



STUDIECENTRUM VOOR ECONOMISCH EN SOCIAAL ONDERZOEK

VAKGROEP MACRO-ECONOMIE

**The Incidence of Corporate Taxation in  
Belgium on Employment and Investment**

**Joseph PLASMANS  
Jacques VANNESTE\***

report 90/253

December 1990

\* The authors thank Raymond Gradus (Tilburg University), Geert Jennes and Marleen Meulepas (SESO-UFSIA) for their constructive remarks and Patricia De Bruyn (SESO-UFSIA) for her excellent typing.

Universitaire Faculteiten St.-Ignatius  
Prinsstraat 13 - B 2000 Antwerpen  
D/1990/1169/17

**Abstract**

The purpose of this paper is to analyse the impact of general corporate tax behaviour on (optimal and effective) private employment and investment, and to apply the analysis to a small open economy, i.e., Belgium.

After a discussion on the legislative characteristics of the Belgian corporate tax behaviour, the impact of the effective corporate tax rate on private investment and private employment in Belgium is measured.

In a final paragraph an optimal dynamic model of the firm with corporate tax measures (the corporate tax rate, the rate of investment tax credit and the rate of investment subsidies) is derived under the Modigliani-Miller hypothesis of perfect capital markets. The paper could be interesting for all tax systems where investment grants and/or tax credits are provided.

JEL-code : S 180

## 1. Definition of the Belgian corporate profit tax base

### 1.1 Corporate "accounting-result" versus corporate "tax-result" in Belgian companies

The notion of profits in an accounting context refers to three elements : current transactions, financial transactions and exceptional transactions. The sum of the net saldi of these three components form the pretax profit or loss of a company.

The corporate tax result, however, is calculated in a quite different way, at least in Belgium. Corporate enterprises in Belgium are taxed upon the increase in taxable **retained earnings** and upon the amount of **distributed profits**. These profits can be distributed to shareholders as dividends or to executives as a bonus.<sup>1</sup> The tax rate is the same for retained earnings as for distributed profits. Up to this point, the corporate tax result is - more or less - equivalent to the "accounting-result".

The first important divergence between the two concepts is due to the immunization of certain distributed profits to shareholders. In order to promote risk capital in enterprises, dividends up to 13 % of net-capital increases realized in 1982 or 1983 are free from corporate profit tax for a period of 9 or 10 consecutive years depending on the year of capital issue. This legislation, known as the **Cooreman-De Clercq law** , had an overwhelming success as an incentive for new risk capital. The Cooreman - De Clercq law was also set up as a stimulus for business investment. The 10 year immunization of dividends could only be granted if 60 % of the net-capital increases were invested in new fixed assets.

---

<sup>1</sup> From assessment year 1991 on, these bonuses will be discarded from the corporate tax result and will thus become deductible operating costs.

The second important difference stems from the inclusion in the tax result of costs qualified as non-deductible according to the Belgian tax legislation. Examples of such **non-deductible costs** are, amongst others : profit tax advances, surplus depreciation on assets due to divergences between accounting rules and tax rules, clandestine commissions, gifts, abnormal royalties and interest payments to affiliated companies ... A recent "innovation" of non deductible costs in Belgian tax legislation is situated in the sector of transportation costs, according to which only 75 percent of the fixed transportation costs (depreciation, insurance ...) are deductible from the operating profits.

The sum of the elements explained above (distributed profits, retained earnings and non-deductible costs) form the so-called **corporate tax result**. However, the statutory tax rates do not apply to this amount, but to the corporate **tax base** which can be substantially lower. The spread stems from a twofold nature : **deductions to avoid economic double taxation** and **tax expenditures**. The effective corporate tax rate is then fairly below the statutory tax rate.

The corporate tax result is registered by year of assessment, for example 1987. The figures then refer to the profits earned in 1986, for which the period of assessment expired on June 30 of 1988.

For 1987 the corporate tax result amounted to 455,9 billion Belgian francs. The major part of this (447,2 billion) is earned within Belgium. The small saldo (8,7 billion) is earned abroad and either completely tax-immune according to international treaties avoiding double taxation, either taxed at a reduced rate (one fourth of the statutory tax rate) in case of absence of such bilateral tax treaty.

The volume of negative tax result for the year considered amounted to 77,4 billion Belgian francs. This volume will

reappear in later fiscal years as deductible losses (carry forward mechanism).

*1.2 The corporate profit tax base in Belgium between 1978 and 1987*

Table 1 sketches the evolution of the positive corporate tax result and the corporate tax base between 1978 and 1987.

As table 1 illustrates, the tax result and the tax base grew unevenly between 1978 and 1987. The tax result increased by factor 3.17, whereas the tax base only increased by factor 2.67. Deductions to avoid economic double taxation (non bis in idem) and tax expenditures amounted to 38 billion BEF in 1978 or 26.4 % of the tax result. In 1987 the total immunizations represented 174 billion BEF or 38.2 % of the tax result.

**Table 1 : Corporate tax result and corporate tax base in Belgium between 1978 and 1987**  
(in billion BEF - by year of assessment N)  
situation on June 30 of year N + 1

|                   | 78  | 79  | 80  | 81  | 82  | 83  | 84  | 85  | 86  | 87  |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>TAX RESULT</b> | 144 | 162 | 202 | 196 | 193 | 275 | 293 | 324 | 387 | 456 |
| <b>TAX BASE</b>   | 106 | 122 | 137 | 133 | 125 | 168 | 184 | 203 | 235 | 283 |

Source : Ministry of Finance, Brussels

In a next step we regrouped the corporate income immunizations in 5 categories : non-taxable elements, immunizations to avoid economic double taxation, investment related tax expenditures, the impact of the carry-forward of losses and capital gains taxable at half the statutory tax rate. The detailed analysis is presented in table 2.

