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Tax Parameters in the Portuguese Economy*

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Abstract

In this paper we formally discuss the correspondences between statutory and effective tax rates in the Portuguese economy. These correspondences depend on the details of the Portuguese tax law, on a wealth of data information, and on certain priors about the values of behavioral parameters in the economy. For each of the different tax margins, we choose a specification of the tax base that is standard in tax policy evaluation exercises, albeit necessarily only an approximation to the true tax base. In addition to the general correspondences, we present our own estimates of the effective tax rates at the different tax margins. More importantly, however, using the information in this paper practitioners of tax policy evaluation can obtain their own estimates of the relevant tax parameters.

Keywords: Tax parameters; Tax policy evaluation; Tax reform.

JEL Classification: H20.

1. Introduction

The objective of this paper is to establish the mapping between statutory and effective tax rates in the Portuguese economy. Ultimately, we address the question of how changes in statutory tax rates induce changes in effective tax rates. This is a critical question from the perspective of tax policy evaluation.

From time to time, the topic of tax reform reenters the political arena. Tax reform proposals are invariably phrased in terms of changes in the statutory tax rates (see, for example, Cavaco Silva (1999), where the former Portuguese Prime Minister presents a comprehensive tax reform package for Portugal). This is understandable since statutory tax rates are under the direct jurisdiction of the legislative powers. Furthermore, statutory tax rates are easily available and readily understood by the general public.

From the standpoint of the practitioner of tax policy evaluation, the formulation of tax reform proposals in terms of statutory tax rates presents several challenges. In general terms this is because, from the perspective of tax policy evaluation, statutory tax rates are close to irrelevant (see, for example, Primarolo (2000), where the Paymaster General of the UK's Treasury addresses this point in the context of tax harmonization in the EU).

In fact, for the economic analysis of the incentives to work, consume, save and invest, that are induced by the tax code, what matters most is economic behavior at the margin. As such, ideally, the proposed tax rate changes should be framed in terms of changes in the marginal tax rates. These, however, are notoriously difficult to obtain. Therefore, an approximation that is often used in tax policy evaluation is the effective tax rate.

The relationship between statutory and effective tax rates is a rather complex matter. It depends, first and foremost, on the details of the tax law, which was clearly not written by nor for economists or policy analysts. It also depends on behavioral parameters for the economy that are often difficult to identify and that, at any rate, reflect the priors of the tax policy analyst. Furthermore, it depends on data information which is either not available or comes from varied and not necessarily compatible sources.

The effective tax rate, τ, can be defined simply as the ratio between total tax revenues, T, and the tax base from which they were obtained, B, i.e.,

$$\tau = \frac{T}{B}.$$

Observed tax revenues, however, are the result of a myriad of tax rules. In reality, statutory tax rates, t, along with deductions, D, and tax credits, CR, are the instruments of tax legislation. A highly stylized description of how these three variables come together to determine tax revenues, in general, is

$$T = t(B - D) - CR.$$

Note that only when there are no credits and no deductions are effective and statutory tax rates equal, i.e., $\tau = t$. In this highly simplified framework, changes in statutory tax rates lead to changes in effective tax rates according to

$$\frac{\partial \tau}{\partial t} = 1 - \frac{D}{B}.$$

Notice how this mapping is independent of the existence of credits. The effective tax rate, however, is not, i.e., $\partial\tau/\partial CR \neq 0$. Note also that, if there are no deductions but credits are non-zero, then the correspondence is one-to-one, even though effective and statutory tax rates differ by CR/B. In that case,

$$\tau = t - \frac{CR}{B}.$$

In addressing the relationship between the statutory tax rate and the effective tax rate from the perspective of tax policy evaluation there is an additional complication. Both the use of analytical instruments and the level of aggregation at which the analysis is done require a degree of abstraction and generalization, which would not be present in a framework of individual tax accounting. This means that many of the finer details of the tax law have to be ignored as the true tax base is approximated using aggregate macroeconomic data. This approach is well suited for mainstream tax policy analysis along the lines of, for example, Auerbach and Kotlikoff (1984, 1987), Ballard, Fullerton, Shoven and Whalley (1985),

Bovenberg (1986), Fullerton and Gordon (1983), Goulder and Summers (1989), Goulder and Thalman (1993), Kotlikoff (1995, 1996), Pereira (1994, 1999) and Shoven and Whalley (1984).

Finally, a word about data information and data sources. In the computation of the effective tax rate, every attempt was made to use all available information from 1990 to 1998. By using this time frame, we guarantee the use of the most recent tax data available. By using averages for this period, we attempt to capture long-term trends in the economy and thereby avoid business cycle effects and the effects of any other spurious economic events. Also, in the computation of the effective tax rate, it was inevitable to use data from different sources. This posed some compatibility problems between national account and public account data. As a quintessential example of this, there is no readily available data, on a national account basis, for tax revenues at the different tax margins we consider. Such a disaggregation only seems to exist on a public account basis. As such, the strategy we follow consists in using national account data (INE *Contas Nacionais*, several issues, and DGEFA, 1999) for the aggregates, and then using public account data (DGEP, 1999) to approximate the shares of each of the tax margins in total revenues.

In this paper we explore the relationship between statutory and effective tax rates at the most significant tax margins in the Portuguese economy. We present several tables that document the technical details on the correspondences between statutory and effective tax rates at the different margins. We highlight not only the mathematical mapping but also the data information and the economic parameters necessary to establish such mappings. As such, the accompanying text is essentially a guided tour of the different tables complemented with a detailed reference to sources. For a comprehensive description of the Portuguese tax system, in legal terms, the reader is referred to CEF (1997) and KPMG (1997).

2. Value-added and excise taxes

2.1. General aspects

In Portugal, from 1990 to 1998, we estimate that value-added and excise tax revenues averaged 14.2% of GDP evaluated at market prices.

Under the Portuguese tax legislation (CIVA), the value-added tax (VAT, hereafter) is designated *im-*

posto sobre o valor acrescentado. All goods and services marketed and sold, whether produced domestically or imported, are liable to VAT as long as they are purchased for use within Portuguese territory. This implies that exports are, in effect, exempt from VAT.

In general terms, VAT is a tax on the purchase of final goods, and follows the general pattern of value-added taxes in most European countries. Being a value-added tax means that only the value that is added through an entrepreneurial activity to the inputs acquired is liable to this tax. Through a chain method, sellers then collect VAT on the value of the good or service sold, deduct the VAT they paid on their inputs and hand over the difference to the Treasury. It follows that, while the seller is the one that is held accountable to the Treasury for the VAT revenues, the incidence generally lies with the economic agents that purchase these final goods. This is because these goods and services will not be resold or incorporated in a new good or service that will be placed on the market and, as such, no VAT rebate is due on these purchases.

In addition to the VAT, the Portuguese tax system considers excise taxes, i.e., special indirect taxes levied on the consumption of specific goods. That is the case of alcohol and alcoholic beverages (*imposto sobre bebidas alcoólicas e sobre o álcool* or $IBAA$), on the purchase of new automobiles (*imposto automóvel* or IA), on petroleum products (*imposto sobre produtos petrolíferos* or ISP), and finally, on tobacco (*imposto sobre o tabaco* or IST).

In practice, VAT is levied *ad valorem* as the last surcharge, i.e., the tax base is the total amount (including other taxes) that would be charged to a buyer if no VAT existed. As an example, for imported goods and services this would include import duties, where applicable. Moreover, goods that are subject to excise taxes are liable to VAT on an already engrossed tax base. These are two instances of double taxation in the Portuguese tax code.

In addition to households, firms and the public sector also purchase goods and services that are liable to VAT and, in some cases, to excise taxes. Accordingly, we disaggregate total value-added and excise tax revenues, T_{VATET}, by five macroeconomic aggregates – private consumption, C, public consumption, CG, private investment, I, public investment in infrastructure and in transportation equipment, IG, and public investment in education, IH. That is,

$$T_{VATET} = T_{VATET,C} + T_{VATET,CG} + T_{VATET,I} + T_{VATET,IG} + T_{VATET,IH}.$$

2.2. Value-added and excise taxes on private consumption spending

We estimate that VAT and excise tax revenues derived from private consumption expenditure activities, $T_{VATET,C}$, totalled 11.416% of GDP evaluated at market prices for the 1990-1998 period.

