

Mignolet, Michel; Eyckmans, Nathalie; Meunier, Olivier

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Location, investment and regional policy: the contribution of the average effective tax rate theory^{*}

Nathalie EYCKMANS
Olivier MEUNIER
Michel MIGNOLET^{}**

Centre de Recherches sur l'Economie Wallonne (CREW),
University of Namur,
8 Rempart de la Vierge,
B-5000 Namur, Belgium.

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ABSTRACT

For decades, most industrialised countries have implemented some forms of fiscal and financial incentives to stimulate fixed capital formation. Tax cuts and capital grants are of great use in regional policy. Since these instruments mobilise huge amounts of public resources the issue of their efficiency is of particular interest for policymakers.

The impact of taxation on investment income was traditionally apprehended through models measuring the effective tax rate on marginal investments. However recent literature, especially Devereux and Griffith (2002), showed the interest of resorting to an alternative tax measure – the effective average tax rate (EATR) - when firms face discrete investment choices that are expected to generate positive economic rent before tax. This effective average tax rate is defined by the difference between the net present value of the rent of the investment before and after taxes scaled by the net present value of the pre-tax income stream. In this sense, the effective average tax rate developed by

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^{**} Nathalie.Eyckmans@fundp.ac.be; Olivier.Meunier@fundp.ac.be; Michel.Mignolet@fundp.ac.be.

Devereux and Griffith (2002) seems to be particularly relevant to shed a new light on the relative effectiveness of tax cuts and capital subsidy grants.

In this paper we intend to compare the costs for public authorities to lower the corporate tax rate or to grant a capital subsidy. These public costs are directly affected by the variation of the after-tax revenue earned by the shareholder. The extent to which each policy must be implemented depends on the channel chosen by the government to stimulate investment. We pay attention to two of these channels: a reduction of the capital cost and a lowering of the EATR. Finally, in order to illustrate the relevance of our approach, we developed a numerical example for the Belgian case.

JEL Classification: H25, H32 and R58

1. Introduction

Economic development is uneven over space. Regions are characterised by performance disparities in factor productivity: some regions are ahead, whereas others lag behind. This discrepancy gives rise to unbalanced patterns of economic growth, with firms deserting underproductive areas to locate in more productive regions. This grounds a regional policy aimed at achieving a better geographical distribution of economic activities. Indeed, as Thisse (2000) points out, most regional policy debates in industrialised countries implicitly assume that there is too much spatial concentration in economic activity. Moreover the cumulative nature of agglomeration economies still reinforces the need for some public intervention. Conversely, the efficiency of regional policy remains a much debated issue.

By and large, the government will seek to promote investments in lagging regions by decreasing the costs of production factor. Such a policy is expected to affect regional economies in a double way: on the one hand, public intervention might strengthen indigenous growth by expanding local firms' investment demand. On the other hand, it might improve the attractiveness of lagging regions so to induce non-regional firms to relocate their activities there. The former case refers to the so-called investment creation effect, whereas the second is related to the investment diversion argument. The government may be sensitive to one or the other argument when it formulates its

regional policy mix so that the effectiveness of public aid will accordingly vary. In this paper, we intend to assess the regional policy efficiency first when the government aims at expanding local firms' investment demand and then when it seeks to act on firms' location decisions. In this preliminary version, we only consider a domestic framework, leaving aside international analysis for a latter stage.

To achieve their objectives, regional policymakers have numerous instruments at their disposal. We have chosen to restrict the analyse to the direct fiscal and financial investment incentives, so neglecting public expenditures in infrastructure. More precisely, we will concentrate on two broad categories of aid: a corporate tax cut and the granting of a capital subsidy.

Models of effective taxation have proved to be an appropriate framework to assess the impact of fiscal and financial incentives on firm's investment decisions. Traditionally, these models evaluate the effect of public policy on the cost of capital and the marginal investment. Grounded on the seminal work of King and Fullerton (1984), this approach provides an indicator – the effective marginal tax rate (EMTR) – of the distortion of tax system on the marginal investment decisions of the firm. However recent literature, especially Devereux and Griffith (2003), showed the interest of resorting to an alternative tax measure – the effective average tax rate (EATR) – when firms face discrete investment choices that are expected to generate a positive economic rent before tax. In this respect, as regional markets are by nature imperfectly competitive, the EATR model provides certainly a valuable tool for spatial economics analysis. In addition, as emphasized by Giannini and Maggiulli (2002), it has the advantage of allowing the computation of both effective marginal and average tax rates within a single framework.