**Table 2a : Tax base smoothing in Belgium between 1978 and 1987**

(in billion BEF - by year of assessment N)  
situation on June 30 of N + 1

|   | 1978 | 1979 | 1980 | 1981 |
|---|------|------|------|------|
| 1. Non-taxable elements                                       | 1.6  | 1.1  | 3.7  | 2.3  |
| 2. Non bis in idem  |      |      |      |      |
| Earned profits  | 1.7  | 1.5  | 3.4  | 6.7  |
| Distributed profits   | 23.0 | 24.6 | 28.9 | 27.3 |
| 3. Investment incentives                                      |      |      |      |      |
| Investment tax credit   | 0.0  | 0.0  | 0.0  | 0.0  |
| Other   | 0.5  | 0.8  | 3.3  | 5.0  |
| 4. Carry forward of losses                                    | 8.1  | 8.8  | 21.6 | 18.0 |
| 5. Capital gains taxable<br>at half the statutory<br>tax rate | 3.0  | 2.7  | 3.8  | 2.6  |
| TOTAL   | 38.0 | 39.6 | 64.7 | 62.0 |

**Table 2b : Tax base smoothing in Belgium between 1978 and 1987**

(in billion BEF - by year of assessment N)  
situation on June 30 of N + 1

|   | 1982 | 1983  | 1984  | 1985  |
|---|------|-------|-------|-------|
| 1. Non-taxable elements                                       | 2.4  | 2.5   | 4.5   | 4.4   |
| 2. Non bis in idem  |      |       |       |       |
| Earned profits  | 7.2  | 5.8   | 5.2   | 7.6   |
| Distributed profits   | 33.1 | 53.8  | 51.9  | 61.2  |
| 3. Investment incentives                                      |      |       |       |       |
| Investment tax credit   |      | 13.0  | 16.7  | 18.8  |
| Other   | 1.1  | 0.5   | 0.5   | 0.6   |
| 4. Carry forward of losses                                    | 21.3 | 27.7  | 27.8  | 30.3  |
| 5. Capital gains taxable<br>at half the statutory<br>tax rate | 3.0  | 3.3   | 2.0   | 2.0   |
| TOTAL   | 68.2 | 106.6 | 108.5 | 125.0 |

**Table 2c : Tax base smoothing in Belgium between  
1978 and 1987**  
(in billion BEF - by year of assessment N)  
situation on June 30 of N + 1

|   | 1986  | 1987  |
|---|-------|-------|
| 1. Non taxable elements                                       | 4.4   | 10.3  |
| 2. Non bis in idem  |       |       |
| Earned profits  | 6.3   | 7.9   |
| Distributed profits   | 81.0  | 88.4  |
| 3. Investment incentives                                      |       |       |
| Investment tax credit   | 25.2  | 34.8  |
| Other   | 0.4   | 0.0   |
| 4. Carry forward of losses                                    | 31.3  | 30.3  |
| 5. Capital gains taxable<br>at half the statutory<br>tax rate | 3.0   | 1.6   |
| TOTAL   | 151.8 | 173.5 |

Source : Ministry of Finance, own computations

Out of the variety of measures to avoid double taxation and corporate tax expenditures, four of the most important - at least as to their budgetary impact - are sketched below.

## 2. **Non bis in idem and main tax expenditures in corporate profit taxation in Belgium**

### 2.1 *Immunization of received dividends from permanent shares*

Financial fixed assets of corporations include shares, bonds and deposits. Shares that remain in the accounts during the entire accounting period are called **permanent financial fixed assets**. Dividends received from those permanent shares are withdrawn from the tax base in the receiving company.

This immunization is meant to avoid double taxation, once in the company distributing the profit and a second time in the receiving company. Received dividends out of permanent shares are "definitively taxed income".

The immunization is not complete, however. Indeed, operating costs to handle the "share-portfolio" such as wages, computertime etc. figure in the profit and loss account and reduce the tax base. Therefore, Belgian tax legislation limits the immunization of received dividends out of permanent shares to 95 %. For holding companies, defined for tax purposes as companies with at least 50 % of their assets invested in financial assets, this immunization coefficient is reduced to 90 %. The tax reform act of December 7, 1988 has reduced those immunization-coefficients to 90 % and 85 % respectively.

In principle this tax-measure is economically sound in view of avoiding economic double taxation. It is less the case when the received dividends were not submitted to any taxation at the stage of the profit distribution. Unfortunately for the Minister of Finance, this happens quite a few times...



Consider for example a company X facing a huge amount of accumulated losses. Suppose company X takes over company Y with brilliant profit prospects. The distributed profits of the new entity leave the company quasi tax free (due to the mechanism of carry forward of losses). Nevertheless, the received dividends will be qualified as "definitively taxed income" if the shares were permanent.

Another remarkable application of this "**sweets without efforts**" principle is situated in the energy sector in Belgium. The major part of electricity distribution is organized by "mixed interurban authorities". These mixed interurban authorities are composed of local authorities representing the public sector and the energy producers representing the private sector.

Economic theory would suggest that the private sector producers maximize their profits by setting monopoly output prices. In reality however, the energy will be supplied at lower output prices than "optimally" would be the case. Instead of fixing their attention to the gross margin per unit of energy sold to the mixed authorities, producers are interested in the distribution mark-up realized by the mixed authorities.

This happens to be quite rational as those mixed authorities are exempted from profit taxes. Energy producers "repatriate" their mark-up as dividends on permanent shares they possess in the mixed authorities. And, according to the Belgian tax-mechanism of almost entire immunization of received dividends out of permanent shares, only 10 % of those receipts figure in the tax base of the energy firms.

The tax reform act of December 22, 1989 has tackled both loopholes. From the revenue year 1990 on the so-called **tax mergers** and **energy-dividends** become **less attractive**. Dividends out of interurban authorities for example, are now considered as distributed profits and taxed at the statutory

tax rate of corporate enterprises, although interurban authorities belong to the non-profit sector by default and are thus not assessable in any income tax system.

