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Anglophone Crisis in Cameroon: Can indirect tax play a crucial role?

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Abstract. The objective of this article is to develop a policy of indirect taxation on output factors that reconciles losses in case of a waiver of the direct tax in Cameroon. This initiative would help in solving the "Anglophone crisis" in Cameroon by addressing the half of the total tax collected that amounts at CFAF 2429.15 billion to their victims. A static computable general equilibrium model has enabled us to determine the equivalent rate applicable to the labor factor that would make it possible to compensate for losses if the government shifts away from taxation of household income. This rate is 34.569% for an income tax rate of 20%. It also enables boosting growth with an impact on GDP of 7.8%. Besides, each household group that receipts all the other half of tax collected from an indirect tax rate of 10% earns on well-being whereas in case of an equal sharing only the poor households benefit from it.
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1. Introduction

Since 2013, Cameroon is facing an unprecedented security crisis. This began with the Boko Haram group in the northern part of the country where the defense and bravery of the armed forces have maintained control over this part of the country. Since October 2016, there have been the corporatist demands of Anglophone lawyers and teachers on the bipolarity of the texts that should have French and English versions. These unresolved claims served as a voice for the emergence of secessionist movements that brought trouble to the national public order. They claim the split of the country giving rise to the birth of a state called Ambazonia. The consequences, are quite disastrous. First on the humanitarian front, International Crisis Group (2018) indicates that, this crisis has caused more than 1850 deaths, 53000 internally displaced persons and 35000 refugees in Nigeria after 30 months of existence. Economically, it has caused losses of 6434 formal jobs and more than 8000 informal jobs for a shortfall of around CFAF 300 billion according to GICAM (2018), given that the two

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Anglophone regions, particularly the North-West and South-west represent abound a fifth of the national wealth. These losses exclusively related to the Anglophone regions are certainly not without ripple effect on the other regions of the country. For example, the difficulties faced by North-West' wood marketing operators in the border west region of the country. The shortage created in addition to causing inflation creates bottlenecks in the local wood processing industries. With this situation, a number of actions have been taken by the government to ease the tensions and frustrations among which: the establishment of a humanitarian assistance plan for the victims of the crisis, the setting up of a demobilization commission for disarmament and social reintegration. But the tensions do not seem to subside. No doubt the call for inclusive national dialogue by national and international political actors is a solution, but the fact remains that other palliative measures must continue to be considered which measures could continue after the crisis.

It is in this context that we situate our study centered on fiscal policy. The upstream of these investigations is to put forth the problem of managing the security crisis in Cameroon.

It is recognized that government revenue has a twofold nature: a part is derived from the indirect tax on production and on the factors of production (Cardenete *et al.,* 2017) and the other part comes from the direct tax collected on households and firms' income. In order to help ease the current social tensions throughout the country, we consider in this study the hypothesis of the collection of an additional tax on output and on labor factor with a half transferable to victims of the crisis and the other transferable to all national households. As a result, the central question is whether such a decision could be effective.

On the theoretical base, a slight intensification of all indirect taxes should reduce demand compensated in the same proportion for all goods as shown by Ramsey (1927). This fall in compensated demand is explained by the substitution effects that will emerge from household behavior. In this sense Sadka (1977) has established a necessary and sufficient condition to make this possible. It will be necessary that the compensated elasticities with respect to the wage rate of the different products are all equal. The theoretical model of Ramsey, however, will suffer from a major criticism that is to consider only one household. For example, Diamond (1975) in his model with several households showed that the reduction in compensated demand may not be proportional to the different household groups. This reduction should be lower if the consumption of the product concerned is concentrated between groups who firstly, have a high valuation of marginal income in terms of welfare and secondly, have a high probability to pay tax.

A better analysis of tax reforms according to Ahmad & Stern (1991) will depend on the efficiency of revenue collection, its impact on the distribution of income, welfare and the motivation of the tax system in relation to economic activities. For these objectives, economic theory plays a central role in the design of the tax structure. It indicates a simple model benchmark from which political implications can be inferred and provides a method for collecting and analyzing data. The focus of the analysis is to question how income can be generated through taxation but so as to continue over time and especially to boost the growth.

On the empirical side, there is a great deal of investigation on the effects of the indirect tax on welfare (Almad & Stern 1991; Chan & Dung 2002; Toan 2005; Verde & Tol 2009; Dung 2018). These are specific to address the issue using a computable general equilibrium (CGE) model. Among these works, Dung (2018) examines the hypothesis of the effects of a 20% increase in VAT in Vietnam and concludes that government revenues increase by 4.9% against a decline in both income and Household consumption. But beyond all these conclusions, a strong observation relayed by Warren (2008) is that consumption taxes have a significant negative impact on the distribution of household disposable income regardless of the methodological approach adopted. This shows at the same time that very few works considered the question of the indirect tax on factors of production which according to Cardenete *et al.,* (2017) is equally an important instrument tax for the government. Moreover, the management of the security crisis like the problems facing Cameroon today seems to be completely ignored in these works. To carry out such a study seems to be very important on the socio-economic level, especially since this crisis is subject to unbearable costs for the government.

This is why we propose in this article to provide a palliative solution based on the indirect tax on the labor factor which will not only help the citizens of the crisis zones, but also to ease the social tensions that are currently rife across the whole of the national territory. This indirect tax on labor would compensate for this loss if the government were to give up the collection of 20% of consumer income. Basically, we assume a 10% increase in the rate of the tax on production so that half of the resulting income is transferable to the victims of the crisis and the other transferable to all national households by distinguishing rich households from poor households. As a result, the central question is whether the adoption of such a decision could be effective.

Thus, the following section 2 is devoted to the review of past works on the policy of indirect taxation, section 3 presents the methodological approach that will help to obtain the results presented in section 4. A conclusion ends our investigations in section 5.

2. Literature review

We first of all carry out a theoretical review on the effects of indirect taxation, then an empirical review of the related works that has addressed the issue of indirect taxation using a computable general equilibrium (CGE) model, a tool used in this work.

2.1. Theoretical review of the indirect taxation

Originally, the fundamental works that put forth the effects of an indirect tax upstream date back to Ramsey (1927) and Diamond (1975). The difference between these two works is that Ramsey (1927) considers in his model a single household while Diamond (1975) considers several ones which also allow him to question some of Ramseys' results. The latter considers an economy of consumption in which the consumer can divide his total budget between leisure and the purchase of a certain number of goods. It studies the effectiveness of commodity taxation by assuming that the income tax is zero. With this in mind, he realizes that a slight intensification of all indirect taxes should reduce the compensated demand in the same proportion for all goods. Substitution effects are associated with efficiency losses. Ahmad & Stern (1991) thought that this finding gives no clarification of the optimal tax structure that it will depend on the efficiency of revenue collection, its impact on income distribution on well-being, and the motivation of the tax system in relation to economic activities. Thus, a necessary and sufficient condition for such a result to occur is that the compensated elasticities with respect to the wage rates of different products are all equal. It also means that a reduction in the wage rate following a proportional increase in the income tax will reduce the claims compensated in the same proportion.