In Portugal, households consume a wide variety of goods and services, many of which are taxed at different rates. This is for two reasons. First, as referred to above, alcoholic beverages, petroleum products,[1] automobiles and tobacco are all liable to specific excise taxes. Second, different categories of goods are effectively subject to different VAT rates.

The general VAT rate which we denote by $t_{VAT,5}$ is 17%. The tax code considers another four expenditure categories that benefit from progressively lower value-added tax rates, $t_{VAT,5} > t_{VAT,4} > t_{VAT,3} > t_{VAT,2} > t_{VAT,1}$. In what follows, we detail the composition of these four additional expenditure categories.

Category 4 encompasses goods like oils, fats, coffee, tea, cocoa, mineral waters, and restaurant tabs that are subject to a rate of $t_{VAT,4} = 12\%$. Also included in this category are general expenditures from Açores and Madeira on goods and services which, if sold on the continent, would pay the general VAT rate, $t_{VAT,5}$, but which enjoy a reduced rate of 12% in these regions. Category 3 is created to accommodate the fact that certain fish, meat, milk and dairy products pay a reduced rate of 5%. Similar products, however, like yoghurts pay 12%, and shellfish pay the general rate of 17%. We assume that the applicable rate for this category is $t_{VAT,3} = 6\%$. In turn, Category 2 is made up of goods and services like fruit, vegetables, grain, potatoes, water, electricity, public transportation, medicine, hotels and cultural shows which, if sold on the continent, are subject to a rate of $t_{VAT,2} = 5\%$. Finally, goods belonging to category

[1] Even though all petroleum products are subject to some form of excise taxes, we focus only on unleaded gasoline. Henceforth, we use gasoline and petrol interchangeably.

1 pay the lowest VAT rate, $t_{VAT,1} = 4\%$. Essentially, these are the goods and services that, if sold on the continent, would be liable to a value-added tax rate of $t_{VAT,2}$. This suggests that the islands of Açores and Madeira enjoy yet another special regime.

To proceed, we need to know the fraction of a representative household's budget that is spent on each of nine expenditure categories - five for VAT rates and four for goods subject to excise taxes in addition to the VAT. To retrieve these budget shares, we resort to INE (1997), a 1994 household budget survey, and adjust the information therein to account for business cycle effects, since 1994 was a year of recession. Essentially, we have increased the shares of automobiles, gasoline and tobacco at the expense of foodstuffs. Therefore, the adjusted budget shares, $\theta_{HH,1}$, $\theta_{HH,2}$, $\theta_{HH,3}$, $\theta_{HH,4}$, $\theta_{HH,alcohol}$, $\theta_{HH,autos}$, $\theta_{HH,petrol}$, $\theta_{HH,tobacco}$ and $\theta_{HH,rest}$, presented as column five in Table 1 reflect our priors based on the available published information as to the fraction of household consumption expenditure valued at market prices, C^{MP}, that is allocated to each expenditure category.

[Table 1]

The information that we have obtained on budget shares, naturally, is defined in terms of market prices. These market prices include, in addition to the factor cost, the excise tax and the VAT payments. This introduces the difference between consumption spending at market prices, C^{MP}, and at factor cost, C^{FC}, or net of tax payments. Dividing a macroeconomic variable, X, evaluated *at market prices*, X^{MP}, by the corresponding *effective* value-added and excise tax rate, $1 + \tau_{VATET,X}$, we obtain the variable evaluated *at factor cost*, X^{FC}.[2]

To pursue the calculation of effective tax rates per expenditure category, we need to transform the budget shares, at market prices, into *real* budget shares at factor cost. For alcoholic beverages, for example, the consumer pays an amount of $\theta_{HH,alcohol}C^{MP}$, which includes both kinds of taxes, but only consumes the equivalent to $\tilde{\theta}_{HH,alcohol}C^{FC}$, where $\tilde{\theta}_{HH,alcohol}$ is the share of *real* consumption, C^{FC}, that is allocated to alcohol.

[2] Note that here we have ignored the subsidies component of the market price value, and thus we somewhat underestimate the true value of the factor cost variable.

Furthermore, note that if a household purchases a good valued at x, that is subject to an excise tax at an effective rate of τ, and a statutory value-added tax rate of t, then the total amount paid will be $(1+t)(1+\tau)x$, which will include $[t+(1+t)\tau]x$ in consumption taxes. This suggests that we define the effective value-added and excise tax rate as $\tau_{VATET} = t+(1+t)\tau$. Thus, total consumption expenditure, evaluated at factor cost, C^{FC}, is computed by deflating the respective total expenditure, valued at market prices, C^{MP}, by $1+\tau_{VATET,C}$, the *effective* value-added and excise tax rate levied on total consumption expenditure.

Using alcoholic beverages as an example again, with an effective excise tax of $\tau_{alcohol}$ and a general VAT rate of $t_{VAT,5}$, nominal and real budget shares for alcoholic beverages are related according to

$$\theta_{HH,alcohol}C^{MP} = (1+t_{VAT,5})(1+\tau_{alcohol})\frac{\tilde{\theta}_{HH,alcohol}C^{MP}}{1+\tau_{VATET,C}}.$$

This formula suggests that one can easily determine the real budget share for any expenditure category j, $\tilde{\theta}_j$ as

$$\tilde{\theta}_j = \frac{\theta_j(1+\tau_{VATET})}{(1+\tau_j)(1+t_{VAT,j})}.$$

The only missing information we still need, relates to the *effective* excise tax rates, the calculation of which we turn to next. Appealing to the definition of the effective tax rate, and using the alcoholic beverages expenditure category as an example once more, the effective excise tax rate, $\tau_{alcohol}$, that is levied on the real consumption of alcohol, $\tilde{\theta}_{HH,alcohol}C^{FC}$, can easily be computed as the ratio between excise tax revenues, ETR, and the relevant tax base, that is

$$\tau_{alcohol} = \frac{ETR_{alcohol}}{\tilde{\theta}_{HH,alcohol}C^{FC}}.$$

Note, however, that because $\tilde{\theta}_{HH,alcohol}(\tau_{alcohol})$, i.e., the real budget share depends on the effective excise tax rate, to determine a value for $\tau_{alcohol}$, one must factor out this variable from the above equality. This yields equation (3) in Table 2.

[Table 2]

For the remaining three kinds of goods that are subject to excise taxes – petroleum products, automobiles, and tobacco – the effective excise tax rates, τ_{petrol}, τ_{autos}, and $\tau_{tobacco}$, respectively, are easily determined using the same procedure. Data on excise tax revenues refer to 1995 and were taken from INE, *Contas Nacionais*. Note, however, that while we assume that tobacco and alcoholic beverages are only consumed by households, gasoline and new automobiles are also purchased by firms and by the public sector. This fact suggests that, to calculate τ_{autos} and τ_{petrol}, the relevant tax bases must include the economy-wide purchases of each type of good. For new automobiles, in particular,

$$\tau_{autos} = ETR_{autos}/(\tilde{\theta}_{HH,autos}C^{FC} + \tilde{\theta}_{Firms,autos}I^{FC} + \tilde{\theta}_{PS,autos}IG^{FC}).$$

There is a wide selection of statutory tax rates to choose from when establishing the relationship between changes in statutory and effective tax rates. For illustration purposes, and because it is the most significant indirect tax margin, we choose to determine how a change in the general VAT rate, $t_{VAT,5}$, would induce changes upon the effective value-added and excise tax rate collected on private consumption purchases. The relevant partial derivative, $\frac{\partial \tau_{VATET,C}}{\partial t_{VAT,5}}$, is equation (7) in Table 2.