The new legislation for the carry forward of losses is subject of the subsequent section.

## *2.2 The carry forward of losses*

Up to the revenue year 1989 tax-losses could be carried forward during five consecutive years and deducted from later earnings. For "start-up" losses, incurred during the first year of operation, the carry forward was unlimited in time. From the revenue year 1990 on, **the carry forward of losses is unlimited in time.** Tax mergers are tackled by a more restrictive law to avoid substantial tax drain.

## *2.3 The investment tax credit system*

As stated before, the Belgian tax legislation does not accept the principles of inflationary accounting. Instead, a tax investment credit system is at work. For the fiscal year 1987 some 13 % of the realized investments is deductible from the corporate tax result. The credit is higher for energy saving investments and lower for office equipment.

Again these investment tax credit rates have been reduced in the tax reform act of December 7, 1988<sup>1</sup>. The immunization of 34,8 billion reported for assessment year 1987 is thus an overstatement of the figures of more recent years.

---

<sup>1</sup> Nowadays, the basic investment tax credit rate is the inflation rate plus 3 % with minimum and maximum brackets of 5 % and 12 % of the realized investments. Investments for research and development and in energy saving become the basic investment tax credit rate plus 10 %. Besides this, companies can obtain a specific qualification by Royal Decree as "innovative companies". These companies are allowed to use augmented tax credit rates for all their investments.

## 2.4 Employment incentives

Most of the employment incentives are of the **"sunset"-legislation type**.

The Royal Decree nr. 118 from December 23, 1982 created so called **"Employment zones"** in each of the three regions of Flanders, Wallonia and Brussels. Each employment zone is clearly marked off and characterized by relative high unemployment. The Commission of the EC approved employment zones with a total surface of 50 hectares in Flanders and Wallonia and of 30 hectares in Brussels.

Enterprises in one of these employment zones benefit substantial tax advantages. Two examples to illustrate this specific tax treatment. Retained earnings and distributed profits are exempted from the corporate profit tax for 10 years. By the same legislation, dividends are totally exempted from withholding tax.

Another legislative initiative attempted to stimulate drastic **worktime-reduction with compensated enrollment**. Enterprises which negotiated such a collective labour agreement between 1.1.1985 and 31.12.1987 are allowed a degressive benefit immunization for six consecutive years for a total amount of 2.000.000 Belgian Francs per extra employee.

A third legislative effort is specifically meant for **small and medium-sized companies**, one of the characteristics of the Belgian economy. For the government these small and medium-sized companies, which are mostly labour intensive, are a leverage for growth policy and job creation. The profit immunization is 150.000 Belgian Francs per extra employee.

### 3. The effective corporate tax rate in Belgium: an empirical investigation.

#### 3.1 The effective corporate tax rate : time series data.

The effective corporate tax rate was defined by the Royal Commission for Tax Reform as follows :

$$t_{\text{effective}} = \frac{\text{Total tax revenue}}{\text{Tax base}}$$

The denominator is a bit larger than the tax base sensu stricto defined in table 2. It also contains the capital gains taxable at half the statutory tax rate (cfr. table 2.5) and some minor elements.

Consistent data on the effective corporate tax rate are only available from 1963 on. This year marked the beginning of a new era for taxation in Belgium. From then on a synthetic tax system was installed instead of the schedular approach which was previously "en vogue".

As table 4 shows, there is a non-negligible fluctuation in the effective corporate tax rate. In fact this evolution results from four-possibly cumulative-effects : autonomous changes in the statutory tax rate, dynamics in corporate profits, the creativity of the tax legislator in defining tax expenditures and the effectiveness of tax collection.

**Table 4 : The effective corporate tax rate in Belgium**  
 (Year of tax assessment N - Situation on  
 June 30 of year N+1)

|      | <b>Tax base</b><br>(in million BEF) | <b>Tax revenue</b><br>(in million BEF) | <b>Effective tax<br/>rate %</b> |
|------|-------------------------------------|--|---------------------------------|
| 1963 | 24.329,1                            | 7.867,5                                | 32,3                            |
| 1964 | 35.407,7                            | 11.451,7                               | 32,3                            |
| 1965 | 43.192,6                            | 13.611,3                               | 31,5                            |
| 1966 | 56.138,6                            | 14.711,7                               | 26,2                            |
| 1967 | 52.910,4                            | 14.047,2                               | 26,5                            |
| 1968 | 56.810,7                            | 15.339,7                               | 27,0                            |
| 1969 | 70.086,5                            | 19.959,1                               | 28,5                            |
| 1970 | 83.810,8                            | 23.901,0                               | 28,7                            |
| 1971 | 94.893,2                            | 27.480,3                               | 29,0                            |
| 1972 | 92.270,9                            | 27.308,0                               | 29,6                            |
| 1973 | 112.049,8                           | 34.986,7                               | 31,2                            |
| 1974 | -                                   | 51.426,2                               | -                               |
| 1975 | -                                   | 50.419,7                               | -                               |
| 1976 | -                                   | 44.653,7                               | -                               |
| 1977 | -                                   | 55.251,7                               | -                               |
| 1978 | 110.675,1                           | 53.706,8                               | 48,5                            |
| 1979 | 126.392,6                           | 61.081,5                               | 48,3                            |
| 1980 | 143.010,1                           | 68.433,3                               | 47,9                            |
| 1981 | 139.032,7                           | 63.595,8                               | 45,7                            |
| 1982 | 130.696,3                           | 60.322,8                               | 46,2                            |
| 1983 | 173.957,8                           | 72.335,9                               | 41,6                            |
| 1984 | 188.631,8                           | 77.522,2                               | 41,1                            |
| 1985 | 207.800,0                           | 87.967,0                               | 42,3                            |
| 1986 | 241.300,0                           | 96.090,0                               | 39,8                            |
| 1987 | 286.600,0                           | 119.492,0                              | 41,7                            |

**Source :** Verslag over de Vennootschapsbelasting, Hoge Raad van Financiën, **Documentatieblad**, Ministerie van Financiën, nr.5, mei 1987, p. 309 and Ministry of Finance, Brussels.

