VALUE ADDED TAX IMPACT ON ECONOMIC ACTIVITY: IMPORTANCE, IMPLICATION AND ASSESSMENT – THE ROMANIAN EXPERIENCE

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Abstract

This paper studies the impact of VAT upon the economic activity in Romania. By developing a new mathematical model we offer several dynamic and efficient possibilities for observing the modifications caused by the temporary reduction of taxes upon the personal incomes which suggest that the resulting additional incomes are often saved and less consumed. Analyzing several temporary reductions in incomes, the model describes also a scheme regarding the developments of economic growth. Based on this scheme, are revealed the different arrangements in which a present economic activity influences a future one. According to the proposed model, it is highlighted that the national income increases as a response to the aggregated demand.

Keywords: aggregate demand, indirect tax, investments, inflation, output.

1. Introduction

Fifty years ago, the Value Added Tax (VAT) was rarely heard outside of France and some specialized handbooks. Nowadays, it is found in over 130 countries where it commonly raises 20% or more of all tax revenues. Widely adopted in sub-Saharan Africa and elsewhere, it has been the centerpiece of the tax reform in many developing countries. By any standards, the rise of the VAT has been the most significant development in tax policy and administration of recent decades.

Since the 1960s, VAT systems have been progressively adopted around the world. The majority of VAT regimes are characterized by a consumption tax base with multiple tax rates, multiple exemptions, and the credit method of tax liability calculation. These VAT characteristics have been incorporated in a number of studies on the incidence and economic effects of VAT. However, three important VAT characteristics have yet to be formalized in applied VAT research: multi production, legislated differences in exemption status, and industry-specific differences in the refund ability of VAT paid on inputs to production and investment. The need for careful and detailed treatment of these VAT characteristics is particularly important in disaggregated general equilibrium models. These models are recognized as well suited for the analysis of the efficiency effects of tax policies. The modeling of VAT within a general equilibrium framework raises a fourth issue not yet addressed in the VAT modeling literature. Even in highly disaggregated models, commodity and industrial definitions are, by necessity, aggregates of hundreds of commodities and industries, each with the possibility of distinct tax rates and exemptions under the relevant VAT statutes. Previous studies have assumed that a commodity is either exempt or taxed.

Several decades ago, there have been numerous theoretical and empirical studies that attempted to investigate the relationship between taxation and economic performance and long-term economic growth. The theory of tax incidence or burden has been a central focus of public sector economics. There is a consensus that the analysis of tax incidence should be conducted within a general equilibrium framework.

The theoretical tax incidence literature argues that if a tax affects the price of an accumulated factor of production (physical capital, human capital and technology) then this tax is distortionary. An increase in distortionary taxation discourages the economic activities and consequently lowers the growth rate of economic output.

Recent papers on base broadening of the VAT have shown how traditional arguments in favor of a broadly based VAT at a low uniform rate can break down if there is an underground economy (Piggott and Whalley, 2001), household production with market provided inputs (Sandmo, 1990), labor (or all factors of production) is internationally mobile (Lockwood *et all.*, 2002), or other non-traditional elements appear.

There are two the key challenges for tax design that face almost all developing countries. The first is that of dealing with a large informal sector. Hard to measure, but put by Schneider (2002) at an average of around 40% of the gross national income in these countries, informality represents both a costly narrowing of the tax base and a potentially serious distortion of economic activity. The impact which informal econ-

omy has on the tax policy design made the subject of research for many scientists among which, the most notable ones are Piggott and Whalley (2001), Stiglitz (2003), Munk (2008), Emran and Stiglitz (2005), and, taking a somewhat different perspective, Gordon and Li (2005).

The second challenge is determining the proper degree of reliance on trade taxes. These still account for 20% or (often) more of all tax revenue in many developing countries, so that continuing pressures towards further trade liberalization, combined with pressing revenue needs, raise the question of how reduced trade tax revenue can be replaced from domestic sources (Keen, 2008). What is troubling here is the emerging evidence which suggests that many low income countries (though by no means all) experienced difficulties in achieving such replacement in the past (Baunsgaard and Keen 2005).

The effects of fiscal policy on economic growth have been the subject of long debates. With respect to short-term effects, a large body of empirical research, primarily for industrial countries, has been devoted to understanding under which conditions fiscal multipliers can be small (and even negative) (Alesina and Perotti, 1996; Alesina and Ardagna, 1998; Perotti, 1999).

Perotti (1999), for example, shows that budgetary consolidations tend to be expansionary when debt is either high or it grows rapidly. Alesina *et al.* (1995) and Alesina and Ardagna (1998) find that, in addition to the size and persistence of the fiscal impulse, budget composition matters when it comes about differentiating all those private sectors which the fiscal policy is applicable to. Fiscal adjustments that rely primarily on cuts in transfers and the wage bill tend to last longer and can be expansionary, while those that rely primarily on tax increases and cuts in public investment tend to be constricted and unsustainable (Von Hagen and Strautch, 2001).

The potential effects of fiscal policy on long-term growth have also generated substantial attention (Tanzi and Zee, 1996). The most recent research studies in the field of endogenous growth suggest that the fiscal policy can either promote or retard both the economic growth and the investments in human and physical capital. The last ones can be affected by taxes while investments can influence the governmental expenditure. Hence, the fiscal policy can influence certain variables which the economic growth depends on (Chamley, 1986; Barro, 1990, 1991; King and Rebelo, 1990; Barro and Sala-i-Martin, 1995; Mendoza *et al.*, 1997).

