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Article

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The Laffer Curve Decomposed[1]

Jan HÁJEK – Karel ŠAFR** – Jiří ROTSCHEDL*** – Jan ČADIL*****

Abstract

The paper analyses the models of the Laffer curve addressed in the academic literature and strives to explain the effects which can exist in relation with the original curve and the one modified by other academicians. The effects are decomposed in a theoretical manner and statistically tested thereafter with a dataset covering the period 2000 – 2012 consisting of data for Belgium, Denmark, Finland, France, Ireland, Italy, Luxembourg, Germany, the Netherlands, Portugal, Austria, Greece, United Kingdom, Spain, Sweden, the Czech Republic, Estonia, Hungary, Norway, Poland, the Slovak Republic and Slovenia. The main value added of the paper lies in the outcomes of the cross-sectional panel data regression testing the model derived from the theoretical decomposition of the curve as well as graphical expression of the particular effects. Based on the result of the analysis only a few of the decomposed effects could have been observed mainly the originally anticipated negative correlation of tax base and tax rate, positive correlation of labor productivity and tax base or negative correlation of tax base and unemployment level. Other effects (grey economy, tax competition, government spending, etc.) were not proven.

Keywords: *Laffer curve, effects, modifications, cross-sectional panel data analysis*

JEL Classification: H20, H21, H26, K34

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Introduction

The cornerstone of any examination of the dependence of the tax rate on the total tax revenue of a fiscal budget of a country or any higher or lower self-governing country municipality with the possibility of taxing a certain type of income (limited to the country level in the article) remains the Arthur Laffer theory, described by Jude Wanniski (1978) in the article entitled Taxes, Revenues and the "Laffer Curve" published in The Public Interest (Wanniski, 1978). It was only a well-known consideration until then, but it was not in fact reflected in the tax policies of particular countries. Reportedly, this relationship was first described by Ibn Khaldun in the 14th century in The Muqaddimah (Laffer, 2004). This thesis was also described later by Adam Smith, David Hume or John Maynard Keynes. Blinder (1981) also refers to Jales Dupuit's statements of 1844 or Edmund Burke's of 1774. In general, he then attributes the origin of the idea to Michel Rolle from the 1690s. Although Wanniski (1978) himself did nothing but a graphical representation of the above-mentioned dependence of the tax revenue and tax rate with examples, it was a rather laconic description of the relationship without any comparative static or empirical verification. General conclusions about the dependence of the tax burden or tax rate on tax revenues have been known for several hundred years.

However, the above has partially remained to this day, and even now some doctrinal approaches use the Laffer curve as a fundamental principle that the country's government should respect in order to avoid a total collapse of public budgets and their revenue side in particular. The 35 years, however, were relatively crucial for this theory (if it can be called like that). In essence, the Laffer curve in the form of Wanniski (1978) was a kind of tautology to be subjected to further exploration and possibly verification on empirical data. Some of those factors were subsequently described several years after e.g. Moszer (1981), Blinder (1981) or Henderson (1981), Buchanan and Lee (1982), Gahvari (1988), Linnemann (2010), Busato and Chiarini (2013), etc.

The paper attempts to summarize and graphically analyze the individual effects determining the shape of the Laffer curve in its original and modified form by other academicians using the deductive-inductive method and panel data regression thereafter. The panel data regression is ran for the econometric model analyzing the relation of the corporate income tax and other macroeconomic indicators representing the effect observed on the Laffer curve for the period of 2000 – 2012 and following countries: Belgium, Denmark, Finland, France, Ireland, Italy, Luxembourg, Germany, the Netherlands, Portugal, Austria, Greece, the United Kingdom, Spain, Sweden, Czech Republic, Estonia, Hungary, Norway, Poland, Slovakia, Slovenia. There are two overlapping main objectives of the

paper. It is to verify the general relation of the tax rate and tax revenue based on the real economic data of the corporate income tax, i.e. to re-confirm the existence of the Laffer curve, and to check the dependency level of all the decomposed effects occurring on the curve. The secondary objective of the paper consists in a detailed graphical analysis of the directions which shapes the original and modified versions of the curve as such decomposition is completely omitted in the literature. The hypothesis of the paper consists in the assumption made in accordance with the economic doctrine, i.e. the statistical correlation of the corporate income tax base with gross domestic product representing the expenditure effect (Laffer, 2004), labor productivity and unemployment rate representing the income and substitution effect (Henderson, 1981), government spending and transfers representing the budgetary effect (Lindbeck, 1982; Gahvari, 1988), volume of grey economy (Gutmann, 1979; Busato and Chiarini, 2013) and tax competition (Hájek, 2009).

The contribution of the present paper to the current literature lies (i) in the complex decomposition of the effects causing the changes in the Laffer curve shape including their graphical illustration and (ii) mainly in the subsequent statistical testing of the existence of the decomposed effects based on the empirical data that proves the existence of the general correlation of the corporate income tax rate with tax revenue (addressed by Laffer, 2004 as an expenditure effect[2]) and country transfers (addressed by Lindbeck, 1982 or Gahvari, 1988 and named for the purposes of this paper as an budgetary effect). Other effects namely grey economy and tax competition effects by Gutmann (1979), Busato and Chiarini (2013) and Hájek (2009) were not observed. Such analysis cannot be found in the current literature and thus may extend the theoretical view on the Laffer curve doctrine.