### 3.2. The effective corporate tax rate by economic sector.

Quite unexpected was the finding by the staff of the Minister of Finance of "tax heaven" economic sectors in Belgium. Indeed, the energy sector (electricity, gas and water) and the petroleum industry both score very low effective tax rates of 1,4 % and 13,1 % respectively (table 5). Both sectors are characterized by a capital intensive production which yields considerable investment tax credit. They might have some qualified tax advisers too.

The calculation of the effective corporate tax rate by economic sectors used a larger concept of tax base than we did for our research purposes<sup>1</sup>.

**Table 5 : The effective corporate tax rate by economic sector in Belgium in 1987.**

| <b>Economic sector</b>        | <b>Effective corporate tax rate</b> |
|-------------------------------|-------------------------------------|
| Agriculture                   | 23,8 %                              |
| Petroleum                     | 13,1 %                              |
| Electricity, gas and water    | 1,4 %                               |
| Non-energetic minerals        | 24,2 %                              |
| Chemistry                     | 39,2 %                              |
| Metal construction            | 34,7 %                              |
| Other transforming industries | 34,0 %                              |
| Construction                  | 27,9 %                              |
| Commerce, restaurants         | 35,3 %                              |
| Transportation, communication | 27,8 %                              |
| Credit and banking            | 27,8 %                              |
| Insurance companies           | 36,6 %                              |
| Services to enterprises       | 29,0 %                              |
| Other services                | 17,2 %                              |
| Average                       | 30,6 %                              |

Source : PEETERS, P., o.c. , p. 243.

---

<sup>1</sup> See P. Peeters, o.c., p. 243.

#### 4. The incidence of corporate taxation in Belgium on private investment and employment

In this section we intend to investigate the impact of the effective corporate tax rate over time on investment and employment behaviour in the Belgian economy. In doing so we introduce government tax-policy as an exogenous variable in private employment and private investment calculus. Indeed, with changes in political coalitions and the economic situation, government can fine-tune the tax expenditures legislation.

This section first specifies an investment and employment function for the Belgian economy. The regression results are discussed in the subsequent section.

##### 4.1 Specification of the regression model.

We specify the following reduced form equations for private investment and private employment<sup>1</sup>.

$$\ln\left(\frac{I}{K}\right) = \alpha + \beta_1 \ln\left(\frac{I}{K}\right)_{-1} + \beta_2 \ln\left(\frac{P^i}{P}\right) + \beta_3 \ln\left(\frac{w}{P}\right) + \beta_4 \ln\left(\frac{P^m}{P}\right) + \beta_5 \ln\left(\frac{P^f}{P}\right) + \beta_6 \ln\left(\frac{Y}{P}\right) + \beta_7 \ln r + \beta_8 \ln \tau + \beta_9 CD + \varepsilon$$

and

$$\ln\left(\frac{L}{K}\right) = \gamma + \delta_1 \ln\left(\frac{L}{K}\right)_{-1} + \delta_2 \ln\left(\frac{I}{K}\right) + \delta_3 \ln\left(\frac{w}{P}\right) + \delta_4 \ln\left(\frac{P^m}{P}\right) + \delta_5 \ln\left(\frac{P^f}{P}\right) + \delta_6 \ln\left(\frac{Y}{P}\right) + \delta_7 \ln r + \delta_8 \ln \tau + \delta_9 CD + \eta$$

where            I    =    Gross private investment  
                   L    =    Private employment

<sup>1</sup> These investment and employment equations are based on an adjustment cost model. See G. Gianelli (1988).

|        |   |  |
|--------|---|--|
| $K$    | = | Capital stock of the private sector  |
| $p^i$  | = | Price of the private investment goods  |
| $P$    | = | Output price of the private sector   |
| $w$    | = | Labour cost per employee in the private sector, including social security premiums paid by the employer. |
| $p^m$  | = | Import price of raw materials  |
| $p^f$  | = | Price of a competitive good abroad   |
| $Y$    | = | Final output of the private sector   |
| $r$    | = | long term interest rate  |
| $\tau$ | = | Effective corporate tax rate   |
| $CD$   | = | Dummy variable for the Cooreman-De Clerq legislation ( $CD = 1$ for 1982 and 1983, zero elsewhere).      |

In this model, the growth of the capital stock of the private sector is explained by the growth in the previous period  $(I/K)_{-1}$ , the real investment prices  $(P^i/P)$ , the real wage rate  $(w/P)$ , the real import prices  $(P^m/P)$ , the real final output  $(Y/P)$  the long term interest rate  $(r)$  and two "new" variables : the effective corporate tax rate  $(\tau)$  and the dummy variable  $(CD)$  for the years in which the Cooreman-Declerq law was in operation.

Similarly, an employment function is specified with analogous explanatory variables.

#### 4.2 *Econometric results*

The model specified in section 4.1. was estimated by OLS on yearly data from 1963 to 1987, using the standard procedure for missing data in the TSP-software. The "best" fit is as follows :



$$\begin{aligned}
\ln\left(\frac{I}{K}\right) &= -98,36 + 0,97 \ln\left(\frac{p^i}{p}\right)_{-1} \\
&\quad (-4,31) \quad (1,81) \\
&\quad - 2,56 \ln\left(\frac{w}{p}\right)_{-1} + 13,82 \ln\left(\frac{p^m}{p}\right)_{-1} - 7,55 \ln\left(\frac{p^f}{p}\right) \\
&\quad (-2,42) \quad (4,52) \quad (-3,95) \\
&\quad + 4,51 \ln\left(\frac{y}{p}\right)_{-1} - 0,14 \ln r_{-1} \\
&\quad (3,28) \quad (-3,51) \\
&\quad - 1,03 \ln \tau + 0,23 \text{ CD} \quad \bar{R}^2 = 0,79 \\
&\quad (-3,09) \quad (1,39)
\end{aligned}$$

The effect of the two tax policy variables is as we expected. The effective corporate tax rate has a significant negative impact on investment behaviour, whereas the law Cooreman - De Clercq has a positive but insignificant effect on investments.