Several empirical studies deal with the relationship between VAT and a multilevel production leading to the conclusion that allowance efficiency effects depend on changes of activity across sectors with different rates of net indirect taxation (Giesecke and Nhi, 2010; De Mello, 2009; Lazarev and Pleshdinskii, 2007). Studies conducted by Christadl, Fetchenhauer and Hoezl (2011) examine the potential confirmation bias in price perception in consequence to a real-world event and different explanations for such a bias and suggesting that participants reported price increases that were significantly higher than the official price development and in line with an undifferentiated belief in market price increases.

Summarizing, the emergence of value added tax stays on the movement of goods. Switching to VAT has made it possible to avoid cumulative taxation of goods movement. It is a unique tax that it is perceived in a fractionated way, corresponding to the added value for each stage of the economical circuit.

2. The VAT evolution and its impact upon the economic activity in Romania

In developing countries, especially in the case of Romania, the studies on the VAT emphasize the importance of the conditions under which a VAT is fully optimal (even though it is a tax on the informal sector of production which is restrictive): an efficient tax structure requires the development of both the VAT and the withholding taxes (Pantazi and Strǎoanu, 2011; Keen, 2008; Zee, 2008).

The VAT was brought in Romania in 1993, its introduction being based on the following considerations: a) there was a need to replace the former tax applied on the commodity flow, and b) the purpose was to increase the resources of the state and to comply with the tax systems existing in the rest of the European countries.

At the beginning, the flat tax was 18%. Later, the VAT system has undergone multiple rearrangements both from the point of view of the taxable operations and the tax subjects as well as from the point of view of the rates. In regards to the VAT regime change, we can mention that initially there were two rates, 18% and 9%, which were later increased to 22% and 11%. Then, the 19% flat rate was introduced; at the moment its value is 24%.

According to the existent Tax Code from 2014, the standard VAT rate in Romania is 24% and it applies to the taxation base of those taxable transactions that are not exempted or not subject for the rate reduction.

The reduced rate is 9% and it applies to the taxation base of the following services and/or commodities:
- Services as granting access to castles, museums, memorial houses, historical monuments, etc.;
- Delivery of textbooks, books, newspapers and magazines, excepting those intended exclusively or primary for advertising;
- Delivery of prostheses and accessories of such, excepting the dental ones;
- Delivery of orthopedic products;
- Delivery of drugs for human or veterinary use;
- Accommodation in the hotel sector, including the rental lands for camping; and
- The delivery of the following goods (valid starting with the 1st of September, 2013):
  - All bread types as well as the following bakery varieties: baguettes, mini baguettes, mini bread and braided bakery;
  - White wheat flour, semi-white wheat flour, dark wheat flour and rye flour; and
  - Triticum spelta, common wheat.

Starting from 2013, the VAT applicable to the basic agro-food products was reduced from 24% to 9%. This measure was taken even in other EU member states, such

as Belgium and Germany, and it was meant to ensure the required social protection and the increase of the collection rate for the state budget. Also, there is a reduced rate of 5% applicable to the taxation base for the delivery of houses as part of the social policy, including the land on which the houses are built.

Regarding the impact of VAT on the economic activity from Romania, we can assess that Romania data are striking. In 1999, Romania had the lowest effective tax report/tax formal throughout the region. The low income could be explained by the fact that firms were granted exemption from payment, arrears accumulations which were removed from tax obligations (not necessarily evasion). Because in Romania normalized tax returns are the lowest in the region, we believe that poor collection and exemptions from tax are the key features in explaining the poor fiscal performance recorded.

In Romania, in the same way as in other developing countries, the level of VAT has an important role in terms of economic growth. Therefore, it is required for any action regarding the application of a lower or a higher VAT rate to be done by taking into account especially the economic situation of Romania.

At the same time, a high VAT rate limits the possibility of consumption and investment, and it generates negative effects on the supply and the demand of economic goods produced by economic agents. The increment of the value-added tax has negative effects on inflation by increasing it and it has a series of inconvenient consequences on the economy.

In the context of the economic and financial problems that Romania is confronted with it would be appropriate to introduce differentiated VAT rates. The application of differentiated VAT rates for ordinary commodities and luxury goods would help disadvantaged people during the crisis by removing the damage and the consumption failure.

In this sense, we propose a mathematical model capable of supporting the statements above. The objectives of the research are to look particularly at the following paths:

- Positioning the VAT in Romania;
- Presentation of the principles and rules governing the organization of VAT in Romania; and
- Formulation of possible solutions to increase efficiency in Romanian and in other European economies based on VAT.

Regarding the research methodology, the inductive method was used. We conducted a qualitative research based on observation of some aspects, and also a quantitative one. The main method used for collecting both the data and the historical pieces of information was the observation (the spontaneous and the provoked types). This method applies to the research subject, which in this case is the Romanian VAT rate, and it is used with the purpose of exposing the evolution of this type of indirect taxation. Information was extracted from reports.

Inductive research is a flexible approach because there is no requirement of pre-determined theory to collect data and information. The researcher uses observed data and facts to reach a tentative hypothesis and to define a theory regarding the research problem. This helps the research to give inductive arguments (Mertens, 2009).

The proposed methodology which was used has several stages: theoretical foundations of the study, selection of the case studies, conducting exploratory semi-structured interviews, analysis of results, achieving scripting support, and presenting the results.