However, Diamond (1975) demonstrates that these results can change if the behavior of several households is taken into consideration. He realizes that it is possible in such a case that the reduction in compensated demand is not proportional to the different household groups. This reduction should be lower if the consumption of the product concerned is concentrated between groups who firstly, have a high valuation of marginal income in terms of welfare and secondly, have a high probability to pay tax. He is followed by Deaton (1981) in his idea, who also shows that if we move to a multi-consumer economy and assume that the planner has preferences in favor of equity, the almost divisibility leads to a progressive tax structure. The low divisibility between commodities and leisure leads to a regressive indirect tax structure in the case of the single consumer. The introduction of an egalitarian planner and many savings in consumption will bring the solution to progressivity. Besley & Jewitt (1995) generalize this result by testing its applicability to a utility function.

2.2. Review of empirical works on the effects of indirect taxation: A CGE approach

Two papers published in the United Kingdom by the Institute for Fiscal Studies (IFS), namely Crawford *et al.*, (2008) and Crossley *et al.*, (2009), question the findings of other research and the widely accepted consensus that indirect taxes such as value added tax (VAT) are regressive. Crawford *et al.*, (2008) postulate that an optimal consumption tax, levied at a rate unchanged over time, equates to a proportional tax on wages, transfers and income from profits. Crossley *et al.*, (2009), while partially admitting the negative effects of VAT on income, moderate their conclusion by stating that when the rich has more savings than the poor, this temporarily allows him to escape a high proportion of his income that could have been subject to VAT. This savings only incurs tax once it is subject to the expense. It is therefore important in such a situation that VAT does not necessarily affect the household income negatively. VAT should follow a progressive system to act in the first direction.

In the framework of the CGE, the studies on the effects of the indirect tax are plethoric and involve the great majority the well-being of the households (Almad & Stern, 1991; Chan & Dung, 2002; Toan, 2005; Verde & Tol, 2009; Dung, 2018). A consequent review of indirect taxation can be found in Warren (2008). The latter shows that beyond the methodological differences, all studies agree that consumption taxes have a significant negative impact on the distribution of household disposable income. Dung (2018), examining the hypothesis of the effects of a 20% increase in VAT in Vietnam, concludes that government revenues increase by 4.9% against a decline in both household income and consumption. Verde & Tol (2009) indicate that the lifestyles of low-income people can exacerbate the regressivity of indirect taxation, particularly carbon taxes, as they are less energy-efficient and use fuels with higher carbon intensity. They also argue that the carbon tax is likely to be less regressive on consumption than on disposable income. Chan *et al.,* (1999) in a tax reform study in Vietnam show that a sale tax reform positively contributes to the economy. It also has significant redistributive effects that tend to overwhelm the overall impact. Chan & Dung (2002) reach almost the same conclusions, with particular emphasis on the positive social well-being effects that such a reform might entail. Then, the tariffs should be eliminated beforehand. However, the elimination of tariffs leads to growing inequalities between rich and poor, but also between rural households and urban households. In the same vein, Chan *et al.,* (2005) obtain similar results by orienting their study on the labor market. Toan (2005), on the other hand, finds a negative impact of the elimination of tariffs but with mixed results between the urban households that earn and the rural households that lose.

3. Methodology

The methodological approach adopted in this article is inspired from the work of Cardenete *et al.,* (2017). The latter in their model determine the tax rate on the labor factor compatible with a cancellation of the direct tax on the income of consumers. They make the following assumptions:

- The economy includes two factors of production including labor and capital, two consumers, the government, two firms and two goods;
- The factors are owned by two consumers who sell them to two firms and the income they derive from them is used to finance their consumption;

- The value added of each firm, resulting from the transformation of the factors of production, is combined with the intermediate consumption to produce the final output;
- Each firm produces only one good;
- The production, consumption and value-added functions are of the Cobb Douglas type with constant returns to scale;
- The government has three sources of revenue: the indirect tax on final output, the indirect tax on factors and the direct tax on the income of consumers;
- All collected tax is transferred to consumers

In this article, we make the following changes and additions:

- The economy still has two households, but the first one is a rich household determined on the basis of national wealth at the official poverty rate[1] and the second one is a poor household;
- The government deploys 50% of the total additional tax collected to support the victims of the security crises of North West and South West and the remainder is transferred to households.

3.1. Variables and parameters of the model

The ratings are those of Cardenete *et al.,* (2017) to which we add variables and parameters that take into account the weight of transferable government income to households. For simplicity we summarize them below.

No	Variables	Description
1	P_i	Price of good i
2	ω_k	Price of the factor of production k
3	ωn_k	Net price of the factor of production k
4	Y_i	Total output of firm i
5	Pva_i	Value added price for firm i
6	$b_{k,i}$	Technical coefficient for the use of the factor of production k by firm i
7	$C_{i,h}$	Individual demand for the consumption of good i by the household h
8	CD_i	Aggregate demand for final consumption of good i
9	$X_{k,i}$	Demand for the factor of production k by the firm i
10	XD_k	Aggregate demand for the factor of production k
11	TC	Total tax collected by the government
12	TCT	Tax collected and transferable to households
13	OT	Tax collected on output
14	FT	Tax collected on production factors
15	MT	Tax collected on household income
16	GDP	GDP based on income approach at market price
17	$iY_{i,j}$	Intermediary consumption of good i by the firm j
18	VA_i	Value added of the firm's branch i
19	Z	Variable for objective function

[1] It is 37.5% in 2017

Parameters		Description
1	$e_{k,h}$	Household endowment h in the factor of production k
2	$\beta_{i,h}$	Elasticity of the demand for good$i$ by household h
3	$a_{i,j}$	Input-output matrix coefficient
4	$\alpha_{k,i}$	Elasticity of demand for the production factor k by the firm i
5	v_i	Coefficient of value added in branch i
6	τ_i	Government tax rate on product i
7	m_h	Income tax rate on household h
8	δ_h	Fraction of tax transferred to household h in TCT
9	t_k	Rate of tax applied on factor k
10	ϑ	Fraction of government income transferred to households

With $I \subseteq \{Agriculture, Industry, Services\}, k \subseteq \{Labour, Capital\}$
$h \subseteq \{Rich\ household, Poor\ household\}$

3.2. Equations

The model is based on a system of simultaneous equations integrating four groups of variables (commodity prices P_i, factor pricesω_k, output levels $Y_i$and tax level T).