The results for the private employment function are as follows :

$$\begin{aligned}
\ln\left(\frac{L}{K}\right) &= -0,95 + 0,86 \ln\left(\frac{L}{K}\right)_{-1} - 0,06 \ln\left(\frac{I}{K}\right)_{-1} \\
&\quad (-1,69) \quad (22,13) \quad (-7,89) \\
&\quad - 0,29 \ln\left(\frac{w}{p}\right)_{-1} + 0,13 \ln\left(\frac{p^f}{p}\right) \\
&\quad (-5,80) \quad (8,15) \\
&\quad + 0,24 \ln\left(\frac{Y}{p}\right)_{-1} - 0,008 \ln r_{-1} \\
&\quad (4,61) \quad (-5,87) \\
&\quad + 0,05 \ln \tau + 0,01 \text{ CD} \quad \bar{R}^2 = 0,99 \\
&\quad (3,34) \quad (2,07)
\end{aligned}$$

The effective corporate tax rate is significantly positive. We also measure a slight positive effect of the Cooreman - De Clercq legislation on employment : this was a rather unexpected finding.

## 5. An optimal dynamic model of the firm with corporate tax measures.

Recently, models of optimal dynamic corporate taxation have been derived (see R. Gradus (1989)). There, it is assumed that the government could maximize a representative consumer's utility function and that, o.a., the government's optimal corporate tax rate is determined accordingly. On the other side, firms are assumed to maximize the discounted stream of net cash flows with respect to investment and labour.

In this paper, only the firm's optimal decision problem will be considered, but, as explained before, with 3 different types of corporate taxation, i.e., taking account of the general rate  $\tau$  of corporate taxation, the rate  $\eta$  of investment tax credit, i.e., that part of net investments which is exempted from taxation, and the rate  $\omega$  of investment subsidies. In a subsequent paper, a dynamic game between the (representative) firm and the government will be formulated.

Firms are assumed to decide on their demands for investment and labour, which are conditional on their expectations, present and future corporate tax rates, credit tax rates for investment and rates of subsidies for investment and present and future interest rates, prices and wage rates, by maximizing the discounted stream of net cash flows of a representative firm over an infinite time horizon (see for simplified examples of firm objectives : Th. van de Klundert and P. Peters (1986, p. 38), F. van der Ploeg (1987, p. 1467), and R. Gradus (1989, p.3)). Assuming that the Modigliani-Miller theorem holds, implying that there does not exist any distinctive price discriminatory behaviour between debt and equity capital (see J. Plasmans and

J. Vanneste (1990) for a relaxation of this hypothesis), the entrepreneurial model is<sup>1</sup> :

$$\max_{I, L} \lim_{T \rightarrow \infty} \int_0^T e^{-\int_0^t r(\theta) d\theta} \{ [Y(t) - \frac{w(t)}{p(t)} (L(t) + \phi_1(L(t))) - \delta(t)K(t)] (1-\tau(t)) + \eta(t)\tau(t) K(t) - (1-\omega(t) (I(t)) + \phi_2(I(t))) \} dt \quad (1)$$

subject to the entrepreneurial production function :

$$Y(t) = F(L(t), K(t)) \quad (2)$$

and the entrepreneurial capital stock accumulation equation :

$$K(t) = I(t) - \delta(t) K(t) , K(0) = K_0 \quad (3)$$

where

- Y(t) denotes the level of the entrepreneurial output at moment t,  
 I(t) denotes the rate of gross investment at moment t,  
 K(t) denotes the level of the entrepreneurial capital stock at moment t,  
 L(t) denotes the number of employed workers at moment t,  
 w(t) denotes the nominal wage rate at moment t, p(t) the price of output at moment t and r(t) the interest rate at moment t ; these three prices are given for the complete time path (0, T) ;  
 τ(t) denotes the corporate tax rate (or direct profit tax rate) at moment t ;

<sup>1</sup> Following A. Abel and O. Blanchard (1983, p. 684), we assume that investment grants are proportional to (total) investment spending, including adjustment costs of changes in the capital stock. At the end of this section we devote a small footnote to the case when investment grants are proportional to investment purchases only.

- $\eta(t)$  the rate of investment tax credit, i.e., that part of net investments which is exempted from taxation;
- $\omega(t)$  the rate of investment subsidies (for employment)
- $\delta(t)$  the rate of depreciation at time  $t$
- $\varphi_1(L(t))$  a strictly convex labour adjustment cost function with  $\varphi_1(0) = 0$ ,  $\varphi_1' > 0$  and  $\varphi_1'' > 0$ , i.e., this adjustment cost function implies that internal labour adjustment costs increase and are zero only if labour input is zero and
- $\varphi_2(I(t))$  is a strictly convex internal adjustment cost function for capital stock changes with  $\varphi_2(0) = 0$ ,  $\text{sign}(\varphi_2') = \text{sign}(I(t))$  and  $\varphi_2'' > 0$ .

Denoting the discount factor :

$$e^{-\int_0^t r(\theta) d\theta}$$

being the rate at which output at time  $t$  can be traded for output at time zero, by  $\rho(t)$ , necessary conditions for the solution of the representative firm's optimal control problem (1 - 3) are derived according to Pontryagin's maximum principle from the unconstrained maximization of the corresponding Hamiltonian  $H(t)$  with respect to the decision variables  $L(t)$  and  $I(t)$ .

