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**Assessing the Revenue Implications of
Indirect Tax Reforms in Rwanda**

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Preface

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Assessing the Revenue Implications of Indirect Tax Reforms in Rwanda

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Abstract

This article analyzes the tax revenue implications of the 2002 Value Added Tax (VAT) rate reform in Rwanda. For this it uses an adaptation of the methodological framework of the elasticity of the taxable base with respect to the tax rate (Gruber and Saez, 2002). Data used are from the second Integrated Survey on the Living Standards of Rwandan Households (EICV2) conducted in 2005-06 by the National Institute of Statistics of Rwanda (NISR). As compared to Gruber and Saez's (2002) method, our adaptation has the merit of using data which are easy to collect and to archive in developing countries. Our analysis led to two main outcomes: (i) the 2002 VAT rate reform slightly raised household consumption expenditure because it grew by only 0.3 per cent; (ii) the increase in tax revenue was significant (approximately 20 per cent), thanks to the mechanical component. The behavioral component was lower and mainly borne by the poorest households. This attests that consumption spending by poor households was relatively insensitive to changes in relative prices after the VAT reform.

Keywords: Indirect tax revenue, VAT, household expenditure.

JEL Classification Codes: H21; H25; H31

1. Introduction

Indirect tax reforms modify the structure of consumption expenditure and so also the tax revenue collected. According to Crossley et al. (2009), a change in indirect tax rates affects consumption through two channels: the income effect and the substitution effect. The substitution effect is a consequence of the change in relative prices, whereas the income effect is a reflection of a change in household purchasing power, for example, the consequent change in consumption expenditure.

For Feldstein (2008) the impact of a tax reform on tax revenue has three components: (i) mechanical change, (ii) behavioral change, and (iii) excess tax burden. Mechanical change is the extra tax revenue when consumption expenditure does not vary. Behavioral change is the extra revenue that depends on the response to the change in the tax rate. And excess tax burden, or deadweight loss, is the additional tax cost endured by a taxpayer because of price distortions (Hines Jr., 2007). The excess tax burden itself is not tax revenue; it is a tax surcharge that the tax reform bears to the taxpayers by lowering consumption. Thus, the analysis of the revenue implications of a tax policy should not be limited to tax productivity, but should also include its inefficiency in terms of deadweight loss.

Value Added Tax (VAT) was introduced in the Rwandan tax system in January 2002, at a flat rate of 15 per cent. The tax reform of January 2002 increased the VAT tax rate to 18 per cent. Undoubtedly, this tax reform entailed many consequences, among them a change in tax yields. Therefore, the main objective of this paper is to evaluate the revenue consequences of the VAT rate reform. More specifically, this article aims: (i) to examine the effects of the 2002 increase in the VAT rate on the consumption expenditure of Rwandan households, and (ii) to determine the impact of this VAT rate reform on the government's tax revenue. To address these two objectives, we adopted the methodological framework of the elasticity of the taxable base with respect to the tax rate (Gruber and Saez, 2002).

Gruber and Saez's (2002) article is a seminal work in the field of labor income taxation. However, to the best of our knowledge, no attempt has been made to apply their methodology to indirect taxation. Also, even if indirect taxes constitute the main source of tax revenue in low-income countries, to our knowledge no empirical study has been done to assess the behavioral consequences of an indirect tax in a developing country. Thus, the merit of this article is mainly empirical.

The data used are from the second Integrated Survey on the Living Standards of Rwandan Households (EICV2), which took place from 12 October 2005 to 3 October 2006. The choice of this survey is justified by the post-reform period during which it was conducted. The consumption expenditure collected in this survey contains post-reform prices and can be useful in judging the behavioral response of household consumption to a change in prices following the 2002 VAT rate reform.

The main outcome is that the increase in VAT rate in 2002 slightly increased Rwandan households' expenditures. This slight increase in households' spending was accompanied by a substantial increase in tax revenues of about 20 per cent. This attests that this increase in revenue was mainly dominated by a mechanical change. Moreover, the 2002 VAT reform resulted in low tax inefficiency, as for 100 Rwandan francs of extra revenue

that were collected households only experienced an excess tax burden valued at about 3 Rwandan francs.

The rest of the paper is organized as follows. The next section gives a literature review, the third section describes the methodology used, while the fourth section is dedicated to empirical results and a discussion. The last section gives a conclusion.

2. Literature review

From Dupuit (1844) it is known that the relationship between tax rate and tax revenue is not linear, because of a change in consumption behavior with respect to the tax rate (Laffer, 2004; Wanniski, 1978). According to Saez (2001), the tax base reacts to a change in the tax rate. For this purpose, depending on taxpayer behavior, an increase in tax rate can lead to a decrease in the taxable base. For individuals who have more opportunities to escape the tax burden by tax evasion or by an inter-temporal tax base shifting, the taxable base is very sensitive to tax rate. In contrast, those who do not have enough opportunities to minimize tax incidence, the tax base is insensitive to the tax rate (Sillamaa and Veall, 2001).

An analysis of the linkage between tax rate and tax base is mainly developed within the income taxation theory. Saez et al. (2012) did a critical review in this area. In indirect taxation, there are limited analyses of the relationship between the tax rate and taxable base. The few studies that exist have been done in developed countries and mainly concern selective taxes (which apply to the volume and not to the goods' value).

In the context of imports regulation within the European Union, Crawford and Tanner (1995) conducted a study in the United Kingdom to determine the revenue effect of a tax rate reduction on alcoholic drink products. Using data from the Irish Family Budget survey over 20 years (1978-96), they estimated the model of domestic demand and pointed out the elasticity of demand for these goods with respect to excise tax rates. Their results show that beer and wine were relatively insensitive to price, and that tax rates in force were below the Laffer, (2004) tax rate. Therefore, they concluded that a decline in the tax rate on alcoholic beverages would lower revenues. On the other hand, Crawford and Tanner's (1995) study showed that liquor is sufficiently sensitive to price; and they did not reject the hypothesis that its tax rate is a Laffer one. This implies that a decline in the tax rate on liquor would raise tax revenues from this commodity.