Let's start from the basic equations formulated by Cardenete *et al.,* (2017) for which the price of the value added $Pva_i$is related to the price of factor ω_k by equation(1)and of the following price equation P_i(2):

$$Pva_i = \prod_k \omega_k{}^{\alpha_{k,i}} \tag{1}$$
$$P_i = (1+\tau_i).\left(Pva_i.v_i + \sum_j P_j a_{j,i}\right) \tag{2}$$

By replacing (1)in(2),we obtain:

$$P_i = (1+\tau_i).\left(\prod_k \omega_k{}^{\alpha_{k,i}}.v_i + \sum_j P_j a_{j,i}\right) \tag{3}$$

The relation (3)gives a system of 3 equations (because the set i contains three elements agriculture, industry and services) and 5 unknown variables in particular $(P_1, P_2, P_3, \omega_1, \omega_2)$. This system can not therefore be solved independently except to fix two variables. To find the additional equations, Let's start from the following equations[2] (4), (5), (6), (7) respectively expressing the technical coefficients for labor and capital$b_{k,i}$, the demand for factors$X_{k,i}$, and aggregate demandXD_k:

$$b_{1i} = \alpha_{1i}.\left(\frac{\omega_2}{\omega_1}\right)^{\alpha_{2i}} \tag{4}$$

$$b_{2i} = \alpha_{2i}.\left(\frac{\omega_1}{\omega_2}\right)^{\alpha_{1i}} \tag{5}$$

$$X_{k,i} = b_{ki}.v_i.Y_i \tag{6}$$

[2] The details of these equations can be found in Cadenete et al. (2017) chapter 4

$$XD_k = \sum_i X_{k,i} \tag{7}$$

By substituting (4) and (5) in (6) then the resulting expression in (7) we obtain:

$$XD_k = \sum_i b_{ki}.v_i.Y_i \tag{8}$$

We thus obtain $b_{ki} = b_{ki}(\omega_k), XD_k = XD_k(\omega_k, Y_i)$. Note also that XD_k does not represent anything else than the total endowment of the factor of production k by the household h that was denoted earlier as $e_{k,h}$ that is:

$$XD_k = \sum_h e_{k,h} = \sum_i b_{ki}.v_i.Y_i \tag{9}$$

The expression (9) gives us a system of 2 equations and 5 unknown variables too $(\omega_1, \omega_2, Y_1, Y_2, Y_3)$ which makes a total of 5 equations and 8 unknown variables $(P_1, P_2, P_3, \omega_1, \omega_2, Y_1, Y_2, Y_3)$. So, there are 3 equations missing to make the system square.

Note to clarify the procedure to be followed for the determination of the latter equations that, because of the tax on the factor t_k, the net price of factor ωn_k is related to its nominal price ω_k by the relation:

$$\omega n_k = \frac{\omega_k}{1 + t_k} \tag{10}$$

This net factor price makes it possible to elaborate equations (11), (12), (13) and (14) respectively representing the tax collected on the output, the tax on the factors, the tax on the income and the total tax:

$$OT = \sum_i \tau_i.Y_i.\left(Pva_i.v_i + \sum_j P_j a_{j,i}\right) \tag{11}$$

$$FT = \sum_i \sum_k t_k.\omega n_k.b_{k,i}.v_i.Y_i \tag{12}$$

$$MT = \sum_h m_h.\left(\delta_h.TC + \sum_k \omega n_k.e_{k,h}\right) \tag{13}$$

$$TC = OT + FT + MT \tag{14}$$

S
tarting from equation (2), expression (11)can be simplified as follows:

$$OT = \sum_i \frac{\tau_i}{(1+\tau_i)} . Y_i . P_i \tag{15}$$

By replacing equations (15), (12)and (13)[3] in (14), we obtain:

$$TC = \sum_i \frac{\tau_i}{1+\tau_i} . Y_i . P_i + \sum_i \sum_k t_k . \frac{\omega_k}{1+t_k} . b_{k,i} . v_i . Y_i + \sum_h m_h . \left(\delta_h . TC + \sum_k \frac{\omega_k}{1+t_k} . e_{k,h} \right) \tag{16}$$

By grouping we deduce TC as follows:

$$TC = \frac{\sum_i \frac{\tau_i}{1+\tau_i} . Y_i . P_i + \sum_i \sum_k t_k . \frac{\omega_k}{1+t_k} . b_{k,i} . v_i . Y_i + \sum_h m_h . \left(\sum_k \frac{\omega_k}{1+t_k} . e_{k,h} \right)}{1 - \sum_h m_h . \delta_h} \tag{17}$$

Equation (17) expresses the total tax collected and is therefore an equilibrium equation of the system with 9 variables $(P_1, P_2, P_3, \omega_1, \omega_2, Y_1, Y_2, Y_3, T)$. Moreover, the behavior of the equilibrium output is given by:

$$Y_i = CD_i + \sum_j a_{ij} . Y_j \tag{18}$$

This equation indicates that the firm produces output i not only to satisfy household consumption demand but also to meet the demand for intermediary consumption of the branches which is then determined by:

$$iY_{i,j} = a_{ij} . Y_j \tag{19}$$

CD_iBeing defined as the aggregated demand for individual consumption $C_{i,h}$i.e.:

$$CD_i = \sum_h C_{i,h} \tag{20}$$

This demand for individual consumption results from a Marshallian maximization program of a Cobb Douglas utility function with constant returns to scale, so the resolution gives:

[3] Equations (12) and (13) have been reduced as a function of P, ω, Y

$$C_{i,h} = \frac{(1-m_h).\beta_{i,h}.\left(\delta_h.TC + \left(\sum_k \frac{\omega_k}{1+t_k}.e_{k,h}\right)\right)}{P_i} \tag{21}$$

Replacing(21)in (20) we obtain:

$$CD_i = \sum_h \frac{(1-m_h).\beta_{i,h}.\left(\delta_h.TC + \left(\sum_k \frac{\omega_k}{1+t_k}.e_{k,h}\right)\right)}{P_i} \tag{22}$$

Thus, (22)in(18), gives:

$$Y_i = \sum_h \frac{(1-m_h).\beta_{i,h}.\left(\delta_h.TC + \left(\sum_k \frac{\omega_k}{1+t_k}.e_{k,h}\right)\right)}{P_i} + \sum_j a_{ij}.Y_j \tag{23}$$

We thus obtain a new system of 3 equations with 9 variables.

This makes a total of 3 + 2 + 1 + 3 = 9 equations (given by systems (3), (9), (17) and (23)) respectively) and 9 variables.

However, equality between the number of equations and the number of variables does not ensure the existence of an equilibrium solution $(P^*, \omega^*, Y^*, T^*)$. According to Walras' law, an equation of the equilibrium system is redundant. So, to solve it, a variable must be chosen as numéraire according to which all the other variables will be expressed. This allows for subsequent analysis of the results of the balance in relative value rather than in absolute value.

In addition to the previous equilibrium system, we determine the amount of tax collected by the government and dedicated to be transferred to households $(TCT)$by the following equation (24):

$$TCT = TC.\vartheta \tag{24}$$

And the GDP is calculated according to income method as follows:

$$GDP = \sum_i VA_i + TC - MT \tag{25}$$

With

$$VA_i = \sum_k X_{k,i} \tag{26}$$

Let's now present the data for analysis.