Substituting production function (2) into the objective functional (1), we get as Hamiltonian :

$$\begin{aligned}
 H(t) := & \rho(t) \left\{ [F(L(t), K(t)) - \frac{w(t)}{p(t)} (L(t) + \varphi_1(L(t))) - \delta(t) K(t)] \right. \\
 & \left. (1 - \tau(t)) + \eta(t)\tau(t)I(t) - \tau(t)\eta(t)\delta(t)K(t) - (1 - \omega(t))(I(t) + \varphi_2(I(t))) \right\} \\
 & + \lambda(t)(I(t) - \delta(t) K(t))
 \end{aligned} \tag{4}$$

with  $\lambda(t)$  the costate variable, associated with the capital stock accumulation equation, which denotes the (discounted) shadow asset price of capital (stock), representing the discounted value of all future investments in (real) cash flow associated with an increment in investment at time  $t$ . The necessary conditions for an optimal pair  $(L(t), I(t))$  satisfy :

$$\frac{\partial H(t)}{\partial K(t)} \Big|_{\text{opt.}} = \rho(t) \left\{ \left[ \frac{\partial F}{\partial K} \Big|_{\substack{K=K(t) \\ L=L(t)}} - \delta(t) \right] (1-\tau(t)) - \tau(t)\eta(t)\delta(t) \right\} -$$

$$\lambda(t)\delta(t) = -\lambda(t) \quad (5)$$

(Euler-Lagrange condition)

$$\frac{\partial H(t)}{\partial L(t)} \Big|_{\text{opt.}} = \rho(t) \left\{ \left[ \frac{\partial F}{\partial L} \Big|_{\substack{L=L(t) \\ K=K(t)}} - \frac{w(t)}{p(t)} (1 + \phi_1'(L(t)))(1-\tau(t)) \right] \right\} = 0 \quad (6)$$

$$\frac{\partial H(t)}{\partial I(t)} \Big|_{\text{opt.}} = \rho(t) \left\{ \eta(t)\tau(t) - (1-\omega(t)) (1 + \phi_2'(I(t))) \right\} + \lambda(t) = 0 \quad (7)$$

$$\lim_{T \rightarrow \infty} \lambda(T) K(T) = 0 \quad (\text{transversality condition}) \quad (8)$$

Writing the optimal discounted shadow asset price  $\lambda(t)$  of capital stock as :

$$\lambda(t) := \rho(t) q(t) = e^{-\int_0^t r(\theta) d\theta} q(t) , \quad (9)$$

with  $q(t)$  the optimal current (i.e., undiscounted) shadow asset (or acquisition) price of capital stock. Hence, the optimal discounted loss that would be incurred if the acquisition of a unit of capital stock were postponed for a short time amounts from the Euler-Lagrange condition (5) and equality (9) to :

$$\begin{aligned}
-\lambda(t) &= r(t) e^{-\int_0^t r(\theta) d\theta} q(t) - e^{-\int_0^t r(\theta) d\theta} q(t) = \rho(t) (r(t) q(t) - \dot{q}(t)) \\
&= \rho(t) \left\{ \left[ \frac{\partial F}{\partial K} \Big|_{K=K(t)} - \delta(t) \right] (1-\tau(t)) - \tau(t)\eta(t)\delta(t) - q(t)\delta(t) \right\}, \quad (10) \\
&\quad L=L(t)
\end{aligned}$$

so that the optimal current "gains"  $q(t)$  (i.e., the optimal rate at which a unit of capital is appreciating), satisfy :

$$\dot{q}(t) = (r(t) + \delta(t)) q(t) + \delta(t) (1 - \tau(t) + \tau(t)\eta(t)) - \frac{\partial F}{\partial K} \Big|_{K=K(t)} (1 - \tau(t)), \quad (11)$$

Moreover, it is directly verified that the optimal marginal productivity of labour in (6) satisfies :

$$\frac{\partial F}{\partial L} \Big|_{\substack{L=L(t) \\ K=K(t)}} = \frac{w(t)}{p(t)} (1 + \phi_1'(L(t))) (1 - \tau(t)), \quad (12)$$

and that from the necessary condition (7), and relationship (9), the optimal shadow asset price of capital stock equals the non-exempted part of the "augmented" marginal adjustment costs of capital stock :

$$q(t) = -\eta(t) \tau(t) + (1 - \omega(t)) (1 + \phi_2'(I(t))). \quad (13)$$

Since the optimal current shadow asset price of capital stock can be interpreted as the (relative) price of acquisition (or installation) of one unit of capital goods, it can be viewed as being the optimal marginal return on investment. Hence, it appears from (13) that, at the optimum, the demand price of investment (i.e., the marginal return) equals the supply price of investment (the marginal cost).

Finally, combining (8) and (9), the transversality condition becomes :

$$\lim_{T \rightarrow \infty} \rho(T) q(T) K(T) = 0 \quad , \quad (14)$$

so that the terminal condition on the optimal discounted shadow asset price of capital (stock) is such that, for example, for a constant optimal shadow asset price  $q(t) = q$ , a constant rate of growth of optimal capital stock and a constant subjective rate of discount  $r > 0$ , the latter being equal to the long run steady state interest rate, this interest rate must exceed the rate of growth of optimal capital stock.