1. Theoretical Framework

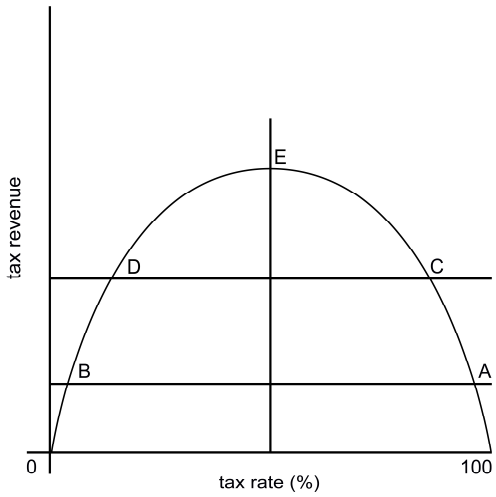
In 1978, Jude Wanniski depicted the Laffer curve as a relationship of the tax rate on the y-axis and the tax revenue on the x-axis. Depending on the depiction of this relationship, it was possible to generate identical tax revenue both at points B and A, despite vastly different tax rates. In point A, however, the tax revenue will be achieved through a high tax burden. The relationship is *in genere* non-linear due to the transition to a barter trade at high taxation, because any financial income which does not arise from an exchange must be taxed. The area

[2] Including the cross-sectional dependence of the labor market and corporate income tax rate (Trabandt and Uhlig, 2011) subsumed under the expenditure effect.

between point E and 100 was then designated as a prohibited zone (Wanniski, 1978). According to Blinder (1981), this negative effect shall manifest itself only at "irrationally high" tax rates. In other words, when applying this theory, it is always possible to consider post-tax and pre-tax income, while if the ratio of post-tax income to pre-tax income is higher than point E, the labor market is affected as the willingness to work drops (Wanniski, 1978). Any increase in the tax rate cannot lead to an increase in tax revenue, as with a higher tax burden, the taxpayer responds to this fact, and the work itself becomes insufficiently profitable due to the substitution effect (Moszer, 1981). Similarly, it would be possible to derive the resulting effects of raising or lowering taxes on the current market of goods and services.

F i g u r e 1

Laffer Curve (Hereinafter also as the *Hypothetical Laffer Curve*)



Source: Wanniski (1978).

Wanniski also surmised that the curve could also be used to illustrate the taxpayer's willingness to pay the tax itself. In an isolated view of the impact of the tax rate on the taxpayer's behavior, the graphical representation might seem appropriate, as it is likely that with high tax rates, the taxpayer will not be willing to tax his income, however conclusions drawn solely on the basis of the tax rate alone would be completely inaccurate. It can be then assumed that Wanniski (1978) viewed the willingness to pay the tax more like a capability, similarly to Lutz (1943). This concept of the willingness to pay the tax corresponds to the Wanniski's assumption that if the taxpayer is willing to procure government bonds, they are also willing to pay taxes. This idea is *de facto* based on the amount of disposable taxpayer's income or, more generally, their pre-tax income, when

the taxpayer with high enough income is willing (more precisely – able) to pay the tax itself and still retain a sufficient disposable income after tax. The same perspective may then be applied to the comparison by Wanniski, yet with a very substantial omission of the fact that the tax, unlike a bond, is a non-repayable payment which does not establish any other taxpayer's rights for future performance by the country. The comprehensive expression of factors influencing the taxpayer's decision to fulfil their tax duties was subsequently defined by the doctrine of taxpayer's willingness to pay taxes: see for instance Beron, Tauchen and Witte (1992) or Alm, McClelland and Schulze (1992), etc. For example, some authors further state that the validity of Laffer's theory is due primarily to a decline in the overall output of the economy under high tax burden, i.e. that the potential output is not achieved (Moszer, 1981) or that sustained economic growth is subsequently withheld (Padovano and Galli, 2001). Vladimier Papava (2009) also believes that some form of hysteresis, i.e. a state where the curve is affected by its previous state, can be observed on the Laffer curve. He then, together with Lipnitski and Vishnevski, adds dynamics to the Laffer curve (Papava, 2009 or 2002). B. Dalamagas (1998) also addressed a dynamic version of the Laffer curve in his paper "*Endogenous growth and the dynamic Laffer curve*". However, Dalamagas addressed the relationship between the tax rate and debt reduction as a result of long-term tax cuts, based on Bar's model of sustainable economic growth. Still, he uses the general tax rate without the distinction whether it is an income tax of corporate entities or natural persons or whether it is an income tax at the level of a specific country or municipality. Samimi, Ebrahimi and Azizi (2012), Trandafir and Brezeanu (2011), Linnemann (2010), Knowles (2010), and Dracea, Cristea and Tomescu (2009) use similar procedures. The above authors considered the tax rate as a rate of taxation calculated from macroeconomic variables as a ratio of the GDP to taxes collected. Since decision-making on the allocation of production factors in the economy, taking place at the level of the public, business and private sectors (e.g. on increasing investment, raising wages, or increasing the number of jobs), in terms of individual economic approaches, is always considered with an existence of a specific tax, the use of compound quotas appears to be oversimplified. Within this context, it is possible to assume *in genere* that different types of taxes may differ, so that the Laffer effect may not always manifest itself to the extent predicted by Wanniski. In her paper, Kadeřábková (2003) also refers to the Laffer curve and the theoretical explanation of its shape.

