

ASSESSMENT OF THE IMPACT OF ELECTRONIC FISCAL
DEVICES ON COMPLIANCE AND VAT COLLECTION IN
MALAWI

ÉVALUATION DE L'IMPACT DES DISPOSITIFS FISCAUX
ÉLECTRONIQUES SUR LA CONFORMITÉ ET LA COLLECTE
DE LA TVA AU MALAWI

AVALIAÇÃO DO IMPACTO DOS DISPOSITIVOS FISCAIS
ELETRÔNICOS NA CONFORMIDADE E COLETA DE IVA EM
MALAWI

James Manuel Kenani*

Michael Masiya†

Mercy Samantha Njolomole‡

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ABSTRACT

The study examined the effectiveness of using electronic fiscal devices (EFDs) in revenue collection and compliance. The study used a quantitative approach for the analysis. Timely filing of tax returns was used as a measure of compliance whereas value-added tax (VAT) revenue collection as a percentage of gross domestic product (GDP) was employed as a measure of revenue collection performance. The data used for the analysis covered July 2005 to June 2019. A sample of 318 taxpayers was used for the analysis of the level of compliance and revenue collection. The sample included a segment of 244 taxpayers using EFDs and 74 taxpayers without EFDs all being small and medium taxpayers. The results indicated that using VAT collection has not increased revenue collection in the period under review as evidenced by a decline after the EFDs were rolled out. The study also found that the mean of growth of VAT revenues in the two periods (pre- and post-EFD implementation) does not reveal any significant difference. We found that taxpayers may be inflating purchases to reduce their tax liability and increase their VAT claims as evidenced by the significance of the change in purchases in pre- and post-EFD periods – the same was evident in sales fluctuations. We further found that the sales-purchases gap is not different between the two periods. In the case of the compliance rate, the findings revealed that EFDs have not been effective in increasing compliance, as shown by a decrease in timely filing of tax returns in the post-EFD era. The study, therefore, concludes that the deployment of EFDs has not resulted in increased VAT collection

* Manager-Tax Policy Analysis & Strategy, Policy Planning & Research Division, Malawi Revenue Authority: jkenani@mra.mw

† Researcher, Research Division, African Tax Administration Forum (ATAF): mmasiya@ataftax.org

‡ Manager-Research & Statistics, Policy Planning & Research Division, Malawi Revenue Authority: mnjolomole@mra.mw

and compliance during the study period. The study, therefore, recommends that the Authority should consider a system that should pair sales and purchases. Further, the Authority should endeavour to understand the reasons why more taxpayers do not submit returns on time despite having EFDs.

Keywords: compliance, electronic fiscal devices, electronic tax registers, value-added tax

RÉSUMÉ

L'étude a examiné l'efficacité de l'utilisation des dispositifs fiscaux électroniques (DFE) dans la perception des recettes et la discipline fiscale. L'étude a utilisé une approche quantitative pour l'analyse. Le respect des délais de dépôt des déclarations fiscales a été utilisé comme mesure de discipline fiscale, tandis que la perception de la taxe sur la valeur ajoutée (TVA) en pourcentage du produit intérieur brut (PIB) a été utilisée comme mesure de performance de la perception des recettes. Les données utilisées pour l'analyse couvraient la période de juillet 2005 à juin 2019. Un échantillon de 318 contribuables a été utilisé pour l'analyse du niveau de la discipline fiscale et de la collecte des recettes. L'échantillon comprenait 244 contribuables utilisant les DFE et 74 contribuables sans DFE, tous issus de la catégorie des petits et moyens contribuables. Les résultats indiquent qu'en utilisant la collecte de la TVA en pourcentage du PIB, les DFE n'ont pas augmenté le recouvrement des recettes au cours de la période considérée, comme le montre la tendance à la baisse après la mise en place des DFE. L'étude a également révélé que la moyenne de la croissance des recettes de la TVA au cours des deux périodes (avant et après la mise en œuvre des DFE) ne révèle pas de différence significative. En ce qui concerne les achats, nous avons constaté que les contribuables peuvent gonfler leurs achats pour réduire leurs obligations fiscales et augmenter leurs demandes de TVA, comme en témoigne l'importance de la variation des achats au cours des périodes précédant et suivant la mise en place des DFE - il en va de même pour les fluctuations des ventes. Nous avons également constaté que l'écart entre les ventes et les achats n'est pas différent entre les deux périodes. En ce qui concerne le taux de discipline fiscale, les conclusions ont révélé que les DFE n'ont pas été efficaces pour accroître la discipline fiscale, comme le montre la baisse du dépôt des déclarations de recettes dans les délais requis pour la période suivant les DFE. Par conséquent, l'étude conclut que le déploiement des DFE n'a pas entraîné une augmentation de la perception de la TVA et de la discipline fiscale au cours de la période étudiée. L'étude recommande donc à l'Administration fiscale d'envisager un système permettant de combiner les ventes et les achats. En outre, l'Administration fiscale devrait s'efforcer de comprendre les raisons pour lesquelles un plus grand nombre de contribuables ne soumettent pas leurs déclarations à temps malgré l'existence des DFE.