For an efficient symbiosis, in our study we used several research papers and articles with a direct impact on our study, especially regarding:

- Knowledge and interpretation of reality in the concerned field;
- Information of management, citizens and the financial authorities regarding the economic and the financial condition, performance achieved, and the efficiency of resource valorization;
- Identification of new sources of competitive advantage;
- Foundation of the measures to reduce or improve performance; and
- Foundation of the development strategies in a dynamic competitive environment.

In the present study it was considered as a major objective to ensure the viability under domestic and international competition within the restrictions imposed by fiscal policy. In our opinion, it was important to present and analyze the way in which differentiated VAT has a positive impact over Romanian economy.

In the relationship between supply and demand, although the first analysis would have the decisive role offer, especially in the developed market economy conditions, application itself, since its knowledge, influence offer guiding and stimulating, neglecting the changes in volume, quality and structure of demand, caused by joint action of various factors. In the following chapter we will use a mathematical optimization for the economic adjustment.

3. Mathematical optimization for the economic adjustment – comparative study

3.1. Description of the economic control model

In this article we present a variant of the Philips multiplication-accelerator. In this model, the command parameter is represented by the budgetary expenditures which need to be chosen in order to attain a desired level of the Gross National Product (GNP). The model is leading, ultimately, to the problem of quadratic functional linear regulator. Using the known results it is precisely analyzed the stability of the optimal trajectories.

The notations will be as following:

$\overline{G}(t)$ - the budgetary expenditure at the t moment,

$\overline{Z}(t)$ - the exports at the t moment,

$\overline{M}(t)$ - the imports at the t moment,

$\overline{C}(t)$ - the consumption at the t moment, and

$\overline{I}(t)$ - the investments at the t moment.

There is a necessary Gross National Product (demand) $\overline{Y}(t_n)$ correspondent to each choice of the budgetary expenditure $\overline{G}(t)$ expressed by the following equation:

$$\overline{Y}_n(t) = \overline{G}(t) + \overline{Z}(t) + \overline{M}(t) + \overline{C}(t) + \overline{I}(t) \tag{1}$$

The $\overline{Y}(t)$ represents the GNP achieved effectively at the t moment. In general, $\overline{Y}_n(t)$ and $\overline{Y}(t)$ quantities are not equal. The evolution of the system is described by the equations:

$$v\overline{Y}(t) = \overline{I}(t),$$
$$\overline{I}(t) = \sigma(\overline{Y}_n(t) - \overline{Y}(t)),$$
$$\overline{C}(t) = (1 - s)\overline{Y}(t), \tag{2), (3), (4), (5), (6)}$$
$$\overline{Z}(t) = z\overline{Y}(t),$$
$$\overline{M}(t) = m\overline{Y}(t) + \overline{Y}_n(t) - \overline{Y}(t),$$

Where $v > 0, \sigma > 0, 0 < s < 1, z > 0, m > 0$ are constant. The equation (2) expresses the fact that the entrance of the $\overline{I}(t)$ in the system is proportional with the $\overline{Y}(t)$ output variation speed. In the control theory, such an equation has the generic name of 'acceleration equation'. The v acceleration coefficient represents the investment necessary quantity for GNP's growth by a unit.

The multiplier equation (3) shows that the investment is proportional with the excess between the necessary GNP and the achieved one. It can be assumed that both consumption and exports represent constant shares from the achieved GNP. Finally, the imports are a constant fraction from the realized GNP plus the excess between the necessary GNP and the achieved one.

By removing $\overline{Y}_n(t), \overline{Z}(t), \overline{M}(t), \overline{C}(t), \overline{I}(t)$ from the (1) – (6) equations the equation obtained will be the following:

$$\overline{Y}(t) = \alpha\overline{Y}(t) + \overline{G}(t) \tag{7}$$

Where:

$$\alpha = \frac{\sigma(z - m - s)}{v(2 - \sigma)}, \tag{8}$$

$$\beta = \frac{\sigma}{v(2 - \sigma)}, \sigma \neq 2 \tag{9}$$

Knowing that the initial value $\overline{Y}(0) = \overline{Y}_0$ of the achieved gross national product, at the $t = 0$ moment, there is a $\overline{Y}(t)$ unique solution of the equation (7) corresponding to any $\overline{G}(t)$, $t \geq 0$ choice for the budgetary expenditures.

$\overline{G}^* > 0$ is a random constant value attribute to the budgetary spending. We will name a equilibrium solution (correspondent for the $\overline{G}^*$ value) of the (1) - (9) equations a solution of it in which all the functions $\overline{Y}_n(t), \overline{T}(t), \overline{Z}(t), \overline{M}(t), \overline{C}(t), \overline{I}(t), \overline{G}(t)$ are constant, $G(t) = \overline{G}^*$, and the necessary GNP is equal to the achieved GNP: $\overline{Y}_n(t) = \overline{Y}(t)$.