3.3. Social accounting matrix

We are implementing Cameroon's Social Accounting Matrix (SAM) for 2016, based on data from the Table of Resources and Employment (TRE) from INS (2017) and from the national accounts. The TRE essentially allows building the input-output table for intermediary consumption. Information on factors of production is collected from the Ministry of Finance (MINFI) in collaboration with the INS. This SAM has 7 accounts, namely: 3 accounts for firms operating at the same time in the agriculture, industry and services; 2 accounts for production factors including labor and capital; 2 household accounts, one for the rich household and the other for the poor household.

For matrix balancing, three approaches are adopted for comparison: the cross-entropy method, the Ordinary Least Squares method and the similarity approach. The first two approaches in the literature offer the best estimates (Robinson *et al.*, 1998; Robinson & El-Said, 2000; Fall, 2010; Lee & Su 2014; Cardenete *et al.*, 2017) of the balanced social accounting matrix indicated in the appendix.

3.4. Calibration of the model

The Calibration procedure consists of determining the initial values of the various parameters of the model from which the model will reproduce the benchmark equilibrium, that is to reproduce the data of the SAM before simulations are performed. Outside the parameters $\tau_i, m_h, \delta_h, t_h$ whose values are fixed by the modeler, the scale and elasticity parameters must be calibrated. This is the place to recall that the values of the output levels are taken directly from the SAM. It is from these values that the calibration is carried out.

Let's start with the parameter $\beta_{i,h}$ representing the elasticity of consumer demand for good i by the household h linked to a Cobb Douglas consumption function as follows:

$$u_h(C_{1h}, C_{2h}, \dots, C_{Nh}) = \prod_i {C_{i,h}}^{\beta_{i,h}} \tag{27}$$

In this economy, the consumer faces N consumer goods and his budget constraint is given by:

$$\sum_i P_i . C_{i,h} = (1 - m_h).\left(\sum_k \omega_k . e_{k,h} + \delta_h . TCT\right) \tag{28}$$

The constraint (27) indicates by the right-hand side the consumer's income, which is essentially derived from the sale of the factors of production (the wage for the labor factor and the return of capital for the capital factor) but also from a government transfer of value $\delta_h.TCT$ since only the TCT amount is allocated to the transfer to households. All this income supports at the same time a direct tax ratem_h. The net income of the household is then used to finance its consumption of goods whose cost is $P_i.C_{i,h}$monetary units.

$$\frac{\frac{\partial u_h(C_{1h},C_{2h},\ldots,C_{Nh})}{\partial C_{1h}}}{\frac{\partial u_h(C_{1h},C_{2h},\ldots,C_{Nh})}{\partial C_{2h}}} = \frac{P_1}{P_2} \Leftrightarrow \frac{\beta_{1,h}}{\beta_{2,h}} = \frac{P_1.C_{1h}}{P_2.C_{2h}} \Leftrightarrow \beta_{1,h} = \beta_{2,h}.\frac{P_1.C_{1h}}{P_2.C_{2h}}$$

Under the assumption of constant returns to scale for two goods, we have
$\beta_{1,h} + \beta_{2,h} = 1$ which leads to:

$$\beta_{1,h} = \frac{P_1.C_{1h}}{P_1.C_{1h} + P_2.C_{2h}} \ et\ \beta_{2,h} = \frac{P_2.C_{2h}}{P_1.C_{1h} + P_2.C_{2h}}$$

In general, the calibration of the parameter $\beta_{i,h}$is given by:

$$\beta_{i,h} = \frac{P0_i.C0_{ih}}{\sum_j P0_j.C0_{j,h}} \tag{29}$$

Note that $P0_i$ and $C0_{ih}$ simply represent the values at the initial year of household prices and individual consumption respectively (see Hosoe *et al.*, 2010, page 63 for the conversion of quantities into monetary value)).

Now proceed to the calibration of $\alpha_{k,i}$starting from a Cobb Douglas production function with technological parameter$\mu_j$defined by.

$$Q_j(X_{k1}, C_{k2}, \ldots, C_{kK}) = \mu_j.\prod_i X_{k,i}{}^{\alpha_{k,i}} \tag{30}$$

Since the producer's budget constraint facing K factors of production is indicated at an output level$Q0_j$, he will try to solve under this constraint the following program:

$$\underset{i}{Min} \sum_k \omega_k.X_{k,i} \tag{31}$$

As previously for the case of the consumer, it is easy to show that the elasticity of demand for the productionfactor k by firm$i$ is defined by:

$$\alpha_{k,i} = \frac{\omega0_k.X0_{k,i}}{\sum_j \omega0_k.X0_{k,j}} \tag{32}$$

Once $\alpha_{k,i}$ is known, the technological parameter μ_j can be determined knowing the production $Q0_j$ which in principle is equal to the value added $VA0_j$ since it does not yet take into account the intermediary demand of the factors. So, we have:

$$VA0_j\left(X0_{k1}, C0_{k2}, \dots, C0_{kK}\right) = \mu_j . \prod_i X0_{k,i}{}^{\alpha_{k,i}}$$

This leads to[4]:

$$\mu_j = \frac{VA0_j}{\prod_i X0_{k,i}{}^{\alpha_{k,i}}} \tag{33}$$

As for the coefficients of the input-output matrix a_{ij}, their calibration is simply deduced from the relation between iY_{ij} and Y_j where we have $iY_{ij} = a_{ij} . Y_j$ but considering that we reason in value rather than in volume we obtain:

$$a_{ij} = \frac{iY0_{ij}}{P0_j . Y0_j} \tag{34}$$

Apart from these parameters intrinsic to the model, other parameters are deduced directly from the SAM, namely: $C0_{ih}, iY0_{ij}, Y0_j, CD0_i, VA0_j, X0_{k,i}, XD0_k$. On the other hand, the initial values of the prices are defined equal to unity, that is $P0_i = 1; \omega0_k = 1$.

3.5. Closure model

Given the objective of this work, which is to determine the threshold of the indirect tax rate on the labor output factor that is revenue neutral with regard to income tax rate[5]; we organize this work around two waves of scenarios. The firsts are aimed primarily at questioning the impact of a transfer of the government tax to households on their utility. The second wave of the scenarios takes up the central question of the labor tax threshold to compensate for legitimate losses by canceling the direct tax.
Specifically, the first wave of scenarios all based on an indirect tax $\tau_i = 10\%$ across all branches, focuses on:

- First, a simulation of the behavior of the economy variables when all the government transferable income TCT is transferred to rich households $\delta_1 = 1$;
- The second scenario assumes an equal sharing of this government income between rich and poor households $\delta_1 = 0.5$;

[4] An alternative formulation of the parameter μ_j is given by $\mu_j = \alpha_{1j}{}^{-\alpha_{1j}} . \alpha_{2j}{}^{-\alpha_{2j}}$ see Cardenete *et al.*, (2017).