Mots-clés : discipline fiscale, dispositifs fiscaux électroniques, registres fiscaux électroniques, taxe sur la valeur ajoutée

ABSTRATO

O estudo examinou a eficácia da utilização de dispositivos fiscais electrónicos (EFDs) na arrecadação de receitas e conformidade. O estudo utilizou uma abordagem quantitativa para a análise. A apresentação atempada de declarações fiscais foi utilizada como medida de cumprimento, enquanto que a arrecadação de receitas do imposto sobre o valor acrescentado (IVA) como percentagem do produto interno bruto (PIB) foi utilizada como medida de desempenho na arrecadação de receitas. Os dados utilizados para a análise abrangeram Julho de 2005 a Junho de 2019. Foi utilizada uma amostra de 318 contribuintes para a análise do nível de conformidade e de arrecadação de receitas. A amostra tinha 244 contribuintes dos que utilizavam os EFDs e 74 contribuintes sem EFDs, todos provenientes de pequenos e médios segmentos de contribuintes. Os resultados indicam que, utilizando a arrecadação do IVA como percentagem do PIB, os EFDs não aumentaram a arrecadação de receitas no período em análise, tal como evidenciado pela tendência decrescente após o lançamento dos EFDs. O estudo concluiu igualmente que a média de crescimento das receitas do IVA nos dois períodos (pré e pós-EFD implementação) não revela qualquer diferença significativa. Sobre as compras, descobrimos que os contribuintes podem estar a inflacionar as suas compras para reduzir a sua obrigação tributária e aumentar as suas dívidas de IVA, como evidenciado pela significância da alteração nas compras nos períodos pré e pós EFDs - o mesmo é evidente nas flutuações das vendas. Constatámos ainda que a disparidade entre as vendas-compras não é diferente entre os dois períodos. Quanto à taxa de conformidade, as conclusões revelaram que os EFDs não têm sido eficazes para aumentar a conformidade, como demonstrado por uma diminuição na apresentação atempada de declarações de impostos na era pós-EFD. O estudo conclui, portanto, que a implantação dos EFDs não resultou num aumento das arrecadações de IVA e do cumprimento durante o período do estudo. O estudo recomenda, por conseguinte, que a Autoridade considere um sistema que combine vendas e compras. Além disso, a Autoridade deve empenhar-se em compreender as razões por quais mais contribuintes não apresentam as suas declarações a tempo, apesar de terem EFDs.

Palavras-chave: *conformidade, dispositivos fiscais electrónicos, registos tributários electrónicos, imposto sobre o valor acrescentado*

I INTRODUCTION

To enhance the collection of value-added tax (VAT), the Malawi government introduced the requirement for VAT operators to use electronic fiscal devices (EFDs). In general, an EFD is a machine designed for use in business for efficient management controls in areas of sales analysis and stock control system and which conforms to the requirements specified by the laws.

Over the years, the main challenge in VAT administration has mainly been tax evasion through non-issuance of tax invoices especially by small

to medium taxpayers¹. The Authority anticipated that the introduction of EFDs would help curb this situation as sales transactions would be monitored electronically, through a GPRS modem to the Authority's central server. To further ensure compliance, buyers were encouraged to demand a tax invoice generated by the EFDs as this was the only way a taxable transaction would be captured.

The EFDs were introduced by amending section 25 of the VAT Act in 2011, which introduced a mandatory requirement for all VAT operators to use EFDs in all their business transactions. With an embedded fiscal memory, the EFDs have the capability of preventing recorded information being tampered with. The devices issue unique identifiable invoices and automatically issue a 'Z' report at pre-defined times. The implementation process met some resistance as some taxpayers obtained a court order stopping the process. To counter the unwillingness of taxpayers to use EFDs, the government of Malawi offered two incentives to taxpayers. First, taxpayers that bought the devices during the first three years were allowed to offset the cost of the devices against their VAT liability. Second, the government also allowed the suppliers of the devices to import the devices duty free. The incentives were aimed at coaxing businesses that were using different accounting devices to quickly migrate to the EFDs.

Following the implementation of the EFDs in November 2014, which government and the tax administration deemed a viable solution to improve VAT revenue collection, there has been no study to assess the impact that the devices have made on VAT collection. This study aims at measuring the effectiveness of the EFDs on VAT collection in Malawi. Investigating and understanding the performance of VAT after the EFD rollout is important and interesting to both government and the Authority as they will be provided with information that may be used to improve the management of EFDs. The findings will also assist the Authority in building institutional capacity in respect of on the management of the EFDs which may promote revenue collection. The study will also benefit future researchers interested in understanding the effect of EFDs on tax compliance and revenue collection in Malawi.