In the paper "*Politics, Time, and the Laffer Curve*", Buchanan and Lee (1982) distinguished between a short-time and long-time Laffer curve and attempted to determine the Laffer effect using comparative statistics. Buchanan and Lee

(1982), however, completely abstract from any Laffer curve dynamic, making the model itself difficult to apply, because if the Laffer effect is going to occur, it will occur in the time $x + 1$, i.e. in a period different from the original state and shape of the Laffer curve. It will subsequently change depending on the time and other factors affecting its course. Buchanan and Lee (1982) also concludes that the Laffer curve must have its long-term and short-term form due to described delays of the effect in economy.

In his paper, Mirowski (1982) identified other pitfalls of the application of the Laffer curve not mentioned above and summarized its four basic problems:

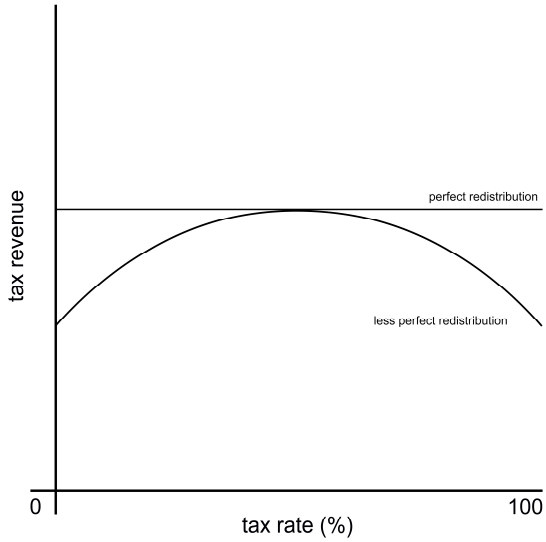
- The question of the magnitude of elasticity of demand of production factors;
- A problem with an empirical verification;
- Omission of potentially significant quantities;
- Impossibility to determine the extent of the grey economy.

In the first point, he disputes one of the original bases of the Laffer curve concerning the taxation of workers, which can be also supported by restrictions on the labor market, since any employee can work only to the extent derived from the specific institutional factors (the extent of working hours, collective agreement, etc.). In the second point, Mirowski addresses insufficient empirical research to prove the Laffer curve. He points out the lacking empirical example of a 100% taxed state that A. Laffer used to explain the shape of the Laffer curve. If the curve form is derived from such extreme taxation, i.e. considering a tax rate of 100%, the situation will arise when the state will achieve zero tax revenue as no one will be willing to undertake any taxable activity at this tax rate. The idea could also be justified in such a manner that individual taxpayers will not have the means for private consumption and will be forced to shift their activities to non-taxable activities at such a high rate of taxation. This would be an extreme situation on a purely theoretical level. On the other hand, it should be inferred in a similar manner that within the public finances the country/municipality could introduce a redistribution of the total tax revenue back to individual taxpayers and thus substitute the market distribution of disposable income. Depending on the efficiency of this country/municipal redistribution, the Laffer curve would not have the shape defined by Wanniski. On a purely hypothetical level, the curve could take the following shapes depending on the efficiency of the redistribution mechanism.

Mirowski (1982) also states that the shape of the curve does not have to take the form of Wanniski's consideration. He also lists other shortcomings of the Laffer curve as the omissions of key variables, for example, investment and consumption levels, interest rates, corporate influence, trade balance and other factors.

Figure 2

Laffer Curve with Partial and Total Perfect Redistribution



Source: Own research.

Based on the above, it can be assumed that the Laffer curve in its basic form was a very simplified expression of the relationship between the total tax revenues of the country/municipal budget and the tax rate.

In 2004, in the article "*The Laffer Curve: Past, Present, and Future*", Arthur B. Laffer subsequently divided the effects taking place on the Laffer curve to the so-called arithmetic and economic ones. The arithmetic effect occurs in a situation where a reduction in the tax rate will lead to a lower tax revenue per currency unit. The economic effect will then occur in a situation where the reduction of the tax burden is accompanied by a positive effect on the entire economy, i.e. cumulative consumption, employment, etc. If the sum of these two effects is positive, the total tax revenue after the tax rate reduction will also be higher. The economic effect consists of a number of partial effects which have an impact on consumption, investment, employment, etc. These include the effects of expenditure, substitution, income, budget, competition, institutional, and the grey economy.

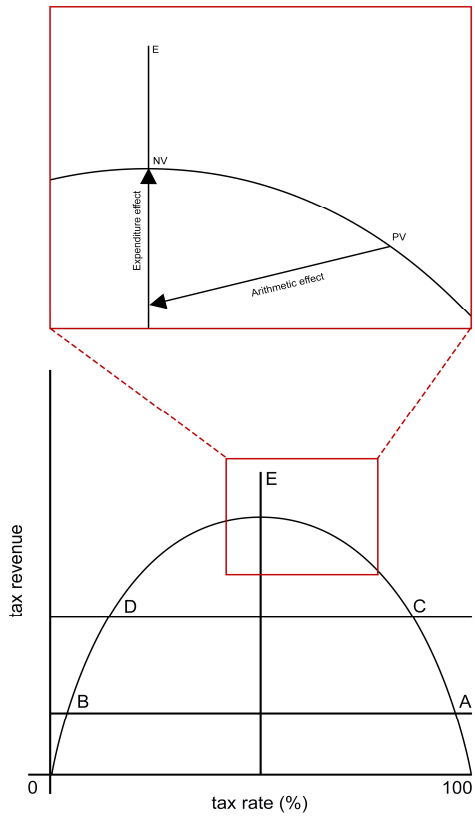
The following graphical analysis of individual phenomena always considers the situation of the original Laffer curve (of purely concave shape), with the course of the function after incorporation of another sub-effect into the economic effect, so that it is possible to deduce how the curve is influenced by the specific phenomenon.