Summarizing, the relationships (11-14), together with production function (2), form the necessary conditions for the representative firm's optimal control problem. According to (13), the optimal investment demand depends on the optimal (real) shadow asset price of capital stock  $q(t)$  and on the three tax rates studied, or

$$I(t) = \phi_2^{-1} \left( \frac{q(t) + \eta(t)\tau(t)}{(1-\omega(t))} - 1 \right) =: \Phi(q(t), \tau(t), \eta(t), \omega(t)) \quad , \quad (15)$$

which is a "quasi-reduced form expression", satisfying,

according to the inverse function theorem :

$$\frac{\partial \Phi}{\partial q(t)} \Big|_{q(t)=q(t)} > 0, \quad \frac{\partial \Phi}{\partial \eta(t)} > 0, \quad \frac{\partial \Phi}{\partial \omega(t)} > 0, \quad \Phi(1,0,0,0) = 0,$$

$$\text{but } \frac{\partial \Phi}{\partial \tau(t)} > 0.$$

Considering a quadratic internal adjustment cost function



$$\Phi_2(I(t)) = b I^2(t), b > 0, \quad (16)$$

(15) can be evaluated as :

$$I(t) = \frac{1}{2b} \left( \frac{q(t) + \eta(t)\tau(t)}{(1-\omega(t))} - 1 \right) \quad (17)$$

Using  $p_1(t)(r(t) + \delta(t))$  as a measure for the user's cost of capital, i.e., as a measure for the shadow price of capital assets  $q(t)$ , we may average this term over the sample period and use it for  $q$  ( $q = 0.09$ ). Furthermore,  $\tau$  is computed to be 0.37,  $\eta = 0.13$  and  $\omega = 0.03$ .

We remark that optimal investment is strongly dependent on variations in  $b$  and  $\eta$ , weaker on variations in  $\tau$  and very weakly on variations in  $\omega$ .

Now, we may consider various specifications for the production function (2).

i) If it is assumed that  $F(L(t), K(t))$  is a Cobb-Douglas (CD-) production function, then from the marginal productivity of labour (12) :

$$\frac{\partial F}{\partial L} \Big|_{\substack{L=L(t) \\ K=K(t)}} = A\alpha L(t)^{\alpha-1} K(t)^\beta = \frac{w(t)}{p(t)} \left( 1 + \Phi_1'(L(t)) \right) (1-\tau(t)), \quad (18)$$

so that under constant returns to scale ( $\beta := 1-\alpha$ ), absence of labour adjustment costs ( $\Phi_1(L) = 0$ ), a constant corporate tax rate and a constant real wage rate, the (optimal) labour input is proportional to the (optimal) capital stock :

$$L(t) = \left( \frac{A\alpha}{\frac{w}{p}(1-\tau)} \right)^{\frac{1}{1-\alpha}} K(t) = \gamma K(t), \quad (\gamma > 0) ; \quad (19)$$

hence, in this case the marginal productivity of capital stock is seen to remain constant too :

$$\frac{\partial F(L,K)}{\partial K} \Big|_{\substack{K=K(t) \\ L=L(t)}} = A(1-\alpha) L(t)^\alpha K(t)^{-\alpha} = A(1-\alpha) \gamma^\alpha =: a, a > 0 \quad (20)$$

so that the necessary condition (11) becomes :

$$q(t) = (r(t) + \delta(t)) q(t) + \delta(t) (1 - \tau + \tau \eta(t)) - a(1 - \tau) \quad (21)$$

The steady-state investment level is just sufficient to provide for depreciation, or from the capital stock accumulation equation with constant, exponential depreciation rate :

$$I^* = \delta K^*, \quad (22)$$

or, for constant tax rates, the steady-state shadow price of capital assets satisfies from (13):

$$q^* = -\eta \tau + (1 - \omega) (1 + \phi_2 (\delta K^*)), \quad (23)$$

so that the steady-state shadow price of a unit of capital goods equals the net costs of purchasing investment goods plus the (net) marginal costs of adjusting the capital stock plus the non-taxed part of the capital exemption function. Necessary condition (21) becomes under steady-state for constant tax rates, constant interest rates, constant prices and wages and an exponential depreciation :

$$0 = (r + \delta) q^* + \delta (1 - \tau + \tau \eta) - a(1 - \tau), \quad (24)$$

or the steady-state capital stock follows from (22-23) (see also (15)) :

$$K^* = \frac{1}{\delta} I^* = \frac{1}{\delta} \phi_2^{-1} \left( \frac{\frac{a(1-\tau)}{(r+\delta)} - \frac{\delta(1-\tau+\tau\eta)}{(r+\delta)} + \eta\tau}{(1-\omega)} - 1 \right) \quad (25)$$

Hence, the dependency of the steady-state capital stock, and, hence, of the steady-state labour input depends on the magnitude of the tax rates, e.g., if there is no investment tax credit ( $\eta = 0$ ), there will be an opposite relationship between the corporate tax rate and the steady-state capital stock formation if  $a > \delta$ .

In general, if  $\eta > 0$  and under quadratic adjustment costs for capital stock ( $\phi_2 = bI^2$ ,  $b > 0$ ), we derive from (25) that :

$$\frac{\partial K^*}{\partial \tau} = \frac{1}{\delta} \frac{\partial I^*}{\partial \tau} \begin{matrix} < \\ > \end{matrix} 0 \iff a \begin{matrix} > \\ < \end{matrix} \delta(1-\eta) + \eta(r+\delta), \quad (26)$$

so that, in deviations from the steady-state, the marginal productivity of capital should be sufficiently high (under CD-production possibilities) in order to generate a positive effect on private investments through a decrease of the effective corporate tax rate. Otherwise, a perverse relationship occurs.

Furthermore, as could be expected,

$$\frac{\partial K^*}{\partial \eta} > 0 \quad \text{and} \quad \frac{\partial K^*}{\partial \omega} > 0,$$

so that investment tax credit and investment subsidies stimulate (steady-state) capital stock.<sup>1</sup>

ii) If it is assumed that  $F(L(t), K(t))$  is a CES-production function, then the marginal productivity condition (12) becomes:

$$\frac{\partial F}{\partial L} \Big|_{\substack{L=L(t) \\ K=K(t)}} = v \delta A^{-\rho/v} Q(t)^{\rho+v/v} L(t)^{(\rho+1)} = \frac{w(t)}{p(t)} \left(1 + \phi_1(L(t))\right) (1-\tau(t)) \quad (27)$$

so that under zero labour adjustment costs and constant prices and tax rates the capital stock satisfies under steady-state (see (11) and (21)) :

$$\frac{\partial F}{\partial K} \Big|_{\substack{K=K^*(t) \\ L=L^*(t)}} = v(1-\delta) A^{-\rho/v} Q^*(t)^{\rho+v/v} K^*(t)^{(\rho+1)} = \frac{(r+\delta)q^* + \delta(1-\tau + \tau\eta)}{1-\tau} \quad (28)$$

Substituting (28) into (11), a steady-state level of investment and labour input can be derived, utilizing (27 - 28).