II LITERATURE REVIEW

Tax administrations are given the mandate of collecting tax revenue from taxpayers that is necessary for governments to finance their national budgets (Casey & Castro, 2015). However, tax collection incurs costs for both the tax administration in the form of administrative costs and for the taxpayers in the form of compliance costs. Both parties

¹ Personal interview with the manager of EFDs at the Malawi Revenue Authority: Mr Bentry Khonje.

strive hard to minimise these costs as they constitute the cost of doing business. For instance, in some studies, high administrative costs have been attributed to tax administrations' lack of efficiency in collecting tax revenues. On the other hand, high compliance costs are an excess burden on the taxpayers and can in some circumstances lead to non-compliance. According to Chege (2010), levels of tax compliance reflect a tax administration's effectiveness and the taxpayers' general attitude towards paying tax and the government itself. The ideal situation for tax administrations is where taxpayers do self-assessment and voluntarily comply with all tax obligations. To that end, most tax administrations employ various strategies such as audits, taxpayers' services and taxpayer education in order to promote voluntary compliance. Some have adopted the use of EFDs such as electronic tax registers (ETRs) to support both their collection efforts and to achieve high levels of compliance. Even though the use of these devices is a fairly new phenomenon for most taxpayers in developing countries, they have been used by taxpayers in developed countries since the dawn of computerisation – taxpayers have used electronic cash registers to record sales and issue receipts on a daily basis (Casey & Castro, 2015).

According to the literature², an EFD is a machine that contains a fiscal memory which is a distinct read-only memory (tax memory) specifically built to store tax information at the time of a sale. The tax memory can store data for up to five years or 1 800 transactions.³ These machines record every transaction made and automatically calculate the VAT amount to be remitted to the government. They are designed so it is neither easy to destroy nor manipulate critical data. The data stored on these machines is well preserved even during power failures or malicious attacks (Kumar, 2005).

(a) Theoretical framework

We derive the enhancement of VAT revenues with EFDs as proxied by input costs.

(i) Maximisation of VAT by implementing electronic fiscal devices

The amount of VAT remitted is a function of extra income from sales after settling the costs of EFD machine/input costs. We use this rationale to establish conditions for maximisation of VAT in a case where we have VAT input costs.

² ZIMRA, Important Notice: Fiscalised Electronic Registers.

³ Taxpayer Seminar at KICC-Nairobi in January 2005: Introduction of Electronic Tax Registers in Kenya.

Suppose revenue from VAT = V , VAT rate = r , sales = S , input costs = C .

We define the propensity to submit a return = α which our model confines within the bounds $0 \leq \alpha \leq 1$

The objective function is presented as:

$$V = r(S - C) \quad (1)$$

That is, VAT revenue is a proportion of sales less input costs

We wish to maximise this subject to input costs (C) constraint:

Now, we also define the equation for the propensity to submit a return as:

$$\alpha = 1 - \frac{C}{S} \quad (2)$$

Various scenarios from the propensity to submit a return will be interpreted as follows:

$S > C$: Sales higher than input costs thereby reducing the C/S ratio and increasing the propensity to submit a return.

$C = S$: This will yield a zero propensity to submit a return.

$C > S$: This will yield a negative propensity to submit a return which, in some instances, may imply the taxpayer is expecting a VAT refund from the tax collecting authority.

We transform equation (2) to express it as a function of costs, thereby creating an objective function:

$$\alpha + \frac{C}{S} = 1$$

$$\frac{C}{S} = 1 - \alpha$$

$$C = S(1 - \alpha) \quad (3)$$

Hence, we present the constraint as equation (3) and have the following to maximise:

Maximise $V = r(S - C)$ subject to $C = S(1 - \alpha)$

We set up a Lagrangian function L as follows: $L = V - \lambda C$

$$L = rS - rC - \lambda [C - S(1 - \alpha)]$$

$$L = rS - rC - \lambda(C - S + S\alpha)$$

$$L = rS - rC - \lambda C + \lambda S - \lambda S\alpha \quad (4)$$

We lay out the first-order conditions as follows:

$$\frac{\delta L}{\delta r} = S - C \quad (5)$$

$$\frac{\delta L}{\delta C} = -r - \lambda \quad (6)$$

$$\frac{\delta L}{\delta S} = r + \lambda - \lambda\alpha \quad (7)$$

$$\frac{\delta L}{\delta \alpha} = -\lambda S \quad (8)$$

$$\frac{\delta L}{\delta \lambda} = -C + S - \alpha S \quad (9)$$

All the above leads to inconclusive results in the second-order condition as all second derivatives equal zero. However, we derive another second-order condition using equations (5) and (8) as follows:

Dividing equation (5) by equation (8) yields:

$$\frac{\delta L \delta r}{\delta L \delta \alpha} = \frac{S - C}{-\lambda S}$$

$$\frac{\delta \alpha}{\delta r} = \frac{C - S}{\lambda S}$$

Dividing by S in the denominator yields:

$$\frac{\delta \alpha}{\delta r} = \frac{C/S - 1}{\lambda}$$

From equation (3), $\frac{C}{S} = 1 - \alpha$ and substituting gives us:

$$\frac{\delta \alpha}{\delta r} = \frac{(1 - \alpha) - 1}{\lambda}$$

$$\frac{\delta \alpha}{\delta r} = -\frac{\alpha}{\lambda} \quad (10)$$

Equation (10) highlights the negative relationship between r (the VAT rate) and α (the propensity to submit a return). We attempt to verify the second-order condition.

