Közgazdász Fórum
Forum on Economics and Business
16 (6), 184–196.

2013/6

Comparison of the equity effect of progressive income and consumption taxation

ERZSÉBET TERÉZ VARGA[1]

The paper compares the progressive income tax with the progressive consumption tax from the aspect of equity. The progressive taxation of personal consumption is possible since Irving and Herbert Fisher published their conception in 1942. The comparison of linear taxes is prevailing while the analysis of various progressive tax types is not typical in the economic literature. The paper defines an equivalence conception for the progressive case to create an opportunity for contrasting. The social inequality is measured by the Gini coefficient in a two-period model with four types of consumers who earn different amounts of income, smooth their consumption and are levied by two-bracket progressive tax systems. According to the results of the model the inequality depends on the composition of the population and the rate of wages; both progressive income tax and consumption tax can lead to a more equitable distribution in adequate circumstances.

Keywords: progressive taxation, expenditure tax, social inequality, equivalent tax, Gini coefficient.

JEL codes: H23, H24.

Introduction

The fundamental reason for the application of progressive taxation is the principle of equity: while progressive taxation unambiguously worsens the efficiency of the economy more than linear taxation does, it is still widely adopted in the world for the sake of social justice (Stiglitz 2000). The tax base of progressive taxation is income earned everywhere in the world. While the opportunity of progressive taxation of personal consumption has existed since 1942 only India and Ceylon have tried to introduce it.

The paper discusses the progressive income based tax with the

[1] PhD candidate, assistant lecturer, Corvinus University of Budapest, Department of Finance, e-mail: erzsebet.varga@uni-corvinus.hu.

Published: Hungarian Economists' Society from Romania and Department of Economics and Business Administration in Hungarian Language at Babeș–Bolyai University
ISSN: 1582-1986 www.econ.ubbcluj.ro/kozgazdaszforum

progressive consumption based tax from the aspect of equity to decide if progressive consumption taxation is worth using for improving the equity of tax policy.

For determining a more equitable tax base a well-defined measure is needed. While the concept of deadweight loss is a plausible asset of measuring the efficiency there is not any obvious measure of justice. While a tax which has less excess burden is more efficient the principles of equal sacrifice or horizontal and vertical equity do not offer acceptable instruments in answering the question: which tax system is more equitable? The Gini coefficient presents an opportunity to compare the effect that different tax systems have on reducing the distribution of the goods.

Social inequality is an evergreen problem which stands in the focus of governmental policy. The (re)distribution is one of the three functions (beside allocation and stabilization) of the modern state according to Musgrave. (Balogh 2007)

The ground for comparison means another problem: there are many opportunities to compare tax systems with linear tax rates but what kind of progressive taxes are comparable? I define an equivalence conception for progressive tax rates which harmonizes with the linear tax case. Following this I construct a model in which I can measure the distributional effect of different taxes using the Gini coefficient. Finally I sum up the results. The purpose of this methodology is to find the most efficient manner of reducing inequality in different circumstances.

Literature review: the opportunity of progressive consumption taxation and its advantages

The progressive taxation of income is widely applied in the world, so its reasonableness is not questionable. The discovery of the personal progressive consumption tax is an outcome of an age-long controversy about the best tax base. From the income versus consumption debate here I mention only the consumption side because this leads us to the practicability of the so called expenditure tax.

It is likely to have started with Thomas Hobbes in the 17th century when he asked in his Leviathan: *"For what reason is there that he which* *laboureth much and, sparing the fruits of his labour, consumeth little should be more charged than he that, living idly, getteth little and spendeth all he gets; seeing the one hath no more protection from the Commonwealth than the other?"* (Hobbes 1651, Ch. XXX. 17th paragraph).

After 200 years John Stuart Mill (1875) returned to consumption taxation on the ground of another consideration, namely dealing with the problem of double taxation of savings in the case of income based systems. If all income (both from labour and capital) is levied on income tax we tax the saved part of the income twice while the consumed part is levied only once. This different handling discriminates negatively future consumption against present consumption.