In obtaining this effect, it should be noted that the real budget shares, $\tilde{\theta}_{HH,category}$, and the effective excise tax rates, $\tau_{category}$, are considered known primitives that do not vary when the general statutory value-added tax rate changes. Furthermore, it is assumed that whatever changes occur in tax rates at the statutory level, the composition of a representative household's consumption bundle, in terms of the nine different expenditure categories, remains unchanged. This means that a change in the statutory tax rate only imparts changes to aggregate consumption through the effect it has upon the effective tax rate. To us, this top-down approach seems the most relevant when evaluating alternative tax policies at an aggregate level.

2.3. Value-added and excise taxes on other spending activities

We estimate that VAT and excise tax revenues derived from private investment spending activities, $T_{VATET,I}$, averaged 1.841% of GDP at market prices for the 1990-1998 period.

We assume that all private investment expenditures, with the exception of automobiles, $\tilde{\theta}_{Firms,autos}I^{FC}$,

petroleum products, $\tilde{\theta}_{Firms,petrol}I^{FC}$, and building or infrastructure investment, $\rho_I I^{FC}$ (AECOPS, 1996), are exempt from value-added tax (see equation 8 in Table 3). In addition, banks and insurance firms cannot deduct any of the VAT paid on their inputs. Clearly, the classification of petroleum products as private investment could be questioned. We use this approach because it is a particularly convenient way of capturing how an increase in the price of fuel affects production costs.

[Table 3]

In turn, we estimate that value-added and excise tax revenues derived from public consumption, $T_{VATET,CG}$, public investment in infrastructure and automobiles, $T_{VATET,IG}$, and public investment in education, $T_{VATET,IH}$, averaged 0.471%, 0.380% and 0.092% of GDP at market prices respectively, for the period 1990-1998.

Looking at equation (9) in Table 3, we see that public consumption expenditures can be decomposed into three categories – public sector wages (excluding wages related to public investment and investment in education activities), petroleum products, and all the rest. The budget shares for these categories were taken from INE *Contas Nacionais* and DGCP (1997).

Wage expenditure is distinct from the remaining outlays in that it is exempt from value-added and other indirect taxes. Data on public sector wages, decomposed by economic activity, $Wages_{PS,CG}$, $Wages_{PS,IG}$, and $Wages_{PS,IH}$, were obtained residually after plugging in all the known parameters in equations (9-11) of Table 3. These values are broadly in line with those of INE *Contas Nacionais*.

Consideration of other public spending categories is justified by different excise taxes inciding on such expenditures. These imply differentiated effective tax rates by expenditure category. In terms of public investment in infrastructure and automobiles, and public investment in education, all non-wage related expenditures are assumed to be subject to the general value-added tax rate. Note that, in addition to $t_{VAT,5}$, public spending on new automobiles is surcharged with an excise tax at the effective rate of τ_{autos}.

The mappings between changes in statutory and in effective tax rates are easily determined and result in equations (16-19) in Table 3. To obtain the effective value-added and excise tax on private investment spending, for example, all one must do is equalize expressions (8) and (12), equations for the calculation

of total tax revenues in statutory and effective terms respectively. Note that, in calculating the differential effects, we assume that $Wages_{PS,CG}/CG^{FC}$, $Wages_{PS,IG}/IG^{FC}$, and $Wages_{PS,IH}/IH^{FC}$ remain invariant to changes in $t_{VAT,5}$.

3. The corporate income tax

Under the Portuguese tax law (CIRC), the corporate income tax (CIT, hereafter) is known as the *imposto sobre o rendimento de pessoas colectivas*. We estimate that corporate income tax revenues, T_{CITd}, which also include municipal taxes called "derramas", averaged 3.1% of GDP at market prices for the period between 1990 and 1998.

The CIRC determines that all types of resident enterprises such as corporations, quota companies and business partnerships are considered taxable entities. Resident enterprises are liable to CIT on their world-wide income and capital gains. Enterprises are considered resident if their head office or effective place of management is located within Portuguese territory, if any of their agents carry out business acts in Portugal for more than 120 days in a year, or if they have a permanent representation from which a commercial, agricultural or industrial activity is exercised.

3.1. The CIT tax base and its basic deductions

The CIT tax base consists of net profits for the year plus certain changes in equity minus allowable previous years' losses and tax incentives. Profit is defined in balance sheet terms as representing the difference in net equity at the beginning and the end of the accounting period, adjusted in accordance with CIRC rules.

In the definition of taxable profits, all costs associated with the normal activity of a company are deductible, subject to limitations, from the CIT base. The main allowable costs are fiscal depreciation allowances and total labor costs, i.e., gross wages plus employers' social security contributions. Other deductions include representation expenses, travel allowances, eligible donations, research and development expenditures, and provisions for irrecoverable debts.

Given the definition of profits as net equity changes, in a framework of individual tax accounting, the determination of the CIT base would require computing a firm's net capital gains as well as evaluating its inventory along with the other deductions mentioned above. Instead, working at a highly aggregated level, we choose to approximate the true tax base using macroeconomic data.

In most tax policy evaluation exercises the corporate income tax is modeled in a very stylized way. Evaluated at factor cost, GDP as a whole is typically considered the tax base, and total labor costs,[3] $\theta_L Y^{FC}$, along with fiscal depreciation allowances are the valid deductions thereto. Fiscal depreciation allowances are determined as a fraction, α, of the private sector's investment spending, I^{FC}. Then, on this adjusted base, a tax at the effective rate of τ_{CITd} is levied. Finally, as a tax incentive, an investment tax credit, T_{ITC}, reduces the CIT burden by an amount that is proportional to the private sector's investment spending.

In reality, however, only corporate firms are liable to CIT. For this reason, a closer approximation of the actual tax base, deductions, and credits, demands that we focus on the incorporated sector. In this regard, we must determine the fraction of production, total economy-wide labor costs, and private investment spending that is carried out by the incorporated sector. Let ϕ_1, ϕ_2, and ϕ_3 represent these three fractions respectively. Note that ϕ_1 can be interpreted as the economy's coefficient of incorporation, and is easily parameterized after recognizing that the gross operating surplus for the incorporated sector is computed as $Y^{FC}(\phi_1 - \phi_2\theta_L)$. This variable as well as parameters ϕ_2 and ϕ_3 are determined directly from national account data (INE *Contas Nacionais*).[4]

The CIT base after deductions is then subject to the corporate income tax at a statutory rate of $t_{CITd} = 0.34$, and surcharged with a municipal levy, or "derrama", at the statutory rate of $t_{der} = 0.10$.

[3] It should be noted that, in addition to employers' social security contributions, total economy-wide labor costs encompass gross wages paid to dependent and self-employed workers, in the private as well as in the public sector.

[4] Unless otherwise noted, data and parameters concerning the incorporated sector refer to averages for the 1988 to 1995 period and make use of the latest available information (INE *Contas Nacionais*).

This yields the firms' pre-ITC corporate income tax liability, which we denote as Υ. Finally, through investment tax credits the CIT levy is reduced.

Table 4 summarizes the data and parameters related to the corporate income tax. Furthermore, it makes clear the distinction between statutory and effective terms, i.e., between our approximation of the way tax revenues are obtained in reality (equations 20 and 21), and how these are depicted in a standard tax policy evaluation model (equations 22 and 23). In addition, equations (24) and (25) show how a changes in the statutory tax rates induce changes in the effective tax rates.

[Table 4]

Let us now see how fiscal depreciation allowances and investment tax credits are, in reality, determined.