Crawford et al. (1999) resumed the same study, and analyzed the long-term effects of a change in tax rates on alcoholic beverages by integrating the cross-price elasticity that had been ignored in their previous study. Comparing wine and liquor, they found that these two drinks were substitutes. On the other hand, beer and wine, and beer and liquor were complements.

Like Crawford and Tanner (1995) they ignored cross-price elasticity and found that lowering the tax rate on liquor could increase the tax revenue collected on it. Further, taking into account the cross-price elasticity, Crawford et al. (1999) found that tax revenue from wine grew with a decline in the tax rate on liquor. Moreover, they found that a decline in the tax rate on wine resulted in rising demand for beer and in a decline in demand for liquor. This could result in an increase in the tax revenue from beer and wine; and in a decrease in revenue from liquor. Therefore, the authors recommended not raising the tax rate on liquor because, overall, this would result in a decrease in revenue

from alcoholic drinks. Ultimately, their result was the same as that of Crawford and Tanner (1995).

The common methodological characteristic of these two studies is that they are based only on the substitution effect and ignore the income effect of revenue change. However, according to Crossley et al. (2009), the change in tax revenue due to a change in the tax rate is separated into income effect and substitution effect. Income effect implies that a decrease in the tax rate increases the purchasing power of households. Depending on the value of the income-elasticity of demand, the income effect may increase or decrease consumer spending. The substitution effect concerns a change in household expenditure in response to a change in relative (or inter-temporal) prices.¹

Studying the revenue impact of the 2009 decline in the VAT rate in England, Crossley et al. (2009) found that the inter-temporal substitution effect prevailed on the income effect. The explanation for this phenomenon is that this decline in the VAT rate was reflected in the prices of luxuries rather than in the prices of necessities. Indeed, luxuries are easier to postpone than necessities (Browning and Crossley, 2000). Further, Barrell and Weale (2009) identified an increase in expenditure on non-perishable goods during the period of the VAT rate decline and called this phenomenon the 'trade off effect'.

Cashin and Unayama (2012) studied the revenue impact of the VAT rate increase in Japan. Contrary to expectations, these authors found that households did not increase their expenditure in the period following the increase in VAT rate. On the other hand, anticipating an increase in the VAT rate, Japanese households increased their expenditure during the period directly following the announcement of increase in this rate. This inter-temporal substitution especially had to do with durables and storable non-durables. In terms of revenue, the substitution effect that followed the announcement of an increase in the VAT rate resulted in minor loss of tax revenue and the actual effect of the increase in the VAT rate was revenue neutral.

Concerning marginal excess tax burden, Harberger (1964) theorized a unit tax and personal income tax. Comparing these two taxes, Harberger (1964) concluded that personal income tax generated a less marginal excess tax burden than the unit indirect tax.

However, Feldstein (1999) used the Harberger method and showed that the marginal excess tax burden of wage income tax, measured in terms of taxable income supply rather than in terms of labor supply, would be more important. Compared to the flat tax, Feldstein, (1999) showed that in the United States the extra tax cost of the wage income tax was 12 times higher than the extra tax cost approximated by Harberger (1964).

Moreover, using the method of behavioral change in tax revenue, Saez (2004) showed that taking account of the sources and destinations of change in taxable income, the marginal excess tax burden of the wage income tax decreased enormously. On the other hand, he also showed that the marginal excess tax burden was almost non-existent for lower income brackets as compared to the richest income bracket.

Comparing the before-tax situation to the after-tax situation of a taxpayer, Saez's (2004) method respects the Pigou conception of excess tax burden (Lind and Granqvist, 2010).

¹ The study of Crossley et al. (2009) refers to change in consumption due to temporal decline in the VAT rate. However, it is even valid in the case of consistent decline in the tax rate.

This is its main difference from the method of the Harberger triangle, which compares the after-tax situation of a taxpayer to that which would prevail if this tax was replaced by a hypothetical flat tax.

Apart from the Harberger's (1964) approximation, to the best of our knowledge no other study has been conducted on the approximation of the efficiency cost of an indirect tax rate reform. Therefore, our study constitutes advancement in this empirical literature.

3. Methods

The tax base of indirect taxes is made up of consumer spending.² This is likely to increase or decrease following a change in the tax rate and households' preferences. To analyze the effects of a change in the tax rate on consumption expenditure, we refer to the methodological framework of the elasticity of taxable income with respect to the marginal tax rate (Gruber and Saez, 2002).

3.1 Elasticity of taxable income with respect to marginal tax rate

Seeking to assess the elasticity of taxable income with respect to marginal tax rate, Gruber and Saez (2002) considered that a taxpayer satisfies his utility using two types of commodities: consumption goods and income. Maximizing the taxpayer's utility, they showed that the supply function of taxable income is:

$$(1) \quad z = z(1-t, I)$$

where z is the taxable income, t is the marginal tax rate and I is the exogenous income. Here exogenous income designates all types of non-taxable income.

Eq 1 highlights two variables that represent arguments of the supply function of a taxable income, namely marginal tax rate and exogenous income. Gruber and Saez (2002) have shown that the two variables influence the supply of the taxable income as:

$$(2) \quad \frac{dz}{z} = -\zeta^c \frac{dt}{1-t} + \eta \frac{dI - zdt}{z(1-t)}$$

with $(dI - zdt)$ defined as a change in post-tax income following a change in the marginal tax rate. For these authors, this value is equivalent to a change in the tax revenue from taxpayers who have a taxable income z . Parameters ζ^c and η represent the compensated elasticity of taxable income with respect to the marginal tax rate and to the income effect respectively; whereas dz , dt and dI represent the infinitesimal change in taxable income, in marginal tax rate and in exogenous income respectively.

