0.000327	0.00391*	-0.000504
	(0.000673)	(0.00232)	(0.000808)
Type of ownership	0.0253	0.106	-0.0211
	(0.0437)	(0.130)	(0.0351)
LagLogSale	0.00695	0.0144	-0.00638
	(0.0336)	(0.0697)	(0.0357)
Observations	7604	2086	5518
R^2	0.044	0.041	0.054
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is revenue share of indirect taxes (in logs). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 8: Effect of VAT Policy on Revenue Share of Profit Taxes

	Ratio of Profit Taxes to Revenue (in Logs)		
	(1)	(2)	(3)
PostBig	-0.416**	-0.0184	-0.479**
	(0.175)	(0.342)	(0.202)
Big	-0.511***	-0.798***	-0.542***
	(0.0870)	(0.232)	(0.126)
ageFirm	0.000657	0.00629**	0.000476
	(0.000560)	(0.00258)	(0.000754)
Type of ownership	0.361***	0.0755	0.465***
	(0.0986)	(0.115)	(0.137)
LagLogSale	0.0785	0.305***	0.0446
	(0.0544)	(0.0771)	(0.0570)
Observations	4003	1080	2923
R^2	0.050	0.070	0.069
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is revenue share of profit taxes (in logs). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 9: Effect of VAT Policy on Revenue Share of Total Taxes

	Ratio of Total Taxes to Revenue (in Logs)		
	(1)	(2)	(3)
PostBig	0.393***	0.468***	0.419***
	(0.0518)	(0.153)	(0.0582)
Big	-0.314***	-0.497**	-0.361***
	(0.0791)	(0.195)	(0.0945)
ageFirm	-0.000423	0.00216	-0.000545
	(0.000705)	(0.00202)	(0.000838)
Type of ownership	0.0228	0.0302	-0.000150
	(0.0399)	(0.0897)	(0.0434)
LagLogSale	0.0147	0.0333	0.00518
	(0.0272)	(0.0629)	(0.0282)
Observations	8075	2205	5870
R^2	0.033	0.030	0.041
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is revenue share of total taxes (in logs). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 10: Effect of VAT Policy on Revenue Share of Foreign Raw Materials Use

	Ratio of Foreign Raw Materials to Revenue (in Logs)		
	(1)	(2)	(3)
PostBig	0.163*	0.152	0.174
	(0.0826)	(0.213)	(0.106)
Big	-0.166*	-0.488**	-0.0833
	(0.0966)	(0.241)	(0.135)
ageFirm	-0.0000128	-0.00239	0.000163
	(0.000590)	(0.00532)	(0.000308)
Type of ownership	0.0743	0.0235	0.0858
	(0.0611)	(0.0787)	(0.0691)
LagLogSale	0.0442*	0.0932*	0.0224
	(0.0224)	(0.0493)	(0.0322)
Observations	6245	1798	4447
R^2	0.009	0.027	0.013
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

Notes: Dependent variable is revenue share of foreign raw materials (in logs). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Table 11: Effect of VAT Policy on Total Factor Productivity

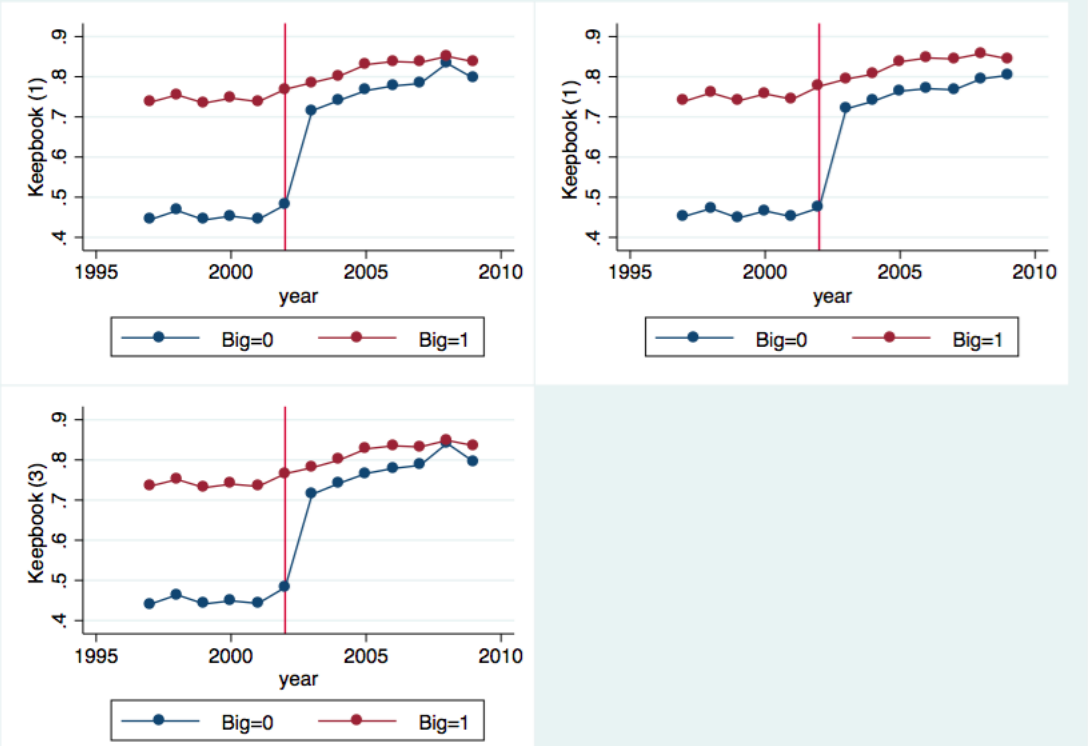
	Total Factor Productivity (in Logs)		
	(1)	(2)	(3)
PostBig	0.0915***	0.209***	0.0526**
	(0.0241)	(0.0768)	(0.0254)
Big	0.832***	0.946***	0.812***
	(0.0491)	(0.110)	(0.0425)
ageFirm	-0.000413***	-0.0000710	-0.000410***
	(0.000108)	(0.00134)	(0.0000886)
Type of ownership	-0.0192	-0.0828	0.0251
	(0.0321)	(0.0664)	(0.0285)
LagLogSale	0.150***	0.112***	0.146***
	(0.0199)	(0.0373)	(0.0231)
Observations	8533	2249	6284
R^2	0.386	0.375	0.382
Firm FE and Year Trend	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