Nevertheless, the average approach does not make the marginal analysis obsolete. Both approaches are complementary. Indeed as explained by Devereux and Griffith (2003), conditional on the choice of location, the size of the investment depends on the EMTR, but the choice of location depends on the level of the EATR. In this respect, the government willing to promote regional endogenous economic development will assess regional policy according to its impact on the EMTR. If the authorities are more sensitive to the investment diversion risk, they will rather seek to lower the EATR. The

extent and consequently the efficacy of public incentives therefore depend upon the policymakers' objectives.

However in order to compare policies whose effects are rather different in kind and are costly in various ways, the efficacy of public incentives alone does not constitute an appropriate indicator for policy makers. Public authorities would instead consider the efficiency of their intervention, that is, for a given level of efficacy, the extent of public expenses associated with the granting of fiscal and financial incentives. Intuitively, the cost for the public sector corresponds to the fiscal revenue forgone due to policy-induced reduction of the effective tax rate. Using Devereux and Griffith (2003)'s framework, we derive the public cost expressions by measuring the sensitivity of the post-tax economic rent to the variation of the public aid.

The layout of this paper is as follows. Section 2 displays Devereux and Griffith (2003)'s theoretical framework. The effective average tax rate is defined by the difference between the net present value of the rent of the investment before and after tax scaled by the net present value of the pre-tax income stream. The post-tax economic rent is the key parameter in Devereux and Griffith (2003)'s model. By calculating the sensitivity of this parameter to the policy instruments, Section 3 derives the public cost associated with the granting of a tax cut and a capital subsidy. Section 3 also investigates how to determine the extent of both incentives first when the government is willing to encourage investment from indigenous regional entrepreneurs and on the other hand when it seeks to attract non-regional firms' activities. Accordingly, the extent of the tax rate and capital grant changes are calculated so that each instrument lowers by the same percentage the EMTR and the EATR, respectively. In Section 4, a numerical example is developed in order to illustrate our approach and its relevance. Section 5 concludes.

2. The model of Devereux and Griffith (1999 and 2003)

The extent to which a tax on income from capital affects the firms' behaviour has been traditionally analysed through neo-classical models. In these models, firms will invest up to equalise the marginal productivity and the marginal cost of capital. The

mainstream of the economic literature focuses on marginal investments. A marginal investment yields a rate of return after tax that is just sufficient to persuade investors to make the initial outlay. This rate of return (also called the cost of capital¹) and the effective marginal tax rate (EMTR) that is a derived indicator enable to measure the impact of taxation and public incentives on investment decision. King and Fullerton (1984) define the EMTR as the ratio of the tax wedge on the capital cost². The tax wedge is the difference between the pre-tax rate of return earned by the firm on the marginal investment and the post-tax rate of return earned by the supplier of funds.

The capital cost and the marginal effective tax rate prove to be appropriate indicators to determine the optimal level of investment. This question requires indeed an approach in terms of marginal calculation. Conversely, a location decision has to discriminate between some discrete choices that are mutually exclusive. In the presence of economies of scale or imperfect competition, the various options may yield different levels of economic rent i.e. some rates of return that are above the minimum required after-tax rate of return. As some recent contributions pointed out, especially Devereux & Griffith (1998, 1999 and 2003), such a matter calls for an approach in terms of effective average tax rate (EATR)³.

The EATR sets out to apprehend the total tax burden that is actually paid by the firm and its shareholders. It is defined by expression (1) that is the ratio of two terms. The numerator measures the difference between the net present value of the economic rent before tax, R^* , earned by the investment and its equivalent after tax, R . The denominator expresses the net present value of the pre-tax total income stream, Y^* :

$$EATR = \frac{R^* - R}{Y^*} \quad (1)$$

The model developed by Devereux & Griffith (2003) is based on the calculation of the value of the firm. It considers a one-period perturbation of the capital stock. Investment is up one unit in period t and reduced in period $t+1$ so that the capital stock is left

¹ For pioneering developments, see Jorgenson (1963) or Hall and Jorgenson (1967).

² See also Alworth (1988), OECD (1991) or Ruding (1992) for international settings.