[5] This objective matches with that of resolving the crises

- The third scenario is based on a full transfer of TCT to poor households$\delta_1 = 0$.

The second wave of scenarios basically holds an equal sharing i.e. $\delta_1 = 0.5$ and includes three simulations but three other simulations are made in order to question the opportunity to tax the capital factor of production:

- A 10% increase in the tax on the labor factor;
- A tax rate of 20% on the direct tax collected on household income;
- An adjustment of the tax rate on the labor factor compatible with the cancellation of the 20% of the direct tax on household income;
- A 10% increase in the tax on the capital factor;
- A 10% tax increase on both labor and capital factors;
- An application of the labor tax equilibrium rate rather than the capital factor.

It should be noted that the last three scenarios are intended to justify the orientation made on the taxation of the labor factor.

However, it must be recognized here that the calibration of models, especially when they become complex, makes it necessary to distinguish the endogenous variables from the exogenous ones. In this case, calibration refers to specifying and justifying the choice and the appropriateness of the exogenous variables according to the problem raised. For more details see Decaluwé *et al.,* (2001) and Hosoe *et al.,* (2010).

4. Results

The results are presented in two stages: firstly, as described above, we present in subsection 4.1 below the results of the first scenarios dealing with the issue of distribution effects of the transferable government tax transferred to households. Then the rate of the tax applicable on the labor factor to compensate for the renunciation of the direct taxes is exposed and supported in subsection 4.2. Moreover, we justify the orientation made on the labor factor in subsection 4.3.

4.1. Tax distribution effects

Let's first recall that the half of the tax collected by the government represents the effective amount of income that has to be transferred in the circumstance of Anglophone crisis in North-west and South-west region. The other half is transferrable to all the households in the country. It derives from an indirect tax on both agricultural, industrial and services productions at the rate of 10% in each. It should also be noted that the interpretation of the results calls for precautionary measures as long as prices are always expressed in terms of numéraire. We have considered in this work as numéraire the net labor price ωn_{lab} . This is actually an arbitrary unit of measurement in which all our results will be expressed. Consider the case of prices: then we must keep in mind that their starting values were set at 1 and therefore any variation found must be analyzed relative to the numeraire. We will therefore be tempted if we consider the first column of Table 1 in appendix to say that, the price of agricultural goods increases by 20.1% or that of industrial goods increases by 16.3%. We cannot validate this because we do not know how much the net price of labor would have changed. What we do know is that initially, a unit of agricultural good purchased a unit of labor and that after simulation, 1.201 units of agricultural good must now be exchanged for one unit of labor. Alternatively, to buy a unit of labor, we will need 1/1.201 that is about 0.8326 units of agricultural good. In other words, the labor becomes more expensive compared to the agricultural good.

This precision leads to the observation that they are increasing when the transfer is made from rich households to poor households. We go for example from 1.201 for $\delta_1 = 1$ to 1.207 for $\delta_1 = 0$ in the agricultural sector. This shows that the policy of taxation and transfer[6] is not neutral to the evolution of the prices of goods. Concretely, this result reveals that it will be necessary to make a little more effort to acquire a unit of each good relative to the acquisition of a unit of labor by the firms, and more again in the case of a transfer to poor households.

On the other hand, when we analyze the results linked to the price of the capital factor also expressed in index, we can see that it becomes cheaper to acquire with respect to the agricultural sector and expensive for industrial and services sectors compared to a unit labor factor. However, we must avoid thinking about a substitution of capital for labor in the case of agricultural good. The ingenuity here is to understand that less capital has been used in each sector of activity except the industrial sector (see appendix SAM). This weakness in the demand for capital has therefore caused the price of this factor to fall. And even beyond that, if there had been a substitution effect of capital for labor, this effect would be rather marginal regarding the output effect which is clearly materialized by the increase in production relative to labor. The latter brings some relevant information.

Indeed, when the entire transfer is made to rich households, agricultural production[7] and industrial production fall relative to labor. Their index values are indeed 0.941 and 0.994, a fall of 5.9% and 0.6% respectively. On the other hand, the service sector is expanding, with production increasing by 2.8%. On the other side, where all the transfer is done for poor households, the effect is totally reversed. In this case, only the services sector is experiencing a fall in production relative to labor, while agricultural and industrial productions are in a better state. They increase by 3.8% and 1.3% respectively. In the case of equal sharing of the transfer, the industrial and services sectors benefit while agricultural production is

[6] It must of course be kept in mind that the tax transferred is first of all derived from an indirect tax rate

[7] A distinction is made here between gross output and net output which takes into account the intermediary production of branches and it is always preferable to pay attention to the net values of production

declining. These results also show that the policy of transfer to the households is not neutral compared to the production of the branches. On top of that it gives relevant remarks.

Indeed, if the government wishes to boost production through this transfer mechanism, she must be known that the results will not be positive for all sectors at the same time. At most two of the three sectors will benefit:

- If he wishes to encourage the development of the agricultural and industrial sectors, she will have to transfer the income to poor households;
- If he aims to boost the industrial and service sectors, she will have to share equally the amount of transferable income between the two groups of households;
- But if he transfers all this income to rich households, she will have to know that only the services sector will benefit.

Let's now focus on the factors allocation in different sectors. The first observation that emerges is that the index values of factors are decreasing in the agricultural and industrial sectors relative to the labor when transfers go to rich households. There are increasing only in the services sector. When poor receive all the transfer, the situation is reverse while agricultural and industrial sector perceive differently the impact. These results corroborate what we have mentioned above on the price of capital. It is understandable that the decline in the value of the capital factor in agricultural sector makes it more abundant. In contrary, the growing of industrial and services sectors explain the other results. Let's end this section with the effects on well-being.

No result on the utility of the household receiving the transfer is surprising even if it is a little mixed for the rich. In the case of a transfer to the poor, their utility increases by 19.986 % while that of the rich decreases by 14.512%. When this income is shared equally, it reduces the welfare of the poor to 1.665% while the decline in the welfare of the rich improves. The latter becomes positive and reaches 11.081% when the rich receives all the transfer while the poor sees his welfare deteriorate in this case. This loss of 15.312% is almost equivalent to the loss recorded by the rich when they receive nothing. Given this result and the security tensions that prevail in the Anglophone regions, a policy oriented towards a transfer to the poor or equal transfer could help to dilute or to allay the social tensions that swarm all over the national territory.