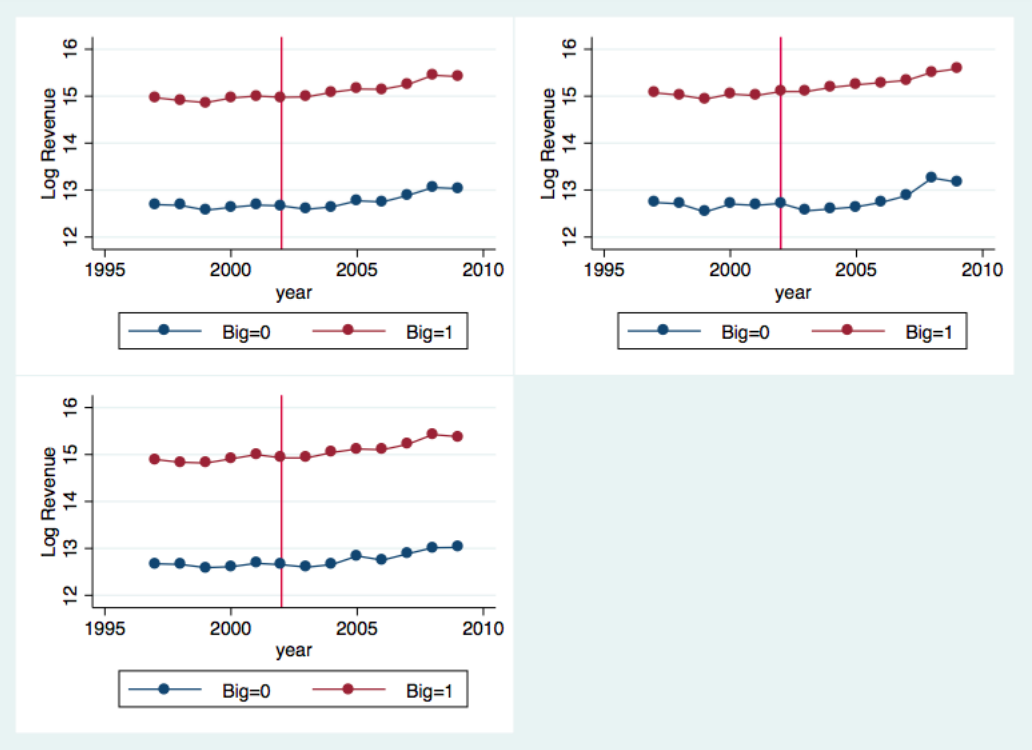
Notes: Dependent variable is total factor productivity (in logs) measured under the methodology of Levinsohn and Petrin (2003). There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Robust standard errors, in parenthesis, are clustered at the industry level. Big means firm with revenue higher than the VAT eligibility threshold of 500000 Birr. Control variables include age of firms, type of ownership (private or public). The excluded threshold range include all firms that are at least 58,000 Birr away (below and above) from the turnover threshold.

Figure 1: Effect of VAT Policy on Whether Firm Keeps Books of Accounts



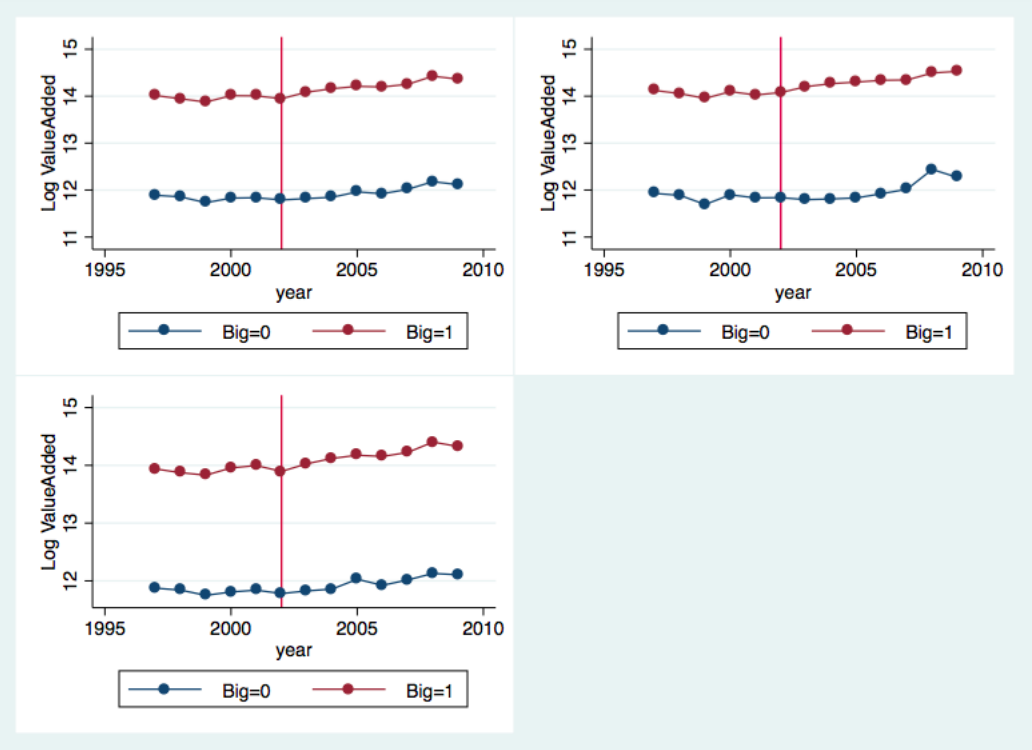
Notes: This graph plots the dummy variable, whether a firm keeps books of accounts or not, against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 2: Effect of VAT Policy on Revenue



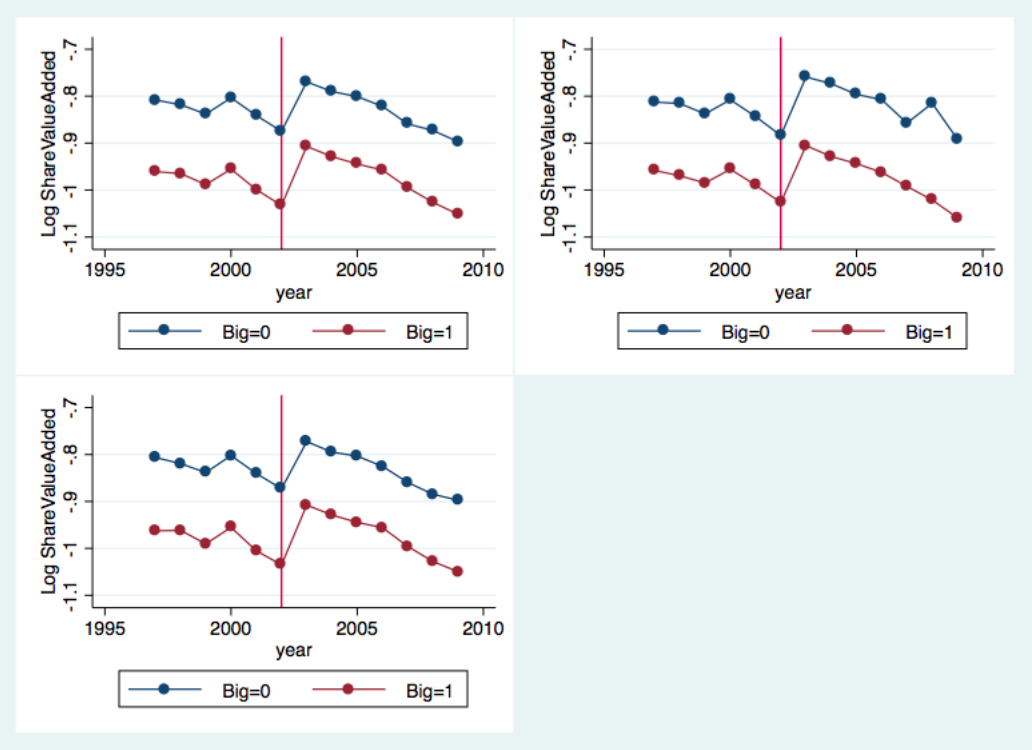
Notes: This graph shows a plot of log of revenue of firms against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 3: Effect of VAT Policy on Value Added