Later came Alfred Marshall and Arthur Cecil Pigou who were advocates of consumption taxation but they recognized its degressive effect. The result of this effect is namely the fact that a poorer taxpayer spends a greater part of his income on consumption than a richer one consequently they suggested a second role for consumption taxes after income taxation. (Musgrave 1996, Kaldor 1955)

In the middle of the last century Fisher and Fisher (1942) and later Kaldor (1955) constructed practicable plans for a *personal (direct) progressive consumption based* tax, namely the *expenditure tax*. The expenditure tax has two main elements: its tax base and its tax rate. The *tax base* is the personal annual consumption which first seems very complex and untreatable.

Controlling a detailed shopping list on every taxpayer at the end of the year would be a real disaster for tax authorities. This task becomes all at once simple if we use the definition of saving: saving of a given period is the part of the income of this period which is not consumed in the same period. Mathematically:

$$S_i = Y_i - C_i \quad (1)$$

where: S_i is the savings in period *i*,
Y_i is the income in period *i* and
C_i is the consumption in period *i*.

After rearranging equation (1) we get a new definition of consumption: namely it is the non saved part of the income. Mathematically:

$$C_i = Y_i - S_i \tag{2}$$

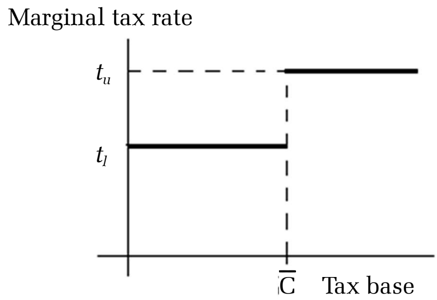
Why is it such a clever and magnificent idea? While the controlling of shopping lists would be an absolute nonsense concept, the income and saving data are available and verifiable information. The taxpayer would have no other task than prove her savings in the period to decrease his tax base while the tax authority should collect information on income as till now (Stiglitz 2000).

The second element of the expenditure tax is its *tax rate*. To eliminate the degressive effect of consumption taxation the tax rate has to be progressive. A tax system is progressive if its average tax rate (which shows the tax burden imposed on the tax base) increases when the tax base increases (Rosen and Gayer 2010).

Methodology

The assumptions of the model

The study applies the progressive two-bracket tax both in the case of income and consumption taxes. Figure 1 illustrates the corresponding marginal tax rate which shows the burden on the last unit of the tax base. The different brackets of the tax base are levied by different tax rates: only the part above the bracket limit is charged with the upper tax rate while the burden of the lower bracket does not change. (Galántainé 2005)



Source: Varga 2012. 602

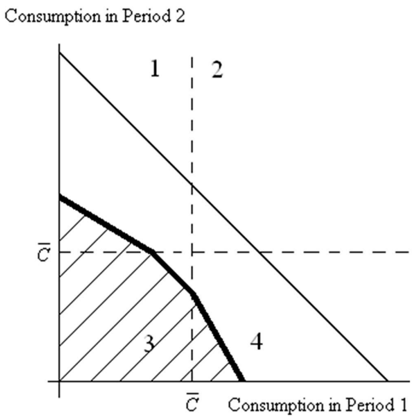
Figure 1. Marginal tax rates of two-bracket progressive tax

Equation (3) gives the burden of expenditure tax (T_i) in period i in function of annual consumption (C_i).

$$T_i = f(C_i) = \begin{cases} t_l \cdot C_i & \text{if } C_i < \overline{C} \\ t_l \cdot \overline{C} + t_u \cdot (C_i - \overline{C}) & \text{if } C_i \geq \overline{C} \end{cases} \quad (3)$$

where: $\overline{C}$ is the bracket limit,
t_l is the lower marginal tax rate (valid under $\overline{C}$) and
t_u is the upper marginal tax rate (valid from $\overline{C}$).

Assuming two periods the expenditure tax modifies the intertemporal budget constraint as shown in Figure 2. The budgetary set is pentangular since its brakes at the two bracket limits (signed by the thick line in Figure 2). In the 1st quarter (where the consumption in the 2nd period is higher while in the 1st one it is lower than the bracket limit) the budget constraint is less steep than the original one while in the 4th quarter just the reverse holds. In the 3rd quarter the budget constraint is parallel to the original one: from equations (4) and (5) the steepness of both lines is $-(1+r)$.



