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# Is consumption-Laffer curve hump-shaped? The VAT evasion channel

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## Abstract

This paper shows a standard RBC model, when augmented with a VAT evasion channel, where evasion depends on the consumption tax rate, can produce a hump-shaped consumption Laffer curve. Furthermore, when the evasion channel is turned off, the hump in the Laffer curve disappears, resulting in a monotone relationship between the VAT rate and both the consumption and total tax revenue. This result comes in stark contrast to Hiraga and Nutahara (2017), who generate a peaking curve for consumption tax revenue in a model with a separable utility in consumption and leisure and no evasion. Their results are contingent on implausible values for elasticity parameters, and in addition predict a revenue-maximizing consumption tax rate which is implausibly high. The paper contributes to the public finance literature by providing evidence for the importance of the evasion mechanism, while at the same time adding to the debate about the existence of a peak tax rate for consumption tax revenue.

**Keywords:** consumption tax, VAT evasion, consumption-Laffer curve, general equilibrium, fiscal policy, Bulgaria

*JEL Classification Codes:* D58, E26, H26

# 1 Introduction and Motivation

Ever since Laffer (1981) and his idea that there is a inverted-U relationship between tax rates and revenue, macroeconomists have tried to incorporate this effect in general-equilibrium setups with government sector.<sup>1</sup> As shown in Trabandt and Uhlig (2011, 2013), Vasilev (2015a), and Junior (2016), among others, the standard RBC model is able to generate such a pattern for both labor and capital taxation, but not for the consumption tax rate. Over a reasonable range for the consumption tax rate, the relationship between the tax rate and the revenue generated is monotone increasing. The explanation for this phenomenon provided in the literature is that since the tax on consumption is a tax on demand (in contrast to capital and labor taxation, which are taxes on the supply of productive inputs), then there should not be any peaking relationship.

Still, there are some economists that believe that the class of neoclassical models should be able to generate a peaking consumption-Laffer curve. For example, when a typical macroeconomic model is simulated with the Trabandt-Uhlig utility function (Trabandt and Uhlig 2011, 2013) and the setup is calibrated using extreme (and even implausible) values of model parameters, the setup is able to produce a hump-shaped consumption Laffer curve. Hiraga and Nutahara (2017) argue that the crucial parameters that allow the model to generate such a relationship are the inter-temporal elasticity of substitution and the labor supply elasticity, which have to be sufficiently high. Hiraga and Nutahara (2017), however, choose reference values from the finance literature, and not macroeconomics, so their results are to be taken with caution: For example, in Hiraga and Nutahara (2015), tax revenue is then maximized for a VAT rate above 100 percent, which is not a plausible value. Similarly, in the Trabandt-Uhlig (2011, 2013) specification, the condition required for the hump-shaped consumption-Laffer curve to appear, ties two parameters describing human behavior (the intertemporal elasticity of substitution and the elasticity of labor supply) to labor tax rate, which is a policy instrument, and for a sufficiently high average effective labor income tax

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<sup>1</sup>Actually, as pointed out in Blinder (1981) before Laffer, there was Dupuit in 1844, and before that Edmund Burke in 1774, who expressed similar ideas. However, if we go back in time even further, we find it first described in Khandun (1377), hence some authors refer to it as the Khandun-Laffer curve, after the person who invented it first, and the person who re-discovered it last.

rate, the model predicts that to maximize revenue, consumption should be subsidized, or that the VAT rate should be negative. Since this is not a case that we observe anywhere, we view those results with skepticism.<sup>2</sup>

We also believe that a standard neoclassical model should be able to produce a hump-shaped consumption-Laffer curve, but for a different reason. More specifically, in this paper we take an alternative, and more constructive approach: Instead of stretching parameter values, or utilizing special cases of utility functions, we take a much more structural approach. Furthermore, we do not want to focus on utility functions, as they are not model primitives, but a non-unique way to summarize ordering of preferences. Instead, we emphasize a new transmission channel, which is understudied in the literature (but emphasized in the empirical literature), and incorporate a tax evasion technology in a micro-founded model based in optimization. More specifically, VAT evasion is a wide-spread phenomenon in Europe. After all, economics wants to understand human behavior, and by modeling the phenomenon, we can learn something new, which would point to policies to fight VAT evasion. In our model, consumption tax evasion is a well-calculated action. It presents households with some benefits, and so rational individuals would optimally choose to evade certain amount of taxes. We show this is not the case, as long as there is possibility for tax evasion.<sup>3</sup>