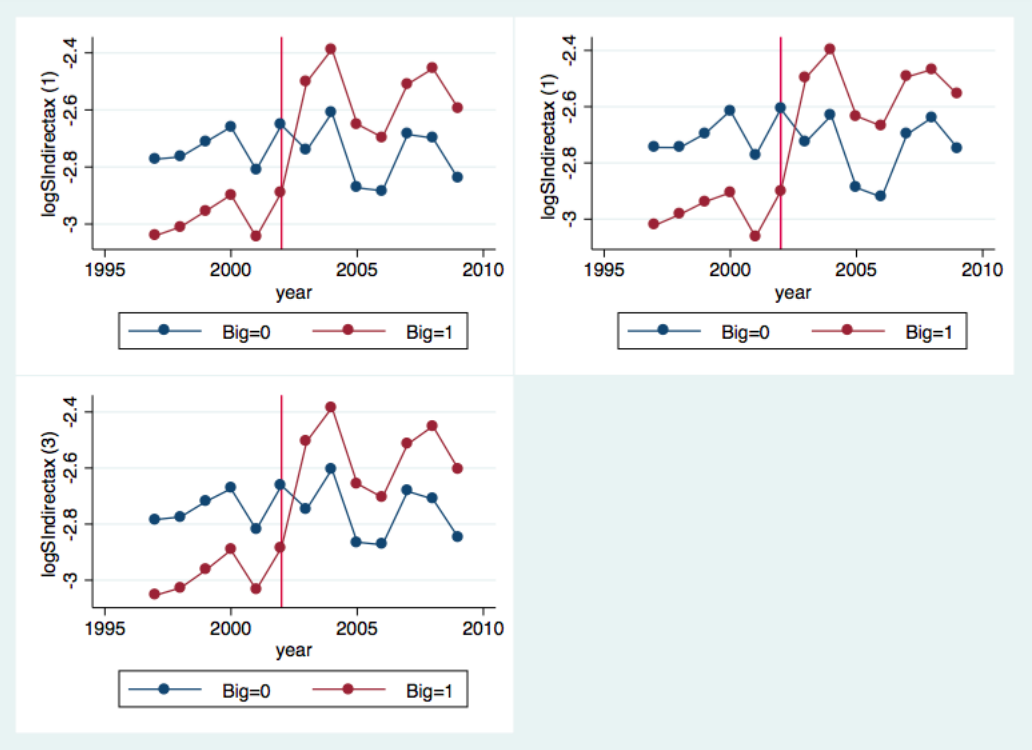
Notes: This graph shows a plot of log of revenue of firms against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 4: Effect of VAT Policy on Revenue Share of Value Added



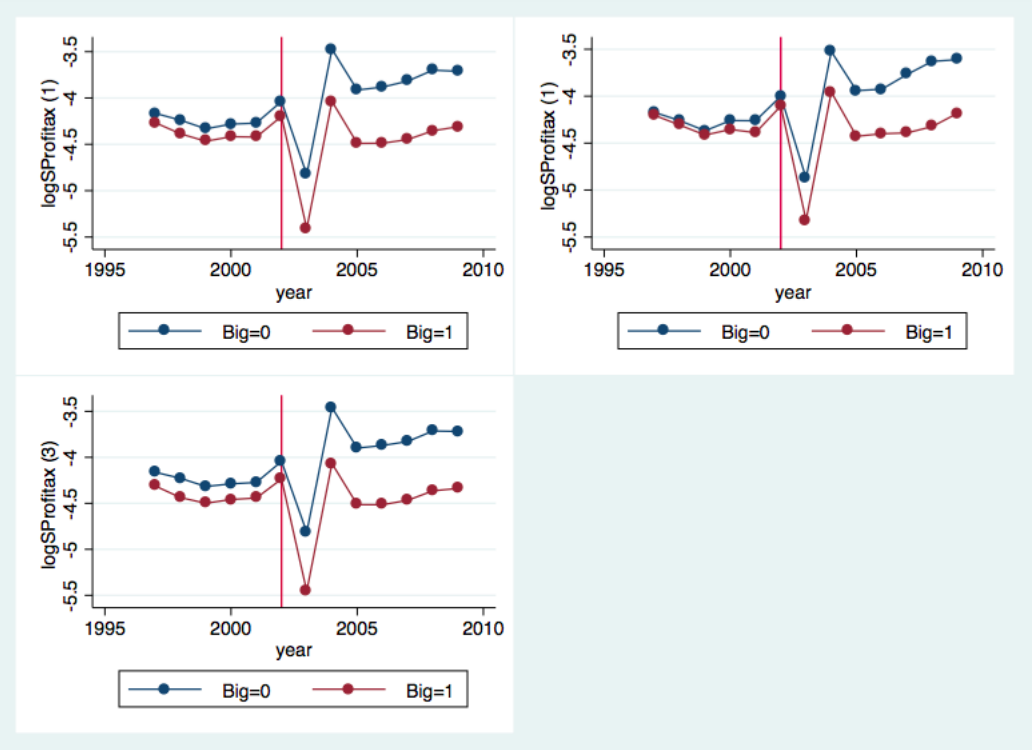
Notes: This graph shows a plot of log of revenue share of value added against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 5: Effect of VAT Policy on Revenue Share of Indirect Taxes Paid



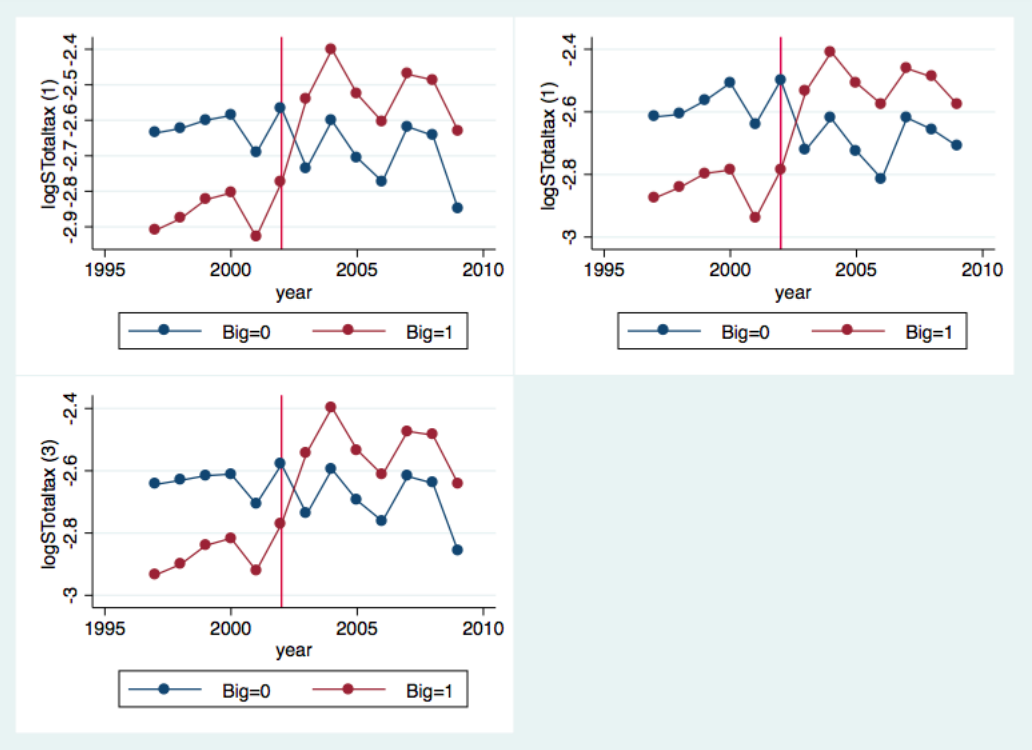
Notes: This graph shows a plot of revenue share of indirect taxes paid against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 6: Effect of VAT Policy on Revenue Share of Profit Taxes Paid