1.1. The Expenditure Effect

The starting point for deriving the way in which the Laffer curve is influenced by the above-mentioned effects consists of the linear dependence of the tax rate and the total tax revenue. Thus, with each further increase in the tax rate, the tax revenue of the country/municipal budget will increase *and vice versa.* The above is illustrated on the cut-out of Figure 3 as a straight line to point *PV* (denoting the original apex under purely arithmetic effect).

Figure 3

Laffer Curve – Expenditure Effect



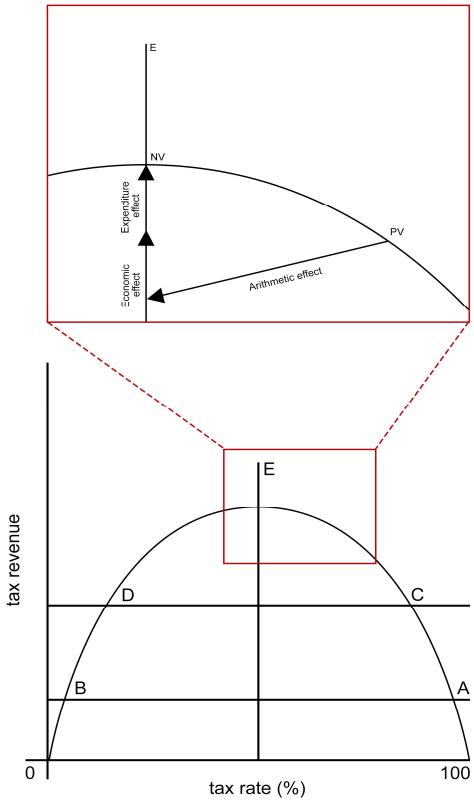
Source: Own research.

The point *NV* (denoting the new apex) is the reached as a result of the expenditure effect which subsequently indicated the apex of the Laffer curve if the original *PV* is located in the so-called "prohibited part" of the Laffer curve. The expenditure effect can thus be described as compensation for the arithmetically calculated reduction of the total tax revenue to the new Laffer point *NV*, due to the possibility of using the newly acquired income in the form of differences in

taxed income before and after tax reduction for private consumption, investments, etc. leading indirectly to the growth of GDP. This further leads to a subsequent repeated increase in total revenues of the country/municipal budget as a secondary consequence of increased consumption, investment, etc., which cause a further increase of the disposable income on the part of the seller. Thus, the expenditure effect indicated by Laffer is primarily caused by a growth stimulus in the form of a reduction in tax rates. Trabandt and Uhlig (2011) further recognizes the positive cross-sectional effect between the corporate income tax rate and level of unemployment which can subsumed under the economic effect. An increase in taxation leads of course to the same effects *vice versa*.

F i g u r e 4

Laffer Curve – Expenditure and Economic Effect



Source: Own research.

This situation could be observed, for example, in the Czech Republic and Slovakia in early 21st century, when the corporate income tax rate gradually decreased, while the total corporate income tax revenues increased faster than the GDP (see Table 1).

T a b l e 1

Development of the Corporate Income Tax for the Period 2000 – 2012 in the Czech and Slovak Republic (constant prices of 2000)

Year	Corporate income tax revenue (mil. EUR, CZ)	Corporate income tax rate (CZ) (in %)	Corporate income tax revenue (mil. EUR, SK)	Corporate income tax rate (SK) (in %)
2000	7,518.3	31	2,633.7	29
2001	9,438.0	31	2,613.4	29
2002	11,636.4	31	3,131.3	25
2003	12,545.9	31	3,588.2	25
2004	14,638.3	28	4,773.0	19
2005	17,433.1	26	5,523.2	19
2006	22,133.1	24	6,531.0	19
2007	24,437.5	24	8,111.2	19
2008	27,677.8	21	9,588.8	19
2009	22,277.3	20	7,448.3	19
2010	23,318.2	19	7,782.3	19
2011	23,773.9	19	7,657.6	19
2012	22,164.3	19	7,449.1	19

Source: Eurostat, gov_a_tax_ag, inflation-corrected data; own research.

1.2. The Income and Substitution Effect of Labor Supply

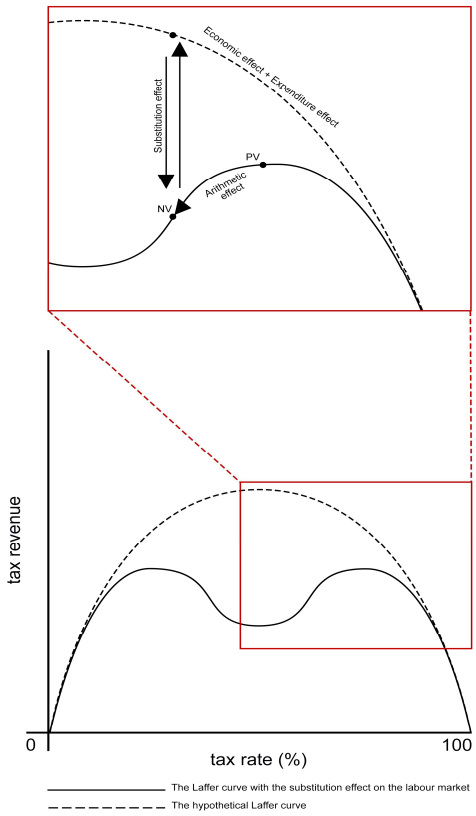
In 1981, David Henderson pointed out the first restrictive simplification of the original Laffer curve, having taken into account the possibility of a 100% income effect on the labor market while lowering the income tax rate of the "prohibited zone" (Henderson, 1981), i.e. if the income effects are above the substitution effect on the labor market, then the total tax revenue, in this case, the personal income tax, would decrease and the tax revenue would decrease in proportion to the tax rates. In other words, if the reduction of the income tax rate for natural persons were exclusively compensated by higher leisure time consumption, the effect of the original Laffer curve would be completely squeezed out and the level of tax revenues would not mean an increase but a decrease in public budget revenues despite the tax rate decrease. If the income effect prevails (i.e. the consumer already offers fewer hours of work with increasing wages, since they have reached the maximum possible number of hours offered and the wage is so high that they would not be able to utilize it during their leisure time), the offered work decreases with the decrease of the tax rate. The above can be incorporated in the Laffer curve as follows:

The case outlined by Henderson (1981) can be considered rather extreme, in which all employees or self-employed workers who are also taxed by this tax would have to reduce their productivity so that their income remains unchanged even after the tax burden has been reduced; the total tax incidence would have been passed exclusively on employees, and the income effect on the labor market would also have to prevail for the taxpayers concerned. At the same time, it can

be inferred that in the open economy, there could be a partial income effect, which would accelerate the arithmetic effect. On the other hand, if the opposite case were to be considered, i.e. that there is only a substitution effect on the labor market, any reduction in the tax rate will lead to an increase in tax revenue depending on the elasticity of labor supply and the resulting economic effect will accelerate. Henderson's (1981) findings, however, albeit on the *ultima ratio* basis, complement Laffer's original theory with phenomena which would certainly have to be taken into account in its real application.

Figure 5

Laffer Curve – Income Effect



Source: Own research.

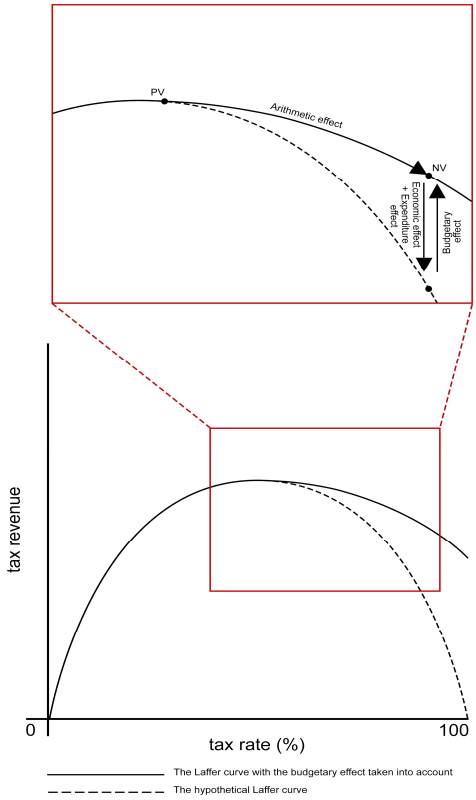
1.3. The Budgetary Effect

The budgetary effect follows the substitution and income effects whose main influence is opposite to other economic effects. The budgetary effects are often referred to as plural. Lindbeck (1982) analyzed the impacts on the labor supply during changes in taxation and public budgets. In essence, he calls the substitution

and income effect "tax effects" counteracted by "budgetary effects" which substitute the possible effects of tax changes through public spending or by subsidizing goods and services provided by private entities. He states that the income effects of tax changes are often mitigated or even eliminated by the accompanying changes in public expenditures (Lindbeck, 1982).

F i g u r e 6

Laffer Curve – Budgetary Effect



Source: Own research.

Using a simplified model of utility function which includes x = private goods, l = leisure time, g = public goods, Gahvari (1988) demonstrates that the Laffer curve may never drop, or that the labor supply can increase owing to the budgetary effect by up to 100% of taxation and can thus displace the income effect of the labor supply. Subsequently, the additionally achieved tax revenue increase can be used for compensations in the form of a reduction in the price of some of the goods offered via subsidies (or direct financial redistribution) for which the same individual demand is assumed. If the reduction in the price of the goods is provided immediately, there will be no change on the labor market, which necessarily

means that any negative effects caused by the increase in the tax burden have been eliminated by the budgetary effect. The reduction of the tax revenue as an effect of the increase of the tax burden does not simply mean a drop of the Laffer curve, but rather its part in the prohibited zone moving to point *NV*, as all additional revenue to the public budget will be redistributed evenly among the participants. The given increase of taxation is *de facto* exclusively theoretical, since it is immediately compensated on the part of the public sector, and the final effect may be completely displaced. Therefore, depending on the level of perfectness of reversed redistribution of additional tax revenues, the effect may be either positive or negative.