4.2. Equivalent rate of the labor tax

The question for the equivalent labor factor rate to reduce the losses from the abandoning of consumer income taxation assumes that the government's transfer to households is done on an equal basis. Let's note from the onset a major piece of information: we note that the three scenarios in Table 2 in appendix contribute to improving the well-being of poor households against the rich. Indeed, the collection of 10% of the tax on the use of labor factor by the firms improves the utility of the poor by 3.18%

and deteriorates that of the rich by 2.325%. These proportions increase to 5.478% and 3.99% respectively when the government collects a 20% tax on the income of each household group. At this point, an explanation may be due to the fact that the equal transfer of government income to households is only profitable to poor households as we have shown above (see Table 1 in appendix). As a result, the higher the income transferred, the better the situation of the poor and the deterioration of the rich. This situation is comparable to the Pareto optimum.

As for the rate applicable to the labor factor to compensate for the losses due to a waiver of the direct taxation of 20%, we obtained a rate of 34.569%. *Indeed, with a rate of 20% on the income of the consumers, the government collects a transferable global income of CFAF 2429.149 billion against a substantially equal amount of CFAF 2429.147 billion for a rate of 34.569% on the use of labor factor.* What can we learn from this rate? Two major pieces of information can flow from this result:

- First, the search for such a compensation rate is not neutral on microeconomic variables

Indeed, by applying this rate, we first notice that the prices of goods increase relative to the price of capital. The price of agricultural products increases from 1.205 to 1.621 henceforth that agricultural goods become less and less expensive compared to the acquisition price of a unit of capital. On the other hand, the nominal price of the labor factor is affected since its net price has been taken as numéraire. This shows that a low tax does not affect the nominal value of the labor while the latter reacts upward when the rate of tax becomes important. The same goes for capital that becomes cheaper to acquire in relation to labor. Its price index goes from 1.006 to 1.353.

- Secondly, there is no neutrality on macroeconomic variables

The case of the GDP is as far as concerned here. In fact, an income tax has a negative effect on growth with an index of 0.801, while substituting a labor rate of 34.569% leads to an increase in growth rate of 7.8%.

In summary, the rate of 34.569% serves to two things:

- First, it allows the amount of the direct tax lost by the government to be recovered as originally intended;
- Secondly, it ensures economic growth. This growth largely depends on the remuneration of the factors that contribute to the value added of the branches.

So, a question at this level deserves to be asked: is there an equitable distribution of transferable income that would at the same time improve the situation of the rich and the poor? In trying to answer this question, we readjust the value ofδ_1, which is the fraction of income allocated to rich households. The fact is that, the two groups of households cannot see their well-being improve at the same time. So, another additional question is: in this case, what is the rate applicable to $\delta_1$that neutralizes the utility of the two household groups? The answer to this last question is that a 56.45% income transfer to the rich versus 43.55% for the poor renders the usefulness of the two household groups almost null. That of rich households is -0.005% against -0.020% for the poor.

4.3. What about the case where the tax on capital is concerned?

Could we have had the same results with a targeted policy around the tax on capital? Or could it have been better to go further? These two questions justify the extension that we make in this point.

The answer to these questions is provided by the results in Table 3 in appendix, which shows that, a policy based on capital factor taxation is ineffective in either recovering direct tax losses or boosting growth. First, the amount of the tax resulting from a tax rate of 34.569% for the capital factor is only CFAF 1337.997 billion contrary to the tax on labor. A fairly simple reason is that households are poorly endowed with capital as we indicated above (see SAM). Besides, growth is reduced by 6.5% while there was a rise of 7.8% with the tax on labor.

5. Conclusion

The purpose of this article was to develop a policy of indirect taxation on output factors which makes it possible to reconcile the losses in case of a waiver of the direct tax. This initiative may help in the resolution of the security crisis in North-west and South-west regions in Cameroon. A static computable general equilibrium model has enabled us to determine the equivalent rate applicable to the labor factor that would make it possible to compensate for losses if the government shifts away from taxation of household income. This rate is 34.569% for an income tax rate of 20%. It also allows boosting growth with an impact on GDP of 7.8%. Apart from this rate, the total revenue that could be allocated to the victims of the Anglophone crisis is CFAF 2429.149 billion. Besides, half of the government income from an indirect tax of 10% on the outputs is transferred completely to the households either all to the rich, or all to the poor, or an equal sharing between the two groups. And according to the adopted policy, the household that receives the totality of the income sees its well-being improve whereas in case of an equal sharing only the poor households benefit from it.

Therefore, one can wonder if it could be quite easy to implement such a policy. That is, could Cameroonian firms support a supplementary tax of 10% on output? This carry out an important issue concerning the economic partnership agreement which is applicable by Cameroon three years ago. Unfortunately, this agreement doesn’t favor this economy. Indeed, the national commission for monitoring and evaluation of the Cameroon EPA indicated in August 2017 that, this agreement has engaged losses of CFAF 685 million without creating any welfare effect on households and these losses seem amplifying one year to another. Thus, we recommend to resign this agreement first in order to allow the local firms to deploy their activity effectiveness.

Appendix

Table 1. *Impact on micro indicators*

	$\delta_1 = 1$	$\delta_1 = 0.5$	$\delta_1 = 0$
Price of commodities			
P_{agr}	1.201	1.204	1.207
P_{ind}	1.163	1.169	1.176
P_{ser}	1.157	1.160	1.162
Factor Price			
ω_{lab}	1.000	1.000	1.000
ω_{cap}	0.993	1.004	1.015
Change in gross output			
Y_{agr}	0.941	0.989	1.038
Y_{ind}	0.994	1.003	1.013
Y_{ser}	1.028	1.001	0.974
Change in net output			
Y_{agr}	0.927	0.986	1.046
Y_{ind}	0.999	1.008	1.016
Y_{ser}	1.065	1.004	0.943
Utility variation (%)			
ΔU_{rich}	11.081	-1.655	-14.512
ΔU_{poor}	-15.312	2.255	19.986
Allocation factor (agr)			
Lab	0.940	0.990	1.040
Cap	0.947	0.998	1.024
Allocation factor (ind)			
Lab	0.990	1.006	1.022
Cap	0.997	1.002	1.007
Allocation factor (ser)			
Lab	1.027	1.002	0.976
Cap	1.035	0.998	0.961
Total tax receipt			
TCT	897.442	904.912	912.510
GDP variation			
GDP	0.998	1.001	1.004

$\tau_i = 10\%$ in all the activity sectors

Table 2. *Result for labour factor controlling*

	$t_{lab}=10\%$	$mi_h=20\%$	$t_{lab}=34.569\%$
Price of commodities			
P_{agr}	1.324	1.205	1.621
P_{ind}	1.286	1.170	1.574
P_{ser}	1.276	1.160	1.561
Factor Price			
ω_{lab}	1.100	1.000	1.346
ω_{cap}	1.105	1.006	1.353
Change in gross output			
Y_{agr}	0.992	0.998	0.996
Y_{ind}	1.004	1.005	1.005
Y_{ser}	1.000	0.996	0.997
Change in net output			
Y_{agr}	0.989	0.997	0.995
Y_{ind}	1.008	1.009	1.005
Y_{ser}	1.001	0.993	0.997
Utility variation (%)			
ΔU_{rich}	-2.325	-3.991	-3.549
ΔU_{poor}	3.180	5.478	4.867
Allocation factor (agr)			
Lab	0.992	0.999	0.997
Cap	0.988	0.993	0.991
Allocation factor (ind)			
Lab	1.007	1.009	1.008
Cap	1.002	1.003	1.002
Allocation factor (ser)			
Lab	1.000	0.997	0.998
Cap	0.996	0.991	0.992
Total tax receipt			
TCT	1345.837	2429.149	2429.147
GDP variation			
GDP	1.027	0.801	1.078