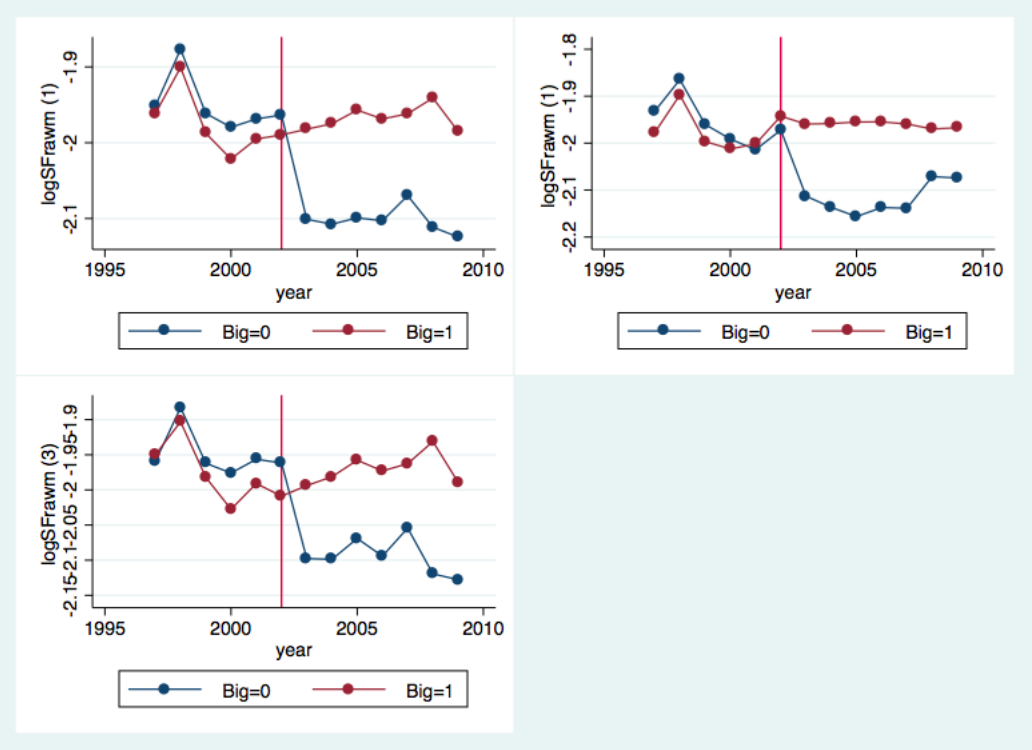
Notes: This graph shows a plot of revenue share of profit taxes paid against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 7: Effect of VAT Policy on Revenue Share of Total Taxes Paid



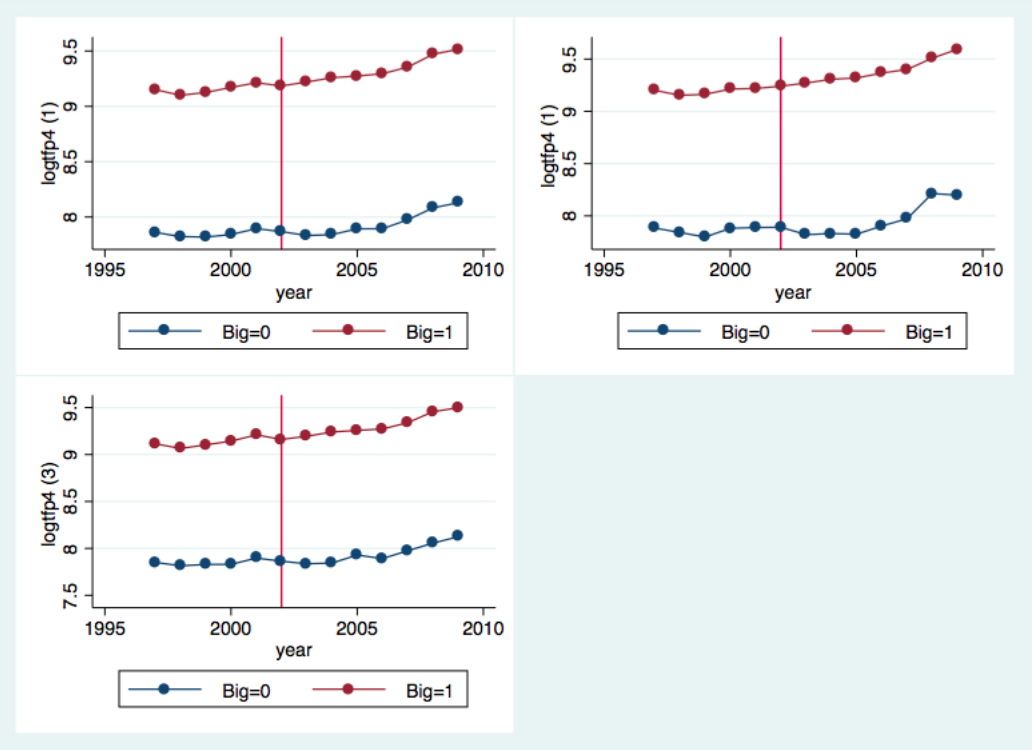
Notes: This graph shows a plot of revenue share of profit taxes paid against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 8: Effect of VAT Policy on Revenue Share of Foreign Raw Materials Use



Notes: This graph shows a plot of revenue share of foreign raw materials use against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

Figure 9: Effect of VAT Policy on Total Factor Productivity



Notes: This graph shows a plot of total factor productivity against time (year) from 1996 to 2009. This is a conditional plot after running the corresponding regression specification.VAT policy was introduced on January 1st 2003. The vertical red line is at year equal to 2002. There are three specifications: (1) includes all firms, (2) includes firm concentrated industries only, (3) includes firms in competitive industries only. The outcome variable is graphed by firm size; a dummy whether firm is big or small where big indicates a firm with revenue higher than the VAT threshold. The graph is plotted using the program binscatter. Binned scatterplots are a non-parametric method of plotting the conditional expectation function. To generate a binned scatterplot, binscatter groups the x-axis variable into equal-sized bins, computes the mean of the x-axis and y-axis variables within each bin, then creates a scatterplot of these data points.

A Appendix: Bunching Estimation

To practically implement VAT, governments in general set a VAT registration turnover threshold. In effect, in the presence of tax evasion and informality, it may be desirable to deviate from production efficiency if this leads to less evasion and therefore greater revenue efficiency (Best et al. (2014)). Because of this trade-off and other administrative feasibility considerations, when implementing VAT, governments set threshold above which firms are required to register for VAT and below which firms pay a low flat tax (often called turnover tax). Firms above this threshold must register for VAT, and get taxed on value added only: they charge taxes on sales but they can reclaim input taxes. Firms below the threshold, face a lower 2% tax on turnover(revenue) but cannot get reimbursement on input taxes. Countries vary considerably in their threshold level (see Table 12). The table shows some countries set a very high level ($700,000 in Singapore) while other countries have the level set at zero. Some countries set different thresholds for different industries; for example Indonesia has three different thresholds for services, manufacturing, and retail (increasing in this order). Many countries in which the threshold is very low (including Italy and Peru, where it is zero) apply simplified schemes to the smallest traders while other countries allow firms below the threshold to register voluntarily (Keen and Mintz (2004)). There is variation in the thresholds even within the EU: it is set around $115,000 in the United Kingdom and zero in other countries.

In Ethiopia, VAT is applied to all firms with a turnover of more than 500000 Birr. For firms with less than the turnover threshold of 500000 Birr, a much lower 2% flat rate is applied. The law requires any firm with high enough turnover to register for VAT. Turnover tax is levied on services rendered locally. It is intended to be equivalent to VAT for non-VAT-registered entities. Of course, a firm can understate its turnover. However, if, after review by the tax authority, it appears that a person has understated its turnover, the authority will issue an additional assessment. If the books of account are deemed unacceptable by the tax authority, the tax authority shall assess the tax on the basis of information available or on the basis of market price of such good or service in the market. Hence firms will weigh the benefits of underreporting turnover against the costs of detection.