The specificity of Eq 2 is that it introduces the income effect in an assessment of the elasticity of a taxable base with respect to the tax rate. However, it is more suitable for personal income taxation rather than for consumption expenditure taxation. To adapt it to indirect taxation, we refer to the theory of the consumer by replacing the supply of

² This methodological approach borrows mainly from Ndemezo and Baye (2015, pp. 185-186).

taxable income by the supply of taxable expenditure, and replacing the marginal tax rate by the implicit tax rate.³

3.2 Elasticity of taxable expenditure with respect to implicit tax rate

We define the taxable expenditure of household h on commodity i as:

$$(3) \quad E_i^h = E_i^h(q, I_h)$$

where E_i^h means the expenditure tax-included on commodity i by household h, q refers to the vector of prices tax-included and I_h designates the income of household h. We assume that only the consumption expenditure is taxable and that household income is not taxed.

Taxable expenditure depends on the vector of final prices and on household income. A change in the indirect tax rate has no effect on household income. Therefore, we assume that a change in the implicit tax rate fully passes through the consumer price: $dq_i = p_i d\pi_i$; where p_i is the price tax-excluded on the commodity i, dq_i and $d\pi_i$ are respectively the changes in price tax-included for commodity i and the change in the implicit tax rate on commodity i.

For household h, after a change in the tax rate, the change in consumption expenditure is induced by a combination of the change in the vector of prices and of the change in real income:

$$(4) \quad dE_i^h = \frac{\partial E_i^h}{\partial q_i} dq_i + \sum_{j \neq i} \frac{\partial E_i^h}{\partial q_j} dq_j + \frac{\partial E_i^h}{\partial I_h} dI_h$$

where dE_i^h is the change in consumption expenditure tax-included of household h on the commodity i; $\frac{\partial E_i^h}{\partial q_i}$ and $\frac{\partial E_i^h}{\partial q_j}$ are the derivatives of the expenditure tax-included of household h on commodity i with respect to the price of the good i and j respectively; dI_h and $\frac{\partial E_i^h}{\partial I_h}$ are changes in real income of household h and the derivative of the expenditure tax-included of household h on commodity i with respect to the real income of household h.

After some manipulations, the change in the consumption expenditure can be written as:

$$(5) \quad \frac{dE_i^h}{E_i^h} = \left[\left(1 + \varepsilon_{ii}^u\right) \frac{d\pi_i}{1 + \pi_i} + \sum_{i \neq j} \varepsilon_{ij}^u \frac{d\pi_j}{1 + \pi_j} \right] + \eta_i \frac{dI}{I}$$

³ We define the implicit tax rate as: $\pi_i = v_i + \tau_i + \tau_i v_i$, where π_i represents the implicit tax rate, τ_i is the excise duty rate on good i and v_i the VAT rate on good i.

with ε_{ii}^u , ε_{ij}^u , η_i respectively designating the uncompensated own price elasticity of demand for the commodity i, the cross-price elasticity of demand for commodity i with respect to the price of commodity j; and variables π_i and $d\pi_i$ representing respectively the implicit tax rate on commodity i and its infinitesimal change. Here variables E_i and dE_i , I and dI are respectively total expenditure on commodity i and its change post the reform, and total household income and its change post the reform.

With some rearrangements, Eq 5 becomes:

$$(6) \quad \frac{dE_i}{E_i} = \zeta_{ii}^u \frac{d\pi_i}{1 + \pi_i} + \eta_i \frac{dI}{I}$$

The parameter $\zeta_{ii}^u \left[= 1 + \varepsilon_{ii}^u + \sum_{i \neq j} \varepsilon_{ji}^u \right]$ is the uncompensated price elasticity of the expenditure of household m on commodity i. Here, ε_{ji}^u designates the cross-price elasticity of demand for commodity j with respect to the price of commodity i. Other variables are defined as earlier.

On the right hand of Eq 6, the first term represents the substitution effect, while the last term is the income effect. The substitution effect is negative in terms of quantity consumed. However, in terms of expenditure, the sign of the substitution effect may be positive or negative. It is non-positive if the demand for the concerned commodity is elastic and non-negative when the demand for this commodity is inelastic. In terms of expenditure, the income effect is non-negative for normal goods and non-positive for inferior goods.

Eq 6 highlights the elasticity of expenditure with respect to the tax rate and with respect to household income. Through this expression, the aggregate elasticity of expenditure with respect to the tax rate and with respect to household income can be estimated using, as explicative variables, the change in implicit tax rates borne by each household and the change in household income; the independent variable being the household expenditure tax-included.

However, for this it is imperative to possess at least a panel data on two cohorts, with at least one cohort relating to the pre-reforms period. To overcome the lack of panel data, we replaced the elasticity of expenditure with respect to the tax rate by the price elasticity of expenditure.

In order to facilitate calculations, and using the Roy identity ($dI/I = w_i dq_i/q_i$), Eq 6 was transformed as:

$$(7) \quad \frac{dE_i}{E_i} = \zeta_{ii}^u \frac{d\pi_i}{1 + \pi_i} + w_i \eta_i \frac{d\pi_i}{1 + \pi_i}$$

with w_i representing the budget share of commodity i; the other variables defined as earlier. Here, $w_i \eta_i$ designates the income effect coefficient, while ζ_{ii}^u is the substitution effect coefficient of the change in consumption expenditure.

The limitation of using this approach is that it takes account of only taxable goods whose tax rates were modified. This technique assumes that indirect tax reforms do not influence the consumption expenditure of non-taxable goods.

3.3 Implications in terms of revenue yields

We recall that the revenue yield of an indirect tax rate reform can be split into two components: behavioral change and mechanical change. Behavioral change in tax revenue is derived from Eq 7, using the Slutsky equation ($\varepsilon_{ii}^u = \varepsilon_{ii}^c - w_i \eta_i$):

$$(8) \quad \Delta B_i = E_i \pi_i \zeta_{ii}^c \frac{\Delta \pi_i}{1 + \pi_i}$$

where ΔB_i is the behavioral change in tax revenue, E_i is the total expenditure tax-included on commodity I; π_i and $\Delta \pi_i$ are respectively the implicit tax rate applicable to commodity i and its change post-reform; $\zeta_{ii}^c \left(= 1 + \varepsilon_{ii}^c + \sum_{i \neq j} \varepsilon_{ji}^u \right)$ is the compensated price elasticity of the consumption expenditure on commodity i. Other parameters are defined as earlier.