We take the empirical findings presented in Matthews (2003), Orsi et al. (2014), and Guedes de Oliveira and Costa (2015) as a motivation for the theoretical model in this paper, and aim to provide a theoretical background for their finding of a consumption Laffer curve. Matthews (2003) emphasizes the importance of evasion motives and the presence of grey economy. He tries to model in an informal way households' incentives to avoid the VAT tax, his explanation being the high tax rate itself, as well as factors such as low tax morale. In addition, Hemming and Kay (1981) point out that the invoicing method, which is considered to make VAT evasion self-refuting, does not guarantee full compliance. The presence of VAT

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<sup>2</sup>Kotamaki (2015) generates a hump-shaped consumption-Laffer curve when private and public consumption are perfect substitutes. Vogel (2012) generates a flattening consumption-Laffer curve in a model with very highly substitutable market and home production in the household aggregate consumption bundle.

<sup>3</sup>When the evasion channel is shut down, then the hump-shaped consumption Laffer curves transforms into a positive relationship between consumption tax rate and both consumption and total tax revenue.

evasion is therefore very important for European economies who depend on consumption taxation to finance the provision of public goods and government transfers. However, a complication stemming from pursuing this line of research is that in some countries consumption taxation is differentiated, with different goods and services being taxed at different rates. Bulgaria, on the other hand, has a common VAT rate, which has been held unchanged for some time now, and is thus a good testing ground for the theory.

The existence of a hump-shaped consumption Laffer curve is also very important for policy-makers, as it would signal the existence of new and interesting trade-offs in terms of raising consumption taxation. Until recently, it was commonly believed that raising indirect taxes, or taxes on final demand, is a cheap way to generate additional revenue, since no limits to the process were believed to exist. In the presence of evasion, however, the economy might find itself beyond the optimal (revenue-maximizing) consumption tax rate. In addition, a high VAT rate, also works like a decrease in disposable income (negative wealth effect): as also discussed in Matthews (2003), as VAT rate increases, people consume less, so there might be a negative effect on overall revenue as well.

In this paper we follow Orsi et al. (2014),<sup>4</sup> and Guedes de Oliveira and Costa's (2015) empirical modeling strategy, and argue that maybe the level of the tax rate itself is a factor that creates evasion; in the absence of consumption taxation, there will be trivially no VAT evasion.<sup>5</sup> The degree of VAT evasion being convex in the tax rate is akin to the government facing certain administrative costs. In addition, Keen and Smith (1996) also show that the incentive to evade is non-linear in the tax rate; similarly, Agha and Haughton (1996) also find evidence that the higher the rate of VAT, the lower the rate of compliance.<sup>6</sup> Alternatively, the prevalence of tax evasion could be a result of government inefficiency, or a principal-agent problem: Finance Minister (principal) and tax administration (agents). In

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<sup>4</sup>In particular, Orsi et al. (2014) show there is a quadratic relationship between the size of the grey economy and the income tax rate. We follow a similar logic for VAT evasion here as well.

<sup>5</sup>In contrast to Guedes de Oliveira and Costa (2015), who explore optimal consumption taxation as a variable conditioned on the business cycle, here we focus on the long-run effect. In their paper, revenue-maximizing consumption tax rates do not differ much over the business cycle.

<sup>6</sup>In contrast to Hiraga and Nutahara (2015),<sup>a</sup> and Nutahara (2015), the model with VAT evasion does not allow for a closed-form solution even in the static case, and thus needs to be solved numerically.

turn, tax administrators also may face a costly state verification problem with the collection of taxes. Similarly, we can add issues such as informational asymmetry, imperfect monitoring, and imperfect agent effort observability to the list of factors contributing to tax evasion.<sup>7</sup>

The rest of the paper is organized as follows: Section 2 describes the model setup, Section 3 describes the model calibration, Section 4 characterizes the symmetric steady-state, Section 5 presents the consumption Laffer curves. and Section 6 concludes.