Studies have show that compliance costs of VAT are highly regressive (Abdella and Clifford (2010)): the financial cost to small businesses as a proportion of their turnover is typically between ten and one hundred times greater than the cost to large businesses (for a small business they are typically 3-5 percent of turnover, as compared to 0.1-0.2 percent of turnover for large businesses). This burden affects particularly small businesses because many of them are non-cash-based businesses, and they have to pay the VAT on their sales before their customers pay them. This causes these small business to have severe cash flow problems, which may force some them out of business. This is one of the reasons why some countries allow businesses with turnover below a certain level to opt out of VAT if their turnover is less than a threshold.

But there is no clear practical mechanism that allows the government to determine which business is VAT eligible. The assessment of VAT eligibility is left to business; and in principle they are supposed to self-report. However, there are plenty of firms who remain outside the VAT net even though they VAT eligible. According to Abdella and Clifford (2010), the main reason for qualified firms to not register for VAT in Ethiopia are: fear of VAT related legal issues, low capacity of firms implement VAT, backward nature of business operations, etc. Hence setting a low VAT registration threshold encourages VAT evasion by exacerbating the potential issues small scale firms face if they register.

While setting a higher threshold might solve the high compliance costs problems of small firms, it might lead to other issues that some registered firms might face. A high threshold may allow firms with significant size to avoid VAT registration. Registered of similar size might perceive this situation as unfair because of potential unequal competition: VAT registered firms pay a higher tax rate. This unequal competition might

induce these registered firms to exit the VAT net. Despite this potential problem, it might be desirable for tax authorities to still set a high threshold because of their low fiscal capacity. In countries such as Ethiopia where fiscal administration have limited capacity, the number of firms that have to be handled by the VAT administration can be sharply reduced by setting a high turnover threshold (Keen and Smith (2006)). They also argue that revenue given up by having a high threshold may be small compared to the saving of administration costs to the authorities and compliance costs to the taxpayer, because the potential tax base is commonly very strongly concentrated in the largest companies. And because firms not registered for VAT cannot claim reimbursement from taxes paid on inputs, they essentially pay a non-zero effective rate of tax.

The government implicitly assumes that VAT feasibility and applicability hinges on the fact that VAT registration requirement depends on firm size. Reasons to define a threshold include the costs of compliance with VAT due to small scale, and the optimal balance between a low flat turnover tax and a VAT tax. The wide variation of VAT threshold levels across countries illustrates the lack of agreement of what is the optimal level. This lack of consensus is due to fact that there is no unified theory or empirical results suggesting what the optimal level of threshold should be. Informing about firm behavior around the threshold is a step forward in finding a solution to this problem.

A.1 Bunching Estimation

We present the empirical procedure to estimate the reported revenue response of firms to a VAT registration threshold. To estimate firm bunching, we follow the techniques from the bunching literature (Saez (2010); Chetty et al. (2011); Kleven and Waseem (2013), Almunia and Lopez Rodriguez (2014)).

To analyze the behavioral response of firms around the turnover threshold, we estimate the degree of bunching around this threshold. So, we compute a counterfactual distribution of reported revenue in the absence of a turnover threshold, and compare it with the observed distribution. We estimate counterfactual density by fitting a flexible polynomial to the empirical density, excluding observations in a range $[z_L, z_U]$ around the threshold point z^*; a range that should correspond to the area affected by bunching responses, which is the area with excess bunching or missing mass. Dividing the data in small bins of width w, we estimate the polynomial regression

$$C_j = \sum_{i=0}^{q} \beta_i \cdot (Z_j)^i + \sum_{i=z_L}^{z_U} \gamma_i \cdot \mathbf{1}\left[Z_j = i\right] + \varepsilon_j \tag{2}$$

where C_j is the number of firms in revenue bin j, Z_j is revenue relative to the kink in 10,000 Birr intervals, q is the order of the polynomial, z_L and z_U are the lower and upper bound of the excluded interval (respectively), and the γ_i are intercept shifters for each of the bins in the excluded interval. Then, using the estimated estimates from regression (2), we estimate the counterfactual distribution of reported revenue:

$$\hat{C}_j = \sum_{i=0}^{q} \hat{\beta}_i \cdot (Z_j)^i \tag{3}$$

We can estimate the excess bunching mass to the left of the threshold (B_n) and the missing mass to the right of the threshold (H_n) by comparing the counterfactual density to the observed distribution. Thus the excess mass to the left and the missing mass to the right are:

$$\hat{B}_n = \sum_{i=z_L}^{z_{lb}} \left(C_j - \hat{C}_j\right) \qquad and \qquad \hat{H}_n = \sum_{i=z_{lb}}^{z_U} \left(\hat{C}_j - C_j\right) \tag{4}$$

But for this estimation to be valid, the constraint that the area under the counterfactual must equal the area under the empirical distribution must hold. This is equivalent to saying that the missing mass (to the left) created by bunching responses must be equal to the bunching mass (to the right). Hence the condition $\hat{B}_n = \hat{H}_n$ must hold, and thus the optimization requires us to define the excluded range $[z_L, z_U]$ such that this condition is satisfied. The lower bound z_L can be visually located and thus defined. But determining z_U is harder because the missing mass above a threshold is a more diffuse phenomenon occurring over a larger range, and hence the upper bound cannot be determined visually. To pin down z_L, we exploit the condition that $\hat{B}_n = \hat{H}_n$. An initial estimate of $\hat{C}_j$ starts with a low value of $z_L \simeq z*$; the upper bound is increased in small increments and the counterfactual reestimated every time until the bunching and missing mass converge:$\hat{B}_n = \hat{H}_n$. Now we can define our empirical estimate of b as the excess mass around the kink relative to the average density of the counterfactual earnings:

$$b = \frac{\hat{B}_n}{\left[\frac{1}{1 + (z_U - z_L)/w}\right] \sum_{j=z_L}^{z^*} \hat{\beta}_i \cdot (Z_j)^i} \tag{5}$$

where $\frac{1}{1 + (z_U - z_L)/w}$ is the number of excluded bins below the threshold.

The estimation procedure is done using the utility program in Chetty et al. (2011) (bunch_count.ado was written by Tore Olsen). Standard error for the estimate of excess mass $\hat{b}$ is caculated using a parametric bootstrap procedure. Before estimating the bunching, figures **10** and 11, visually suggest the existence of bunching after VAT law passed and a threshold was implemented.

A.2 Results of Our Bunching Estimates

We present the bunching estimates described in section 3. Remember the bunching estimate was defined as the ratio of excess bunching over the height of the counterfactual density at the VAT threshold: $b \approx d\bar{y}^S$.

We find evidence of firm bunching around the VAT revenue registration threshold. Figure 12 shows the counterfactual and empirical distributions of reported revenue overlaid. Revenue is normalized around 500000 Birr[3], which is the VAT revenue registration threshold. The figure shows spike around the threshold, illustrating a possible bunching. The number of bunching firms as computed from equation (4) is 134 (see Table 13). From our estimation procedure 3, we obtain a bunching estimate of $b = 4.80$ with a bootstrapped standard error of $b_{se} = 2.15$. The null hypothesis that there is no excess mass at the kink relative to the counterfactual distribution is rejected with a $p-value = 0.025$. Because the reported response is $b \times binwidth$, the bunching estimate implies that marginal bunching firms reduce their reported revenue by 48,000 Birr in response to the VAT registration threshold (bins were split into 10,000 Birr intervals). So some firms with revenue slightly above the threshold lower their revenue by about 9-10% to become VAT ineligible.