³ See also EEC (2001).

unchanged in any other periods. This investment generates a real financial return, p , in period $t+1$.

Therefore, if we denote the real market interest rate as r , the net present value of the pre-tax economic rent R^* is equal to:

$$R^* = \frac{p - r}{(1 + r)} \quad (2)$$

The discounted value of the pre-tax total income stream, net of depreciation, Y^* , is computed as:

$$Y^* = \frac{p}{(1 + r)} \quad (3)$$

The net present value of the post-tax economic rent, R , is the key parameter in Devereux and Griffith (1999)'s approach. It captures in a summary statistics the major features of the tax system, including the investment subsidy, which might affect the decision of the firm, as well as the economic parameters, such as the economic depreciation rate, the real financial return of the investment or the inflation rate. Moreover, it is defined in different terms depending on the financing choice. Devereux and Griffith (2003) show that the value of the post-tax economic rent can be broken up into two terms, depending on whether the investment is financed by retained earnings or by raising external funds (loan or issue of new shares). The external finance generates additional cash flows which come in addition to the rent associated with a financing by undistributed profits. Accordingly, the post-tax economic rent R can be expressed as :

$$R = R^{RE} + F \quad (4)$$

where R^{RE} is the after-tax rent for a financing by retained earnings and F stands for the additional cash flows arising from the use of external finance. The change in the firm's market value that is induced by the one-period variation of the capital stock provides Devereux and Griffith (1999) with the following expression of the post-tax economic rent, when the investment is financed by retained earnings:

$$R^{RE} = -\gamma(1-A) + \frac{\gamma}{1+\rho} [(1+\pi)(p+\delta)(1-\tau) + (1+\pi)(1-\delta)(1-A)] \quad (5)$$

In expression (5), γ is the tax discrimination between new equity and distributions. In analytical terms, γ is equal to $(1-m^d)/(1-c)(1-z)$ where m^d is the personal tax rate on dividend income, c is the rate of tax credit on dividend paid and z denotes the capital gain tax. The variable ρ denotes the shareholder's nominal discount rate with $\rho = (1-m^i)i/(1-z)$ where m^i is the personal tax rate on interest income. δ is the one-period cost of depreciation of the asset; π measures the expected inflation rate, τ is the corporate tax rate and A expresses the discounted value of any public allowances.

Effective tax models traditionally distinguish three main categories of public incentives: standard depreciation allowances, immediate expensing or free tax depreciation and capital grants. The present value of public allowances per unit of investment can be therefore expressed as $A = \tau A_d + \phi\tau + g$. The term $A_d\tau$ is the present value of tax savings from depreciation allowances; ϕ expresses the proportion of investment expenditure which is entitled to immediate expensing and g is the rate of capital grant.

What is the meaning of R^{RE} ? The firm finances the investment by reducing dividends in the first period (period t). This operation is thereafter offset in period $t+1$ by a corresponding increase of distributed dividends. In time t , the cost of the investment in net present value amounts to $(1-A)$. In period $t+1$, the additional dividend is accordingly equal to $(1-A)(1+\pi)(1-\delta)$. The after-corporate-tax nominal return of the investment in period $t+1$ is equal to $(p+\delta)(1+\pi)(1-\tau)$. The revenue generated in period $t+1$ is then taxed at the rate γ , which reflects the various aspects of the personal taxation. Finally, it is discounted at ρ , the shareholder's nominal discount rate.

The financing of the investment by an issue of new equity or by debt generates additional cash flows, F , that affect the post-tax net present value of the economic rent. In the case of new equity finance, the shareholder's contribution rises by $(1-\phi\tau-g)$, i.e. the cost of the investment reduced by the immediate tax rebate and the investment subsidy. In period $t+1$, the firm repurchases the new shares, generating an increased net

income equal to $\gamma(1-\phi\tau-g)$. The expression of additional cash flows when the investment is financed by new equity is therefore written as follows:

$$F^{NE} = -\frac{\rho(1-\gamma)}{(1+\rho)}(1-\phi\tau-g) \quad (6)$$

When the investment is financed by debt, the firm borrows the amount $(1-\phi\tau-g)$ in period t , giving the shareholder an additional income equal to $\gamma(1-\phi\tau-g)$. In the second period, the firm repays the debt with interest, that is $(1-\phi\tau-g)(1+i)$. However, the interest payments are tax deductible, what reduces the financial cost by $(1-\phi\tau-g)i\tau$. Combining this, the additional cash flows in case of debt financing are expressed as:

$$F^D = \frac{\gamma(1-\phi\tau-g)}{(1+\rho)}[\rho-i(1-\tau)] \quad (7)$$

Finally, it is a major advantage of the Devereux and Griffith (2003)'s framework to permit to calculate easily the cost of capital, that is the pre-tax financial rate of return that is required to generate a post-tax economic rent equal to zero. We therefore obtain the following expression for the capital cost, denoted \tilde{p} :

$$\tilde{p} = \frac{(1-A)}{(1-\tau)(1+\pi)}[\rho + \delta(1+\pi) - \pi] - \frac{F(1+\rho)}{\gamma(1-\tau)(1+\pi)} - \delta \quad (8)$$

where F corresponds to F^{NE} or F^D , depending on the source of finance, respectively new equity or debt. When the firm uses retained earnings, F is equal to zero.

Expression (8) of the capital cost is quite similar to the traditional King and Fullerton (1984)'s formulation, except that the net present value (NPV) of depreciation allowances A is calculated using the shareholder's discount rate ρ (instead of the financial cost) and that the immediate tax expensing ($\tau\phi$) plays a role, rather than simply the net present value of allowances.

In section 3, we will use Devereux and Griffith (2003)'s analytical framework to derive the cost for the public authorities to grant investment incentives.

3. Assessing the impact of public policy

By and large, public authorities use both fiscal and financial incentives to directly stimulate capital formation. In this paper we pay attention to two of these incentives that are commonly used in regional policy, i.e. lowering the corporate tax rate and granting a capital subsidy. These two instruments necessarily affect the public treasury. In order to evaluate their relative efficiency, we develop a methodology aimed at measuring the amount of public expenses associated with a lowering of the corporate tax rate and the granting of a capital subsidy.

3.1 The public costs

In Devereux and Griffith (2003)'s analytical framework public policies affect the post-tax economic rent R earned by the shareholder, whereas the pre-tax economic rent R^* principally depends on the real financial return of the investment project, which is exogenous in the model. Accordingly any change of the corporate tax rate or of the capital grant modifies the tax wedge between the pre- and post-tax economic rent. This change in the tax wedge corresponds to the variation of the tax revenue for the government and therefore represents the public cost generating by the policies. However, since the pre-tax economic rent remains constant whatever the policy, the costs for the public authorities to grant a tax cut or a capital grant can be derived from the sensitivity of the NPV of the post-tax economic rent respectively to the corporate tax rate and the rate of capital subsidy. Let us consider first the costs associated with a variation of the tax rate before deriving the costs for the government to grant a capital subsidy.

Table 1 presents the analytical expressions of the public cost generated by a lowering of the corporate tax rate (τ). The cost varies according to the investment financing used by

the firm: retained earnings, new equity or debt. Since we consider the viewpoint of public authorities, the discount rate used is the public opportunity cost, ρ^* .

TABLE 1: Public cost of lowering the corporate tax rate (C_τ)

Retained Earnings	$C_\tau^{RE} = \frac{\partial R_t^{RE}}{\partial \tau} d\tau = \frac{\gamma}{1+\rho^*} \left\{ (A_d + \phi) [\rho^* + \delta(1+\pi) - \pi] - (p + \delta)(1+\pi) \right\} d\tau$
New Equity	$C_t^{NE} = \left(\frac{\partial R_t^{RE}}{\partial \tau} + \frac{\partial F_t^{NE}}{\partial \tau} \right) d\tau = \left\langle \frac{\gamma}{1+\rho^*} \left\{ (A_d + \phi) [\rho^* + \delta(1+\pi) - \pi] - (p + \delta)(1+\pi) \right\} + \frac{\rho^*(1-\gamma)}{1+\rho^*} \phi \right\rangle d\tau$
Debt	$C^D = \left(\frac{\partial R_t^{RE}}{\partial \tau} + \frac{\partial F_t^D}{\partial \tau} \right) d\tau = \frac{\gamma}{1+\rho^*} \left\{ (A_d + \phi) [\rho^* + \delta(1+\pi) - \pi] - (p + \delta)(1+\pi) + (1 - \phi\tau - g)i - \phi[\rho^* - i(1-\tau)] \right\} d\tau$