## 2 Model Description

For the most part, the model follows Vasilev (2016): The novelty here is in the more careful modeling of the rent-seeking technology. There is a unit mass of households who derive utility out of consumption, leisure and public services. The time available to households can be spent in productive or in activities leading to VAT evasion. The benefit from opportunistic behavior is measured in terms of the share of extracted VAT payments. Thus, the government is assumed to be inefficient, and not being able to collect all the tax revenue, and will thus spend less on utility-enhancing public purchases and government transfers. On the production side, there is a representative firm, which produces a homogeneous final good, which could be used for consumption, investment, or government purchases.

### 2.1 Households

There is a unit mass of one-member households, indexed by  $i$ . Each household  $i$  maximizes its utility function:

$$\sum_{t=0}^{\infty} \beta^t \left\{ \ln c_{it} + \gamma \ln(1 - h_{it}) + \ln g_t^c \right\}, \quad (2.1)$$

where  $c_{it}$  denotes household's  $i$  private consumption in period  $t$ ,  $h_{it}$  are non-leisure hours in period  $t$ ,  $g_t^c$  is per-household consumption of public services,  $0 < \beta < 1$  is the discount

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<sup>7</sup>In a way, we add value by bridging different fields in the literature by incorporating findings from the political economy literature, e.g. Cukierman and Meltzer (1986) and Rogoff and Sibert (1988), who utilize "government competence" models. They summarize government's ability to manage/handle the economy, to decrease inefficiencies, to raise revenue through taxation in a single parameter, which we also do here.

factor, and  $\gamma > 0$  is the relative weight that each household attaches to leisure.<sup>8</sup>

Each household  $i$  starts with an initial stock of physical capital  $k_{i0}$ , and has to decide how much to add to it in the form of new investment. Every period physical capital depreciates at a rate  $\delta$ ,  $0 < \delta < 1$ . The law of motion for physical capital is then

$$k_{i,t+1} = i_{it} + (1 - \delta)k_{it}, \quad (2.2)$$

and the real interest rate is  $r_t$ , hence the before-tax capital income of household  $i$  in period  $t$  equals  $r_t k_{it}$ .

In addition to capital income, each household can generate labor income. However, not all hours are spent in productive activities: only  $\eta_{it}$  share,  $0 < \eta_{it} < 1$ , is dedicated to working in the representative firm, where the hourly wage rate is  $w_t$ , so labor income equals  $w_t \eta_{it} h_{it}$ . The remaining hours,  $(1 - \eta_{it})h_{it}$ , are used to engage in activities, whose aim is to evade paying VAT taxes.<sup>9</sup> The reward from engaging in VAT evasion is that the household can capture a share of the lost aggregate VAT tax revenue from the government, and thus augment its income. The "prize," or the rent, obtained as a result of the opportunistic behavior,  $R_{it}$ , is represented by the following technology, which is akin to the one used in Angelopoulos *et al.* (2009, 2011):

$$R_{it} = \theta \tau^c C_t \frac{(1 - \eta_{it})h_{it}}{\sum_i (1 - \eta_{it})h_{it}}, \quad (2.3)$$

where  $\tau^c$  is the VAT/consumption tax rate,  $C_t$  denotes aggregate consumption, and  $\tau^c C_t$  represents total VAT revenue in period  $t$ . Since the individual household is assumed to be small relative to the aggregate,  $C_t$  is taken as given. Parameter  $\theta$ ,  $0 < \theta < 1$ , is the efficiency of the rent-seeking technology) while  $\frac{(1 - \eta_{it})h_{it}}{\sum_i (1 - \eta_{it})h_{it}}$  is the endogenous probability of winning

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<sup>8</sup>The logarithmic form for consumption utility was chosen as in Prescott (1986), and in line with parameters for consumption utility estimated in Hansen and Singleton (1983), while the logarithmic utility of leisure was set as in Gali (2008). Setting the utility of leisure to be linear as in Hansen (1985) and Rogerson (1988), or iso-elastic, does not affect qualitatively the results obtained. Changing elasticities in the model only complicated the algebra, that is why we decided to go with the most parsimonious model, and focus on the main ingredients that would create a hump-shaped consumption-Laffer curve later on, which was the main contribution of the paper.