To check the robustness of our results, we also estimate potential firm bunching around the threshold before VAT was adopted. Figure 13 and Figure 14 shows the counterfactual and empirical distributions of reported revenue overlaid (excluding and including the year 2002). Both figures show negative bunching. From Table 13, we obtain a bunching estimate of $b = -1.88$ with a bootstrapped standard error of $b_{se} = 1.53$, $b = -0.76$ with a bootstrapped standard error of $b_{se} = 1.57$. The null hypothesis that there is no excess mass at the kink relative to the counterfactual distribution is not rejected in both cases. We find no bunching before 2003 when VAT was introduced, which suggest the VAT threshold created the bunching. Finally,

[3]for estimation functionality, the normalization is around 510000Birr

when firms are divided into firms with high ratio and low ratio of inputs to revenue, we find a lower bunching estimate for high input firms (even though the estimates are not significant). These results suggest high input firms have less incentive to bunch which is consistent with the fact that taxes on inputs are reimbursable under VAT. The existence of bunching shown above might be due to two non-exclusive factors: tax evasion and size efficiency.

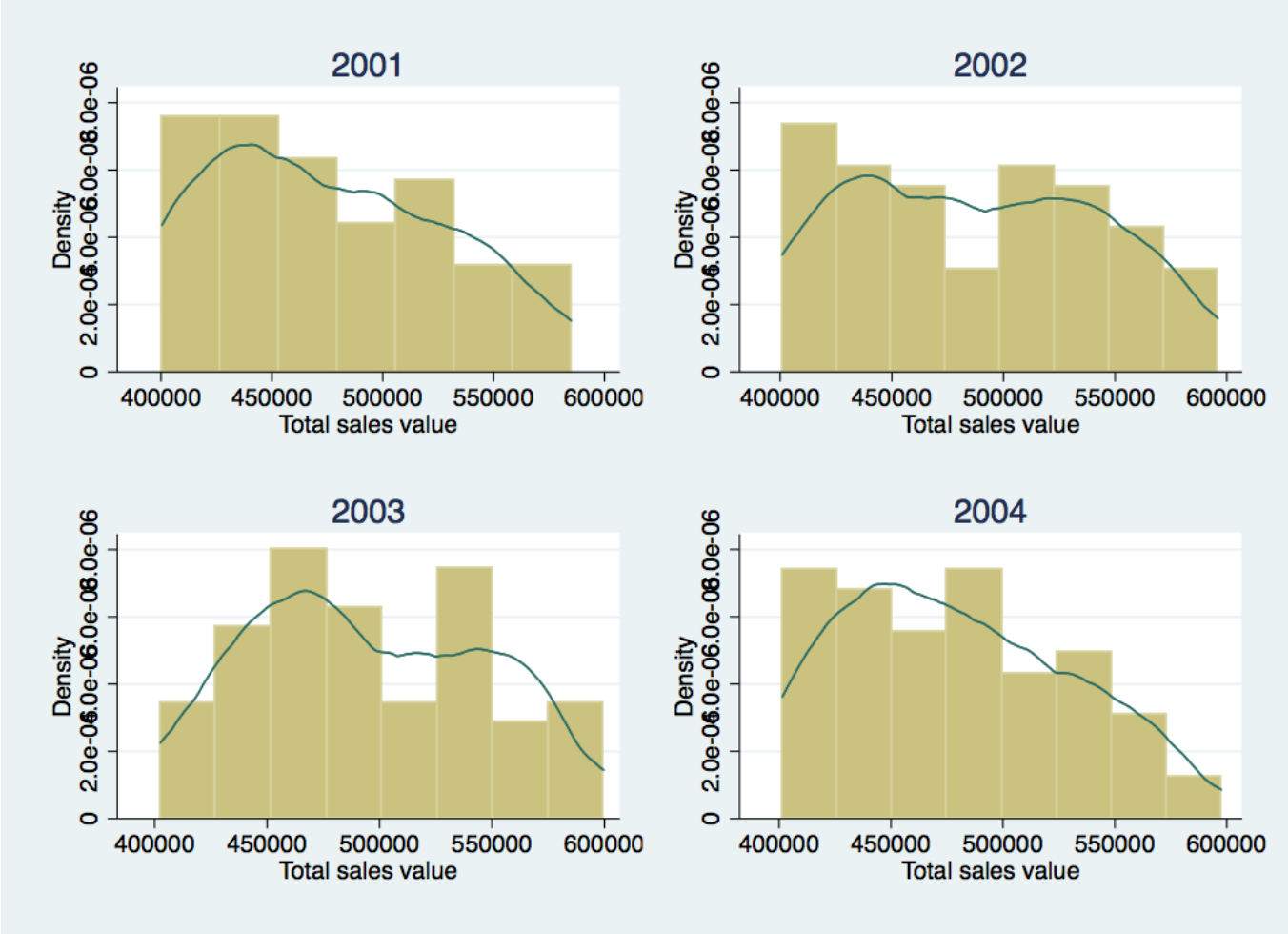
On the one hand, the bunching might be to due to tax evasion because the low turnover tax might much more attractive than the VAT for firms just above the threshold. These type of firms weigh benefits of VAT from productive efficiency and lower inputs taxes against the low turnover tax after taking into account the potentially low evasion cost around the margin. On the other hand, because of market effects from the policy change, it is possible that firms around the threshold may optimally decrease their size. If firms maximize profits, then they optimally choose the level and mix of inputs, and the level of output to produce given market prices (assuming competition). If firm are registered can reclaim taxes paid inputs whereas if they are not they benefit from the low turnover tax on output. Therefore there might an equilibrium, where the optimal output is just below the VAT registration threshold. We believe the former reason is why firms bunch, but it is not in the scope of this paper to determine whether it is the case [4].

A.3 Bunching Estimates: Discussion

This lack of consensus on the optimal VAT threshold is due to fact that there is no unified theory or empirical results that suggest what the optimal level should be. Informing about firm behavior around the threshold is step forward in finding a solution to this problem because a key challenge in the implementation of value-added taxation is setting an appropriate threshold level of turnover at which firms are obliged to register for the tax. The main reason is a high threshold level lowers tax revenue while a low threshold imposes high compliance costs for both small firms and the government. This paper analyzes the behavior of Ethiopian manufacturing firms around the government implemented VAT threshold after the adoption of VAT in 2003. Using bunching estimation techniques, we show the existence of firm bunching around the threshold: marginal bunching firms lower reported revenue by 48,000 Birr in order to avoid registration. This suggested firm response to the threshold can help governments be more informed about how to choose an optimal VAT threshold.
The next step is to estimate elasticities of taxable income at the threshold and at different counterfactual thresholds. The goal is to elicit the size of the tradeoff for different threshold levels; this analysis will hopefully lead towards the empirical determination of the optimal VAT registration threshold under certain conditions. Liu and Lockwood (2015), using UK tax data, find evidence of bunching at the VAT threshold, and they provide an estimate of the elasticity of the VAT tax base.

[4] Ongoing project

Figure 10: Histogram Showing Density Around VAT Eligibility Threshold (500000 Birr)



Notes: Histogram showing density around the 500000 Birr VAT eligibility threshold for year: 2001, 2002, 2003, 2004. VAT was implemented in January 2003.