Source: Varga 2012. 607

Figure 2. The intertemporal budgetary set in the case of progressive consumption tax

The intertemporal budget constraint before taxation (which is marked by the thin line in Figure 2) is given by equation (4):

$$Y_1(1 + r) + Y_2 = C_1(1 + r) + C_2 \quad (4)$$

where Y_i is the income in period i, i=1, 2
r is the (real) interest rate.

The budget constraint after taxation in the 3rd quarter (where $C_1, C_2 < \overline{C}$) modifies as equation (5) shows:

$$Y_1(1 + r) + Y_2 = C_1(1 + t_l)(1 + r) + C_2(1 + t_l). \quad (5)$$

The income tax is similar to the consumption tax. Its lower rate will be τ_l (it is valid until the bracket limit denoted by $\underline{w}$) while the upper rate will be τ_u which is valid only above $\underline{w}$.

In the model two periods are assumed: every agent lives for two periods and depletes all of his wealth in the second period. In both periods p_L part of the society earns w_L while p_H part earns w_H, where $p_L + p_H = 1$ and p_L, $p_H > 0$. The wages of the particular periods are independent. Consequently there are four types of consumers with different lifetime income as Table 1 shows.

Table 1. Lifetime income before taxation

		Period 2	
		(w_L, p_L)	(w_H, p_H)
Period 1	(w_L, p_L)	$Y_{LL} = w_L + w_L/(1+r)$	$Y_{LH} = w_L + w_H/(1+r)$
	(w_H, p_H)	$Y_{HL} = w_H + w_L/(1+r)$	$Y_{HH} = w_H + w_H/(1+r)$

Source: own calculation

In general Y_{ij} lifetime income belongs to $p_i \cdot p_j$ part of the society where $Y_{ij} = w_i + w_j/(1+r)$. Let us denote the $p_i \cdot p_j$ product by p_{ij} henceforward.

Gini coefficient

In the model we measure the social inequality by Gini coefficient. Here this statistical indicator shows the average absolute difference of the lifetime income data relative to their average value. Equation (6) shows the formula of average absolute difference while equation (7) shows the concentration coefficient. (Hunyadi et al. 2000)

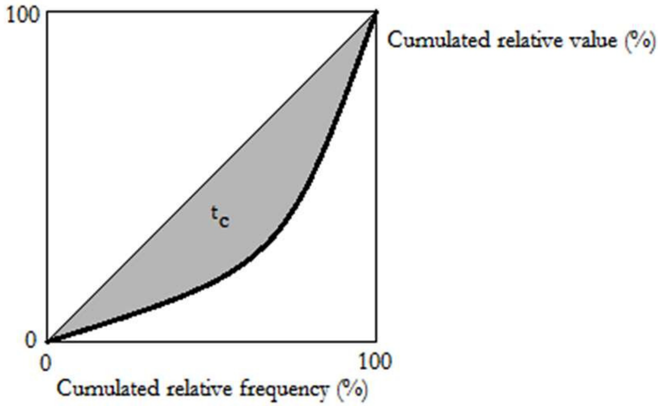
$$G = \Sigma_i \Sigma_j |Y_i - Y_j| / (N * (N-1)) \quad (6)$$

$$L = G / 2 * \underline{Y} \quad (7)$$

where $\underline{Y}$ is the average lifetime income and equation (8) gives its value in the model.

$$\underline{Y} = p_{LL} \cdot Y_{LL} + p_{LH} \cdot Y_{LH} + p_{HL} \cdot Y_{HL} + p_{HH} \cdot Y_{HH}. \quad (8)$$

The concentration coefficient L measures the deviation from the perfectly equable distribution of income. In this model Figure 3 shows the so-called Lorenz curve which illustrates the cumulated relative lifetime income as a function of cumulated population. If the Lorenz curve coincides with the diagonal there is perfect equality in the society. The deviation from perfect equality can be featured by the area between the Lorenz curve and the diagonal. Let us denote this so-called concentration area by t_C. The Gini coefficient defined by equation (7) is just twice this area: $L = 2\, t_C$.