Now, letting equation (7) equal to zero as a first-order condition requirement yields:

$$\frac{\delta L}{\delta S} = r + \lambda - \lambda \alpha = 0$$

$$r + \lambda - \lambda \alpha = 0$$

Solving for λ gives:

$$\lambda = \frac{r}{\alpha - 1} \quad (11)$$

Substituting this λ into equation (10) yields:

$$\begin{aligned} \frac{\delta \alpha}{\delta r} &= -\frac{\alpha}{r(\alpha - 1)} \\ \frac{\delta \alpha}{\delta r} &= -\frac{\alpha(\alpha - 1)}{r} \end{aligned} \quad (12)$$

Which yields a second-order condition of:

$$\frac{\delta^2 \alpha}{\delta r^2} = -\frac{1}{r^2}(\alpha - \alpha^2)$$

Simply put,

$$\frac{\delta^2 \alpha}{\delta r^2} = \frac{\alpha^2 - \alpha}{r^2} \quad (13)$$

which is negative hence satisfying the condition for maximisation set in the first-order condition in equation (10).

Therefore, to maximise the propensity to submit a VAT return, there is a need to reduce the VAT rate. Other variables linked to EFD such as high input costs (as a proxy of EFD machine) showed zero result in the second-order condition hence they have an ambiguous effect on the maximisation of the propensity to submit a return and on VAT revenues. The theoretical framework has not provided a definite direction of the impact of input costs on VAT collection, hence we now turn to empirical studies to understand how the relationship has been defined in studies on various countries.

(b) Empirical evidence

Even though EFDs have long been adopted in most developed countries, their adoption and use is a fairly recent phenomenon in developing countries like Malawi. As such, very few studies have been conducted to establish their effect on tax collection (Mohammed & Gela, 2014). In the case of the studies that have been done, there have been mixed findings regarding the impact that EFDs have had on revenue collection

and general compliance. The findings range from EFDs having no significant impact on revenue collection to EFDs having improved revenue collection and compliance. Much of the success of the implementation of EFDs to improve revenue collection and to clamp down on non-compliance hinges on the tax administration's ability in ensuring that the EFDs are actually being used by the retailers.

Chege (2010), in his study on the impact of ETRs on VAT compliance among classified hotels in Nairobi, found that the introduction of ETRs led to an increase in the declared VAT by improving the accuracy of VAT reporting. These findings are supported by a study in Kenya by Weru et al (2013) who found that in addition to enhancing tax collection, the introduction of ETRs improved the efficiency and effectiveness of the tax system by saving both the tax administration and taxpayers time, thereby lowering the cost of administering the tax. Mohammed & Gela (2014), stated that the modernisation of tax collection by implementing ETRs assists taxpayers in reducing the time they normally spend on going over their records and reducing tax preparation costs charged by tax agents. Furthermore, ETRs make it easy to handle tax refund claims thereby reducing costs for businesses. In their study conducted to assess problems faced by traders using ETRs in Addis Ababa, Mohammed & Gela (2014) found that 92.3 per cent of the respondents specified that using ETRs had significantly reduced the amount of time it takes them to prepare and calculate VAT return payments. Most of the respondents also reported that even though using ETRs to record their transactions is better than manual systems, the downside is that the machines are susceptible to power interruptions and breakdowns due to technical faults. In addition, once these technical faults had been reported to ETRs' suppliers (who have the responsibility of rectifying the faults), they were taking longer than the mandated 48-hour response time. The traders were also bearing very high maintenance costs which are non-deductible expenses. However, the authors stated that the Ethiopia Revenue and Customs Authority officials informed them that the improvement in VAT collection was not only as a result of the introduction of ETRs, importantly, but also the merging of sales tax to VAT in 2003 and the increasing number of VAT payers. This supports some observations by Casey & Castro (2015) that EFDs have hardly improved compliance and tax collection. These sceptics have argued that in addition to the introduction of EFDs, the overall improvement in the tax administrations' operations is key to improving both compliance and tax revenue collection.

In her assessment of the challenges associated with the implementation and utilisation of EFD in tax collection in Tanzania, Ikasu (2014) found that EFDs to a great extent helped in the improvement of tax compliance. However, the study identified regular breakdowns, taxpayer's perception

of the fairness of the tax, lack of education on the use of the EFD machines, maintenance of machines and underpricing of tax by traders as some of the challenges encountered in the implementation of the EFDs in Tanzania.