Table 12: VAT thresholds in selected countries

Table 1
VAT thresholds[a] in selected countries (in US$)

Albania	32 000
Austria	8300
Barbados	30 000
Benin	80 000
Burkina Faso	25 800 (services)
	86 000 (other)
Canada	25 000
China	121 000 (production)
	217 000 (distribution)
Cote d'Ivoire	50 000 (services)
	25 000 (other)
Croatia	8000
Denmark	1560
Egypt	16 000
France	17 800
Germany	60 000
Greece	900 (services)
	700 (other)
Indonesia	51 200 (services)
	103 000 (manufacturing)
	430 000 (retailers)
Italy	Nil[b]
Japan	269 000[c]
Latvia	18 000
New Zealand	15 000
Netherlands	Nil[d]
Niger	16 700 (other)
	50 000 (services)
Peru	Nil[e]
Senegal	180 000
Spain	Nil[f]
Singapore	710 000
Sweden	Nil[g]
Togo	40 000 (services)
	60 000 (other)
UK	82 800
Zambia	33 000

Sources: Miscellaneous tax guides; H.M. Customs & Excise (1998); OECD (1994); Oldman and Schenk (1995).

[a] Figures shown are levels of turnover at which registration is compulsory.

[b] Administrative simplifications are available, depending on turnover. In 1992, some reduction in liability (by a factor dependent on activity) was also available for those with turnover under L 18 million.

[c] Businesses with annual sales of less than 30 million yen are exempt; the liability of those with sales between 30 and 50 million yen is reduced by the fraction $(50 - Y)/20$, where Y denotes actual sales.

[d] Unincorporated firms whose liability is less than Gld 2173 are exempt. Liabilities between Gld 2173 and Gld 4150 are reduced by a proportion that decreases with the extent of that liability.

[e] A simplified system (replacing VAT and income tax) is available for those with turnover under US $4000.

[f] Those with turnover below 50 million Ptas are taxed under a presumptive scheme, liability depending on line of business, size of premises etc.

[g] Those with turnover below SKr 30 000 are exempt; those with turnover between SKr 30 000 and 1 million do not submit VAT returns but declare on their income tax returns.

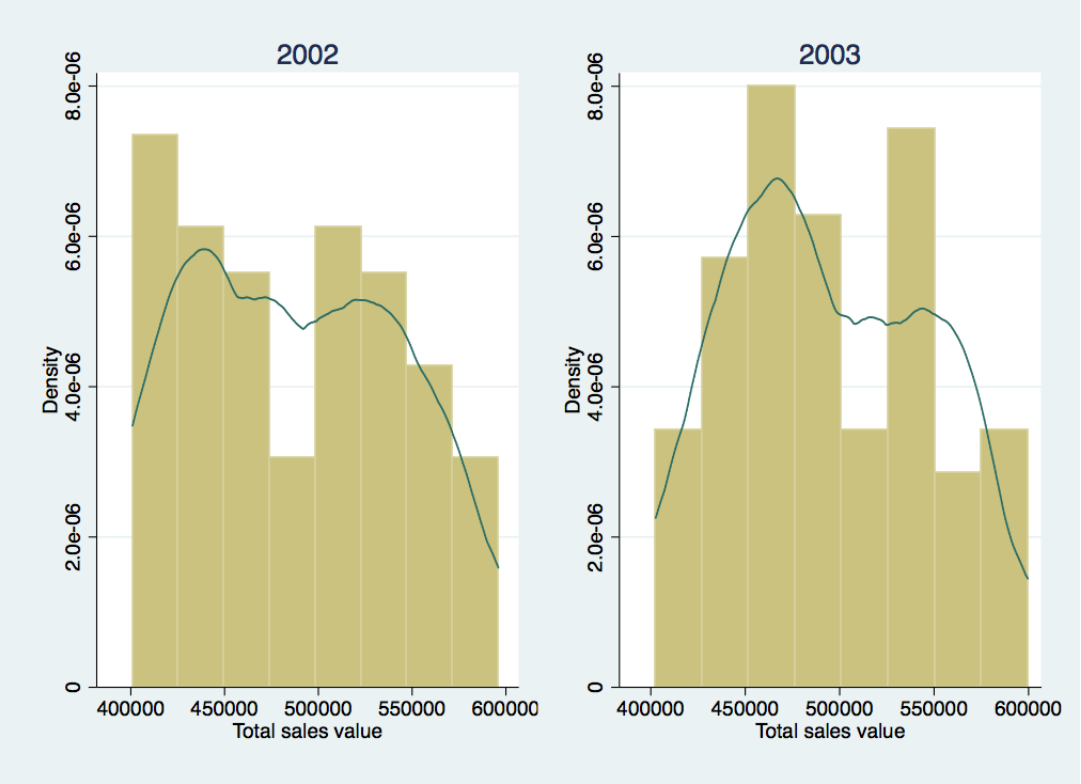
Notes: Graph taken from Keen and Mintz (2004)

Table 13: Bunching Estimation

	Bunching Estimator ($\hat{b}$)	Number Bunchers (B)
Post VAT	4.80**	134
	(2.15)	
Pre-VAT	-0.76	-48
	(1.57)	
Pre-VAT	-1.88	-37
Excluding 2002	(1.53)	

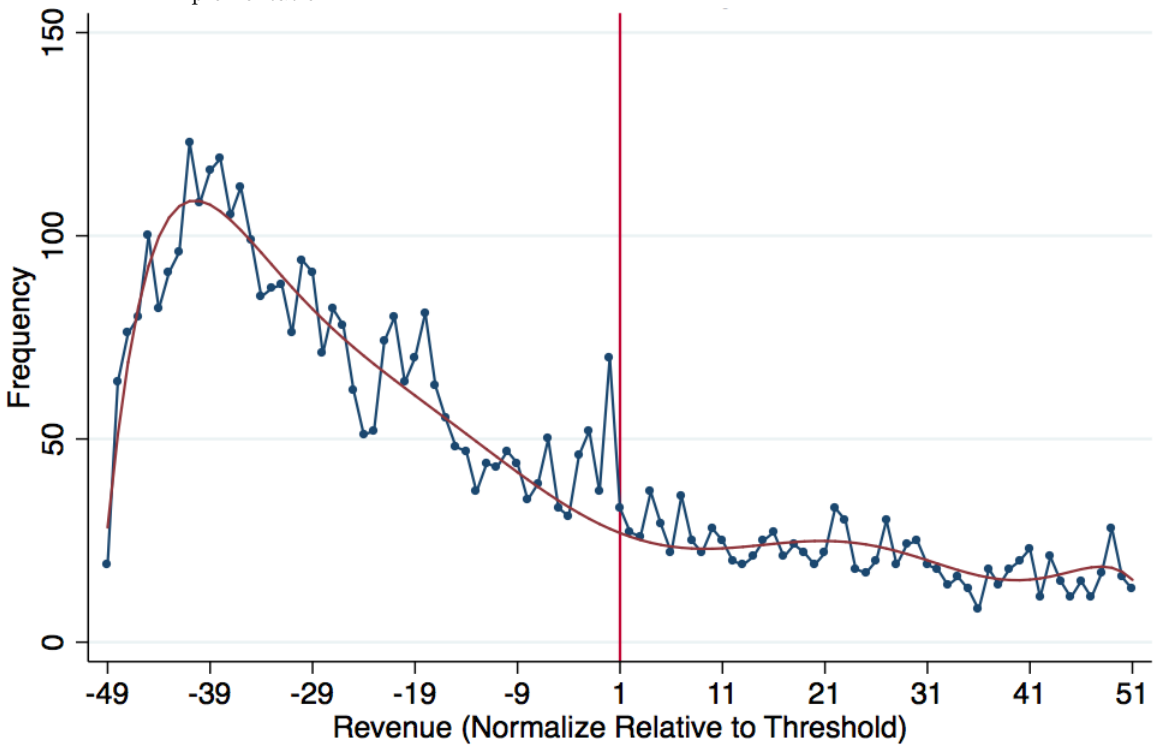
Notes: Table shows estimates of excess mass before and after the VAT policy. *** indicate significance at the 1% level, **at the 5% level, and * at the 10% level. Standard errors are in parenthesis. B is the number of bunching firms, and $\hat{b}$ is the bunching estimate. The results indicated the marginal bunching firm lowers reported revenue by 48000 Birr.