Hence, in order for the constant sizes $\overline{Y}_n^* = \overline{Y}^*, \overline{Z}^*, \overline{M}^*, \overline{C}^*, \overline{I}^*, \overline{G}^*$ to represent a necessary equilibrium solution, the following equations must be checked:

$$\overline{Y}^* = \overline{G}^* + \overline{Z}^* - \overline{M}^* + \overline{C}^* + \overline{G}^*,$$
$$\overline{I}^* = 0,$$
$$\overline{C}^* = (1-s)\overline{Y}^*, \ \overline{Z}^* = z\overline{Y}^*, \ \overline{M}^* = m\overline{Y}^*.$$

By solving this system according to $\overline{G}^*$, the results are the following:

$$\overline{Y}^* = \frac{\overline{G}^*}{s-z-m}, \overline{C}^* = \frac{(1-s)}{s-z-m}\overline{G}^*, \ \overline{Z}^* = \frac{z}{s-z-m}\overline{G}^*,$$

$$\overline{M}^* = \frac{m}{s-z-m}\overline{G}^*, \ \overline{I}^* = 0. \tag{10}$$

Let it be:

$$Y_n(t) = \overline{Y}_n(t) - \overline{Y}^*, \ Y(t) = \overline{Y}(t) - \overline{Y}^*, \ G(t) = \overline{G}(t) - \overline{G}^*, \ Z(t) = \overline{Z}(t) - \overline{Z}^*,$$
$$M(t) = \overline{M}(t) - \overline{M}^*, \ C(t) = \overline{C}(t) - \overline{C}^*, \ I(t) = \overline{I}(t) - \overline{I}^*,$$

The deviation of $\overline{Y}_n(t), \overline{Y}(t), \overline{G}(t), \overline{Z}(t), \overline{M}(t), \overline{C}(t), \overline{I}(t)$ from their equilibrium state. It is easy to notice that these deviations satisfy the equations:

$$Y_n(t) = G(t) + Z(t) - M(t) + C(t) + I(t), C(t) = (1-s)Y(t),$$
$$vY(t) = I(t),$$
$$Z(t) = zY(t),$$
$$I(t) = \sigma(Y_n(t) - Y(t)),$$
$$M(t) = mY(t) + Y_n(t) - Y(t).$$

As well as previously, the following differential equation results from the elimination of the $Y_n(t), Z(t), M(t), C(t), I(t),$:

$$Y(t) = \alpha Y(t) + \alpha G(t), \tag{11}$$

Where α and β are given by equations (8) and (9).

We note by D(t), the exterior commerce balance (in deviation terms) accumulated till the t moment:

$$D(t) = \int_0^t [M(\tau) - Z(\tau)]d\tau + D(0).$$

It is obvious that D(t) = M(t) – Y(t). The results are the following, by expressing the M(t) and Z(t) according to Y(t) and G(t):

$$D(t) = \gamma Y(t) + \delta G(t), \tag{12}$$

Where:

$$\gamma = \frac{(m-z)(1-\sigma)-s}{z-\sigma}, \delta = \frac{1}{2-\sigma}. \tag{13}$$

The (11) and (12) equations describe the dynamic of the system. Considering $G(t)$ the command function and assuming that the initial values of the status variables are known, the minimization for both the global quadratic deviation and command over the $[0,\infty)$ interval are mandatory.

In other words, the problem is considered the following:

Let's minimize:

$$\int_0^\infty \left[l_1 Y^2(t) + l_2 D^2(t) + G^2(t) \right] dt \tag{14}$$

By the restrictions:

$$Y(t) = \alpha Y(t) + \beta G(t),$$
$$D(t) = \gamma Y(t) + \delta G(t),$$
$$Y(0) = Y_0, D(0) = D_0,$$

Where the constant negative weights are $l_1 \geq 0, l_2 \geq 0$

Using the notations:

$$A = \begin{pmatrix} \alpha & 0 \\ \gamma & 0 \end{pmatrix}, B = \begin{pmatrix} \beta \\ \delta \end{pmatrix}, x(t) = \begin{pmatrix} Y(t) \\ D(t) \end{pmatrix}, x_0 = \begin{pmatrix} Y_0 \\ D_0 \end{pmatrix}, Q = \begin{pmatrix} l_1 & 0 \\ 0 & l_2 \end{pmatrix},$$

The problem (14) can be written as the following:

Minimize:

$$\int_0^\infty \left[\langle Qx(t), x(t) \rangle + \langle u(t), u(t) \rangle \right] dt$$

With the restrictions:

$$x(t) = Ax(t) + Bu(t), x(0) = x_0. \tag{15}$$

3.2. The study on the optimal solution

The problem is considered the following:

Minimize:

$$\int_0^\infty \left[\langle Qx(t), x(t) \rangle + \langle Ru(t), u(t) \rangle \right] dt$$

Having the following restrictions:

$$x(t) = Ax(t) + Bu(t), x(0) = x_o,$$

Where $x(t)$ and $u(t)$ are the dimension vectors n, respectively r, the A,B,Q,R matrixes are the type of $n \times n, n \times r, r \times n, r \times r, Q$ is defined as the negative symmetric, R

is defined as positive symmetric. It is shown that if this problem satisfy the so-called 'stability condition', then the optimal command is obtained by the following synthesis form:

$$u_0(x) = -R^{-1}B^T K x, \tag{16}$$

Where the K matrix is a algebraically Riccati equation solution:

$$KA + A^T K - KBR^{-1}B^T K + Q = 0 \tag{17}$$

In other words, the optimal status is the solution of the problem:

$$x(t) = (A - BR^{-1}B^T K)x(t), x(0) = x_0 \tag{18}$$

At the same time, it is noticeable the fact that a sufficient condition for stability is provided by the demand for the (A, B) matrix to be controllable:

$$rang(B, AB, ..., A^{n-1}B) = n \tag{19}$$

The Q symmetric matrix can be written as $Q = H^T H$, where the H matrix is the maximum rank. It was proved that apart from the (19) condition of controllability of the (A, B) pair, the controllability pair condition (A^T, H^T) is satisfied as well:

$$rang(H^T, A^T H^T, ..., (A^T)^{n-1} H^T) = n \tag{20}$$

The Riccati algebraic equation (17) admits a $K > 0$ solution and the optimal status is stabilized:

$$x(t) \to 0 \text{ when } t \to \infty.$$

We will apply these results to the problem (15). Thereby:

$$A = \begin{pmatrix} \alpha & 0 \\ \gamma & 0 \end{pmatrix}, B = \begin{pmatrix} \beta \\ \delta \end{pmatrix},$$