For the public authorities, the costs incurred in modifying the corporate tax rate by $d\tau$ is determined by the sensitivity of the post-tax economic rent in present value to the corporate tax rate, $\partial R/\partial \tau$. The extent of the tax cut, $d\tau$, will be discussed further.⁴

For all sources of investment finance, the direct effect of lowering the corporate tax rate⁵ is to increase the before-personal tax revenue of the investment. However, this effect is indirectly lessened by a reduction of the tax savings due to immediate expensing as well as to depreciation allowances. The term $\left\{ (A_d + \phi) [\rho^* + \delta(1+\pi) - \pi] - (p + \delta)(1+\pi) \right\} d\tau$ in the expressions above reflects both direct and indirect effects.

When the firm uses external finance, i.e. new equity or debt, additional cash flows (respectively F^{NE} and F^D) modify the economic rent and, therefore, the public costs. For both new equity and debt, a lower corporate tax rate reduces the value of the immediate tax allowance ($\phi\tau$) that can be claimed on the additional cash flows. In case of debt financed investment, this effect is still reinforced by the declining of tax savings due to the deductibility of interests from the tax base $(1-\tau)i$.

Table 2 now shows the analytical expressions of the public cost associated with the granting of a capital subsidy. The capital subsidy is defined net of corporate tax.

⁴ See Table 3.

⁵ That is $d\tau < 0$.

TABLE 2: Public cost of granting a capital subsidy (C_g)

Retained Earnings	$C_g^{RE} = \frac{\partial R_t^{RE}}{\partial g} dg = \frac{\gamma}{1+\rho^*} [\rho^* + \delta(1+\pi) - \pi] dg$
New Equity	$C_g^{NE} = \left(\frac{\partial R_t^{RE}}{\partial g} + \frac{\partial F_t^{NE}}{\partial g} \right) dg = \left\{ \frac{\gamma}{1+\rho^*} [\rho^* + \delta(1+\pi) - \pi] + \frac{\rho^*(1-\gamma)}{1+\rho^*} \right\} dg$
Debt	$C_g^D = \left(\frac{\partial R_t^{RE}}{\partial g} + \frac{\partial F_t^D}{\partial g} \right) dg = \frac{\gamma}{1+\rho^*} \left\{ [\rho^* + \delta(1+\pi) - \pi] - [\rho^* - i(1-\tau)] \right\} dg$

In Table 2, dg stands for the extent of the capital grant. Compared with the former policy, the public cost is here independent of the real financial return, p . The rate of capital subsidy only applies to the value of the investment effectively used by the firm, which is the difference between the investment value in periods t and $t+1$. This is expressed by $1 - [(1-\delta)(1+\pi)/(1+\rho^*)]$. However, since the capital subsidy is granted in the first period, it can be used to finance a proportion of the investment, therefore reducing the amount of external finance the firm has to raise.

In addition to the sensitivity of the NPV of the post-tax economic rent, the public cost associated to a tax cut or the granting of a capital subsidy is determined by the extent of these incentives, respectively noted $d\tau$ and dg . This extent obviously depends on the objective adopted by the government, as well as on the ability of the policy instruments to achieve this objective. This will be discussed now.

3.2 The extent of public incentives

Traditionally, the effectiveness of investment incentives has been apprehended through their impact on the effective marginal tax rate. Some recent works show however that if the EMTR proves to be an appropriate indicator of the level of investment, discrete investment decisions principally depend on the average effective tax rate. So, as pointed out by Giannini and Maggiulli (2002), both average and marginal approaches are important but they serve different purposes: the former captures the effects of taxation on the location decisions (and other discrete choices) while the latter influences the size of investment, once the location decision has been

made. In terms of regional policy, whether it seeks to attract non-local firms' investment projects or rather to expand investment demand of firms already settled in the region, the government will pay attention to the effective average or marginal tax rates, respectively. Both objectives are considered in this contribution. Accordingly the extent of public interventions, expressed by $d\tau$ and dg respectively for lowering the corporate tax rate and granting a capital subsidy, can be analytically apprehended first by the differential of the EMTR ($dEMTR$) and then by the differential of the EATR ($dEATR$). For the sake of simplicity, each investment incentive will be examined separately. The expressions of the differentials and the extent to which each policy has to be implemented are shown in Table 3.