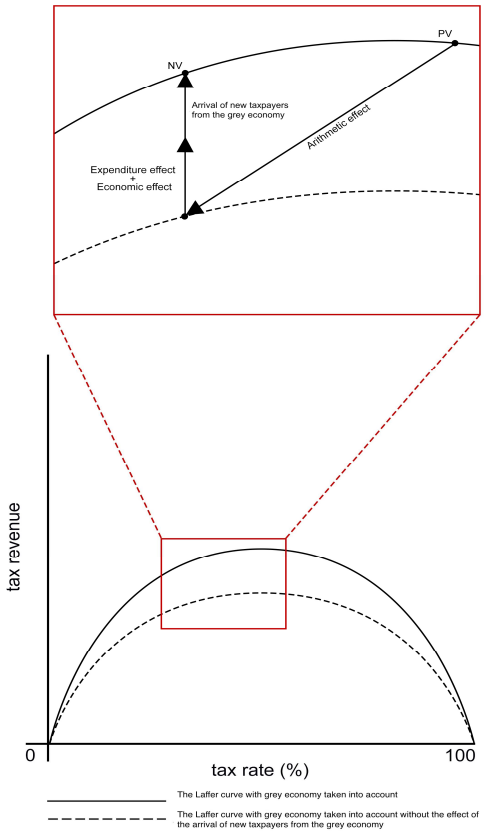
1.4. The Effect of the Grey Economy

For the Laffer curve model to correspond as closely as possible to the real economic environment, an element of the grey economy, previously pointed out by Peter Gutmann (1979), has been incorporated into its design by Francesco Busato and Bruno Chiarini (Busato and Chiarini, 2013). Max Moszer called the effect of the grey economy at one time the Guttman effect. Both above-mentioned authors arrive at the same conclusions about the dependence of the tax rate on the volume of the grey economy or of illegal income. In this form, it is also necessary to consider another effect which may be derived from the hypothetical curve, representing a state in which none of the economic entities is affected by the possibility of not taxing/concealing their income and the curve of the mathematical-statistical model for the Laffer curve in the grey economy environment. Given the circumstances, the economic operators in the ordinary economy are not driven solely by rational considerations to maximize their current or future benefits, but also by the choice between taxation and non-taxation of the respective income.

In a situation where the rate of taxation is already too high, taxpayers may move towards an activity which is not subject to tax or, in general, to behavior in which the entity does not tax all its income. Thus, the taxpayer transfers their activity to the so-called grey economy. The costs associated with this transfer then represent transit costs. If these costs exceed the potential benefit or additional income generated by changing the taxpayer's behavior, the form of the Laffer curve will remain unchanged. However, once the value of the additional income reaches at least the level of the transit cost and the taxpayer begins to realize non-taxed income, the whole curve will then shift towards the *x*-axis and the value of the maximum possible tax revenue will decrease. In the case of a reduction of the tax burden, however, the considered effect is quite the opposite, i.e. the amount of undeclared income should be reduced (Gutmann, 1979; Busato and Chiarini, 2013), which would manifest itself in higher tax revenue than the hypothetical/original Laffer curve.

Figure 7

Laffer Curve – the Effect of the Arrival of New Taxpayers from the Grey Economy



Source: Own research.

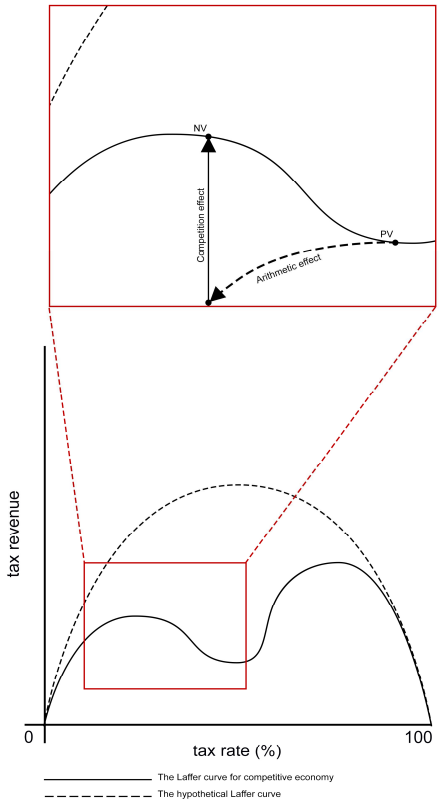
1.5. Tax Competition Effect

Hájek (2009) also complements all the above models with an element of the open competitive economy, i.e. an element of the existence of tax competition between countries. He then states that the original Laffer curve may work, if at all, exclusively in a closed economy, where tax competition between neighboring countries is not possible at all, and thus the so-called tax residence (the state where all income is taxed) of the taxpayer cannot be transferred. When considering the competitive tax environment, one can further observe the effect which can be considered to occur at a level where the tax burden is already at such a low level that it motivates neighboring companies and individuals to move their residences (or their choice for direct foreign investments alone) to the respective low-taxation jurisdiction. However, this is not an isolated phenomenon, as the country in question must have similar characteristics of the economy as the

country of origin from which the residence is transferred (or is invested), or the taxation rate must compensate for certain shortcomings. However, it can be assumed that the competitive effect can absorb only a small part of the shortcomings. In other words, a low tax rate is a kind of an additional benefit for the entity, since it cannot be claimed with certainty that a low tax rate is a decisive factor for investors when choosing the region of business. Thus, the competitive effect represents a situation in which the arithmetic effect is completely absorbed (the expenditure and economic effects aside) by an additional increase in tax revenue by the arrival of new tax residents (or investors) in the country in question. It is then necessary to set the competitive effect aside separately, as it would not occur in a closed three-sector economy. It means that it cannot simply be classified under the expenditure effect, even though they are identical in terms of their secondary effect (not the original cause). It should be noted, however, that there will generally be some delay in the occurrence of this phenomenon.

Figure 8

Laffer Curve – Tax Competition Effect



Source: Own research.