The following will be obtained:

$$(B, AB) = \begin{pmatrix} \beta & \alpha\beta \\ \delta & \beta\gamma \end{pmatrix}.$$

The controllability condition of the (B, AB) = 2 ranks is satisfied only and only if:

$$\alpha\delta \neq \beta\gamma. \tag{21}$$

If according to the expressions (8), (9), (13)

$$\alpha = \frac{\sigma(z - m - s)}{v(2 - \sigma)}, \beta = \frac{\sigma}{v(2 - \sigma)}, \gamma = \frac{(m - z)(1 - \sigma) - s}{z - \sigma}, \delta = \frac{1}{2 - \sigma}, \sigma \neq 2,$$

Hence, (21) will be written as:

$$\frac{\sigma(z - m - s)}{v(2 - \sigma)^2} \neq \frac{\sigma(m - z)(1 - \sigma) - \sigma s}{v(2 - \sigma)^2}.$$

We get:

$$2\sigma(\sigma - 2)(z - m) \neq 0,$$

And the controllability condition turns out into:

$$z \neq m. \tag{22}$$

We will consider, as until now, that the equation (22) has been verified. Further on, we will discuss the controllability condition satisfaction (19) in relation with the l_1 and l_2 coefficients from the (14) performance function problem and we will describe the optimal solution behavior.

Case (a). $l_1 > 0$ and $l_2 > 0$. Matrix

$$Q = \begin{pmatrix} l_1 & 0 \\ 0 & l_2 \end{pmatrix}$$

Admits the decomposition $Q = H^T H$, where:

$$H = \begin{pmatrix} \sqrt{l_1} & 0 \\ 0 & \sqrt{l_2} \end{pmatrix}.$$

It results the following:

$$(H^T, A^T H^T) = \begin{pmatrix} \sqrt{l_1} & 0 & \alpha\sqrt{l_1} & \gamma\sqrt{l_2} \\ 0 & \sqrt{l_2} & 0 & 0 \end{pmatrix}.$$

As $l_1, l_2 \neq 0$, the $(H^T, A^T H^T)$ matrix rank is equal to 2 and the condition (20) the optimal status of our problem is the solution for the problem:

$$x(t) = (A - BB^T K)x(t), x(0) = x_0 \tag{23}$$

Where K matrix verifies the Ricatti algebraic equation:

$$KA + A^T K - KBB^T K + Q = 0 \tag{24}$$

Moreover, the optimal status is stabilizing: $x(t) \to 0$ when $t \to \infty$. But

$$x(t) = \begin{pmatrix} Y(t) \\ D(t) \end{pmatrix}, Y(t) = \overline{Y}(t) - \overline{Y}^*_*$$

So that:

$$\overline{Y}(t) \to \overline{Y}^*_* \ D(t) \to 0 \text{ when } t \to \infty. \tag{25}$$

The (b) case where $l_1 = 0$ and $l_2 > 0$. (Function Y(t) does not interfere in the performance index). In this situation:

$$(H^T, A^T H^T) = \begin{pmatrix} 0 & 0 & 0 & \gamma\sqrt{l_2} \\ 0 & \sqrt{l_2} & 0 & 0 \end{pmatrix}.$$

The rank(H^T, A^{T}H^T) = 2 controllability condition is satisfied if and only if $\gamma \neq 0$. In this case, the optimal situation is given by the same equations (23), (24) stabilizes.

The (c) case where $l_1 > 0$ and $l_2 = 0$. (Function D (t) does not interfere in the performance index). In this situation:

$$(H^T, A^T H^T) = \begin{pmatrix} \sqrt{l_1} & 0 & \alpha\sqrt{l_1} & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}.$$

It results that:

The (H^T, A^{T}H^T) rank = 1

So, the condition (20) is not verified. We will show that an optimal status of the problem (15) – which doesn't stabilize – can be built. In this purpose, we are looking for a solution of the Riccati algebraic equation (24) as the following:

$$K = \begin{pmatrix} k & 0 \\ 0 & 0 \end{pmatrix}.$$

Taking into account the shape of the A, B and Q matrix, the (24) algebraic equation is explicitly written as the following:

$$\begin{pmatrix} k & 0 \\ 0 & 0 \end{pmatrix}\begin{pmatrix} \alpha & 0 \\ \gamma & 0 \end{pmatrix} + \begin{pmatrix} \alpha & \gamma \\ 0 & 0 \end{pmatrix}\begin{pmatrix} k & 0 \\ 0 & 0 \end{pmatrix} - \begin{pmatrix} k & 0 \\ 0 & 0 \end{pmatrix}\begin{pmatrix} \beta \\ \delta \end{pmatrix}(\beta \quad \delta)\begin{pmatrix} k & 0 \\ 0 & 0 \end{pmatrix} - \begin{pmatrix} l_1 & 0 \\ 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}.$$

Performing the calculations from the left side of the matrix equation, it is found that:

$$\begin{pmatrix} 2\alpha k - \beta^2 k^2 + l_1 & 0 \\ 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}.$$