TABLE 3: Calculating the extent of public incentives ($d\tau$ and dg)

	Differential	Extent of the policy
EMTR (marginal approach)	$dEMTR = \frac{\partial EMTR}{\partial \tau} d\tau + \frac{\partial EMTR}{\partial g} dg$	$d\tau = dEMTR \left(\frac{\partial EMTR}{\partial \tau} \right)^{-1}$ $dg = dEMTR \left(\frac{\partial EMTR}{\partial g} \right)^{-1}$
EATR (average approach)	$dEATR = \frac{\partial EATR}{\partial \tau} d\tau + \frac{\partial EATR}{\partial g} dg$	$d\tau = dEATR \left(\frac{\partial EATR}{\partial \tau} \right)^{-1}$ $dg = dEATR \left(\frac{\partial EATR}{\partial g} \right)^{-1}$

A numerical example will help us go further in the analysis.

4. Applications

In order to illustrate the relevance of our approach and to solve the indetermination of the analytical expressions derived in Section 2, we shall consider the following scenario, which captures the main tax devices in force in Belgium. The corporate tax rate (τ) amounts to 33.99% for distributed profits as well as for retained earnings and there is no double tax relief for dividends (the classical system is implemented). The personal tax rates are equal to 15% both for interest (m^i) and dividend income (m^d).

Capital gains are not taxed at the individual level. The pattern allowed for tax depreciation is the straight-line method. We suppose that the life-time of capital is 10 years. We also consider that an immediate tax allowance can be claimed at the rate of 10% (ϕ). Finally, the following parameters are used to characterise the economic environment: the real interest rate (r) and the inflation rate (π) are respectively equal to 6% and 1.5%. The capital depreciation rate (δ) is supposed to be exponential and equal to 20% and the public opportunity cost (ρ^*) is set at 4%.

As already mentioned the cost for the public authorities to grant a tax cut or a capital subsidy depends on two elements. The first one is the sensitivity of the post-tax economic rent to the corporate tax rate and to the rate of the capital subsidy, which are the unit costs of both policies. The second element measures the variation of both public instruments. This variation depends on the variable chosen by the government to stimulate investment, either the EMTR or the EATR. The results will therefore be presented successively according to these channels.

4.1 Lowering the effective marginal tax rate

Table 4 shows the public costs associated with a tax cut and a capital subsidy, when the government aims at lowering the effective marginal tax rate by one point of percentage. We distinguish but the three sources of finance, various real financial returns of the investment.

TABLE 4: Public cost (in cents) associated with a corporate tax cut and a capital subsidy, when the government aims at lowering the EMTR by one point of percentage.

		Investment profitability (p)		
		Cost of capital	20%	40%
Corporate tax cut (C_τ)	Retained Earnings	0.075	0.184	0.355
	New Equity	0.109	0.226	0.437
	Debt	0.008	-0.174	-0.417
Capital subsidy grant (C_g)	Retained Earnings	0.052	0.052	0.052
	New Equity	0.078	0.078	0.078
	Debt	0.029	0.029	0.029

What are the main results? As shown in Table 4, the public cost associated with the granting of a capital subsidy (C_g) is invariant whatever the profitability of the investment is. It only depends on the value of the investment and thus is not affected by the rate of return of the investment. For debt financing, the public cost is equal to 0.029 cent per euro invested. It rises to nearly 0.08 cent for an issue of new shares. An investment financed by retained earnings induces a cost of 0.052 cent per euro of private capital.

On the contrary, the public cost associated with a corporate tax cut (C_τ) varies with the profitability of the investment. This result was expected because the corporate tax rate applies to the total capital income. It is useful to distinguish according to the source of investment financing. For retained earnings and new equity, the higher is the real financial return of the investment, the more expensive is the public policy generated by a lowering of the corporate tax rate. When the investment is financed by debt, the results in Table 4 show an opposite pattern. The cost borne by the public authorities becomes lower as the financial return of the investment increases. Positive for the marginal investment, the public cost becomes even negative as the financial return rises to 20% and 40%, which means that the policy generates an additional fiscal revenue for the government.

How to explain these latter outcomes? Broadly speaking, whatever the source of finance, lowering the corporate tax rate has a direct impact on the firm's tax liability. However, this effect is lessened by the reducing of the tax savings due to immediate

expensing and depreciation allowances. In addition, when the investment is financed by new equity or by debt, other indirect effects occur. By reducing the value of the tax rebate which can be immediately claimed on external finance, the tax cut increases the amount of new equity and debt the firm has to raise. Finally, this negative effect is still reinforced in case of debt financing: it reduces the tax savings due to the deductibility of interests from the tax base. In this respect, it is *a priori* difficult to determine which effect will prevail.