A more recent study by Mascagni, Mukama & Santoro (2019) from companies to individual traders. Internal discrepancy is the gap between different data sources, namely VAT declaration and VAT annexes, for the same taxpayer. External discrepancy refers to the gap, for the same transaction, between buyer's and seller's reports. We summarise the extent and depth of these discrepancies, as well as any changes that have occurred since a new VAT refund claim validation procedure was introduced in January 2017, which mainly affected buyers' reporting. While internal discrepancy does not seem to be an issue, external discrepancy is much more frequent, with just 18 per cent of our observations reporting the same VAT amount across buyers and sellers. This share rises to 40 per cent when buyers' reports are compared to sellers' electronic billing machine (EBM found that 25 per cent of cases for which actual VAT declared was less than that captured by EFDs (in Rwanda called "electronic business machines" (EBMs)). They found evidence of sales under-reporting and issuance of falsified receipts. They concluded that without data matching at the revenue administration, usage of EFDs/EBMs alone may not yield the potential VAT revenues.

III RESEARCH DESIGN AND ANALYTICAL APPROACH

The study used a quantitative analysis approach to determine the effectiveness of the EFDs. The data used for the analysis was collected from the tax administration database covering the period July 2005 to June 2019. GDP figures were sourced from the International Monetary Fund (IMF). The study randomly sampled 318 taxpayers for the analysis of the level of compliance and revenue collection from the small and medium segments of the taxpayers. The sampled taxpayers consisted of 244 from the taxpayers currently using EFDs and 74 taxpayers not using EFDs. The segmentation was done to analyse whether EFDs have helped in achieving the set objectives as it was difficult to get information on the compliance gap for the country.

The sample of 318 taxpayers was sufficient to yield statistically significant results as Hill (1998) has pointed out that 30 observations of the population are considered as the minimum for statistical analysis. The use of the random sampling technique for both types of the population was justified due to homogeneity of the taxpayers.

To assess whether the deployment of EFDs has resulted in increased VAT collections or not, analysis of monthly VAT collections and GDP data was conducted. Besides, VAT collections and GDP data, we also

used purchases and sales data from the taxpayers. As the GDP data is an annual aggregate and the analysis required high-frequency data at the monthly level, we proceeded to interpolate our annual GDP data to monthly series using a quadratic method. This method was selected as the other techniques⁴ used for data interpolation require the use of closely related indicators that should be reported at the desired frequency. As we did not have a closely related indicator at a monthly level that could be used with the available annual GDP data for temporal disaggregation, the quadratic method was selected as the best approach to interpolate the data. The data was divided into pre-EFD implementation and post-EFD implementation.

IV RESEARCH FINDINGS

(a) Revenue performance

Though different approaches are used to analyse tax compliance improvement; but the compliance gap is regarded as the best approach that tax administrations could use to conduct the analysis. However, the method is not regularly used by many tax administrations in developing countries due to the absence of robust data that can complement the analysis, as such tax administrations use alternative methods such as the ratio of VAT collection to overall tax collection when determining compliance improvements.

In this study, we first use VAT revenue collection as a percentage of GDP, the method which Casey & Castro (2015) employed in their study. This uses data of 12 months before and 26 months after EFD implementation. The results are presented in Figure 1.

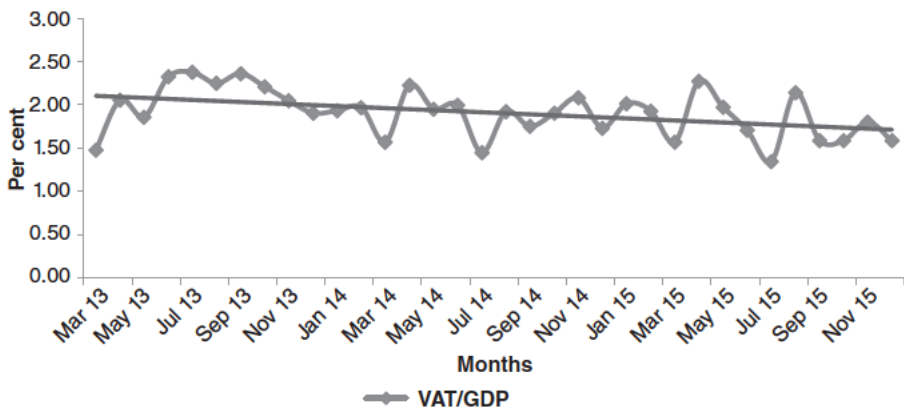


Figure 1: VAT revenue as a percentage of GDP

⁴ Other econometric disaggregation methods include Denton (1971) and Chow & Lin (1971).