Depending on the sign of the price elasticity of the consumption expenditure, the behavioral change in tax revenue may be positive or negative. Otherwise, the behavioral change is negative for luxuries and positive for necessities.

The mechanical change in tax revenue is given by:

$$(9) \quad \Delta M_i = E_i \frac{\Delta \pi_i}{1 + \pi_i}$$

with ΔM_i referring to mechanical change in tax revenue; the other variables being defined as previously.

Mechanical change is always non-negative. The total growth of tax revenue is the sum of mechanical change and behavioral change:

$$(10) \quad \Delta R_i = E_i \left[1 + \pi_i \zeta_{ii}^c \right] \frac{\Delta \pi_i}{1 + \pi_i}$$

with ΔR_i designating the total change in the tax revenue from expenditure from commodity i; π_i and $\Delta \pi_i$ are the implicit tax rate on commodity i before the tax reform and its post-reform change; other variables are defined as earlier.

3.4 Implications in terms of marginal excess tax burden

To compute the marginal excess tax burden, we adopted the Saez (2004) approach. According to Saez, the additional excess tax burden is measured in terms of the ratio of behavioral change in tax revenue over a change in total tax revenue. However, we only

count the negative behavioral change, because the positive one cannot be considered as an additional excess tax burden because it is counted in the total additional government revenue:

$$(11) \quad \Delta EB_i = \frac{|\Delta B_i|}{|\Delta R_i|} = \frac{|\pi_i \zeta_i^c|}{|1 + \pi_i \zeta_i^c|}$$

where ΔEB_i represents the additional excess tax burden due to an increase in the indirect tax rate on commodity i ; other variables are defined as earlier. The bars that surround the values of Eq 11 indicate that the concerned amount is in absolute value. Therefore, the total extra excess tax burden is the added additional excess tax burden borne by all commodities.

According to Eq 11, the higher the implicit tax rate and more the price elasticity of expenditure, more significant is the additional excess tax burden. Therefore, a marginal excess tax burden is important for goods whose demand is much more elastic than the others, that is, for goods which are considered luxuries.

4. Variables and data

The variables required to implement Eqs (7) to (11) are:

- (i). Consumption expenditures tax-included (before and after the VAT rate reform),
- (ii). Implicit tax rates and their changes post-reform,
- (iii). Uncompensated and compensated price elasticity of expenditure.

Data on consumption expenditure are from the second Integrated Survey on the Living Standards of Rwandan households (EICV2). This survey was conducted in 2005-06 by the National Institute of Statistics of Rwanda (NISR). Thus, consumption expenditure collected by EICV2 contains post-reform prices.

Tax data are from implicit tax rates calculated using the VAT rate and the excise duty rates prevailing in 2001 and in 2006. In order to compute the change in implicit tax rates, we compared the implicit tax rates in 2006 and in 2001.

Price elasticities of expenditure were estimated using the Linear Expenditure System (LES) model, as extended by Creedy and Sleeman (2006). Data used to estimate the LES model are consumption expenditure from EICV2.

5. Empirical findings and discussion

We focus first on the effects of the VAT rate reform on the structure of household expenditure, and then analyze the effects of the increase in the VAT rate on tax revenue and on excess tax burden.

5.1 Effects of increase in the VAT rate on household expenditure

The increase in the VAT rate in January 2002 slightly modified the consumption habits of Rwandan households. The increase in the VAT rate resulted in the growth of all the

implicit tax rates applicable to different commodity groups. Moreover, this change in the implicit tax rate caused several slight changes in households' choices. Table 1 summarizes the splitting of behavioral effects of indirect taxes, computed through Eq 7.

Insert Table 1 about here

Most of the commodity groups experienced slight increases in spending. Overall, the increase in households' spending is valued at about 0.29 per cent of pre-reform expenditure. The substitution effect is estimated at 0.07 per cent, and the income effect is approximated at 0.22 per cent of a household's pre-reform spending. The positive sign of the substitution effect means that the increase in relative prices is much more borne by necessities than by luxuries.

Further, two commodity groups experienced a positive substitution effect greater than 1 per cent: private fuel (2.4 per cent) and communication (1.9 per cent). These two commodity groups are luxuries; but also, according to cross-price elasticity, they are substitutes for all other commodity groups, and their related spending increases with an increase in the prices of other goods. Despite a very low income effect, the significance of the substitution effect gives these two commodity groups the first two ranks in the total behavioral change in consumption expenditure.

The income effect is positive everywhere, attesting that all commodities are normal. It exceeds 0.3 per cent of the post-reform expenditure for three commodity groups: clothing (0.62 per cent), hygiene products (0.36 per cent) and housing (0.30 per cent). The budget shares of these three commodity groups are very high (greater than 12 per cent). This implies that they are more represented in the consumption bundle of households rather than the others. As a result, a significant portion of the household budget is devoted to them, and they benefit more from income effect.

The conjunction of income and substitution effects indicates that three commodity groups experienced a very slight decline in their spending, because they are luxuries: (in descending order) leisure and recreation, beer and personal effects. Four commodity groups underwent a higher total behavioral effect compared to others: private fuel (2.4 per cent), communication (2.0 per cent), clothing (0.9 per cent) and preventive health (0.6 per cent). All these commodities have a positive and higher substitution effect. Further, clothing had a higher average budget share (29 per cent) and, consequently, a bigger income effect.

Ultimately, the increase in the VAT rate forced households to increase their spending to cope with the increase in prices. However, this does not imply necessarily that the increase in the VAT rate increased the quantity consumed; our analysis concerns only expenditure modifications.