<sup>9</sup>In data,  $1 - \eta$  would correspond to the "hidden employment" share.

the "prize" (or getting a larger per-household "slice" of the rent pie). This probability is positively related to the own time spent evading taxes, and negatively related to the time other households' spend in tax evasion.

The rent is determined to depend on the aggregate, rather than simply on individual household consumption, since we are interested in the aggregate size of the grey economy, and not on the distributional effect of tax evasion. In addition, in contrast to Vasilev (2016), here we model the evasion parameter  $\theta$  as a convex function of consumption taxes:

$$\theta = \theta_0(\tau^c)^2 \quad (2.4)$$

Therefore, VAT evasion could be a result of government incompetence/inefficiency, driven by some administrative costs. Note that this particular modeling choice does not affect the consumer problem in any way, since households take both  $\tau^c$  and the scale parameter  $\theta_0$  as given.

Next, household  $i$ 's problem can be now simplified to

$$\sum_{t=0}^{\infty} \beta^t \left\{ \ln c_{it} + \gamma \ln[1 - (1 - \eta_{it})h_{it} - \eta_{it}h_{it}] + \ln g_{it}^c \right\} \quad (2.5)$$

s.t.

$$(1 + \tau^c)c_{it} + k_{i,t+1} - (1 - \delta)k_{it} = (1 - \tau^y)[w_t\eta_{it}h_{it} + r_tk_{it} + \pi_{it}] + g_{it}^t + \theta\tau^c C_t \frac{(1 - \eta_{it})h_{it}}{\sum_i (1 - \eta_{it})h_{it}}, \quad (2.6)$$

where  $\tau^y$  is the proportional income tax rate ( $0 < \tau^y < 1$ ), levied on both labor and capital income,  $g_{it}^t$  is household  $i$ 's government transfer, and  $\pi_{it}^t$  is household  $i$ 's claim on the firm's profit. The problem generates the following optimality conditions:

$$c_{it} : \frac{1}{c_{it}} = \lambda_t(1 + \tau^c) \quad (2.7)$$

$$k_{i,t+1} : \lambda_t = \beta\lambda_{t+1}[1 + (1 - \tau^y)r_{t+1} - \delta] \quad (2.8)$$

$$\eta_{it}h_{it} : \frac{\gamma}{1 - h_{it}} = \lambda_t(1 - \tau^y)w_t \quad (2.9)$$

$$(1 - \eta_{it})h_{it} : \frac{\gamma}{1 - h_{it}} = \lambda_t\theta\tau^c C_t \frac{1}{\sum_i (1 - \eta_{it})h_{it}} \quad (2.10)$$

$$TVC : \lim_{t \rightarrow \infty} \beta^t \lambda_t K_{t+1} = 0, \quad (2.11)$$



where  $K_t$  denotes aggregate physical capital in period  $t$ , and  $\lambda_t$  is the Lagrangean multiplier attached to household  $i$ 's budget constraint in period  $t$ .

The interpretation of the first-order conditions above is standard: the first one states that for each household, the marginal utility of consumption equals the marginal utility of wealth, corrected for the consumption tax rate. The second equation is the so-called "Euler condition," which describes how each household chooses to allocate physical capital over time. Next, at the margin, each hour spent working for the firm should balance the benefit from doing so in terms of additional income generates, and the cost measured in terms of lower utility of leisure. Similarly, at the margin, an hour spent rent-seeking should equate the benefit (in terms of captured VAT revenue) and the utility cost. The last condition is called the "transversality condition" (TVC): it states that at the end of the horizon, the value of physical capital should be zero.