Source: Hunyadi et al. 2000. 124

Figure 3. The Lorenz curve

In the model the average absolute difference is calculated according to eq. (9):

$$G = p_{LL}\cdot p_{LH}\cdot|Y_{LL}-Y_{LH}| + p_{LL}\cdot p_{HL}\cdot|Y_{LL}-Y_{HL}| + p_{LL}\cdot p_{HH}\cdot|Y_{LL}-Y_{HH}| + \\ + p_{LH}\cdot p_{HL}\cdot|Y_{LH}-Y_{HL}| + p_{LH}\cdot p_{HH}\cdot|Y_{LH}-Y_{HH}| + p_{HL}\cdot p_{HH}\cdot|Y_{HL}-Y_{HH}|. \quad (9)$$

Now assume that the government introduces a progressive income tax. The income tax modifies the lifetime income denoted by $Y^{\tau}{}_{ij}$ as eq. (10)–(13) shows assuming the following relations: $w_L < \underline{w} < w_H$.

$$Y^{\tau}{}_{LL} = w_L(1-\tau_l) + w_L(1-\tau_l)/(1+r) \quad (10)$$

$$Y^{\tau}{}_{LH} = w_L(1-\tau_l) + [w_H(1-\tau_u) + \underline{w}(\tau_u-\tau_l)]/(1+r) \quad (11)$$

$$Y^{\tau}{}_{HL} = w_H(1-\tau_u) + \underline{w}(\tau_u-\tau_l) + w_L(1-\tau_l)/(1+r) \quad (12)$$

$$Y^{\tau}{}_{HH} = w_H(1-\tau_u) + \underline{w}(\tau_u-\tau_l) + [w_H(1-\tau_u) + \underline{w}(\tau_u-\tau_l)]/(1+r) \quad (13)$$

The Gini coefficient is calculated similarly as without taxation. Now we only have to change the pre-tax lifetime income variables (Y_{ij}) to taxed variables ($Y^{\tau}{}_{ij}$). Let us denote the Gini coefficient after income taxation by L^{τ}.

Taxation reduces the differences in disposable income so the aftertax Lorenz curve will be closer to the diagonal than the pre-tax curve was. Consequently the concentration area (let us denote it by $t^{\tau}{}_{C}$) and from it the concentration coefficient (the amount of L^{τ}) will be smaller than the original one (t_C and L respectively). The smaller Gini coefficient means more equable distribution.

Equivalent taxes

Now let us calculate the effect of progressive consumption. For a comparable result we have to use adequate rates. Comparison of linear tax systems is by far simpler, consequently its literature is also extensive. The most usual approach of equivalence is the equal tax revenue of the state (sometimes including the riskiness of it as well) or the equal utility achieved by consumers (Bonds and Myles 2007, Hashimzade and Myles 2006).

These equivalence concepts cannot be applied in the case of progressive taxation because they would not be unambiguous. Three elements determine a two-bracket progressive tax: its lower tax rate, its upper tax rate and its bracket limit. If we used the principle of equal tax revenue for determining equivalent tax systems we would get one equation for three variables which problem generates an infinite quantity of solutions and this would result in different measures of inequality and also Gini coefficients.

Now I introduce an unusual equivalence concept for the case of progressive tax rates. Henceforward I regard two tax systems as equivalent if the same part of the earned income is consumable. It means that if someone's gross wage is y_i the consumable part of it will be x_i in both tax systems. This requires the following relation between income and consumption tax rates and bracket limits (Varga 2012):

$$t_j = \tau_j /(1 - \tau_j),\ j \in (l, u) \qquad (14)$$

$$\overline{C} = \overline{w}(1 - \tau_l). \qquad (15)$$

This equivalent concept meets the following requirement as well: "any two sets of taxes that generate the same changes in relative prices have equivalent incidence effects" (Rosen and Grayer 2010. 320). Assuming only one period the budgetary constraints in the case of progressive income and consumption taxation are the same so their effects on relative prices are identical as well. Regarding more periods the budget lines are not the same but they are parallel accepting the assumption of consumption smoothing (see later) so they generate the same changes in relative prices (Varga 2012).