$\tau_i=10\%$ in all the activity sectors and $\delta_1=0.5$

Table 3. *Impact for capital factor controlling*

	$t_k = 10\%$	$t_{cap} = 10\%$	$t_{cap} = 34.569\%$
Price of commodities			
P_{agr}	1.325	1.204	1.204
P_{ind}	1.286	1.169	1.170
P_{ser}	1.276	1.160	1.160
Factor Price			
ω_{lab}	1.100	1.000	1.000
ω_{cap}	1.105	1.004	1.005
Change in gross output			
Y_{agr}	0.993	0.991	0.993
Y_{ind}	1.004	1.004	1.004
Y_{ser}	0.999	1.000	0.999
Change in net output			
Y_{agr}	0.991	0.988	0.991
Y_{ind}	1.008	1.008	1.008
Y_{ser}	0.999	1.002	0.999
Utility variation (%)			
ΔU_{rich}	-2.717	-2.046	-2.761
ΔU_{poor}	3.720	2.795	3.782
Allocation factor (agr)			
Lab	0.994	0.991	0.994
Cap	0.989	0.987	0.989
Allocation factor (ind)			
Lab	1.007	1.006	1.007
Cap	1.002	1.002	1.002
Allocation factor (ser)			
Lab	1.000	1.001	0.999
Cap	0.995	0.997	0.994
Total tax receipt			
TCT	1514.420	1058.080	1337.997
GDP variation			
GDP	1.001	0.977	0.935

$\tau_i = 10\%$ in all the activity sectors and $\delta_1 = 0.5$

Table 4. *Social Accounting Matrix (SAM for Cameroon 2016)*

	AGR	IND	SER	LAB	CAP	RICH	POOR	TOT
AGR	171,6986	425,4018	246,2275			1208,9920	1927,6801	3980,0000
IND	981,3960	852,6727	956,5011			2008,1634	1651,2668	6450,0000
SER	1091,2840	1023,9110	880,9074			2782,8445	771,0531	6550,0000
LAB	1516,2997	1587,5483	3896,1521					7000,0000
CAP	219,3218	2560,4663	570,2119					3350,0000
RICH				4021,7148	1978,2852			6000,0000
POOR				2978,2852	1371,7148			4350,0000
TOT	3980,0000	6450,0000	6550,0000	7000,0000	3350,0000	6000,0000	4350,0000	