1.6. Summary of the Effects and their Influence

If the individual effects are denoted as follows: the arithmetic effect *AE* and the economic effect *EcE*, which consists of the above-mentioned effects: the expenditure *ExE*, substitution *SE*, income *IE*, budgetary *BE*, tax competition *CE*, and grey economy effect *GE*, the direction of these effects on the resulting tax revenue can be summarized for a tax rate decrease as follows:

$$LF = -AE + EcE \tag{1}$$

where

$$EcE = + ExE + SE - IE + BE + CE + GE \tag{2}$$

by substituting EcE

$$LF = -AE + ExE + SE - IE + BE + CE + GE \tag{3}$$

further expressed as full Laffer function

$$\Delta y = f(\Delta AE, \Delta ExE, \Delta SE, \Delta IE, \Delta BE, \Delta CE, \Delta GE) \tag{4}$$

then by substituting the effects via macro-economic indicators

$$\begin{aligned} \Delta TB = &-\beta_1 \Delta TR + \beta_2 \Delta GDP + \beta_3 \Delta FC + \beta_4 \Delta E + \beta_5 \Delta LP + \beta_6 \Delta G \pm \\ &\pm \beta_7 \Delta TRA - \beta_8 \Delta GE + \beta_9 \Delta IFC - \beta_{10} \Delta OFC + \sigma \end{aligned} \tag{5}$$

where (ΔTB) represents the tax base change, (ΔTR) is the tax rate change, the economic and expenditure effect represents the change in the GDP (ΔGDP), the expenditure effect should be further supported by the change of formation of gross fixed capital (ΔFC) and of employment (ΔE), while ΔE may at the same time represent the substitution effect on the labor market, the income effect on the labor market then represents a change in labor productivity (ΔLP), the budgetary effect can be expressed as the change of government expenditures (ΔG) and the costs of social welfare (ΔTRA), the grey economy effect may be represented by the change of the share of the grey economy in the economy (ΔGE), and the competitive effect can be derived from the change of the variable inflow ΔIFC) and outflow (ΔOFC) of foreign capital to the country in question. It must be further noted the signs at β_1 and β_2 depend on the particular level of taxation of the respective country, i.e., on the position on the Laffer curve.

In addition, the above model can be described as complete while testing it on real empirical data may be problematic as it may not always be available for the selected sample and time series.

2. Empirical Data Analysis

Normally, the Laffer curve is derived using a simple regression analysis of the tax rate depends on the tax base. However, this approach omits, as mentioned above, both the complexity and also some effects which may be significant. This approach also completely ignores the possibility of increasing the total tax revenue independently of the change in the tax rate (ITEP, 2012). With respect to the observed decrease in the corporate income tax rates of the countries included in the dataset, the full model as referred in (5) was used (including the respective signs at β_1 and β_2), however, due to cross-dependency of variables ΔTB and ΔGDP,[3] it was transposed into the following statistically stationarized model (6)

$$\Delta \frac{TB_{CIT}}{GDP}_{it} = -\beta_1 \Delta TR_{CIT\,it} + \beta_2 \Delta FC_{it} + \beta_3 \Delta E_{it} + \beta_4 \Delta LP_{it} + \beta_5 \Delta G_{it} \pm \\ \pm \beta_7 \Delta TRA_{it} - \beta_8 \Delta GE_{it} + \beta_9 \Delta IFC_{it} - \beta_{10} \Delta OFC_{it} + \sigma \tag{6}$$

where newly added index *cit* expresses corporate income tax which was selected as the outcome variable for the statistical testing. However, in comparison to the model (5) the independent variables ΔE and ΔLP do not represent the income and substitution effect (Henderson, 1981), which should be theoretically observable in relation to the personal income tax only, but the cross-sectional dependence of the corporate income tax revenue and labor market (Trabandt and Uhlig, 2011).

For the testing of the model (6), the period 2000 – 2012 and data for the member states of the European Union by 1995 (Belgium, Denmark, Finland, France, Ireland, Italy, Luxembourg, Germany, Netherlands, Portugal, Austria, Greece, the United Kingdom, Spain, and Sweden), with the Czech Republic, Estonia, Hungary, Norway, Poland, Slovakia, Slovenia and Switzerland also included, were chosen for its completeness and availability of the data and in particular the *GE* variable data were taken from papers by Professor Friedrich Schneider (Schneider, Buehn and Montenegro, 2010; Schneider, 2013).[4]

All analyzed data, except for the grey economy coefficients, came therefore from the Eurostat database (gov_a_tax_ag in the current datasets available tagged as t_gov_a), whereas the TB_{cit} variable was calculated as a fraction of the tax revenue (gov_a_tax_ag) and the TR_{cit} variable. All analyzed data were adjusted to reflect selected price level of the year 2005. The dataset includes 262 observations in total with 21 cross-sections. The following table shows the estimates of the regression model (least squares).

[3] Even after the price normalization.

[4] Grey economy coefficient estimated through the MIMIC approach (for details see Schneider and Buehn, 2008).