The Gini coefficient regarding the consumption tax

For the calculation of Gini coefficients in the case of consumption taxation (let us denote its value by L^t) the lifetime income data are modified (reduced) by the discounted value of the consumption tax. For calculating the consumption tax burden we need information on the consumption decision of the consumers. Let us assume that when the decision makers maximize their lifetime utility they choose a smooth consumption path: an agent consumes the same amount in both periods of his life regarding his net lifetime income.

This assumption is really factual, accepted and proved by many economists. It works according to the Life Cycle/Permanent Income Hypothesis (Modigliani and Brumberg 1954, Friedman 1957) and even corresponds to the buffer-stock behaviour (Carroll 1996) or the habit persistence approach by Deaton (1987). Actually all of them support the concept of consumption smoothing. Consequently in the model the consumption decision of a person are determined by equations (16) and (17):

$$C_{ij} = Y_{ij}(1 + r)/[(2 + r)(1 + t_l)] \text{ if } Y_{ij}(1 + r)/[(2 + r)(1 + t_l)] \leq \overline{C} \quad (16)$$

$$C_{ij} = [Y_{ij} + C(2 + r)(t_u - t_l)/(1 + r)](1 + r)/[(2 + r)(1 + t_u)] \text{ if } Y_{ij}(1 + r)/[(2 + r)(1 + t_l)] > \overline{C} \quad (17)$$

where C_{ij} is the one-period consumption of a taxpayer who has Y_{ij} lifetime income.

After calculating consumption in the two periods the consumption tax is determined by equation (3).

Results and discussions

The calibration of the model

The lower and upper income tax rates are calibrated respectively with 20 and 40 per cent. The lower and upper consumption tax rates come from eq. (14) and their values are 25 and 67 per cent.

The bracket limit of the income tax ($\underline{w}$) is the simple (not weighted) arithmetic average of the low and high wage: $\underline{w} = (w_L + w_H)/2$.

The income is standardized assuming w_L equals to 1. I investigated two cases of high wage. In the first version high wage (w_H) is 2 while in the second version its value is 10.

I calculated the impact of the different tax systems on the Gini coefficient by different distribution of population. I calculated the concentration coefficients as a function of the value of p_L (the rate of the "poorer" people of the society in a given period) both for income and consumption taxes.

Thereafter I determined the difference of the Gini coefficients of income and consumption taxes (let's denote it by ΔL) as equation (18) shows.

$$\Delta L = L^{\tau} - L^{t} \quad (18)$$

The sign of ΔL reflects which tax reduces social inequality more.

When income tax is more efficient in reducing inequality then L^{τ} is lower than L^{t} so ΔL is negative and vice versa (when consumption tax is more efficient ΔL is positive).

The results of the model

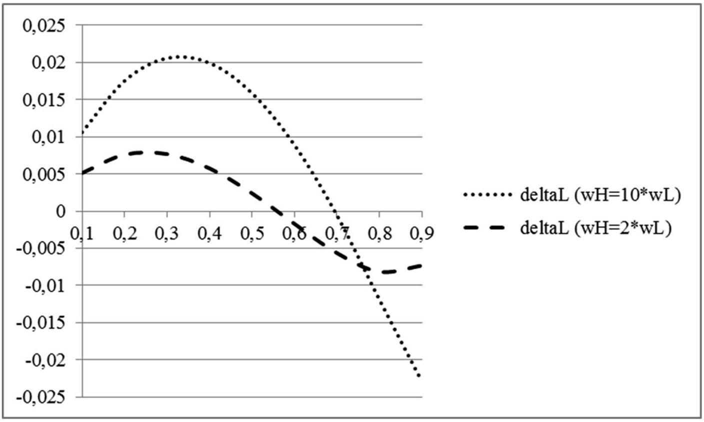
According to my calculations ΔL can be both positive and negative. It depends on the composition of the population and the difference of the lower and higher wages as Figure 4 depicts.

The income tax reduces inequality more than the consumption tax when the rate of people with higher income is less.