5.2 Effects of an increase in the VAT rate on tax revenue

The growth in household expenditure is reflected in the behavioral component of an increase in tax revenue, which was about 0.5 per cent (Table 2). The behavioral increase in the revenue exceeded the increase in expenditure. As seen earlier, this attests that a change in the VAT rate mainly resulted in an increase in money being spent on goods that were heavily taxed (communication and private fuel) or more consumed (clothing, hygiene products and housing). Moreover, this outcome means that indirect tax revenue

is elastic with respect to its tax base; this elasticity can be estimated at 1.6875 (that is, $0.486/0.288$).

Insert Table 2 about here

Further, even if the behavioral growth of the tax revenue remained low, the increase in the VAT rate overall increased indirect tax revenue (about 20 per cent of the previous revenue). The total growth of indirect tax revenue was widely dominated by the mechanical component (97.6 per cent). Behavioral growth represented only 2.4 per cent of the total increase in indirect tax revenue. Overall, the substitution effect was less than the income effect, thus justifying that the VAT rate change effect was proportional to budget shares. The effect of the VAT rate reform on relative prices and so on the structure of the consumer bundle was less significant.

However, compared to the change in consumer expenditure, the income effect of the VAT rate reform on tax revenue was lower. As mentioned earlier, this certifies that the increase in households' spending on highly taxed goods is mainly from the substitution effect. Further, at the individual level, the substitution effect in absolute value outweighed the income effect for most commodity groups. Goods that did not meet this 'rule' are tobacco, clothing, housing, furnishings and appliances, curative health and hygiene products. All previous products have a greater average budget share (above 2 per cent) and, consequently, experienced a significant income effect as mentioned earlier.

The unequal significance of the substitution effect indicates that the impact of the VAT rate was unequal among commodities and that it restructured households' consumption baskets. The substitution effect and the trade-off effect (Barrell and Weale, 2009) were low for goods which represent little immediate interest (durable goods and luxury goods) compared to other goods deemed most essential for households, like manufactured food products, preventive health, home water, energy and private fuel.

The total behavioral effect was negative for three commodity groups (in descending order): (i) leisure and recreation, (ii) beer, and (iii) personal effects. As seen earlier, these three commodity groups are luxuries, which experienced a higher negative substitution effect which outweighed the income effect. On the other hand, the behavioral effect was positive and greater than 1 per cent for two commodity groups: private fuel (3.8 per cent) and communication (2.3 per cent). These two groups complement each other and benefit a price increase following an increase in the VAT rate.

Ultimately, on the one hand, the behavioral effect of the increase in the VAT rate was negative for luxury commodities, and on the other hand, it was positive and relatively high for goods which complement each other, even if they are luxuries. The former are easy to postpone when there is an increase in indirect tax rates (Browning and Crossley, 2000), whereas the latter have a higher positive substitution effect thanks to an increase in the relative prices of other commodity groups.

Further, only mechanical change in revenue from the commodity groups that bear excise taxes is different from 20 per cent (which is also the percentage increase in the VAT rate). However, in absolute value, these taxable goods experienced higher growth in their tax rates at about 5 per cent or more. The higher growth in tax revenue from communication is explained by the significant increase in its tax rate during the post-reform period; while slow growth in tax revenue from other goods bearing excise duties originated from their pre-reform higher tax rates.

Considering households' standard of living, the behavioral growth of tax revenue was relatively higher among households in the first three quintiles, and relatively lower among households in the last two quintiles (see Figure 1). This attests that facing an increase in market prices, poor households relatively increase their spending rather than non-poor households. Also, this fact confirms the finding shown earlier, that indirect taxes are mainly levied on necessities.

Insert Figure 1 about here

The behavioral growth of tax revenue among poor households is about 0.7 per cent, while it is about 0.5 per cent in the fourth quintile and 0.3 per cent among households in the last quintile. However, it is important to mention that the change in tax revenue was widely dominated by the mechanical component for all household categories. Thus, the decreasing behavioral response cannot be interpreted as a regressiveness of the VAT rate reform of January 2002.

Further, behavioral change in tax revenue is more influenced by the income effect (over 70 per cent) for all households. The substitution effect is slightly negative in the last quintile. Thus, the low participation of wealthy households in the behavioral growth of tax revenue comes partly from their negative reactions to a change in relative prices. Also, the first quintile experienced the most important substitution effect and a higher behavioral growth of tax revenue. This attests that households in this quintile are much more insensitive to changes in prices than others.

These results are consistent with the results of Saez (2002) about commodity taxation with non-linear optimal direct taxation. For the author, in order to increase tax revenue, it is optimal to tax those goods which are more consumed by wealthy households low. This means that the elasticity of consumption expenditure with respect to the indirect tax rates is overall lower among richer households and overall higher among poor households. This also conforms to the inverse-elasticity rule which states that tax rates on goods should be inversely related to their compensated elasticity of demand if redistribution does not count.

However, considering total growth⁴ rather than behavioral growth of tax revenue, the contribution of households in the last quintile is predominant (see Figure 2). Total revenue growth in the last quintile is in the order of 20.2 per cent, thus slightly exceeding the overall average of 20 per cent. This is a consequence of the predominance of wealthier households' consumption expenditure on taxable goods.

Insert Figure 2 about here

Households which are comparatively less wealthy participate in the total growth of indirect tax revenue at a much lower rate (below average), which varies from 18.7 per cent (fourth quintile) to 19.1 per cent (second and third quintile). As compared to households in the other quintiles, the fourth quintile consumed relatively less taxable goods. However, overall, the total growth of tax revenue was progressive.

⁴ The total growth of indirect tax revenue is a combination of behavioral change and of mechanical change in indirect tax revenue.