Figure 1 shows that VAT collection as a percentage of GDP during the period under review has not shown any improvement. The figure shows that VAT collection was higher in the pre-implementation period compared to the post-implementation period. The downward VAT revenue collection trend is more noticeable in the post-EFD implementation period. The foregoing performance confirms that, holding other factors constant, EFD implementation in Malawi has not improved revenue collection. This decline in performance may suggest that taxpayers have started inflating the purchases just to keep the same or lower level of tax liability as before the implementation of EFDs when purchases were not monitored by devices. Moreover, the purchases do not require fiscalised receipts to be submitted as evidence of input VAT claim.

The results prompted deeper analysis by extracting some statistics on sales and purchases to compare the trends. Table 1 presents the sales and purchases data for the sampled VAT operators.

Table 1: *Trend of sales and purchases*

Year	Sales (MK'000)	Purchases (MK'000)
2005	56.17	7.10
2008	208.99	104.66
2009	73.19	58.11
2010	13 225.76	6 548.29
2011	191 159.44	130 473.41
2012	437 741.31	311 115.17
2013	569 352.96	414 928.14
2014	340 852.62	292 630.53
2015	1 425 349.26	1 114 277.20
2016	1 987 669.97	1 490 709.35
2017	2 405 134.74	1 822 540.40
2018	2 606 102.79	1 958 053.93
2019	1 020 966.23	744 421.79

The trend of sales and purchases has been increasing since 2005. To obtain a better understanding of the trend, we plotted a graph (Figure 2) which shows both sales and purchases and the share of the purchases in the sales. The figure shows that after the year 2014, there was a sharp

rise in both sales and purchases despite the lower share of purchases in sales compared to the period before 2014.

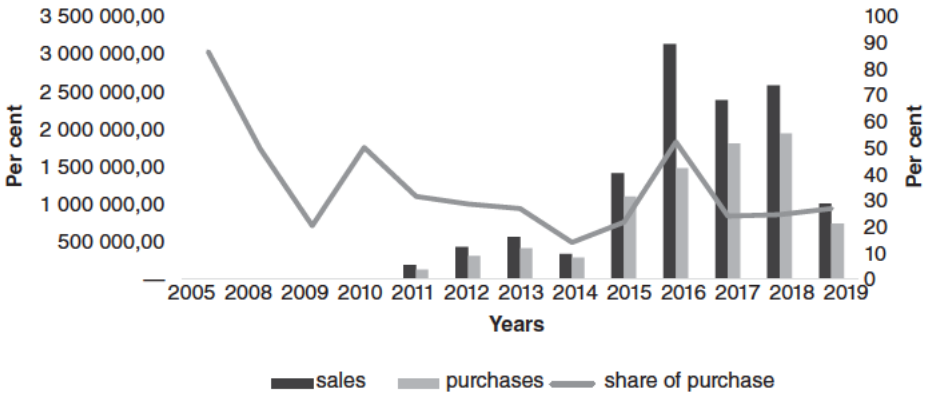


Figure 2: Trend of sales and purchases and share of purchases in sales

The graph shows the growth in sales and purchases over the period 2005 to 2018. The trend shows that prior to 2011, the growth of purchases and sales were close together but after 2011, the growth of purchases remained persistently above sales.

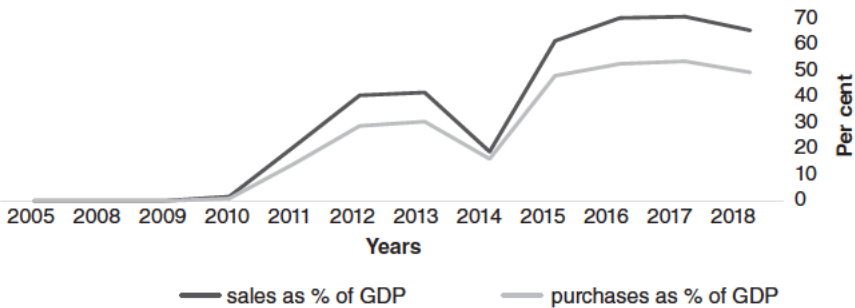


Figure 3: Comparison of growth of sales-GDP shares and purchases-GDP shares

We also computed the growth of sales as a share of GDP and compared to the growth of purchases as a share of GDP and we observed that they grew in the same pattern. In 2014, there was a drop in both growth rates of the shares but after that, both grew at higher rates than prior to the year 2014 as shown in Figure 3.

(b) Test of mean difference approach

Next, we carried out a t-test to compare the difference in the means of the two periods. The null hypothesis of the t-test is that there is no difference between the means of the growth rates of the two periods. Mathematically denoted as:

$$H_0: \mu_1 - \mu_2 = 0$$

$$\text{against } H_1: \mu_1 - \mu_2 \neq 0$$

First, we tested the mean difference in VAT collection as a percentage of GDP from July 2011 to June 2018. The period was split into two equal halves of pre-implementation and post-implementation each spanning 76 months. We computed the year-on-year growth rates of VAT revenues as a per cent of GDP after adjusting for the tax policy changes. Table 2 presents the VAT/GDP ratio from the period. The table shows that VAT collection after adjusting for tax policy changes declined from 2014 to 2016 before increasing in 2017. In the year 2013/14, there were some tax measures implemented which had an impact on VAT revenues. However, in the year 2014/15 and 2015/16, there were no VAT tax policy changes despite VAT collection registering a decline.