---

<sup>1</sup> Notice that all the marginal tax sensitivities

$$\frac{\partial K^*}{\partial \tau}, \frac{\partial K^*}{\partial \eta}, \frac{\partial K^*}{\partial \omega},$$

remain valid when the rate of the investment subsidies is assumed to be proportional to investment purchases (in real terms) only, i.e., when the last part of the integrand of the entrepreneurial objective functional (1) is changed as :

$$I(t) - \phi_2(I(t)) + \omega(t) I(t) \text{ i.s.o. } - (1-\omega(t)) (I(t) + \phi_2(I(t))).$$

## Conclusion

In this paper various aspects of corporate tax behaviour, principally for the Belgian situation, are discussed.

After an elaboration on the legislative characteristics of the Belgian corporate tax behaviour, the impact of three types of tax variables on private investment and private employment in Belgium is measured. These three types of variables involve : the effective corporate tax rate itself which is found to be considerably lower than the statutory corporate tax rate, the rate of investment tax credit, i.e., that part of net investment which is exempted from taxation, and the rate of (employment) subsidies on investment.

A time series analysis is conducted for measuring the incidence of corporate taxation on private investment and employment in Belgium. By using yearly data from 1963 to 1987 (taking account of four missing data on the corporate tax rate between 1974 and 1977), it is found that effective corporate tax rate increases have significantly decreasing effects on effective private investment and significantly increasing effects on Belgian private employment.

In the last section an optimal dynamic model of the firm with corporate tax measures is derived under the Modigliani-Miller hypothesis of perfect capital markets. Under Cobb-Douglas production possibilities, this analysis leads to a surprising paradox, i.e., that corporate tax rate increases have (only) stimulating effect on (steady-state) private investments if and only if the marginal productivity of capital is sufficiently high. The critical value depends on the depreciation rate, the interest rate and the rate of investment tax credit. When there is no investment tax credit, a stimulating effect of corporate tax rate decreases emerges if and only if the marginal productivity of capital stock is larger than the depreciation rate.

## References

- Abel, A.B. and O.J. Blanchard** (1983), "An Intertemporal Model of Saving and Investment", Econometrica, vol. 51, pp. 675-692
- Gianelli, G.** (1988), Labour Demand, Pricing and Investment Decisions in Italy, An Econometric Analysis, European University Florence, Working Paper N° 88/352
- Gradus, R.** (1989) Optimal Dynamic Taxation, Saving and Investment, FEW-Research Memorandum, n° 400, University of Tilburg.
- Plasmans, J. and J. Vanneste** (1990), Corporate Taxation and its Incidence on Employment and Investment in Belgium, Discussion Paper, Univ. of Antwerp, UFSIA.
- van de Klundert th. and P. Peters** (1986), "Tax Incidence in a model with perfect foresight of agents and Rationing in Markets ; Journal of Public Economics, vol. 30, pp. 37-59.
- van der Ploeg, F.** (1987), Trade Unions, Investment, and Employment. A noncooperative Approach", European Economic Review, vol. 31, pp. 1465 - 1492.

## LIJST VAN RECENTE SESO-RAPPORTEN

DE BORGER B., Estimating a multiple output generalized Box-Cox cost function : cost structure and productivity growth in Belgian railroad operations, 1950-1986, October 1989, 39 blz. (89/239)

DE GRAEVE D. en G. CARRIN, Costs, benefits and effects on prescribing of a drug information campaign, an experiment with respect to benzodiazepines, November 1989, 35 blz. (89/240)

DE BORGER B., Output aggregation and estimates of railroad technology and productivity growth : Belgian railroads 1950-1986, December 1989, 33 blz. (89/241)

HEYLEN F. and P. VERHULST, The Phillips curve slope and the cost of disinflation in the 1980s - An institutional account of differences among OECD countries, February 1990, 33 blz. (90/242)

TORMANS G., CARRIN G., CLARA R., EYLENBOSCH W. en P. VAN DAMME, Cost-effectiveness analysis of prenatal screening and vaccination against hepatitis B virus - the case of Belgium, April 1990, 37 blz. (90/243)

DE GRAEVE D., Economische evaluatie van in-vitro fertilisatie, augustus 1990, 32 blz. (90/244)

TORMANS G., CARRIN G., LAUWERS P. en L. MARTENS, The costs of coronary heart diseases, August 1990, 53 blz. (90/245)

DE BORGER B., KERSTENS K., MOESEN W. en J. VANNESTE, Efficiency and equity in block grant design : simulating some alternatives for Flemish municipalities, August 1990, 35 blz. (90/246)

DE BRABANDER G. en E. GIJSBRECHTS, City marketing, van promotie tot plan ? een verkennend overzicht van een nieuw gebied, augustus 1990, 38 blz. (90/247)

VAN POECK A. en J. VAN GOMPEL, Unemployment and wage formation in small industrial countries (1973-1989), September 1990, 44 blz. (90/248)

DE BORGER B., The economic environment and public enterprise behavior : Belgian railroads 1950-1986, October 1990, 44 blz. (90/249)

KESENNE S., A guaranteed basic income as a cultural policy, October 1990, 12 blz. (90/250)

VANNESTE J. en W. MOESEN, De gemeentefinanciën in Vlaanderen : verkenning en verklaringen, oktober 1990, 47 blz. (90/251)

HENDRICKX K., Sectoriële bronnen voor produktiviteitsmeting : Definities, classificaties en methodologie, december 1990, 122 blz. (90/252)