5.4 Effect of the VAT rate reform on excess tax burden

The overall utility loss resulting from the VAT rate reform is valued at about 2.878 Rwandan francs⁵ (RWF) for 100 additional Rwandan francs collected as indirect taxes. The marginal excess tax burden due to the VAT rate increase is greater for leisure and creation, which is a luxury good.

Insert Figure 3 about here

Considering the standard of living (Figure 3), households in the third quintile were less disadvantaged; they consumed relatively less taxable luxuries. The last two quintiles were the most disadvantaged. Overall they experienced a tax surcharge equivalent of 4.352 per cent and 17.039 per cent for the fourth and the last quintile respectively. This can be justified by the higher consumption of luxuries by wealthier households.

6. Summary and conclusion

In this article, we computed the change in household expenditure and in indirect tax revenues consecutive to an increase in the VAT rate in January 2002 in Rwanda. For this purpose, we adapted the methodological framework of a change in the income tax base with respect to the marginal tax rate (Gruber and Saez, 2002), in order to conform it to indirect taxation. As compared to Gruber and Saez's (2002) method, our adaptation has the merit of using data which were easy to collect and to archive in developing countries.

Our analysis resulted in two main outcomes. First, the increase in VAT rate in January 2002 caused a slight growth in consumption expenditure (of 0.3 per cent) of Rwandan households. The second outcome concerns the increase in tax revenue which was significant (about 20 per cent of the pre-reform revenue). Therefore, the mechanical effect largely prevailed on the behavioral effect. Moreover, the excess tax burden remained modest because it represented only approximately 3 RWF for 100 RWF of extra revenue collected.

These outcomes permit us to recommend using indirect taxes much more for revenue yield targets. This also seems to be true as our analysis says that during the period studied indirect tax revenue was elastic with respect to consumption expenditure. However, some tax arrangements are advisable in order to compensate the poorest households because they were much affected by the VAT rate reform. This can be, for example, an exoneration of necessities like manufactured foods and water and energy, and an increase in the tax rate applicable to luxuries like housing and furnishings and appliances.

⁵ Rwandan Franc (RWF) is the currency used in Rwanda. Currently, one (1) USD is equivalent to about 750 RWF. The overall excess tax burden is calculated as a weighted average of the excess tax burden per quintile. The weight used is the share of households' expenditure per quintile.

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Table 1. Splitting up the behavioral effect of the VAT rate increase on indirect taxes' revenue per commodity groups (in per cent)

Products	Substitution effect	Income effect	Total behavioral effect
Agricultural foods	0	0	0
Manufactured foods	0.323	0.033	0.356
Non-alcoholic beverages	0.307	0.009	0.316
Beer	-0.012	0.005	-0.007
Wine and liquor	0.433	0.000	0.433
Outside meals	0.125	0.019	0.144
Tobacco	0.047	0.060	0.107
Clothing	0.238	0.620	0.858
Personal effects	-0.050	0.047	-0.003
Leisure and recreation	-0.162	0.100	-0.062
Housing	-0.140	0.300	0.160
Furnishings and appliances	-0.161	0.214	0.053
Home water and energy	0.223	0.023	0.246
Home repairs	0.200	0.001	0.201
Private fuel	2.384	0.002	2.387
Public transport	0	0	0
Preventive health	0.571	0.004	0.575
Curative health	0.069	0.116	0.185
Hygienic products	-0.057	0.355	0.298
Communication	1.901	0.096	1.997
Education	0	0	0
Total	0.073	0.215	0.288
<i>per cent</i>	<i>25.3</i>	<i>74.7</i>	<i>100</i>

Source: Author's computations from EICV2.

Table 2. Splitting up the 2002 VAT rate increase effects on tax revenue (in per cent)

PRODUCTS	BEHAVIORAL CHANGE			MECHANICAL CHANGE	TOTAL CHANGE
	Substitution	Income	Total		
Agricultural foods	0	0	0	0	0
Manufactured	0.371	0.038	0.409	20	20.409
Non-alcoholic	0.491	0.015	0.506	7.602	8.108
Beer	-0.022	0.009	-0.013	5.847	5.835
Wine and liquor	0.846	0.001	0.847	5.34	6.187
Outside meals	0.144	0.022	0.165	20	20.165
Tobacco	0.086	0.110	0.196	5.714	5.910
Clothing	0.274	0.713	0.986	20	20.986
Personal effects	-0.057	0.054	-0.003	20	19.997
Leisure	-0.186	0.115	-0.071	20	19.929
Housing	-0.161	0.345	0.184	20	20.184
Furnishings	-0.185	0.246	0.061	20	20.061
Water and energy	0.256	0.026	0.282	20	20.282
Home repairs	0.230	0.002	0.232	20	20.232
Private fuel	3.756	0.004	3.760	7.142	10.902
Public transport	0	0	0	0	0
Preventive health	0.656	0.005	0.661	20	20.661
Curative health	0.080	0.133	0.213	20	20.213
Hygienic products	-0.066	0.408	0.342	20	20.342
Communication	2.186	0.110	2.296	43.6	45.896
Education	0	0	0	0	0
Total	0.152	0.334	0.486	19.523	20.009
<i>per cent</i>	<i>31.34</i>	<i>68.66</i>	<i>100</i>	-	-
	<i>0.761</i>	<i>1.668</i>	<i>2.429</i>	<i>97.571</i>	<i>100</i>

Source: Authors' calculations from EICV2.