## 2.2 Firm

There is a representative firm in the economy, which produces a homogeneous product. The price of output is normalized to unity. The production technology is Cobb-Douglas and uses both physical capital,  $k^f$ , and labor hours,  $h^f$ , to maximize static profit

$$\Pi_t = A(k_t^f)^\alpha (h_t^f)^{1-\alpha} - r_t k_t^f - w_t h_t^f, \quad (2.12)$$

where  $A$  denotes the level of technology. Since the firm rents the capital from households, the problem of the firm is a sequence of static profit maximizing problems. In equilibrium, there are no profits, and each input is priced according to its marginal product, *i.e.*:

$$k_t^f : \alpha \frac{y_t}{k_t^f} = r_t, \quad (2.13)$$

$$h_t^f : (1 - \alpha) \frac{y_t}{h_t^f} = w_t. \quad (2.14)$$

## 2.3 Government

In the model setup, the government is levying taxes on labor and capital income, as well as consumption in order to finance spending on utility-enhancing government purchases. However, due to VAT evasion (which could be due to inefficiencies in the way tax officials

operate), the government is able to collect only  $1 - \theta$  share of the consumption tax revenue. The government budget constraint is as follows:

$$g_t^c + \sum_i g_{it}^t = \left(1 - \theta_0(\tau^c)^2\right) \tau^c \sum_i c_{it} + \tau^y \left( w_t \sum_i \eta_{it} h_{it} + r_t \sum_i k_{it} \right) \quad (2.15)$$

Government consumption-to-output ratio would be chosen to match the average share in data, and government transfers would be determined residually in each period so that the government budget is always balanced. Note that since we consider only the exogenous policy case here, the government sets a constant VAT rate, and since it takes  $\theta_0$  as given, that is equivalent to the setup described in Vasilev (2016), where the government takes the resulting  $\theta$  as given.<sup>10</sup>

## 2.4 Market Clearing

In addition to the optimality conditions from the household's and firm's problem, as presented in the previous subsections, and the government budget constraint above, we need to impose consistency among the different decisions. More specifically, this would require that in equilibrium (i) aggregate quantities equal the sum of individual allocations, and (ii) output, capital and labor markets all clear, or for all  $t$ :

$$\sum_i \left[ c_{it} + k_{i,t+1} - (1 - \delta)k_{it} \right] + g_t^c = y_t \quad (2.16)$$

$$\sum_i c_{it} = C_t \quad (2.17)$$

$$\sum_i g_{it}^t = g_t^t \quad (2.18)$$

$$\sum_i k_{it} = k_t^f = K_t \quad (2.19)$$

$$\sum_i \eta_{it} h_{it} = h_t^f. \quad (2.20)$$

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<sup>10</sup>We consider the importance of VAT evasion with respect to a balanced budget restriction faced by the government. Bulgaria has a low level of debt so the balanced budget assumption is not such a bad approximation. Furthermore, under a currency board arrangement, the government cannot run chronic deficits, and instead should try to achieve modest budget surpluses.

## 2.5 Dynamic Competitive Equilibrium (DCE)

For a given level of technology  $A$ , average tax rates  $\{\tau^c, \tau^y\}$ , initial individual capital endowments stock  $k_{i0}, \forall i$ , and aggregate allocations  $\{C_t, K_t\}_{t=0}^\infty$ , the decentralized dynamic competitive equilibrium is a list of sequences  $\{c_{it}, i_{it}, k_{it}, \eta_{it}, h_{it}\}_{t=0}^\infty$  for each household  $i$ , input levels  $\{k_t^f, h_t^f\}$  chosen by the firm in each time period  $t$ , a sequence of government purchases and transfers  $\{g_t^c, g_t^t\}_{t=0}^\infty$ , and input prices  $\{w_t, r_t\}_{t=0}^\infty$  such that (i) each household  $i$  maximizes its utility function subject to its budget constraint; (ii) the representative firm maximizes profit; (iii) government budget is balanced in each period; (iv) all markets clear.

### 2.5.1 Symmetric DCE

In the general, non-symmetric, case it is very difficult to solve the system defined in the subsection above. More specifically, the model in its general formulation can generate a multitude of distributions of capital stock holdings across households, and in this sense, the equilibrium is indeterminate. Therefore, we will concentrate on a particular equilibrium, one in which all households are identical, or the symmetric solution. This requires setting  $k_{i0} = k_0$ , and imposing symmetry in the DCE system for all  $i$ , which in turn greatly simplifies the optimality conditions derived above. Since the model features a unit mass of households, this produces  $c_{it} = C_t, k_{it} = K_t, h_{it} = h_t, \eta_{it} = \eta_t$ , etc. In addition, in the symmetric equilibrium every household will receive an equal share of the pie, or the rent from VAT evasion will be spread uniformly (note that total rent is now  $R_t = \theta \tau^c C_t$ ). Indeed, this might be a shortcoming of the setup, but since the main objective is to make a prediction about the aggregate size of the VAT extracted, not how the degree of evasion is distributed across the population, the focus on the symmetric DCE does not pose a significant limitation of the analysis.