In our scenario, as shown in Table 5, the government willing to reduce by one point of percentage the effective marginal tax rate of an investment financed by retained earnings or new equity has to lower the corporate tax rate by 1.03 or 1.27 point of percentage, respectively. However, in case of debt financing, we observe paradoxical results. The addition of the various indirect effects of a tax change (on immediate expensing, depreciation allowances and deductibility of interests from the tax base) invites the government to rise the corporate tax rate by 1.47 point of percentage. Table 5 shows the extent of the capital grant (dg) and of the corporate tax rate change ($d\tau$) required to reduce the EMTR by one point of percentage.

TABLE 5: Corporate tax rate change and capital subsidy required for a lowering of one point of percentage of the EMTR

	Corporate tax rate change ($d\tau$)	Capital subsidy (dg)
Retained Earnings	- 1.03	+ 0.28
New Equity	- 1.27	+ 0.41
Debt	+ 1.47	+ 0.15

The values for dg and $d\tau$ are expressed in points of percentage.

The same conflicting effects affect the unit cost of changing the corporate tax rate. However, the unit public cost also depends on the financial return of the investment.

Combining the direct and indirect effects of the corporate tax cut on the extent of the policy and on its unit cost, as well as the level of the investment profitability, allows explaining the results shown in Table 4. Especially, for an investment financed by debt and generating a pre-tax financial return equal to 20% or 40%, the increase of the corporate tax rate provides the public authorities with an additional fiscal revenue,

respectively equals to 0.174 and 0.417 cent per euro invested. However, when the investment profitability is close to the cost of capital, the public cost associated with the rise of the corporate tax rate amounts to 0.008 cent per euro invested. In this latter case, the tax base is not large enough so that the additional tax revenue can compensate the increase of the tax allowances value resulting from a higher corporate tax rate.

What is the most efficient investment incentive when the government aims at lowering the effective marginal tax rate? When the investment is financed by retained earnings or by new equity, granting a capital subsidy is the least costly policy. The public cost associated with a tax cut is superior to that of a capital grant and increases with the profitability of the investment. In case of debt financing, the results are quite different: whatever the rate of profit of the investment, raising the corporate tax rate is more efficient than granting a financial subsidy. For the projects, whose profitability is just sufficient and accordingly returns are close to the capital cost, raising the corporate tax rate implies a positive public cost, but this cost rapidly becomes negative as the real financial return of the investment increases. Therefore, *in no case*, our results show that decreasing the corporate tax rate is an efficient approach to expand local investment demand.

4.2 Lowering the effective average tax rate

Alternatively, public authorities can choose to reduce the effective average tax rate in order to attract non-regional firms' activities. As shown by Devereux and Griffith (2003), discrete investment choices do depend on the level of the average effective taxation, while the effective marginal tax rate is expected only to affect the size of the project. Table 5 shows respectively the public cost associated with a corporate tax cut and with a capital subsidy. Both incentives are granted in order to lower the effective average tax rate by one point of percentage. We still consider three sources of finance (retained earnings, new equity and debt) and various real financial returns of the investment.

TABLE 6: Public cost (in cents) associated with a corporate tax rate cut and a capital subsidy, for a lowering of one point of percentage of the effective average tax rate

		Investment profitability (p)		
		Cost of capital	20%	40%
Corporate tax cut (C_τ)	Retained Earnings	0.090	0.213	0.406
	New Equity	0.106	0.213	0.406
	Debt	0.013	0.220	0.407
Capital subsidy grant (C_g)	Retained Earnings	0.063	0.174	0.349
	New Equity	0.076	0.172	0.344
	Debt	0.049	0.193	0.386

As shown in Table 6, whatever the source of finance, public costs associated with a corporate tax cut and with a capital subsidy rise as the profitability of the investment increases. These results significantly differ from the public costs presented in Table 4.

How to explain these differences? As mentioned the public costs are composed of two elements: the unit cost and the extent of the measures. The former, which corresponds to the sensibility of the post-tax economic rent, is invariant whether the policymakers seek to lower the EMTR or rather the EATR. Conversely the extent of public intervention does depend on the variable chosen by the government to stimulate investment. Table 7 shows the extent of public incentive ($d\tau$ and dg) required to reduce the EATR by one point of percentage.