Figure 11: Histogram Showing Density Around VAT Eligibility Threshold (500000 Birr) Right Before and After VAT Policy



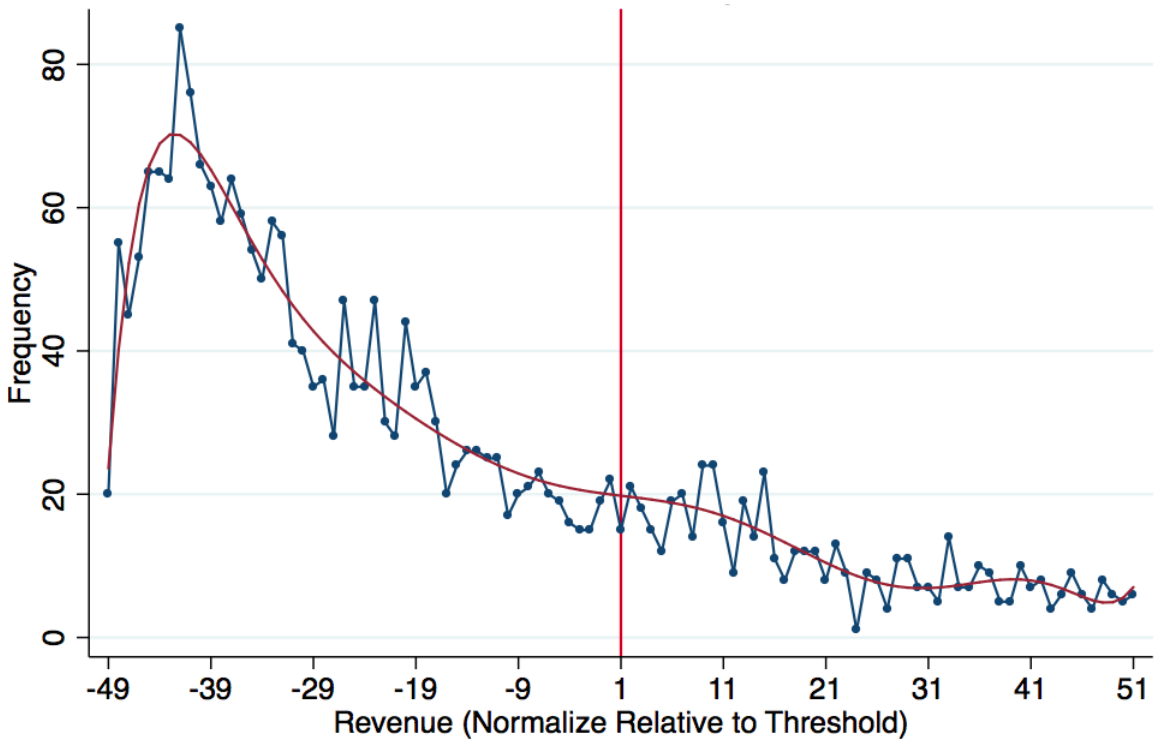
Notes: Histogram showing density around the 500000 Birr VAT eligibility threshold for year:2002, 2003. VAT was implemented in January 2003.

Figure 12: Comparing Empirical and Counterfactual Distributions of Reported Revenue After VAT Implementation



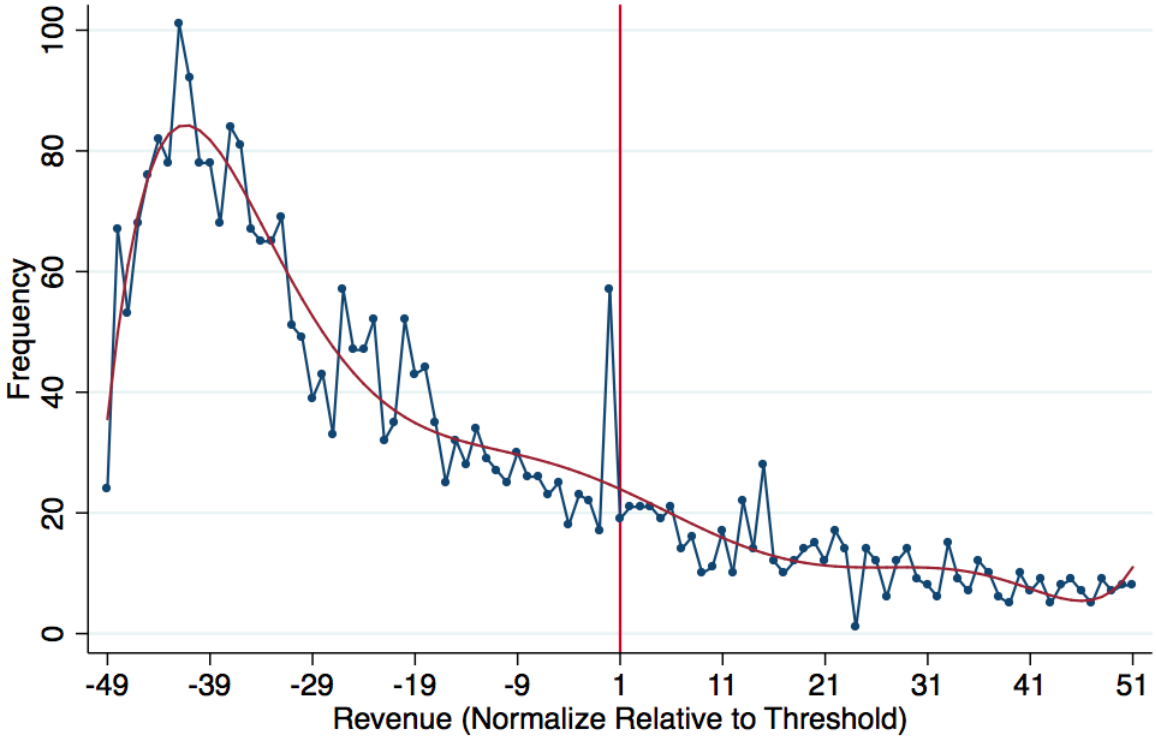
Notes: Graph comparing empirical and counterfactual distributions of reported revenue after VAT implementation. The counterfactual distribution is the smooth curve. The empirical distribution show bunching around the normalized VAT eligibility threshold. Revenue bins are in 10,000 Birr. The estimated excess mass is $b = 4.80$ with standard error $b_{se} = 2.15$. The results indicated the marginal bunching firm lowers reported revenue by 48000 Birr, which is about 9.6% of the VAT threshold revenue.

Figure 13: Comparing Empirical and Counterfactual Distributions of Reported Revenue Before VAT Implementation: Not including 2002



Notes: Graph comparing empirical and counterfactual distributions of reported revenue after VAT implementation. The counterfactual distribution is the smooth curve. The empirical distribution show bunching around the normalized VAT eligibility threshold. Revenue bins are in 10,000 Birr. The estimated excess mass is $b = -1.88$ with standard error $b_{se} = 1.53$. There is no evidence of bunching.

Figure 14: Comparing Empirical and Counterfactual Distributions of Reported Revenue Before VAT Implementation



Notes: Graph comparing empirical and counterfactual distributions of reported revenue after VAT implementation. The counterfactual distribution is the smooth curve. The empirical distribution show bunching around the normalized VAT eligibility threshold. Revenue bins are in 10,000 Birr. The estimated excess mass is $b = -0.76$ with standard error $b_{se} = 1.57$. There is no evidence of bunching.