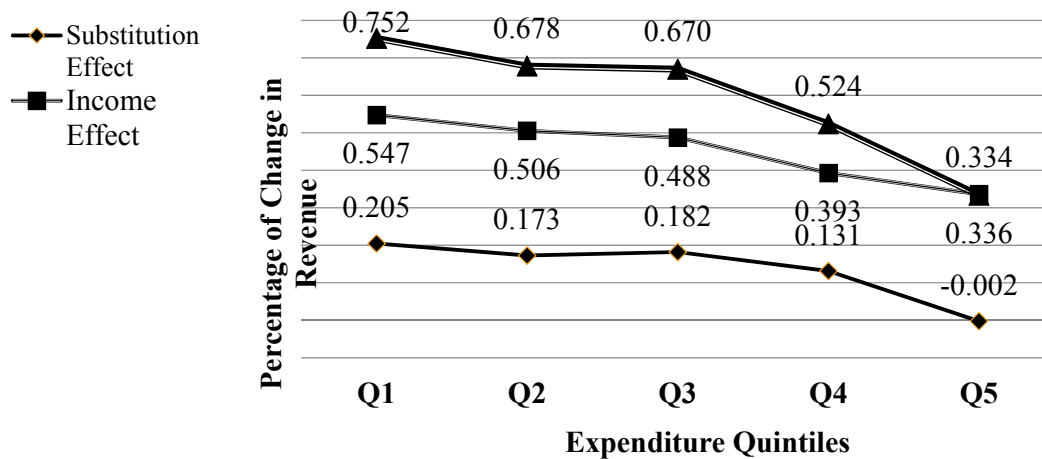


Figure 1. Splitting up the behavioral change in tax revenue per expenditure quintile (in per cent)
 Source: Authors' calculations from EICV2.

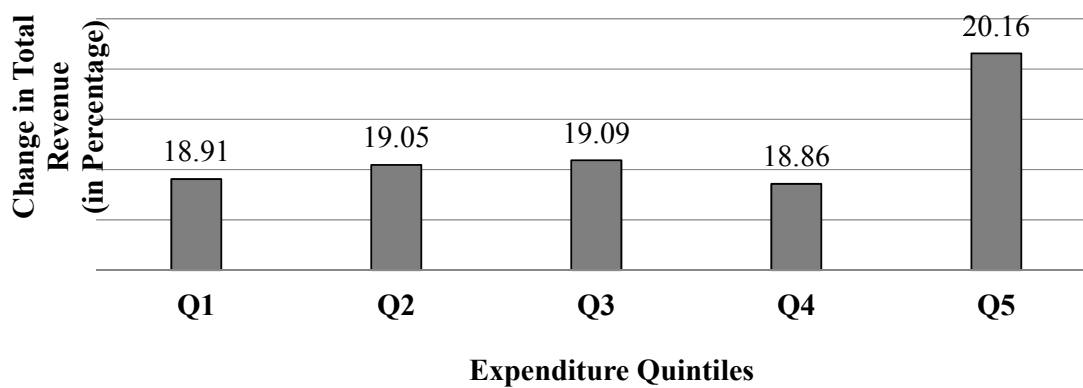


Figure 2. Households' contribution to total tax revenue growth per quintile (in per cent)
 Source: Authors' computations from EICV2.

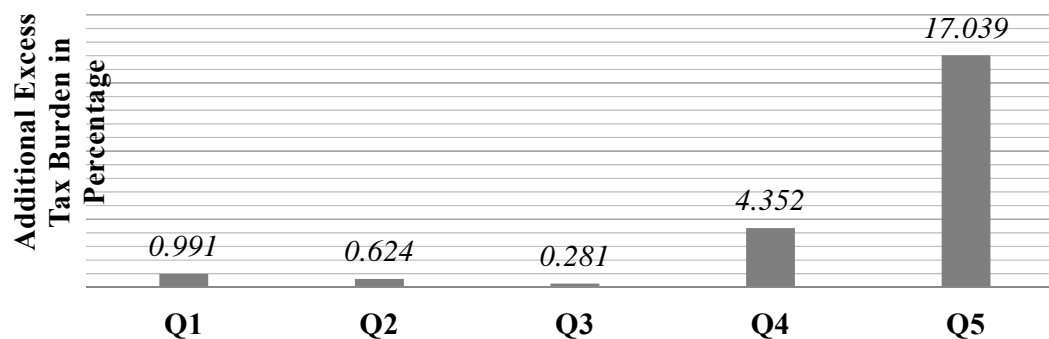
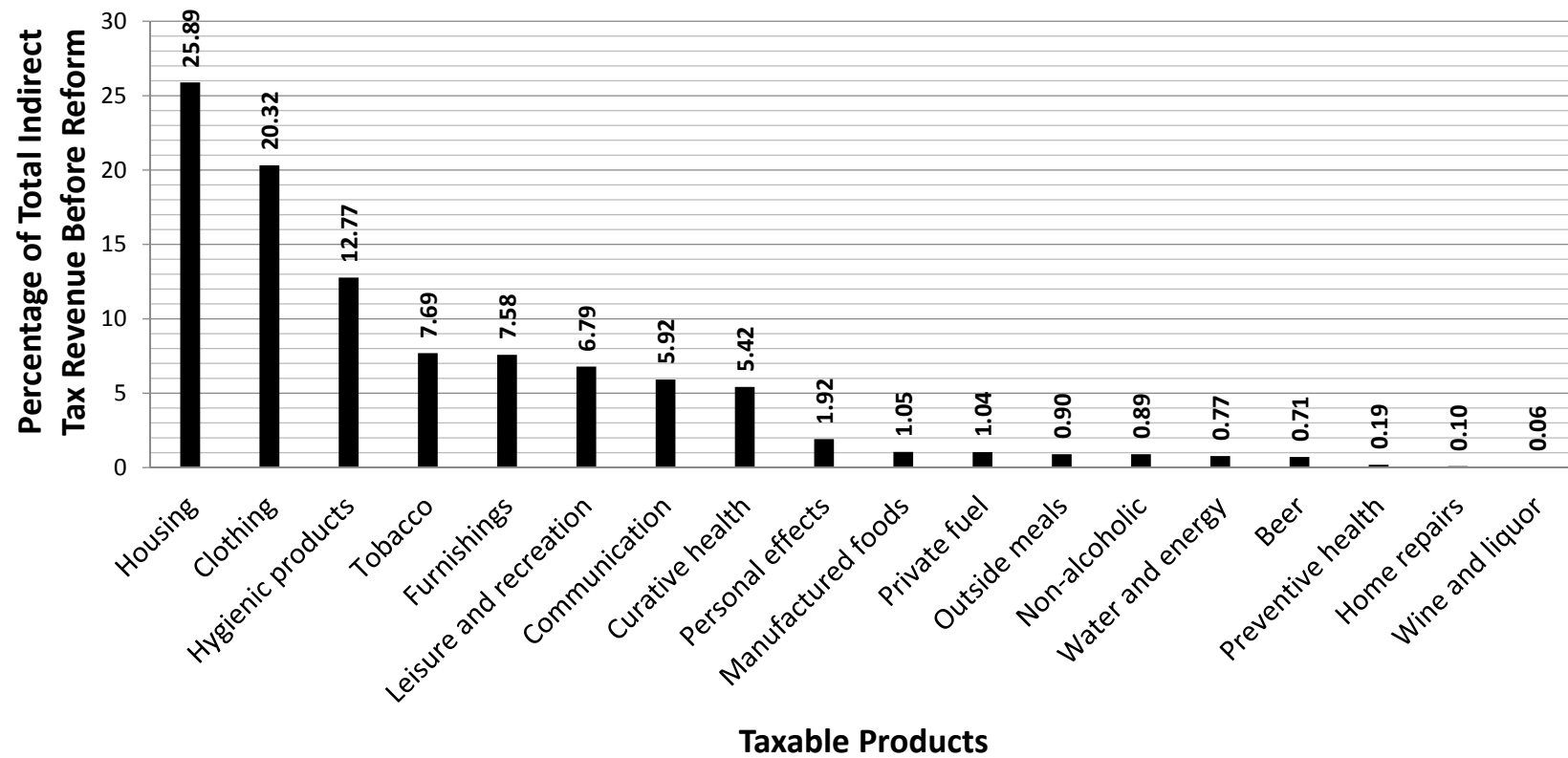