TABLE 7: Public policies that are required to lower the effective average tax rate of one point of percentage

		Investment profitability (p)		
		Cost of capital	20%	40%
Corporate tax cut ($d\tau$)	Retained Earnings	-1.235	-1.189	-1.176
	New Equity	-1.238	-1.195	-1.180
	Debt	2.478	-1.862	-1.432
Capital subsidy grant (dg)	Retained Earnings	0.336	0.936	1.872
	New Equity	0.395	0.895	1.791
	Debt	0.253	0.992	1.985

The values for $d\tau$ and dg are expressed in points of percentage.

From Table 7 and contrary to the previous case, i.e. when the government aims at lowering the effective marginal tax rate, we notice that the change in each instrument that is required to lower the EATR of one point of percentage varies with the investment profitability. On the one hand, the extent of the capital subsidy increases when the rate of the real financial return of the investment increases. In other words, the sensitivity of the EATR to the rate of capital subsidy lowers when the investment profitability increases. Conversely, the extent of the tax cut always decreases as the predicted return of the project becomes higher.

These results derive from an interesting property of the EATR highlighted by Devereux and Griffith (2003). As the rate of the investment profitability increases, the EATR becomes more and more determined by the rate of corporate taxation. This is intuitive: “for very profitable investment projects, allowances become insignificant: the only relevant factor is the rate at which income is taxed”.⁶ Therefore, lowering the EATR requires a more and more higher capital subsidy as the rate of profit increases. Conversely, the more profitable is the investment, the lesser should be the extent of the corporate tax cut. However, for poorly profitable investments financed by debt, the government should actually raise the corporate tax rate in order to obtain a reducing of the EATR by one point of percentage.

This property of the EATR directly accounts for the results in Table 6 relative to the public costs of the policy instruments. A capital subsidy is more costly as the financial return of the investment increases. On the other hand, we observe that the public cost of lowering the corporate tax rate also increases with the level of profit. Although the required extent of the tax cut may be less important, the fiscal losses are of growing importance as the rate of profit of the investment grows.

As before, granting a capital subsidy appears to be a better policy choice than lowering the corporate tax rate. However, for marginal and lightly profitable investments financed by debt, the public authorities should raise the corporate tax rate. This effect, previously explained, comes from the greater extent of the tax change on the various allowances than on the tax liability.

⁶ Devereux and Griffith (2003), p. 11.

5. Conclusion

For decades, most industrialised countries have implemented some forms of fiscal and financial instruments to promote local capital formation. This paper has investigated the efficiency of two instruments commonly used in regional policy: a tax cut and a capital subsidy. These incentives are expected to produce a double effect on the economic development of regions: on the one hand, they can expand local firms' investment demand and on the other hand, they can help attract non-regional firms' activities. In determining its policy, the government can be sensitive to one or the other of these arguments. Accordingly, the effectiveness of a tax cut or of a capital grant cannot be assessed disregarding the option chosen by the government.

Effective marginal and average tax rates prove to be appropriate indicators to evaluate the impact of taxation and public incentives on firms' investment decisions. The size of the investment directly depends on the effective marginal tax rate, whereas the average approach is adequate to determine the location choice (or any other discrete investment decisions generating after-tax positive economic rent).

The model of effective average taxation, recently developed by Devereux and Griffith (2003), provides an adequate framework to analyse the efficiency of public incentives. It allows the calculation of both effective marginal and average tax rates.

Calculating the sensitivity of the expected after-tax economic rent of the investment to the public incentives, we have derived the analytical expressions of the public cost associated with a lowering of the corporate tax rate or the granting of a capital subsidy. This public cost necessarily depends on the effective tax rate – either marginal or average – that the government aims at lowering to influence firms' investment decisions.

The results suggest that, whatever the public authorities' objective, lowering the corporate tax rate do not appear to be an efficient policy tool in comparison with the granting of a financial aid, which is generally the least costly intervention. However, depending on the level of the project profitability, it should be better for the government

to increase the corporate tax rate in case of debt financing. These outcomes are explained by the complex interplay of various direct and indirect effects of a tax cut and the granting of a capital subsidy on the post-tax economic rent of the investment.

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