3.2. Depreciation allowances

The CIRC contemplates fiscal depreciation allowances as valid deductions to a firm's taxable profits. In effect, it allows that a fraction of past and present capital expenditures be written off as a cost for tax purposes. Under the straight-line depreciation method over a number, $NDEP$, of periods, depreciation allowances are computed as

$$(I_t + I_{t-1} + ... + I_{t-NDEP+1})/NDEP.$$

Assuming that corporate capital investment grows at an average rate of g, fiscal depreciation allowances simplify to a proportion, α, of the contemporaneous corporate investment, with α given by

$$\alpha = [1 - (1+g)^{-NDEP}]/NDEP[1 - (1+g)^{-1}].$$ [5]

[5] In this definition of the depreciation allowances we capture the depreciation corresponding to investments occurred in the past. While this is the relevant notion for tax purposes it should be pointed out that investment decisions are at the margin forward looking. This means that they are based on the future depreciations derived from such investment spending (King and Fullerton, 1984, and Jorgenson and Landau, 1993). If we assume that the past trend of growth or corporate investment, g, continues into the future, then historical depreciations will be a good guide for investment decisions at the margin around

This expression is the reduced form of the difference between two infinite geometric progression sums In computing CIT and "derrama" revenues in statutory terms (see equation 20 in Table 4) after plugging in all the known data and parameters, a value of $\alpha = 0.73477$ is determined residually. In turn, the solution to the above equation for α, after assuming that $NDEP = 16$, is $g = 0.0449$. Since gross fixed capital formation for the economy as a whole grew an average of 4.87% from 1990 to 1998 (DGEFA, 1999), the implicit value for g we estimate is very reasonable.

3.3. Investment tax credits

From 1990 through 1998, corporate income tax credits including investment tax credits and transitory regimes, T_{ITC}, averaged 0.09744% of GDP at market prices (Ministério das Finanças, 1993, 1995, 1997, 1998).

Investment tax credits, or ITCs, are commonly used by tax authorities as an incentive for some firms to purchase certain capital goods. Clearly, a change in tax credits is important inasmuch as it alters the effective tax rate. This is so, even though the correspondence between statutory and effective tax rates is independent of tax credits.

With the exception of financial intermediaries – such as banks and insurance companies – all entities that are subject to the corporate income tax can apply for an ITC. In effect, by incurring in capital expenditures, with the exception of land (except for firms operating in the primary sector), buildings (except for factories), furniture and light automobiles, these non-financial firms have the opportunity of lowering their pre-ITC CIT liability.

Under the current tax code, a firm's ITC for a given year, is computed as a fraction, $t_{ITC} = 0.10$, of the eligible investment expenditure, measured at factor cost, up to a limit of thirty percent of its pre-ITC adjusted CIT liability. That is, the ITC can never exceed

$$min\{0.3\Upsilon; t_{ITC} I^{FC}_{Eligible}\}.$$

that trend.

To proceed, let us begin by assuming that the thirty percent limit is not an active constraint for any firm. Then, ITCs are attributed according to $t_{ITC} I^{FC}_{Eligible}$.

Recall that only non-financial corporations can qualify for investment tax credits. From 1988 to 1995, non-financial corporations carried out investment expenditures that totalled 10.848% of GDP at market prices, only $\varepsilon = 0.35$ of which was eligible for ITCs (INE *Contas Nacionais*). Evaluated at factor cost, non-financial corporate investment represents $\eta = 0.77728$ of all corporate investment, $\phi_3 I^{FC}$. Therefore, $I^{FC}_{Eligible} = \varepsilon \cdot \eta \cdot \phi_3 I^{FC}$, which corresponds to 3.472% of GDP at market prices.

Data on the ITCs effectively attributed, however, suggest that only a fraction, $\beta = 0.28067$, of the eligible investment spending is covered by the above formula. It follows that the value of the ITCs actually granted can be written as

$$T_{ITC} = t_{ITC} \cdot \varepsilon \cdot \eta \cdot \phi_3 I^{FC} \cdot \beta,$$

where β is a coverage coefficient residually determined using equation (21) in Table 4.

Note that, if the thirty percent limit is in fact an active constraint, then the fraction of all eligible corporate investment covered is even lower.

If all of the eligible non-financial corporate investment had been covered, the ITCs handed out would have reached an average of 0.347% of GDP at market prices, from 1990 through 1998, around 3.5 times the value that was in reality attributed. Therefore, our calculations suggest that, in the recent past, most of the eligible non-financial corporate investment, i.e. around 2.5% of GDP at market prices did not take advantage of this tax incentive.

These figures suggest that the ITC benefits are underutilized. What can explain this fact? If we reject, as we should, the hypothesis that entrepreneurs are unaware that such a tax incentive exists, the answer is that tax evasion may be a factor in the underutilization of ITCs.

Finally, given the aggregate nature of most tax policy evaluation models, it is custom to express ITCs as a fraction, τ_{ITC}, of total private investment, evaluated at factor cost, i.e.,

$$T_{ITC} = \tau_{ITC} \cdot I^{FC}.$$

Using the available data, the effective ITC rate is calculated at $\tau_{ITC} = 0.4957\%$.

The differential effect of a change in the statutory ITC rate on the associated effective rate is determined according to

$$\frac{\partial \tau_{ITC}}{\partial t_{ITC}} = \varepsilon \eta \phi_3 \beta = \frac{\tau_{ITC}}{t_{ITC}} = 0.04957.$$

4. Social security contributions

The Portuguese social security system operates on a pay-as-you-go basis in accordance with an inter-generational solidarity principle. Under the conventional taxonomy of the three pillars (see World Bank (1994) for example), only the first pillar – a state-operated regime with mandatory contributions – and the third pillar – an individual complementary regime with favorable tax treatment that is managed by pension funds – exist.

The state-operated social security comprises two systems: a general system for private sector workers and a civil servants' system. In addition to these two, a special system for banking employees exists that operates on a capitalization basis.

Within the general system, or *Regime Geral*, two sub-regimes exist – a general contributory regime funded by employers' and employees' contributions, and a non-contributory regime funded by Government transfers. The general contributory system grants pensions in substitution for lost income due to old age and other contingencies such as sickness, invalidity, death and unemployment. The non-contributory scheme provides a minimum protection to persons not covered and suffering from social and or economic hardships, with an income level below a certain threshold.

The public sector workers' scheme, or *Caixa Geral de Aposentações*, is financed by civil servants' contributions as well as by Government transfers. Contributors are covered for all the above mentioned contingencies with the exception of unemployment.

We estimate that social security contributions from private sector employers, or *contribuições patronais para a Segurança Social*, T_{FSSC}, represent an average of 5% of GDP at market prices for the period 1990-1998. Note that this value does *not* include contributions paid out by the public sector, as an employer, to the civil servants' social security fund. Also, social security contributions of the self-employed are accounted for under the employees' social security contributions.

More formally, private sector enterprises pay a statutory social security contribution rate of $t_{FSSC} = 0.2375$ on the gross wages paid out to their dependent workers. Gross wages for dependent workers in the private sector are obtained by netting out the civil servants' gross wages, $Wages_{PS}$, and gross self-employed workers' income, from economy-wide gross labor income, $\theta_L Y^{FC} - T_{FSSC}$. Data limitations regarding the share of the gross labor income that is absorbed by self-employed workers force us to use an approximation to the statutory tax base. We assume gross private-sector labor income as the relevant tax base to be adjusted by a parameter, ξ. That is, we use

$$\xi(\theta_L Y^{FC} - T_{FSSC} - Wages_{PS})$$

as an approximation of the statutory tax base for employers' social security contributions (see equation 26 in Table 5). Note that, because self-employed workers' income is non-zero, a value of ξ below one is determined.[6]

[Table 5]

Tax policy evaluation models do not generally distinguish between public and private sector employees, much less between dependent and self-employed workers. As presented by equation (27) in Table 5, firms' social security contributions, T_{FSSC} are computed as a fraction, τ_{FSSC}, the effective firms' social security contributions rate, of the economy-wide gross labor income.

To determine how changes in the statutory tax rate, t_{FSSC}, induce changes in the effective tax rate,

[6] Our calculations imply that of the total gross labor income, civil servants, private dependent workers, and self-employed workers receive 38.64%, 58.89%, and 2.47%, respectively.

τ_{FSSC}, we factor out T_{FSSC} in equations (26) and (27) of Table 5 to obtain expression (28) in Table 5. This differential effect is computed according to

$$\frac{\partial \tau_{FSSC}}{\partial t_{FSSC}} = \left(\frac{\partial T_{FSSC}}{\partial \tau_{FSSC}}\right)^{-1} \frac{\partial T_{FSSC}}{\partial t_{FSSC}}.$$

4.1. Employees' social security contributions

We estimate that employees' social security contributions, or *contribuições dos empregados para a segurança social*, T_{WSSC}, averaged 4.1% of GDP at market prices over the period 1990-1998.