## 3 Data and Model Calibration

To compute the size of VAT evasion in Bulgaria, we will focus on the period after the introduction of the currency board (1999-2014). Data on output, consumption and investment was collected from National Statistical Institute (2015), while the real interest rate is taken from Bulgarian National Bank Statistical Database (2015). The calibration strategy described

in this section follows a long-established tradition in modern quantitative macroeconomics: first, the discount factor,  $\beta = 0.937$ , is set to match the steady-state capital-to-output ratio in Bulgaria,  $k/y = 3.491$ . The labor share parameter,  $1 - \alpha = 0.571$ , was obtained as the average value of labor income in aggregate output over the period 1999-2014. This value is slightly lower as compared to other studies on developed economies, due to the overaccumulation of physical capital during the communist regime, which was in place until 1989 (which in turn made capital share in Bulgaria higher than the value measured in other Western countries).

The relative weight attached to the utility out of leisure in the household's utility function,  $\gamma$ , is calibrated to match that in steady-state consumers would supply one-third of their time endowment to working. This is in line with the estimates for Bulgaria as well over the period studied. The depreciation rate of physical capital in Bulgaria,  $\delta = 0.05$ , was taken from Vasilev (2015b). It was estimated as the average depreciation rate over the period 1999-2014. The share of working time used in the VAT evasion technology,  $1 - \eta = 1/3$ , was set as the average hidden employment share as estimated by Center for the Study of Democracy (2015).<sup>11</sup> With its help, the value of  $\theta$ , the share of VAT tax evasion out of total consumption tax revenue, can be then calibrated. Finally, the average income tax rate was set to  $\tau^y = 0.1$ . This is the average effective tax rate on income between 1999-2007, when Bulgaria used progressive income taxation, and equal to the proportional income tax rate introduced as of 2008. Finally, the tax rate on consumption is set to its value over the period,  $\tau^c = 0.2$ .<sup>12</sup> Table 1 below summarizes the values of all model parameters used in the paper.

## 4 Steady-State

Once the values of model parameters were obtained, the steady-state equilibrium system solved, the "big ratios" can be compared to their averages in Bulgarian data. The results are reported in Table 2 on the next page. The steady-state level of output was normalized to

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<sup>11</sup>Angelopoulos *et al.* (2011) find a similar value for Mexico,  $\eta = 2/3$ .

<sup>12</sup>Here we abstract away from excise taxes, import duties, as well as the reduced VAT rate applied in the tourism sector (8%).

Table 1: Model Parameters

Parameter	Value	Description	Method
$\beta$	0.937	Discount factor	Calibrated
$\alpha$	0.429	Capital Share	Data average
$1 - \alpha$	0.571	Labor Share	Calibrated
$\gamma$	0.867	Relative weight attached to leisure	Calibrated
$\delta$	0.050	Depreciation rate on physical capital	Data average
$\eta$	0.670	Share of working hours used productively	Set/Estimated
$\theta$	0.867	Share of evaded VAT revenue	Calibrated
$\tau^y$	0.100	Average tax rate on income	Data average
$\tau^c$	0.200	VAT/consumption tax rate	Data average

unity, which greatly simplified the computations.<sup>13</sup> Next, the model matches consumption-to-output ratio by construction; The investment and government purchases ratios are also closely approximated. The shares of income are also identical to those in data, which is an artifact of the assumptions imposed on functional form of the aggregate production function.

The after-tax return, net of depreciation,  $\tilde{r} = (1 - \tau^y)r - \delta$ , is also relatively well-captured by the model. Lastly, besides correctly predicting the magnitude of VAT evasion relative to output, the model with a VAT evasion channel also can generate a hump-shaped consumption Laffer curve, as demonstrated in the next section.