Based on the performed robustness check the overall model can be considered as statistically significant (R^2: 0.29529; Adjusted R^2: 0.20719) with the independent estimates predicting the dependent variable (F-stat: 3,35213; Prob(F-stat): 0.000). Durbin Watson test showed no autocorrelation (Durbin-Watson stat: 2,139). The unit root test (Levin-Lin_chu test) did not demonstrate for the statistically significant independent variables the presence of a non-stationarity at the level of reliability (ΔTR_{cit}: p-value: 0.0000, t-stat: –4,358169; ΔE: p: 0. 0022, T-stat: –3,094240; ΔLP: p: 0.0320; t-stat: 2,157768; ΔTRA: p: 0,0298, –2,185912). As a result, the negative correlation of ΔTR_{cit}, ΔE and ΔTRA with $\Delta \frac{TB_{cit}}{GDP}$ and positive correlation with and ΔLP with the same predictor on the respective statistical confidence levels can be accepted. On the other hand, none of the independent variables ΔFC, ΔG, ΔGE, ΔIFC and ΔOFC did prove to be significant and moreover in case of ΔFC *and* ΔOFC the direction of effect does not correspond to the economic theory. The results can be interpreted using the following relation: if ΔTR_{cit} increases by 1 pp, the share of ΔTB_{cit} in the *GDP* will decrease by 0.3567 pp., etc. Assuming fully stacionarized data with the fixed price level of the year 2005, the results treated as the direct correlation of the respective dependent variable and its predictors.

T a b l e 2

Variable Estimates

Variable	Coefficient	Std. Error	t-stat	p-value	
ΔTR_{cit}	–0.356755000	0.081859	–4.358169	0.0000	***
ΔFC	–0.000000006	0.000000	0.310315	0.7566	
ΔE	–0.003400000	0.001099	–3.094240	0.0022	***
ΔLP	0.000847000	0.000392	2.157768	0.0320	*
ΔG	0.000000009	0.000000	0.980632	0.3278	
ΔTRA	–0.000000037	0.000000	–2.185912	0.0298	*
ΔGE	–0.002568000	0.001780	–1.442640	0.1505	
ΔIFC	0.000000000	0.000000	0.005426	0.9957	
ΔOFC	0.000000002	0.000000	0.472187	0.6372	
σ	–0.001675000	0.001155	–1.450170	0.1484	

Note: *** – 99.9 %; ** – 97.5%; * – 99.5 %

Source; External sourced data, own research.

T a b l e 3

Robustness Checks

Checks	Value
R^2	0.29529
Adjusted R^2	0.20719
Durbin-Watson stat.	2.13852
F-stat	3.35213
Prob(F-stat)	0.00000
n (g)	262 (20)

Source: Own research.

Conclusion

The paper describes and analyses the individual effects which may occur when applying the Laffer curve in the real economy, namely the arithmetic, expenditure, economic, income, substitution, budgetary, grey economy and competitive effect. The effects were derived from the literature by (i) comparing the shape of the original Laffer curve (as denoted by Wanniski, 1978) with its modifications and (ii) graphical explanation of the impact of the newly added elements resulting from the respective papers. For these purposes the original Laffer curve was decomposed to the effects mentioned by Laffer (2004), i.e. arithmetic, economic and expenditure, and Trabandt and Uhlig (2011), i.e. cross-sectional effect of employment level and corporate taxes, as well as it was shown how they interact with each other. To such decomposition each additional effect mentioned in Gutmann (1979), Lindbeck (1982), Gahvari (1988), Hájek (2009) and Busato and Chiarini (2013) was added. Further, a general Laffer curve function was described and transposed into a model expressing the overall dependence of tax revenues ΔTB with tax rate ΔTR, fixed capital ΔFC, employment level ΔE, labor productivity ΔLP, government spending ΔG, government transfers ΔTRA, grey economy ΔGE, inflow of foreign capital ΔIFC and outflow of foreign capital ΔOFC, where each of variables covers aforementioned effects, either standalone or in combination. For the subsequent statistical testing the corporate income tax was chosen.

Based on the outcomes of the panel data regression the alternative hypothesis was accepted as the general dependence of the corporate income tax rate ΔTR_{cit} and tax revenues ΔTB_{cit} was confirmed (in line with the prevailing academic opinion, e.g. the most recent Mankiw, 2019). The manner in which the dependent ΔTB_{cit} affects the predictors can be considered in accordance with the economic theory with respect to ΔTR_{cit}, ΔE, ΔLP and ΔTRA. Thus the existence of the arithmetic, economic and expenditure effect (Laffer, 2004) was demonstrated together with (i) the cross-sectional dependency of the employment level and corporate income tax (Trabandt and Uhlig, 2011), creating the part of the economic effect, and (ii) the budgetary effect (Lindbeck, 1982; Gahvari, 1988). The other effects, specifically, grey economy ΔGE (Gutmann, 1979; Busato and Chiarini, 2013) and tax competition ΔIFC and ΔOFC (Hájek, 2009), were not statistically significant. It cannot based on this paper concluded whether the income, substitutional, grey economy and tax competition effect can be clearly observed at all or whether only one unified Laffer effect (Papava, 2009) is present. Considering the predictor ΔTRA with an extremely limited correlation with ΔTB_{cit} the Papava's (2009) hypothesis cannot be fully rejected.

Given the above, the results are contradictory to Balatskii (2002), stating that the Laffer curve was defined as a general principle that can be difficult to verify in a real economic environment (also Mirowski, 1982; Movshovich and Sokolovskii, 1994) or Blinder (1981) taking the Laffer curve from an aggregate perspective with a limited possibility to observe separate effects.

It might be advisable to re-verify the results in the future with an extended dataset as due to the limited data availability (mainly caused by the grey economy estimates taken from Schneider, Buehn and Montenegro (2010) and Schneider (2013) only data for the period 2000 – 2012 was included into the statistical testing.

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