Dependent workers in all sectors, private and public, pay a statutory social security contributions rate of $t^{dep}_{WSSC} = 0.11$ on their gross labor income. Gross wages for dependent workers are computed as the sum of gross dependent labor income in the private sector, $\xi(\theta_L Y^{FC} - T_{FSSC} - Wages_{PS})$, and gross labor income in the public sector, $Wages_{PS}$.

Self-employed workers, however, whose contributions are included in T_{WSSC}, can choose their contribution base – between 1 and 12 statutory minimum wages – as well as a statutory contribution rate of $t^{se,min}_{WSSC} = 0.254$ or $t^{se,max}_{WSSC} = 0.32$, depending on whether they want a mandatory minimum or a broader coverage, respectively. This fact introduces a great degree of ambiguity in the definition of both the tax base and the tax rate for self-employed workers. All we can infer is that, on average for the 1990-1998 period, social contributions from self-employed workers, $t^{se,min}_{WSSC} \cdot B^{se,min}_{WSSC} + t^{se,max}_{WSSC} \cdot B^{se,max}_{WSSC}$, amount to 0.2624% of GDP at market prices, approximately 6.5% of all employees' social security contributions.[7]

Once again, as tax policy evaluation models are often highly aggregated, we write T_{WSSC} as a fraction, τ_{WSSC}, the effective social security contributions rate, of gross economy-wide labor income (see equation 30 in Table 6).

[Table 6]

[7] It is interesting to note that if all self-employed workers had opted for the maximum coverage, implying that $B^{se,min}_{WSSC} = 0$, then, on average, the contribution base chosen would have been equivalent to 93.35% of their gross labor income.

Finally, in computing the correspondence between statutory and effective tax rates we focus only on dependent workers because both the contribution base and the contribution rate for self-employed workers cannot be determined. The differential effect, by which changes in the statutory tax rate for dependent workers, t^{dep}_{WSSC}, induce changes in the effective tax rate, is determined as equation (31) in Table 6.

5. The personal income tax

5.1. General aspects of the PIT base

Under the Portuguese tax legislation (CIRS) the personal income tax (PIT, hereafter) is designated by *imposto sobre o rendimento de pessoas singulares*, or IRS. We estimate that personal income tax revenues, T_{PIT}, averaged 6.1% of GDP at market prices for the period 1990 to 1998.

The taxable unit is the family which is composed of either a married couple living in a joint household with their dependent children, or separated persons, unmarried parents and their dependents. A married couple living in a single household is taxed according to an income splitting system which allows spouses to divide their combined income to avoid a higher tax rate. Individuals are deemed to be residents if they remain within Portuguese territory for more than 183 days. Residents in Portugal are liable to IRS on their world-wide income. Non-residents are liable to IRS only on income derived in Portugal, subject to a myriad of bilateral international tax agreements.

In Portugal, the PIT is a levy on the family's entire income, irrespective of its source. In practice, though, capital and non-capital incomes are taxed quite differently. Capital income is paid out net of a flat tax immediately withheld at the source. Non-capital income, on the other hand, which is essentially comprised of labor and pension incomes, benefits from certain deductions that are contingent on the behavior and characteristics of the household, and is then subject to a progressive tax rate structure. Tax credits then effectively lower the family's tax burden. For these reasons we analyse the taxation of capital and non-incomes separately. It should be pointed out that such a distinction is also common in tax policy evaluation models.

Until recently, the concept of income encompassed nine categories, which differed with respect to

the source of income: employment income including fringe benefits, self-employment income, income from commerce and industry, income from agriculture, investment or capital income, real-estate income, capital gains, pensions including annuities and alimony payments, and other income which included proceedings from lotteries, gambling and other games of chance.[8]

Even though capital income is one of the nine income categories considered, the taxpayer can choose whether or not to report in his PIT return the capital income he has received and on which a rate of t_r was already levied (see section 4.3.). Naturally, he will only choose to report this income as long as the marginal tax rate he is subject to, on all of his personal income, is strictly smaller than t_r, in which case he is entitled to a rebate. As such, to simplify matters, we assume that capital income is only paid out to high-earning households, who would choose not to report their capital income in their PIT returns because doing so would entail paying higher taxes.

5.2. Non-capital income

We estimate that the PIT revenues corresponding to the taxation of non-capital income, T_{NCI}, averaged 3.224% of GDP at market prices from 1990 to 1998.

We base our calculation on the taxation of non-capital income on a tax calculator developed at the Ministry of Finance. A family's personal income levy is computed on the basis of the information annually reported to the tax authorities in the form of a tax return. DGITA (1999) is a 1997 database that contains 40000 of these individual tax records. This information is primarily used to build a tax calculator that performs tax policy analyses in a micro-simulation framework. By definition, the 1997 vintage of this instrument contains the mathematical formulas that the Treasury then used to determine how much personal income tax each person had to pay on the income received. In general, the tax calculator as a whole can be considered the expression of the PIT in statutory terms. On aggregate, such calculations

[8] As of 2001, the number of categories is reduced to six - basically, self-employed, commercial, industrial and agricultural income merge into a single category called business and professional income.

allow us to compute the fraction, $\tau_{PIT,NCI}$, of the non-capital income reported that was paid in personal income tax.

Essentially, non-capital income comprises labor and taxable pension income, including dependent workers' and self-employed workers' income as well as business income from the non-incorporated sector. This suggests that we define the non-capital income base for PIT purposes as

$$(1 - \tau_{WSSC})(\theta_L Y^{FC} - T_{FSSC}) + \varphi TR,$$

where $(1-\tau_{WSSC})(\theta_L Y^{FC} - T_{FSSC})$ is gross labor income net of employees' social security contributions, and TR represents old age, survivors', and disability pensions, only a fraction, φ, of which enters the PIT base. This fraction corresponds to the percentage of all pensions that exceed a multiple of the annual statutory minimum wage.[9]

In computing the net income of each income category, a percentage of expenses on activities directly related to generating such income is deductible. In 1997, these deductions included unreimbursed health-related expenditures, interest on health-related loans, compulsory pension payments, a part of home mortgage interest payments, a fraction of premiums paid on qualifying insurance policies, trade union dues, education expenses, housing and living expenses for the elderly, costs with the acquisition of equipment for producing renewable energy, and part of the contributions made to a complementary pension plan.[10]

After deducting certain expenses from total gross income, the resulting balance is the taxable base to which a progressive tax rate structure is applied. This is depicted by equation (32) of Table 7, where net

[9] In 2000, with the monthly statutory minimum wage at PTE 63800, and the exemption limit for pensions set at PTE 1482000, this multiple was set at 1.6592.

[10] In 1999, for equity reasons, the expensing regime was changed. Certain expenses, such as unreimbursed health expenditures, insurance premiums, spending on old age and nursing homes, and real estate expenses, that used to be claimed as deductions to total income were then transformed into tax credits.

income, RL, that is total income minus specific deductions, is subject to a rising schedule of marginal tax rates, $t_{PIT,1} < ... < t_{PIT,4}$, one for each of the income brackets that have $E_0 < ... < E_3$ as their upper limits. See Table 7 for the parameterization of these variables in 1997.

[Table 7]

It should be noted that reporting income for PIT purposes is only compulsory for households with gross annual incomes that exceed the threshold of fourteen times the monthly statutory minimum wage, that is E_0. The proportion of all non-capital income that is received by these households is $Pr(RL < E_0) = 5.4\%$ (DETEFP, 1997). For this reason, the DGITA (1999) income base had to be scaled up by dividing it by $1 - Pr(RL < E_0)$.

Finally, a resident taxpayer may then credit against his final tax liability certain lump-sum amounts. This is the case of family credits which increase with the number of dependents and depend on the marital status of the taxpayer. Also, if the tax payer received rent income, he can credit the lowest of the following two amounts: the municipal real estate tax, or *contribuição autárquica*, that was paid on the underlying real estate, and a fraction, the share of rent income in total non-capital income, of his pre-tax credits PIT levy.