## 5 Consumption Laffer curve

In this section we perform the following experiment: we allow the consumption tax rate to vary, while holding  $\theta_0$  and  $g^t$  fixed, to see how consumption and total tax revenue respond. As seen from Fig. 1 on the next page, in the absence of VAT evasion (corresponding to setting  $\eta = 1$  and  $\theta_0 = 0$ ), there is no hump-shaped consumption-Laffer curve. Only in the presence of a VAT evasion channel, and evasion that depends on the rate of the consumption tax, do we see (in Fig. 2) a peaking consumption-Laffer curve for a positive consumption tax

<sup>13</sup>Note that the steady-state level of technology  $A$  now differs from unity.

Table 2: Data Averages and Long-run Solution

Variable	Description	Data	Model
$y$	Steady-state output	N/A	1.000
$c/y$	Consumption-to-output ratio	0.674	0.674
$i/y$	Investment-to-output ratio	0.201	0.175
$g^c/y$	Government cons-to-output ratio	0.159	0.151
$w\eta h/y$	Labor income-to-output ratio	0.571	0.571
$rk/y$	Capital income-to-output ratio	0.429	0.429
$h$	Share of time spent working	0.333	0.333
$A$	Scale parameter of the production function	N/A	1.095
$\tilde{r}$	After-tax net return on capital	0.056	0.067
$\theta\tau^c c/y$	VAT evasion-to-output ratio	0.265	0.257

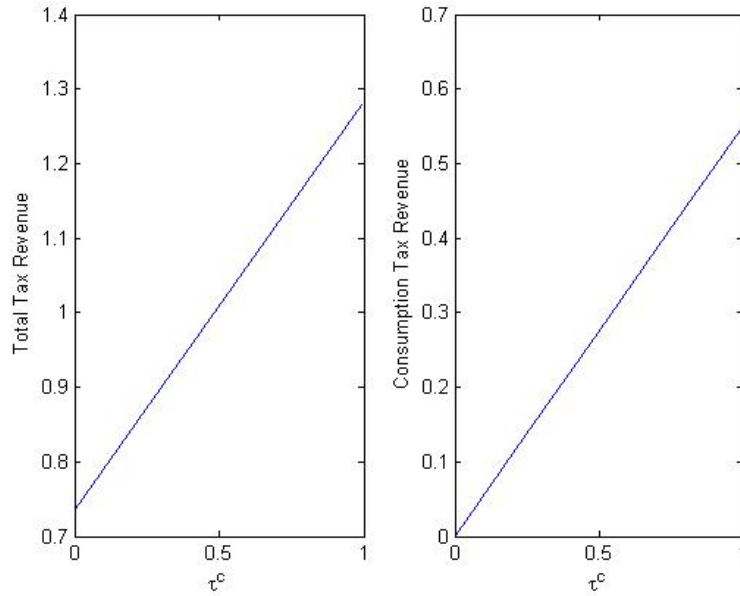


Figure 1: Consumption Laffer Curves, no evasion

rate.<sup>14</sup> The revenue maximizing consumption tax in Bulgaria turns out to be  $\tau^c = 3.38\%$ .

<sup>14</sup>In addition, the consumption tax revenue raised by the government is maximized when  $\tau^c = (2\theta_0)^{-0.5}$ . Also, for a very high tax rate, consumption tax revenue is negative (due to the extraction being very high). Such cases correspond to fraudulent deduction of VAT as part of some fake exports scheme, etc. Note