Figure 3. Additional Excess Burden resulting from the 2002 VAT rate reform
 Source: Authors' calculations from EICV2.

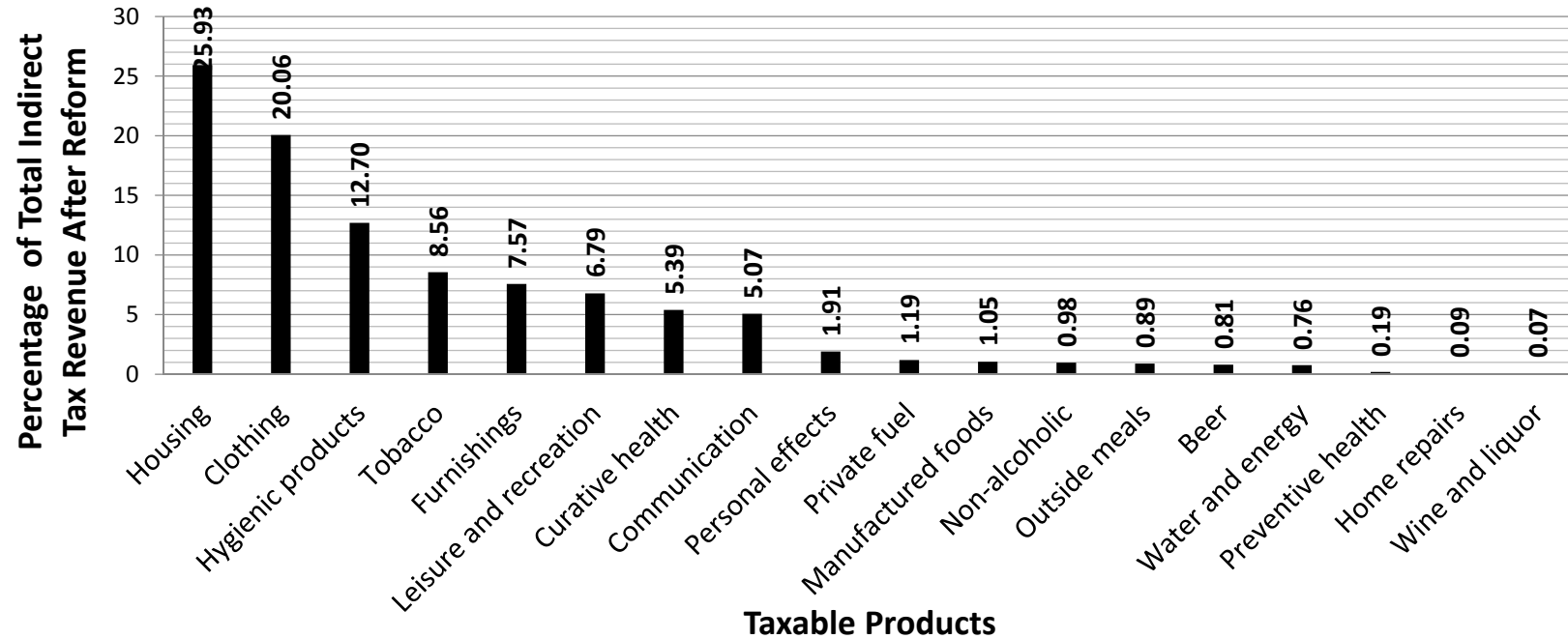
Appendix 1



Contribution of taxable products to total indirect tax revenue before VAT reform (in percentage)

Source: Authors' computations from EICV2.

Appendix 2



Contribution of taxable products to total indirect tax revenue after VAT reform (in percentage)

Source: Authors' computations from EICV2.

According to Appendix 1 and 2, eight products contributed separately to the total indirect tax revenue by more than 5 per cent before and after VAT reform. They are: Housing, Clothing, Hygienic Products, Tobacco, Communication, Furnishings and Appliances, Leisure and Recreation and Curative Health. The collective contribution of these eight products exceeded 92 per cent before and after the VAT reform. Consequently, the remaining 10 products contributed to indirect tax revenue by less than 8 per cent.