With the effective tax rate, $\tau_{PIT,NCI}$, determined using the tax calculator, after plugging in values for all the known variables of equation (33) in Table 7, PIT revenues levied on non-capital income are estimated at 3.224% for the 1990-1998 period.

A different statutory tax rate exists for each of the non-capital income brackets. Therefore, there are just as many correspondences between the statutory tax rates and the non-capital income effective tax rates. For illustration purposes we chose to present how a change in the statutory tax rate of the highest income bracket, $t_{PIT,4}$, would induce a change in the effective non-capital income tax rate, $\tau_{PIT,NCI}$. This is depicted by equation (34) in Table 7. Put simply, it means that a change in the statutory tax rate, $t_{PIT,4}$, only impacts the effective tax rate by altering the tax liability of the households with the highest incomes.

5.3. Capital income

We estimate that personal income taxes levied on reported capital income, T_{CI}, averaged 2.876% of GDP at market prices from 1990 to 1998. According to the CIRS, capital income is subject to a flat tax, t_r, the proceeds of which are withheld by the payer at the source and then handed to the Treasury. This means that capital income is paid out net of taxes.

At the PIT margin, three components make up the capital income base – interest received on national public bonds, $r^{PD}PD$, other interest income, OII, such as interest received on saving certificates and bank deposits, and distributed profits, that are a fraction, Γ, of after-tax corporate profits, Π. It should be noted that the capital income that is paid out and reported to the tax authorities generally differs from the capital share in the economy, $\theta_K Y^{FC}$, because not all firms belong to the incorporated sector, these may choose to retain part of their earnings, and finally, some of the distributed profits will inevitably escape taxation. This suggests that we define capital income, reported for personal income tax purposes, as

$$CI = r^{PD}PD + OII + \Gamma \cdot \Pi.$$

Under the assumption that the average gross yield of a Treasury bond is $r^{PD} = 0.0525$ in real terms, and knowing that public indebtedness averaged 63.21% of GDP at market prices from 1990 to 1998 (DGEP, 1999), straightforward arithmetic suggests that other interest income plus distributed corporate profits, i.e., $OII + \Gamma \cdot \Pi$, averaged 11.061 % of GDP at market prices from 1990 to 1998.

Finally, it should be noted that, because neither deductions nor tax credits are considered, capital income taxation at the PIT margin is written in the same way both in statutory and in effective terms. Obviously then, the differential effect is unitary.

6. Some concluding remarks

In this paper, we formally discuss the correspondence between statutory and effective tax rates in the Portuguese economy. Value-added and excise taxes, the corporate income tax, employers' social security

contributions, employees' social security contributions, and the personal income tax are all considered in great detail. The correspondence between statutory and effective tax rates depends on the details of the Portuguese tax law, on a wealth of data information, as well as on certain priors about the values of behavioral parameters in the economy. In addition to the general correspondences, we present our own estimates of the effective tax rates at the different tax margins. In doing so, detailed tax information was organized in a systematic way and the main characteristics of the Portuguese tax system were sketched and parameterized.

The information in this paper was recently put to good use by Pereira and Rodrigues (2000a, 2000b), in the context of an ongoing research project on tax reform in Portugal. More importantly, however, using the technical information in this paper practitioners of tax policy evaluation can obtain their own estimates of the relevant tax parameters to be used in their own work.

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Table 1 - *Tax parameters related to the taxation of private consumption*

Category j	τ_j	$t_{VAT,j}$	1994 budget shares (INE)	$\theta_{HH,j}$	$\tau_{VATET,j}$
(1)	–	4%	0.07491	0.07491	4.000%
(2)	–	5%	0.16225	0.15225	5.000%
(3)	–	6%	0.02065	0.02065	6.000%
(4)	–	12%	0.13178	0.10232	12.000%
(alcohol)	23.999%	17%	0.01481	0.01481	45.079%
(autos)	12.214%	17%	0.07291	0.11291	31.290%
(petrol)	161.713%	17%	0.02855	0.06900	206.204%
(tobacco)	201.795%	17%	0.01099	0.02000	353.100%
(rest)	–	17%	0.48315	0.43315	17.000%

Sources: DGEP (1999), INE (1997), INE *Contas Nacionais*, Authors' calculations.

Table 2 - *Value-added and excise taxes on private consumption*

In statutory terms ...

$$\begin{aligned} T_{VATET,C} = [&t_{VAT,1}\tilde{\theta}_{HH,1} + t_{VAT,2}\tilde{\theta}_{HH,2} + t_{VAT,3}\tilde{\theta}_{HH,3} + t_{VAT,4}\tilde{\theta}_{HH,4} + \\ &+(1+t_{VAT,5})\tau_{alcohol}\tilde{\theta}_{HH,alcohol} + (1+t_{VAT,5})\tau_{tobacco}\tilde{\theta}_{HH,tobacco} + \\ &+(1+t_{VAT,5})\tau_{autos}\tilde{\theta}_{HH,autos} + (1+t_{VAT,5})\tau_{petrol}\tilde{\theta}_{HH,petrol} + \\ &+t_{VAT,5}(\tilde{\theta}_{HH,alcohol} + \tilde{\theta}_{HH,tobacco} + \tilde{\theta}_{HH,autos} + \tilde{\theta}_{HH,petrol} + \tilde{\theta}_{HH,rest})]\cdot \\ &\cdot(C^{MP} - T_{VATET,C}) \end{aligned} \tag{1}$$

In effective terms ...

$$T_{VATET,C} = \tau_{VATET,C} C^{FC} \tag{2}$$

$$\tau_{alcohol} = \frac{ETR_{alcohol}(1+t_{VAT,5})}{\theta_{HH,alcohol}C^{MP} - (1+t_{VAT,5})ETR_{alcohol}} \tag{3}$$

$$\tau_{tobacco} = \frac{ETR_{tobacco}(1+t_{VAT,5})}{\theta_{HH,tobacco}C^{MP} - (1+t_{VAT,5})ETR_{tobacco}} \tag{4}$$

$$\tau_{autos} = \frac{ETR_{autos}(1+t_{VAT,5})}{(\theta_{HH,autos}C^{MP} + \theta_{Firms,autos}I^{MP} + \theta_{PS,autos}IG^{MP}) - (1+t_{VAT,5})ETR_{autos}} \tag{5}$$

$$\tau_{petrol} = \frac{ETR_{petrol}(1+t_{VAT,5})}{(\theta_{HH,petrol}C^{MP} + \theta_{Firms,petrol}I^{MP} + \theta_{PS,petrol}CG^{MP}) - (1+t_{VAT,5})ETR_{petrol}} \tag{6}$$

How a change in the statutory general VAT rate, $t_{VAT,5}$, alters the effective tax rate

$$\begin{aligned} \frac{\partial \tau_{VATET,C}}{\partial t_{VAT,5}} = &\tilde{\theta}_{HH,rest} + \tilde{\theta}_{HH,autos}(1+\tau_{autos}) + \tilde{\theta}_{HH,petrol}(1+\tau_{petrol}) + \\ &+\tilde{\theta}_{HH,alcohol}(1+\tau_{alcohol}) + \tilde{\theta}_{HH,tobacco}(1+\tau_{tobacco}) \end{aligned} \tag{7}$$

Table 2 (Cont'd) - *Value-added and excise taxes on private consumption*

Data

$T_{VATET} = 0.142Y^{MP}$, $C^{MP} = 0.649Y^{MP}$, $T_{VATET,C} = 0.11416Y^{MP}$,

$ETR_{alcohol} = 0.159\%Y^{MP}$, $ETR_{autos} = 0.8566\%Y^{MP}$,

$ETR_{petrol} = 2.752\%Y^{MP}$, $ETR_{tobacco} = 0.7418\%Y^{MP}$

Parameters

$\tilde{\theta}_{HH,1} = 0.08740$, $\tilde{\theta}_{HH,2} = 0.17595$, $\tilde{\theta}_{HH,3} = 0.02364$, $\tilde{\theta}_{HH,4} = 0.11086$, $\tilde{\theta}_{HH,rest} = 0.44924$,

$\tilde{\theta}_{HH,alcohol} = 0.01239$, $\tilde{\theta}_{HH,autos} = 0.10436$, $\tilde{\theta}_{HH,petrol} = 0.02735$, $\tilde{\theta}_{HH,tobacco} = 0.00687$,

See Table 1 for an average household's nominal budget shares.