So k is the root of the equation:
$$\beta^2 k^2 - 2\alpha k - l_1 = 0.$$

As it follows:

$$k = \frac{\alpha + \sqrt{\alpha^2 + \beta^2 l_1}}{\beta^2} \text{ or } k = \frac{\alpha - \sqrt{\alpha^2 + \beta^2 l_1}}{\beta^2}.$$

The optimal status is the solution for the problem:
$$x(t) = (A - BB^T K)x(t), x(0) = x_0$$

I.e.:

$$\begin{pmatrix} Y(t) \\ D(t) \end{pmatrix} = \begin{pmatrix} \alpha - \beta^2 k & 0 \\ \beta - \beta\delta k & 0 \end{pmatrix}\begin{pmatrix} Y(t) \\ D(t) \end{pmatrix}, Y(0) = Y_0, D(0) = D_0.$$

It will be obtained:

$$Y(t) = Y_0 e^{(\alpha - \beta^2 k)t},$$

$$D(t) = \frac{\beta - \beta \delta k}{\alpha - \beta^2 k} Y_0 e^{(\alpha - \beta^2 k)t} + D_0 - \frac{\beta - \beta \delta k}{\alpha - \beta^2 k} Y_0.$$

For

$$k = \frac{\alpha + \sqrt{\alpha^2 + \beta^2 l_1}}{\beta^2}$$

It results:

$$\alpha - \beta^2 k = -\sqrt{\alpha^2 + \beta^2 l_1} < 0.$$

So

$$Y(t) \to 0, D(t) \to D_0 - \frac{\beta - \beta \delta k}{\alpha - \beta^2 k} Y_0 \text{ when } t \to \infty.$$

For

$$k = \frac{\alpha - \sqrt{\alpha^2 + \beta^2 l_1}}{\beta^2}$$

It results:

$$\alpha - \beta^2 k = -\sqrt{\alpha^2 + \beta^2 l_1} > 0.$$

So:

$$Y(t) \to \pm\infty \quad \text{(after as } Y_0 > 0, Y_0 < 0),$$

$$D(t) \to \pm\infty \quad \text{(after as } \frac{\beta - \beta \delta k}{\alpha - \beta^2 k} Y_0 > 0, \frac{\beta - \beta \delta k}{\alpha - \beta^2 k} Y_0 < 0)$$

When $t \to \infty$.

The equations and/or inequality which form the model represent in fact the system, but at the same time the problem which has to be resolved. Hence, we can notice that this representation manner offers a decision model.

4. The impact of the VAT quota share at micro-level according to the multiplier-accelerator model at economic level

The public authorities use fiscal policy for granting finalities *vis-á-vis* of influencing the economical process, adjusting the business cycle, and removing the economic imbalances. In this context, it is important to assess the main objectives of the fiscal policy throughout the following model which will improve the correlation between the VAT and the economic activity, namely: economic stabilization, cyclical adjustment and economy recovery, economic restructuring and economic growth.

In this model, the command parameter is represented by the budgetary expenditure which decreases together with the diminishment of the VAT for food products, this decrease must be cancelled by the increase of the GNP.

To each choice of G (t) budgetary expenditure there is a necessary level of Y (t) GNP which corresponds to it and it is expressed by the following equation:

Y (t) = G (t) + Z (t) – M (t) + C (t) + I (t);

Where:

Y (t) – the GNP at the 't' moment;
G (t) – budgetary expenditure at 't' moment;
Z (t) – exports at 't' moment;
M (t) – imports at 't' moment;
C (t) – consumption at the 't' moment;
I (t) – investments at the 't' moment

We assume that both the imports and exports are constant.

The analysis of the VAT percent regarding food products in the Romanian economic context has been made in accordance with the Philips' accelerator-multiplier model.

The modern theories on the consumption function combine the two hypotheses and in the consumption income theory function the factors analysis which determine the income expectations is included, analysis offered by the theory of the permanent income. A simplified version of such a consumption function is as it follows:

$C = a \times A + b \times j \times Y_D + b \times (1\text{-}j) \times Y_{D-1}$

Where:

Y_D – is the available work income.

It illustrates the role of wealth which has a great influence on the consumption expenses. The equation can approximate pretty accurately the consumption and it is the expression of permanent income estimation implied by it.

Both theories explain better the total consumption behavior, although there are still several debating aspects as: the excessive sensibility of consumption regarding the current income.

In the case the consumers' expectations are rational, then their projections regarding the permanent incomes must be in compliance with the way the income varies in reality. An increase in the current income cannot be appreciated automatically – it is a long-run process. But by relying on the past experience, it can predict the future. For example, in previous periods an increase of 1 monetary unit is equivalent to 0.25 monetary units of permanent increase and the rest is a temporary gain.

J's dimension represents the proportion in which the current income transforms into permanent income and it is determined on the study of income evolution from the previous period, based on the following consumption function:

$C = c^{/} \times Y^P$

Taking into account also the relationships between the current and permanent income, the current income consumption inclination is obtained and it's equal to $c' \times j$, measure acquired by the combination of the two theories.