When the higher wage is more times bigger than the lower wage the consumption tax performs better in a wider interval of possible society structures.

When the high wage is 10 times the low wage the consumption tax is more effective if the rate of poorer is not greater than 70 per cent whereas if the high wage is only twice the low wage the consumption tax has a more favourable impact until the rate of poorer is around 55 per cent.

In both cases the consumption tax works better in a broader interval.



Source: own figure

Figure 4. The difference of the Gini coefficients as a function of the rate of the poorer part of the society

Conclusions

Equity is a main argument in the debate over the ideal tax base. I investigated the reduction in inequality implied by different taxes measured by the Gini coefficient. According to my model the effectiveness of reducing inequality depends on the own features of a given society: the composition of the population and the rate of wages.

The higher the rate of poorer persons the better the equalizing effect of the income tax and the higher the difference between wages the better the consumption tax. It means that the effect on inequality is favourable but not as high as the problems of the introduction of a progressive consumption tax. Certainly if other aspects prefer the consumption tax the effect on inequality can contribute to a favourable assessment as well.

Necessarily the assumptions of the model limited its adaptability. I assumed two periods, only two income categories and they were certain and known in advance. Taking account of the riskiness of the income path would deliver further solutions to the problem.

References

Balogh, L. (2007). Államháztartás – Adórendszer. In Bánfi, T. (ed.): *Pénzügytan*. Budapest: Tanszék Kft.

Bond, S. and Myles, G. D. (2007). *Income and Consumption Taxation: An Equivalence Result*. http://people.exeter.ac.uk/gdmyles/papers/pdfs/IncConEq.pdf, downloaded at 10.06.2013.

Carroll, C. D. (1996). *Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis*. NBER Working Paper. http://www.nber.org/papers/w5788.pdf, downloaded at 08.05.2013.

Cullis, J. and Jones, Ph. (2003). *Közpénzügyek és közösségi döntések*. Budapest: Aula.

Deaton, A. (1987). Life-cycle models of consumption: is the evidence consistent with theory. In *Advances in Econometrics*. *Fifth World Congress*, vol. 2, pp. 121-148, Cambridge and New York: Cambridge University Press.

Fisher, I. and Fisher, H. N. (1942). *Constructive Income Taxation: A Proposal for Reform*. New York and London: Harper & Bros.

Friedman, M. (1957). *A Theory of the Consumption Function*. Princeton: Princeton University Press.

Galántainé, M. Zs. (2005). *Adó(rendszer)tan. EU-konform magyar adók*. Budapest: Aula.

Hashimzade, N. and Myles, G. D. (2006). *Inequality and the Choice of the Personal Tax Base*. http://people.exeter.ac.uk/gdmyles/papers/pdfs/ExpInEq.pdf, downloaded at 28.05.2013.

Hobbes, T. (1651). *Leviathan or the Matter, Forme and Power of a Commonwealth Ecclasiasticall and Civil*. London: Printed for Andrew Crooke.

Hunyadi, L., Mundruczó, Gy. and Vita, L. (2000). *Statisztika*. Budapest: Aula.

Kaldor, N. (1955). *An Expenditure Tax*. London: George Allen and Unwin.

Mill, J. S. (1875). *A nemzetgazdaságtan alapelvei, s ezek némelyikének a társadalom-bölcsészetre való alkalmazása. 4. és 5. kötet.* Budapest: Légrády testvérek.

Modigliani, F. and Brumberg, R. (1954). Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data. In Abel, A.: *Collected Papers of Franco Modigliani*. Cambridge: MIT Press.

Musgrave, R. A. (1996). Public Finance and Finanzwissenschaft Traditions Compared. *Finanzarhiv*, 53, 145-193.

Rosen, H. S. and Gayer, T. (2010). *Public Finance*. Singapore: McGraw-Hill.

Stiglitz, J. E. (2000). *A kormányzati szektor gazdaságtana*. Budapest: KJK-KERSZÖV.

Varga, E. (2012). A jövedelem és fogyasztás alapú sávosan progresszív adóztatás összevetése. In *Tavaszi szél konferenciakötet*, Budapest: Doktoranduszok Országos Szövetsége.