The calculated effective tax rate

$\tau_{VATET,C} = 0.21345$

See Table 1 for the different effective tax rates for the several categories.

The calculated differential effect for the general VAT rate

$\frac{\partial \tau_{VATET,C}}{\partial t_{VAT,5}} = 0.674022$

Sources: DGEP (1999), INE (1997), INE *Contas Nacionais*, Authors' calculations.

Table 3 - *Value-added and excise taxes on other spending activities*

In statutory terms ...

$$T_{VATET,I} = (I^{MP} - T_{VATET,I})[t_{VAT,5}(\rho_I + \tilde{\theta}_{Firms,autos} + \tilde{\theta}_{Firms,petrol}) + \\ + \tilde{\theta}_{Firms,autos}(1 + t_{VAT,5})\tau_{autos} + \tilde{\theta}_{Firms,petrol}(1 + t_{VAT,5})\tau_{petrol}] \quad (8)$$

$$T_{VATET,CG} = (CG^{MP} - T_{VATET,CG})[1 - \frac{Wages_{PS,CG}}{CG^{MP}}(1 + \tau_{VATET,CG})] \cdot \\ \cdot [t_{VAT,5} + \tilde{\theta}_{PS,petrol}(1 + t_{VAT,5})\tau_{petrol}] \quad (9)$$

$$T_{VATET,IG} = (IG^{MP} - T_{VATET,IG})[1 - \frac{Wages_{PS,IG}}{IG^{MP}}(1 + \tau_{VATET,IG})] \cdot \\ \cdot [t_{VAT,5} + \tilde{\theta}_{PS,autos}(1 + t_{VAT,5})\tau_{autos}] \quad (10)$$

$$T_{VATET,IH} = (IH^{MP} - T_{VATET,IH})[1 - \frac{Wages_{PS,IH}}{IH^{MP}}(1 + \tau_{VATET,IH})]t_{VAT,5} \quad (11)$$

In effective terms ...

$$T_{VATET,I} = \tau_{VATET,I} I^{FC} \qquad T_{VATET,CG} = \tau_{VATET,CG} CG^{FC} \quad (12), (13)$$

$$T_{VATET,IG} = \tau_{VATET,IG} IG^{FC} \qquad T_{VATET,IH} = \tau_{VATET,IH} IH^{FC} \quad (14), (15)$$

How a change in the statutory general VAT rate, $t_{VAT,5}$, alters the effective tax rate

$$\frac{\partial \tau_{VATET,I}}{\partial t_{VAT,5}} = \rho_I + \tilde{\theta}_{Firms,autos}(1 + \tau_{autos}) + \tilde{\theta}_{Firms,petrol}(1 + \tau_{petrol}) \quad (16)$$

$$\frac{\partial \tau_{VATET,CG}}{\partial t_{VAT,5}} = (1 - \frac{Wages_{PS,CG}}{CG^{FC}})(1 + \tilde{\theta}_{PS,petrol}\tau_{petrol}) \quad (17)$$

$$\frac{\partial \tau_{VATET,IG}}{\partial t_{VAT,5}} = (1 - \frac{Wages_{PS,IG}}{IG^{FC}})(1 + \tilde{\theta}_{PS,autos}\tau_{autos}) \quad (18)$$

$$\frac{\partial \tau_{VATET,IH}}{\partial t_{VAT,5}} = 1 - \frac{Wages_{PS,IH}}{IH^{FC}} \quad (19)$$

Table 3 (Cont'd) - *Value-added and excise taxes on other spending activities*

Data

$I^{MP} = 0.215Y^{MP}$, $T_{VATET,I} = 0.01841Y^{MP}$, $CG^{MP} = 0.111Y^{MP}$,

$T_{VATET,CG} = 0.00471Y^{MP}$, $IG^{MP} = 0.038Y^{MP}$, $T_{VATET,IG} = 0.00380Y^{MP}$,

$IH^{MP} = 0.065Y^{MP}$, $T_{VATET,IH} = 0.00092Y^{MP}$,

$\theta_{PS,autos} = 0.10735$, $\theta_{PS,petrol} = 0.0218$, $\rho_I = 0.32$,

$\theta_{Firms,autos} = 0.06848$, $\theta_{Firms,petrol} = 0.02283$,

$\frac{Wages_{PS,CG}}{CG^{MP}} = 0.7269$, $\frac{Wages_{PS,IG}}{IG^{MP}} = 0.3535$, $\frac{Wages_{PS,IH}}{IH^{MP}} = 0.9025$

Parameters

$\tilde{\theta}_{PS,autos} = 0.0909$, $\tilde{\theta}_{PS,petrol} = 0.0074$, $\tilde{\theta}_{Firms,autos} = 0.0570$, $\tilde{\theta}_{Firms,petrol} = 0.0081$

The calculated effective tax rates

$\tau_{VATET,I} = 0.09365$, $\tau_{VATET,CG} = 0.04431$, $\tau_{VATET,IG} = 0.11111$, $\tau_{VATET,IH} = 0.01438$

The calculated differential effects for the general VAT rate

$\frac{\partial \tau_{VATET,I}}{\partial t_{VAT,5}} = 0.40530$, $\frac{\partial \tau_{VATET,CG}}{\partial t_{VAT,5}} = 0.24377$, $\frac{\partial \tau_{VATET,IG}}{\partial t_{VAT,5}} = 0.61396$, $\frac{\partial \tau_{VATET,IH}}{\partial t_{VAT,5}} = 0.08454$

Sources: AECOPS (1996), DGCP (1997), DGEP (1999), Authors' calculations.

Table 4 - *Corporate income tax and investment tax credits*

In statutory terms ...

$$T_{CITd} = t_{CIT}(1 + t_{der})[(Y^{MP} - T_{VATET})(\phi_1 - \phi_2\theta_L) - \alpha\phi_3(I^{MP} - T_{VATET,I})] - T_{ITC} \tag{20}$$

$$T_{ITC} = t_{ITC} \cdot \varepsilon \cdot \eta \cdot \phi_3(I^{MP} - T_{VATET,I}) \cdot \beta \tag{21}$$

In effective terms ...

$$T_{CITd} = \tau_{CITd}[Y^{FC}(1 - \theta_L) - \alpha I^{FC}] - T_{ITC} \tag{22}$$

$$T_{ITC} = \tau_{ITC} I^{FC} \tag{23}$$

How a change in the statutory tax rate induces a change in the effective tax rate

$$\frac{\partial \tau_{CITd}}{\partial t_{CIT}} = (1 + t_{der})[Y^{FC}(\phi_1 - \phi_2\theta_L) - \alpha\phi_3 I^{FC}]/[Y^{FC}(1 - \theta_L) - \alpha I^{FC}] \tag{24}$$

$$\frac{\partial \tau_{ITC}}{\partial t_{ITC}} = \varepsilon\eta\phi_3\beta = \frac{\tau_{ITC}}{t_{ITC}} \tag{25}$$

Table 4 (Cont'd) - *Corporate income tax and investment tax credits*

Data

$T_{CITd} = 0.031Y^{MP}$, $T_{ITC} = 0.0009744Y^{MP}$, $T_{VATET} = 0.142Y^{MP}$, $\theta_L = 0.475$,

$T_{VATET,I} = 0.01841Y^{MP}$, $I^{MP} = 0.215Y^{MP}$, $t_{CIT} = 0.34$, $t_{der} = 0.10$, $t_{ITC} = 0.10$,

Gross operating surplus for the incorporated sector $= Y^{FC}(\phi_1 - \phi_2\theta_L) = 0.17926Y^{MP}$