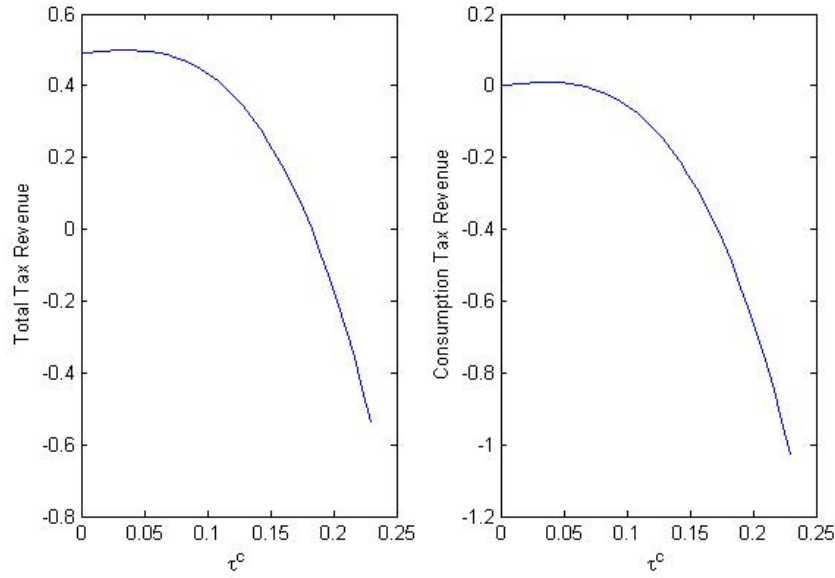


Figure 2: Consumption Laffer Curves, VAT evasion case

Overall revenue is close to zero, due to the fact that as the consumption tax rate increases, evasion increases at an exponential (quadratic) rate, so after some point evasion is so large that consumption and total tax revenue become negative.

The revenue maximizing consumption tax rate in Bulgaria might look too low at first glance, so we are cautious in our interpretation. First, we are not suggesting that a government should set its VAT rate at the consumption-revenue-maximizing rate obtained above; just the contrary- one argument against that is that the model ignores important frictions, such as the costs of administering consumption taxation and VAT accounts, so in reality the rate may need to be much higher in order to at least cover those costs. In addition, a primary objective of the government is the provision of pure public goods (courts, law and order, army, etc) to necessitate the very functioning of the state. Raising the funds to finance the provision of those public services may necessitate the government to give up on some other objectives, such as consumption tax-revenue-maximization.<sup>15</sup> What the current paper aims to show is that, contrary to popular belief, raising VAT rate as a cheap way (being that when  $\theta$  is modeled to be independent of the consumption tax rate, the model does not generate a hump-shaped consumption Laffer curve.

<sup>15</sup>Maximizing tax revenue in turn decreases households' after-tax income, and thus lowers welfare.

a tax on demand) to finance government expenditure, is still not a free lunch, and raising the rate, especially in a country with substantial VAT evasion, quickly leads to a drop in the revenue associated with that category. Furthermore, in the case of Bulgaria, where the public finance system is organized around indirect taxes, and taxing consumption makes almost half of the total tax revenue, the economy is likely to be on the right-hand-side of the consumption-Laffer curve, significantly to the right of the peak. In addition, in the presence of VAT evasion, where the evasion itself is driven by the consumption tax rate itself, lowering the VAT rate might both lower evasion, while increasing the consumption tax revenue. Whether, and how much exactly the rate should be cut, is a topic for future research, which requires a much more sophisticated model. But for now, the very fact that the shape of the consumption-Laffer curve changes substantially when a model is augmented with VAT evasion, gives some credence to the quantitative importance of this transmission channel, which is then to be taken as an important ingredient in the discussion of fiscal policy issues. From that perspective, adding consumption-tax evasion in a macro model, which is able to generate a peaking consumption-Laffer curve (which a setup without evasion cannot) is an important contribution to the literature.

## 6 Conclusions

This paper shows a standard RBC model, when augmented with a VAT evasion channel, where evasion depends on the consumption tax rate, can produce a hump-shaped consumption Laffer curve. Furthermore, when the evasion channel is turned off, the hump in the Laffer curve disappears, resulting in a monotone relationship between the VAT rate and both the consumption and total tax revenue. This result comes in stark contrast to Hiraganda and Nituhara (2015), who generate a peaking curve for consumption tax revenue in a model with a separable utility in consumption and leisure and no evasion. Their results are contingent on implausible values for elasticity parameters, and in addition predict a revenue-maximizing consumption tax rate which is implausibly high. The paper contributes to the public finance literature by providing evidence for the importance of the evasion mechanism, while at the same time adding to the debate about the existence of a peak tax rate for consumption tax revenue.



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