Table 2: VAT/GDP ratio after adjusting for the tax policy changes

Year	VAT (MK'bn)	Tax policy impact	Adjusted VAT (MK'bn)	GDP (MK'bn)	Initial GDP ratio	GDP ratio (net of tax policy changes)	Variance
2005/06	9.11		9.11	435.91	2.09%	2.09%	0.00%
2006/07	12.03		12.03	523.21	2.30%	2.30%	0.00%
2007/08	14.48		14.48	625.88	2.31%	2.31%	0.00%
2008/09	18.63		18.63	751.82	2.48%	2.48%	0.00%
2009/10	21.63		21.63	891.04	2.43%	2.43%	0.00%
2010/11	25.75		25.75	1,062.55	2.42%	2.42%	0.00%
2011/12	31.02		31.02	1,252.07	2.48%	2.48%	0.00%
2012/13	40.81		40.81	1,583.69	2.58%	2.58%	0.00%
2013/14	56.45	-0.66	55.79	2,097.96	2.69%	2.66%	0.03%
2014/15	67.15	0	67.15	2,691.14	2.50%	2.50%	0.00%
2015/16	75.70	0	75.70	3,280.75	2.31%	2.31%	0.00%
2016/17	108.06	-4.57	103.49	3,938.85	2.74%	2.63%	0.12%
2017/18	133.20	-3.33	129.87	4,605.32	2.89%	2.82%	0.07%
2018/19	163.49	-4.42	159.07	5,213.01	3.14%	3.05%	0.08%

We then conducted t-tests for the means of the trends in order to explain the differences in observed revenue performance for the 76 months. We present the test results in Table 3. From the table, we observe that the p-value of 0.4872 is too high for all the levels of significance. Hence, we do not reject the null hypothesis of zero difference between the means.

Table 3: *t-Test: two-sample assuming equal means and variances*

	Pre-EFD	Post-EFD
Mean	0.0397	0.0383
Variance	0.0349	0.0473
P(T<=t) one-tail	0.4872	
P(T<=t) two-tail	0.9746	
t Stat	0.0319	
t Critical one-tail	1.6628	
t Critical two-tail	1.9879	

Next, we conducted t-test to compare the average of sales-GDP growth rate before and after the EFD growth. The results are presented in Table 4. The results show that the difference was significant meaning that in the post-EFD, the sales-GDP ratio increased compared to the period before the EFDs.

Table 4: *t-Test: two-sample assuming equal means (sales)*

	Pre-EFD	Post-EFD
Mean	0.180794	0.494896
Variance	0.030158	0.035615
P(T<=t) one-tail	0.004737	
P(T<=t) two-tail	0.009474	
t Stat	-4.67621	
t Critical one-tail	2.131847	
t Critical two-tail	2.776445	

Similarly, the growth rate of the purchases-GDP share was significantly higher compared to the period prior to implementation of the EFDs as shown in Table 5.

Table 5: *t-Test: two-sample assuming equal means (purchases)*

	Pre-EFD	Post-EFD
Mean	0.12814	0.37916
Variance	0.015855	0.018355
P(T<=t) one-tail	0.003991	
P(T<=t) two-tail	0.007982	
t Stat	-4.91074	
t Critical one-tail	2.131847	
t Critical two-tail	2.776445	

These results show that compared to the period before EFDs, sales increased significantly as a share of GDP, yet purchases also increased to match sales. This could provide some evidence that taxpayers may have been keeping constant the base for VAT (sales-purchases gap).

To get a complete picture we conducted t-test for the sales-purchases gap between the two periods. The results presented in Table 6 show that there was no significant difference between the two periods. This confirmed the earlier assertions that the decline in VAT collection may be a result of inflating the purchases after the implementation of the EFDs to keep the sales-purchases gap the same - consequently, the VAT liability.

Table 6: *T-test: two-sample assuming equal means (sales-purchases gap)*

	Pre-EFD	Post-EFD
Mean	28.6	30.2
Variance	189.8	165.7
P(T<=t) one-tail	0.428858	
P(T<=t) two-tail	0.857715	
t Stat	-0.19115	
t Critical one-tail	2.131847	
t Critical two-tail	2.776445	

(c) *Compliance improvement*

After the trend analyses and test-of-mean difference approaches, the study analysed the compliance pattern as measured by registration, timely filing of returns, correct filed returns and timely payment of tax liabilities as provided in literature (OECD, 2012; IMF, 2012;

Anyaduba et al, 2012; Wang, 2010 & Nguyen, 2013). The failure to meet any of the four obligations is an indication of the taxpayer’s non-compliance. Our study used timely filing of returns as a measure of tax compliance associated with EFDs. The study analysed whether there was a difference in the filing times before and after the implementation of EFDs. The underlying assumption was that the introduction of EFDs improved the timely preparation of tax returns: hence taxpayers filing returns timeously to the Authority.