GAMS CODE OF THE MODEL

When importing data make sure that the excel file is in the same directory with gams file. You will just need to follow File-View in explorer and you paste the Excel file. **you should download the demo version of** GAMS at **(http://www.gams.com)**

```
$title Cameroon tax general equilibrium model:
option decimals=3;
option nlp=conopt;

set m sam accounts / agr, ind, ser, lab, cap, rich, poor, tot/

   i(m) goods /agr, ind, ser/

   k(m) factors /lab, cap/

   h(m) households /rich, poor/

 alias (i,j)
 alias(k,l)
 alias(m,n);

 parameters
 sam(m,n)         social accounting matrix entries
 e(h,k)           endowment
 beta(i,h)        cd utility coefficients
 a(i,j)           input-output coefficients
 alpha(k,i)       production function coefficients
 v(i)             value-added coefficients
 va0(i)           value added
 p0(i)            prices for goods
 wn0(k)           net prices for factors
 w0(k)            prices for factors
 y0(i)            total output
 pva0(i)          price of value-added
 b0(k,i)          flexible factor coefficients
 c0(i,h)          individual demand for final consumption
 cd0(i)           aggregate demand for final consumption
 x0(k,i)          firms factor demand
 xd0(k)           aggregate factor demand
 iy0(i,j)         intermediate consumption of good i by firm j
 mu(i)            technological parameter of value added
 gdp0             baseline gdp;

 parameter
 tau(i)           output tax rates
 mi(h)            income tax
 t(k)             factor tax
 theta            fraction of government income transferred to consumers
 del(h)           lump sum shares;

 tau(i)=0;
 mi(h)=0;
 t(k) = 0;
 del(h)=0;

*===========importation of data from social accounting matrix======

$call gdxxrw.exe i=proj.xlsx o=pour.gdx par=sam rng=feuil1!a1:i9 rdim=1 cdim=1
$gdxin pour.gdx
$load sam
$gdxin

*=======initialization and calibration of parameters===============
```

```
p0(i)            = 1;
w0(k)      = 1;
wn0(k)           = 1;
y0(i)      = sam('tot',i);
pva0(i)    = 1;
c0(i,h)    = sam(i,h);
cd0(i)           = sum(h, c0(i,h));
x0(k,i)          = sam(k,i);
xd0(k)     = sum(i,x0(k,i));
iy0(i,j)   = sam(i,j);
e(h,k)     = sam(h,k) ;
beta(i,h)  = p0(i)*c0(i,h)/sum(j,p0(j)*c0(j,h));
a(i,j)     = iy0(i,j)/y0(j);
alpha(k,i)       = w0(k)*x0(k,i)/(sum(l,w0(l)*x0(l,i)));
va0(i)           = sum(k,x0(k,i));
v(i)             = va0(i)/y0(i);
b0(k,i)          = x0(k,i)/(v(i)*y0(i));
theta            = 0.5;
mu(i)            = va0(i)/prod(k, x0(k,i)**alpha(k,i));
gdp0       =  sum(i,va0(i)) ;

display p0,sam,w0,y0,pva0,va0,gdp0,c0,cd0,x0,xd0,iy0,b0,e,beta,a,alpha,v,mu;

*==================definition of variables=====================
variable
p(i)          prices for goods
w(k)          prices for factors
wn(k)         net prices for factors
y(i)          total output
pva(i)        price of value-added
b(k,i)        flexible factor coefficients
c(i,h)        individual demand for final consumption
cd(i)         aggregate demand for final consumption
x(k,i)        firms factor demand
xd(k)         aggregate factor demand
tc            total tax collections
ot            output tax collections
ft            factor tax collections
mt            income tax collections
iy(i,j)       intermediate consumption of good i by firm j
va(i)         value added for firm i
gdp           gdp-income calculation
z             maximizing dummy
tct           total transferable tax ;

*===================declaration of equations===================
equation
vaprice(i)      price index for value added
prices(i)       price formation
facprices(k)    net and gross factor prices
demand(i)       total demand for goods
housdem(i,h)    households demand for goods
lab(i)          variable coefficient for labour
cap(i)          variable coefficient for capital
zdfac(k,i)      firms demand for factors
zfacdem(k)      total demand for factors
governm         government budget constraint
incometax       income tax collections
factortax       factor tax collections
outputtax       output tax collections
eqgoods(i)      equilibrium for goods
eqfactors(k)    equilibrium for factors
inter(i,j)      intermediate consumption of good i by firm j
```

```
eqva(i)           value added for firm i
eqgdp             gdp-income calculation
eqtax             share tax equation
maximand          aux objective function;

*==================definition of equations======================

vaprice(i)..        pva(i) =e= prod(k, w(k)**alpha(k,i));
prices(i)..         p(i) =e= (1+tau(i))*(pva(i)*v(i)+sum(j,p(j)*a(j,i)));
facprices(k)..      w(k) =e= wn(k)*(1+t(k)) ;
demand(i)..         cd(i) =e= sum(h, c(i,h));
housdem(i,h)..  c(i,h)=e=(1-mi(h))*beta(i,h)*(del(h)*tc+sum(k, wn(k)*e(h,k)))/p(i);
lab(i)..            b('lab',i) =e= alpha('lab',i)*(w('cap')/w('lab'))**alpha('cap',i) ;
cap(i)..            b('cap',i) =e= alpha('cap',i)*(w('lab')/w('cap'))**alpha('lab',i) ;
zdfac(k,i)..        x(k,i) =e= b(k,i)*v(i)*y(i);
zfacdem(k)..        xd(k) =e= sum(i, x(k,i));
governm..           tc =e= ot + ft+ mt ;
incometax..         mt =e= sum(h, mi(h)*(del(h)*tc+sum(k, wn(k)*e(h,k))) );
factortax..         ft =e= sum( (i,k), t(k)*wn(k)*b(k,i)*v(i)*y(i) );
outputtax..         ot =e= sum(i, tau(i)*p(i)*y(i)/(1+tau(i)));
eqtax..             tct =e= tc*theta ;
eqgoods(i)..        y(i)=e= cd(i) + sum(j, a(i,j)*y(j));
eqfactors(k)..      xd(k)=e= sum(h, e(h,k));
inter(i,j)..        iy(i,j) =e= a(i,j)*p(j)*y(j);
eqva(i)..           va(i) =e= sum(k, x(k,i));
eqgdp..             gdp  =e=  sum(i,va(i)) + tc-mt;
maximand..          z =e= 1;


*=======================model declaration====================
model taxcam /all/;

*=====================fixing lower bounds on variables===========
scalar lb lower bound /1e-4/;

p.lo(i)=lb; y.lo(i)=lb; w.lo(k)=lb; pva.lo(i)=lb; c.lo(i,h)=lb;
b.lo(k,i)=lb; x.lo(k,i)=lb; iy.lo(i,j)=lb;

*===================numeraire: net price factor==================
wn.fx('lab') = 1;     z.fx = 1 ;

*==================initialisation of variables====================
p.l(i)=p0(i); y.l(i)=y0(i);  w.l(k)=w0(k);  pva.l(i)=pva0(i);  c.l(i,h)=c0(i,h);
b.l(k,i)=b0(k,i);  x.l(k,i)=x0(k,i);  va.l(i)=va0(i);  iy.l(i,j)=iy0(i,j);
  wn.l('cap') = wn0('cap');  cd.l(i) = cd0(i) ;   tc.l =0; xd.l(k) = xd0(k);
 gdp.l =gdp0;   ft.l =0; ot.l= 0; tct.l = 0; mt.l = 0;


* taxcam.iterlim=0;

solve taxcam maximizing z using nlp ;

option limrow = 0, limcol = 0, solprint = off, solvelink = %solvelink.loadlibrary%;

*=================save benchmark results======================
parameter
y0(i)                 benchmark gross output of i
ny0(i)                benchmark net output of i
pc0(i)                benchmark consumption of i
u0(h)                 benchmark utility of h;

y0(i)        = y.l(i);
ny0(i)                = y.l(i)-sum(j, a(i,j)*y.l(j));
```

```
 pc0(i)                  = sum(h, c.l(i,h));
 u0(h)                   = prod(i, c.l(i,h)**beta(i,h));

*========for different scenarios both for first and second results=======
tau(i)                   = 0.1;

*  t('lab')   = 0.1;
*  t('lab')   = 0.34569;
*  mi(h)                 = 0.20;
*  t(k)                  = 0.10;
*  t('cap')  = 0.10;
t('cap')                 = 0.34569;

*=======choose redistribution parameter=======================
 del('rich') = 0.5     ; del('poor') =1-del('rich');
*  del('rich') = 0.56444 ;    del('poor') =1-del('rich');

*===============solve model under policy====================
 solve taxcam maximizing z using nlp ;

 parameter
 u(h)           utility of h's household
 du(h)          utility changes
 wag            wages
 kap            capital income
 pc(i)          consumption of good i
 prc            private consumption
 gdpi           gdp-income
 gdpe           gdp-expenditure
 ny(i)          net output
 dny(i)         change or index for net output of i
 dy(i)          change or index for gross output of i
 igdpi          gdp income
 igdpe          gdp expenditure
 ip(i)          price index
 ic(i,h)        consumption index
 ix(k,i)        index for factor allocation
 gdpi0          benchmark gdp
 ;

 u(h)        = prod(i, c.l(i,h)**beta(i,h));
 du(h)       = (u(h)/u0(h)-1)*100;
 wag         = wn.l('lab')*xd.l('lab');
 kap         = wn.l('cap')*xd.l('cap');
 pc(i)       = sum(h, c.l(i,h));
 prc         = sum(i, p.l(i)*pc(i));
 gdpi        = wag+kap+tc.l;
 gdpe        = prc;
 ny(i)       = y.l(i)-sum(j, a(i,j)*y.l(j));
 ix(k,i)     = x.l(k,i)/x0(k,i) ;
* output indexation:
 dny(i)      = ny(i)/ny0(i) ;
 dy(i)       = y.l(i)/y0(i);
 gdpi0       = sum(i,va0(i))+  tc.l;
 igdpi       = (sum(i,va0(i))+  tc.l)/gdpi0  ;
 ip(i)       = p.l(i)/p0(i);
 ic(i,h)     = c.l(i,h)/c0(i,h);
 igdpe       = prc/gdpi0 ;

 display del, tau,e,igdpi,ip,ic,t,pva.l,du,c.l,pc,prc,iy.l, m,
 p.l, w.l,wn.l,cd.l,ix, b.l,dy, dny,ft.l,ot.l, x.l, y.l,
 gdpi, gdpi0, igdpe,wag, kap, tc.l,tct.l, gdpe;
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