In the following section, we will assess the dependence between the demand elasticity, the supply elasticity and the tax repercussions – this will contribute to the comprehension of the taxation pressures problems.
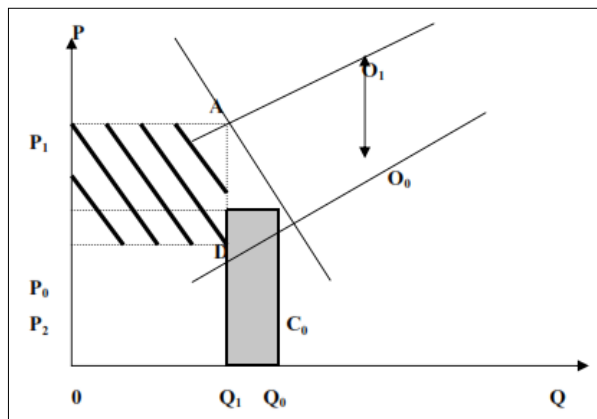

Figure 1: The effects of the indirect taxes settlement

Source: By authors

At the settlement of a specific tax or subvention upon a good (which hasn't been taxed) there is a movement of the supply curve to the left side in an appropriate manner; the assessment of a subvention determines the movement of supply curve to the right side.

The specific evolution of the demand and supply curves generates balanced intersections which aren't anything else but the price values.

The separate analysis of the indirect tax assessments or the subvention upon prices implies the decryption of their influence upon the distribution of these effects between producer and consumer and the coordination by the state as the institutor and leading entity.

The following quotations will be used:

T = the indirect tax;
O = the supply curve;
Q = the production;
P = the price; and
C = the demand curve.

According to the demand curve C_0, the application of the T indirect tax upon a product will determine a movement in the upward part of the supply curve from the level O_0 to O_1 due to the price increase from P_0 to P_1, which corresponds to a lower demand. In consequence, the quantity and equilibrium price before (Q_0 P_0) and after the

tax settlement (Q_1 P_1) will be identified, due to the intersection of the demand curve with the supply curve.

From the analysis of the generated effects, the following can be noticed:

a. a) $P_1 > P_0$; $Q_1 > Q_0$;

b. The government, through the estimated T indirect tax, will obtain an income equal with the hatched surface ($Q_1{}^*T$);

c. The assessment of an indirect tax supposed a reallocation of resources.

In this respect, in the processed commodity industry on which the tax is settled, a reduction of production takes place from Q_0 to Q_1 and the available resources are re-directed. The shaded area represents the equivalent freedom from the variable factors to the tax settlement. The more the inelastic is the offer the smaller will be the grey surface.
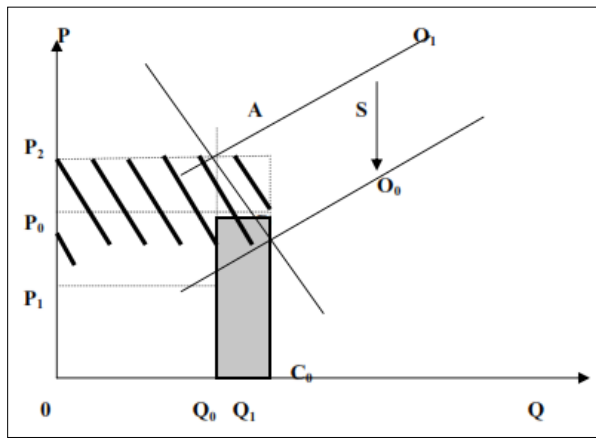

Figure 2: The effects of the subsidies granted by the state

Source: By authors

Due to granting the S subvention by the government, the supply curve will get down and the effects will be opposite from the previous situation.

From the analysis of the generated effects, the following can be noticed:

a. $P_1 < P_0$; $Q_1 > Q_0$;

b. The government bears the production growth program cost equal to the hatched area ($Q_1 * S$);

c. For producing the additional quantity from Q_0 to Q_1, the subvention beneficiary units will attract the variable producing factors which have the equivalent illustrated by the grey surface.

Using the demand and supply concept, we determined graphically the changes in the supply and demand elasticity and we represented the different proportions in the tax burden distribution regarding the tax on the business figure. With the purpose of simplifying the next analysis the demand curve segments is represented by some linear lines. The supply curve is represented by S and S_t and the demand curve by DQ.
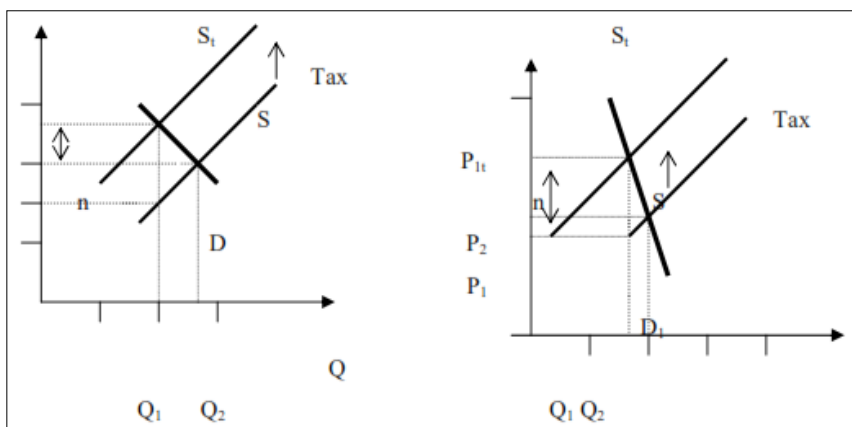
The demand curve equation will have the following form, taking into account the corresponding sales and the volume of the prices:

$$P = \frac{P_2 - P_{1t}}{Q_2 - Q_1} * Q + \frac{P_{1t} * Q_2 - Q_1 * P_2}{Q_2 - Q_1} \qquad (26)$$
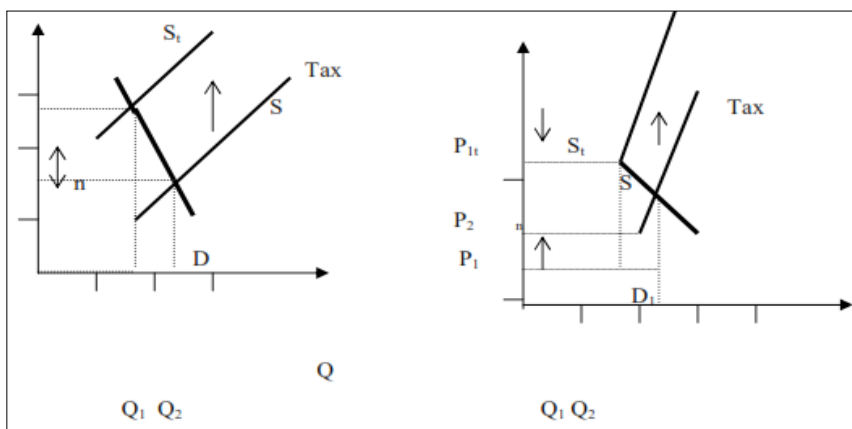
Where:

Q_2 and Q_1 – the sales amounts;

P_2 and P_1 – the correspondent prices.

a) taxes and elastical demand   b) taxes and inelastical demand

c) taxes and elastical demand   d) taxes and inelastical demand

Figure 3: Interdependence between taxation and the demand/supply elasticity

Source: By the authors

The elasticity of the demand is determined by the demand curve's position on the Q*P surface, namely after the respective curve angle over the Q axis. Because the (26) angle inclination is characterized by the k tangent, for the D curve from the a) and b)

figures, it will be equal to:

$$k = \frac{P_2 - P_{1t}}{Q_2 - Q_1} \leq 0$$

Because: $P_2 - P_{1t} \leq 0$ and $Q_2 - Q_1 \geq 0$ or $P_2 \leq P_{1t}$ and $Q_2 \geq Q_1$.

If -1<k<0, the demand is inelastic. In figure a) it can be observed that if the demand is inelastic in the correspondent diapason of the prices, then at the entry of the tax on the business figure the price will go upward (from P_1 to P_2). Accordingly, the taxation pressure will be borne by the producer. If the demand is inelastic, according to figure b), then the price for consumer will grow in a considerable manner (from P_1 to P_{1t}) and the major side of the taxation burden will be transposed on the buyers.

In this sense, the more k will tend to 0, the more elastic the demand will be and the bigger will be the taxation pressure borne by the producer of goods and services. The more k will tend to 1, the more inelastic will be the demand. Correspondent, the more will the taxation pressure grow, the more it will be reverberated upon the buyer.

In figures c) and d), the supply curve segments were represented from the same consideration as the a) and b) figures and they took the shape of lines. The supply line angle inclination tangent is equal to the coefficient calculated by the formula:

$$k = \frac{P_2 - P_1}{Q_2 - Q_1}$$

Where:

k – The S curve inclination angle tangent;

Q_1 and Q_2 – Different sales volumes which correspond to an offer status;

P_1 and P_2 – the prices which correspond to these volumes of sales.

The equation of the S curve represented in the figures c) and d) has the following shape:

$$P = \frac{P_2 - P_1}{Q_2 - Q_1} * Q + \frac{P_1 * Q_2 - Q_1 * P_2}{Q_2 - Q_1}$$

The figure c) proves that in the conditions of an elastic offer (0≤k<1) the sales tax produce a sensible growth of prices (from P_1 to P_2) and because of this, the tax is borne mostly by the consumers. If the offer is inelastic (k>1) as it is presented in Figure 3, the price will increase insignificantly (from P_1 until P_2) and the preponderant part of the tax will be borne by the sellers.

5. Conclusions

In this article we addressed an economic and mathematical model regarding economic adjustment to determine the optimal solution and to highlight the impact of the VAT percentage change on the multiplier-accelerator at economic level.

VAT has replaced the traditional taxes in the quasi-totality of countries, and it is regarded as 'neutral' compared to turnover taxes. In particular, it does not incite to

vertical business integration of companies, and has a special plan to promote economic competition. Between pure model of VAT and tax regulations under that name differences occur. In the first place, regarding VAT rate – in fact, particularly across Europe – there are three types of allowances: 'normal', 'low' and 'zero'. Zero rate is for goods and exported services from abroad, on the basis of destination – the exported good is taxed in the country in which is consumed. In the second place, there are the exceptions to the trend over the years to generalize VAT for all goods and services. Such exceptions concern certain operations (financial), certain categories of legal persons (Government, universities) or businesses that do not exceed a certain threshold of turnover. Of concrete rules VAT, depending on the elasticity of supply and demand, can reach that part of the tax burden which is not passed on the consumers.

The assessment of VAT tax incidence reduces to the analysis: at first, VAT is tantamount to a tax levied only on a bestselling retail stage when we are interested in the effects of the changes in the rate applied to an object; second, incidence of a tax in general balance when we are interested in the effects of simultaneous changes in VAT for all goods and services.

The Romanian households assign a disposable income which is established in the aftermath of fees reduction (especially taxes), either for the current consumption, or for the satisfaction of future consumption needs. According to the consumption peculiar expenditures distribution legislation, gaining maximum satisfaction levels is the equal utilities conditions of each group of consumed goods from each expenditures category designated to consumption. In the emerging and developing countries, which is the Romanian case, the dynamics and structure of the consumption expenditures register rates and directions in line with decreasing the real income, while the food expenditures weight reach over 60% from the total amount of the expenditures.

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