Table 7 presents a summary of taxpayers that were sampled and had filing information in the system. The table shows that of the 244 EFD taxpayers, 125 (51 per cent) had no tax returns available in system higher than the 119 (49 per cent) who had their VAT returns available in the system. Among those taxpayers without EFDs, 54 per cent had no tax returns while 46 per cent had tax returns available. This meant that the sample size filing compliance analysis focused on 153 taxpayers.

Table 7: *EFD and VAT data*

EFD	Data		Total
	NO	YES	
NO	40	34	74
YES	125	119	244
Total	165	153	318

The study analysed the filing rates of 153 taxpayers. Table 8 presents the results of filing rates on monthly basis for a period of 38 months split between pre- and post-EFD implementation. The results show that 49.60 per cent of the taxpayers were filing their tax returns on time while 46.55 per cent were not filing, and 3.85 per cent were filing late. Late filers and non-filers had a slightly higher percentage (50.4 per cent) than those that were filing on time.

Table 8: *Overall VAT compliance rates*

	Freq	Per cent
Timely filing		49.60
	2 035	46.55
		3.85
No filing	1 910	
Late filing	158	
Total	4 103	100.00

(n = 153)

The study also investigated whether there were differences in filing times before and after the implementation of EFDs. The results in Table 9 reveal that prior to 2014, the percentage rate for filers was 53.47 per cent higher than the combined percentage of 46.53 of both non-filers and late filers. After EFD implementation, timely filers dropped to 46.11 per cent but a percentage of non-filers and late filers increased to 53.89 per cent.

Table 9: VAT compliance rates pre-EFD and post-EDF implementation

Compliance	Pre-EFD		Post-EDF	
	Freq	Per cent	Freq	Per cent
Timely filing	1 040	53.47	995	46.11
No filing	805	41.39	1,105	51.20
Late filing	100	5.14	58	2.69
Total	1 945	100.00	2 158	100.00

Similarly, the study investigated whether the taxpayer would remain compliant in filing timeously in the next period. The results are presented in Table 10. In Table 8, the rows reflect the initial values, and the columns reflect the final values. The values at top are frequencies and at the bottom, we present percentages.

Table 10: Compliance transition probabilities

Compliance	Compliance			Total
	Timely filing	Late filing	No filing	
Timely filing	711 77.96	29 3.18	172 18.86	912 100
No filing	185 17.82	13 1.25	840 80.92	1 038 100
Late filing	31 56.36	14 25.45	10 18.18	55 100
Total	927 46.23	56 2.79	1 022 50.97	2 005 100

The study found that 78 per cent of the taxpayers who filed timeously in the data remained timely filers in the next period (succeeding month); and of the remaining 22 per cent, some became non-filers and a few late filers. Although timely filers had 18 per cent chance of becoming

non-filers in the succeeding month, the non-filers had a 1 per cent less chance of becoming (or returning to) timely filers and an 81 per cent chance of remaining as non-filers. In this case, EFDs has not improved the compliance behaviour as evidenced by inconsistency in filing of the tax returns and non-improvement in filing time.

V CONCLUSIONS AND RECOMMENDATIONS

The study adopted a quantitative approach to examine the effectiveness of the EFDs in revenue collection and compliance. Timely filing of tax returns was used as a measure of compliance whereas VAT revenue collection as percentage of GDP was employed as a measure of revenue collection performance.

Though EFD machines present a compelling case for the collection of VAT, without effective administration they may continue to perform below expectation. The issue goes beyond contemplating the mere usage of EFDs by ensuring that VAT revenues respond to the usage of EFDs. In this case, resorting to big data analytics to track taxpayer payments may be important for the Authority as was suggested by Mascagni, Mukama & Santoro (2019) who discovered evidence of sales under-reporting in Rwanda.

The empirical findings have shown that using VAT collection as a percentage of GDP, EFDs have not increased revenue collection in the period under review as evidenced by the declining trend after the devices were rolled out. Additionally, the mean growth of VAT revenues in the two periods (pre- and post-EFD implementation) does not reveal any significant difference. We therefore conclude that the deployment of EFDs has not resulted in more VAT collections during the study period. We found evidence of taxpayers' inflating of purchases to reduce their tax liability and increase their VAT claims. We recommend that the Authority should consider a system that could pair sales and purchases.

The findings on the compliance rate have revealed that EFDs have not been effective in increasing the compliance as shown by a decrease in timely filing of tax returns in the post-EFD era. We therefore recommend that the Authority should attempt to understand the reasons why more taxpayers do not submit returns despite having EFDs.

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