Parameters

$\phi_1 = 0.51554$, $\phi_2 = 0.6454937$, $\phi_3 = 0.6491375$, $\alpha = 0.73477$,

$\varepsilon = 0.35$, $\eta = 0.77728$, $\beta = 0.28067$

The calculated effective tax rates

$\tau_{CITd} = 0.10449$, $\tau_{ITC} = 0.004957$

The calculated differential effects

$\frac{\partial \tau_{CITd}}{\partial t_{CIT}} = 0.30734$, $\frac{\partial \tau_{ITC}}{\partial t_{ITC}} = 0.04957$

Sources: DGEP (1999), INE *Contas Nacionais*, Authors' calculations

Table 5 - *Employers' social security contributions*

In statutory terms ...

$$T_{FSSC} = \xi \cdot t_{FSSC}[\theta_L(Y^{MP} - T_{VATET}) - T_{FSSC} - Wages_{PS}] \tag{26}$$

In effective terms ...

$$T_{FSSC} = \tau_{FSSC}[\theta_L Y^{FC} - T_{FSSC}] \tag{27}$$

How a change in the statutory tax rate induces a change in the effective tax rate

$$\frac{\partial \tau_{FSSC}}{\partial t_{FSSC}} = \frac{(1+\tau_{FSSC})^2}{\theta_L Y^{FC}} \cdot \frac{\xi[\theta_L Y^{FC} - Wages_{PS}]}{(1+\xi t_{FSSC})^2} \tag{28}$$

Data

$T_{FSSC} = 0.05Y^{MP}$, $t_{FSSC} = 0.2375$, $Wages_{PS} = 0.13818Y^{MP}$,

$T_{VATET} = 0.142Y^{MP}$, $\theta_L = 0.475$

Parameters

$\xi = 0.959686$

The calculated effective tax rate

$\tau_{FSSC} = 0.139841$

The calculated differential effect

$\frac{\partial \tau_{FSSC}}{\partial t_{FSSC}} = 0.546565$

Sources: DGEP (1999), INE *Contas Nacionais*, Authors' calculations

Table 6 - *Employees' social security contributions*

In statutory terms ...

$$T_{WSSC} = t^{dep}_{WSSC}\{\xi[\theta_L(Y^{MP} - T_{VATET}) - T_{FSSC} - Wages_{PS}] + Wages_{PS}\}+$$
$$+t^{se,min}_{WSSC} \cdot B^{se,min}_{WSSC} + t^{se,max}_{WSSC} \cdot B^{se,max}_{WSSC} \quad (29)$$

In effective terms ...

$$T_{WSSC} = \tau_{WSSC}[\theta_L Y^{FC} - T_{FSSC}] \quad (30)$$

How a change in the statutory tax rate induces a change in the effective tax rate

$$\frac{\partial \tau_{WSSC}}{\partial t^{dep}_{WSSC}} = \frac{\xi(\theta_L Y^{FC} - T_{FSSC} - Wages_{PS}) + Wages_{PS}}{\theta_L Y^{FC} - T_{FSSC}} \quad (31)$$

Data

$T_{WSSC} = 0.041Y^{MP}$, $t^{dep}_{WSSC} = 0.11$, $t^{se,min}_{WSSC} = 0.254$, $t^{se,max}_{WSSC} = 0.32$,

$T_{VATET} = 0.142Y^{MP}$, $T_{FSSC} = 0.05Y^{MP}$, $\theta_L = 0.475$, $Wages_{PS} = 0.13818Y^{MP}$

Parameters

$\xi = 0.959686$, $t^{se,min}_{WSSC} \cdot B^{se,min}_{WSSC} + t^{se,max}_{WSSC} \cdot B^{se,max}_{WSSC} = 0.002624Y^{MP}$

The calculated effective tax rate

$\tau_{WSSC} = 0.114669$

The calculated differential effect

$\frac{\partial \tau_{WSSC}}{\partial t^{dep}_{WSSC}} = 0.975266$

Sources: DGEP (1999), Authors' calculations

Table 7 - *Personal income tax: non-capital incomes*

In statutory terms ... according to the tax calculator model

$$\tau_{PIT,NCI} = \left[\sum_{i=1}^{40000} RL_i 1(RL_i \geq E_0)[1 - Pr(RL < E_0)]^{-1}\right]^{-1} \cdot$$

$$\cdot\{t_{PIT,1}\left[\sum_{i=1}^{40000}(E_1 - E_0)1(RL_i \geq E_1)\right] +$$

$$+t_{PIT,2}\left[\sum_{i=1}^{40000}(E_2 - E_1)1(RL_i \geq E_2)\right] +$$

$$+t_{PIT,2}\left[\sum_{i=1}^{40000}(RL_i - E_1)1(E_2 > RL_i \geq E_1)\right] +$$

$$+t_{PIT,3}\left[\sum_{i=1}^{40000}(E_3 - E_2)1(RL_i \geq E_3)\right] +$$

$$+t_{PIT,3}\left[\sum_{i=1}^{40000}(RL_i - E_2)1(E_3 > RL_i \geq E_2)\right] +$$

$$+t_{PIT,4}\left[\sum_{i=1}^{40000}(RL_i - E_3)1(RL_i > E_3)\right] - Credits\} \tag{32}$$

In effective terms ...

$$T_{NCI} = \tau_{PIT,NCI}[(1 - \tau_{WSSC})(\theta_L Y^{FC} - T_{FSSC}) + \varphi TR] \tag{33}$$

How a change in the highest statutory tax rate, $t_{PIT,4}$, induces a change in $\tau_{PIT,NCI}$

$$\frac{\partial \tau_{PIT,NCI}}{\partial t_{PIT,4}} = \sum_{i=1}^{40000}(RL_i - E_3)1(RL_i > E_3)\cdot$$

$$\cdot\left(\sum_{i=1}^{40000} RL_i 1(RL_i \geq E_0)[1 - Pr(RL < E_0)]^{-1}\right)^{-1} \tag{34}$$

Table 7 (Cont'd) - *Personal income tax: non-capital incomes*

Data

$T_{PIT} = T_{CI} + T_{NCI} = 0.061Y^{MP}$, $TR = 0.093Y^{MP}$, $Pr(RL < E_0) = 0.054$,

$\theta_L = 0.475$, $\varphi = 0.075$, $t_{PIT,1} = 0.15$, $t_{PIT,2} = 0.25$, $t_{PIT,3} = 0.35$, $t_{PIT,4} = 0.40$,

In 1997 (PTEs): $E_0 = 793800$, $E_1 = 1050000$, $E_2 = 2435000$, $E_3 = 6150000$

Parameters

$T_{NCI} = 0.03224Y^{MP}$

The calculated effective tax rate

$\tau_{PIT,NCI} = 0.09964$

The calculated differential effect for the tax rate associated with the highest income bracket

$\frac{\partial \tau_{PIT,\,NCI}}{\partial t_{PIT,4}} = 0.07100$

Sources: DETEFP (1997), DGEP (1999), DGITA (1999), Authors' calculations

Table 8 - *Personal income tax: capital income*

In statutory terms ...

$$T_{CI} = t_r(r^{PD}PD + OII + \Gamma \cdot \Pi) \tag{35}$$

In effective terms ...

$$T_{CI} = \tau_r(r^{PD}PD + OII + \Gamma \cdot \Pi) \tag{36}$$

How a change in the statutory tax rate induces a change in the effective tax rate

$$\frac{\partial \tau_r}{\partial t_r} = 1 \tag{37}$$

Data

$T_{PIT} = T_{CI} + T_{NCI} = 0.061Y^{MP}$, $t_r = 0.20$, $r^{PD} = 0.0525$, $PD = 0.6321Y^{MP}$

Parameters

$T_{CI} = 0.02876^{MP}$, $OII = 0.10851^{MP}$, $\Gamma \cdot \Pi = 0.0021Y^{MP}$

The calculated effective tax rate

$\tau_r = t_r = 0.20$

The calculated differential effect for the tax rate associated with the highest income bracket

$\frac{\partial \tau_r}{\partial t_r} = 1$

Sources: DGEP (1999), Authors' calculations