Fondazione Eni Enrico Mattei

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NOTA DI LAVORO 14.2002

JANUARY 2002

CLIM – Climate Change Modelling and Policy

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Summary

Nearly all the macroeconomic literature on environmental policies deals with taxes and tradable permits. A policy instrument that still needs to be looked at is a switch in government expenditure away from environmentally-damaging goods, in particular fossil fuels, and toward resource- and energy-saving expenditure.
We analyse such policy with a two-sector theoretical general equilibrium model. A composite good is produced with constant returns to scale, and a natural resource is extracted with diminishing returns and yields a differential rent to its owners. The government purchases natural resources and composite goods from private firms.
We show that a switch in public spending from the natural resource to the composite good increases employment. It also raises private consumption and welfare if the initial share of resource in public spending is smaller than that of private consumption, or if the difference is small enough. Simulations show that last condition holds in France for energy.

Keywords: Resource conservation, energy conservation, public spending, employment, general equilibrium, multi-sectors models

JEL: E62, H57, Q38

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This paper was presented at the European Council for an Energy-Efficient Economy 2001 Summer study and at the EUREQua (University of Paris I) seminar in environmental economics. The author thank participants, referees from ECEE and FEEM, Randall Bowie, Pierre Courtois, Minh Ha Duong, Khalil Helioui, Antonio Mele and Tarik Tazdaït for helpful comments, and the Institut français de l'énergie for financial support.

1. Introduction

The largest part of the literature on macroeconomic effects of environmental policies deals with ecological tax reforms – the so-called "double dividend" debate (Bosello et al., 2001). Taxes, however, are far from being the most common policy instrument for protecting the environment. Therefore a couple of recent papers, e.g. Goulder *et al.* (1999) also analyse emissions quotas, performance standards and mandated technologies. Another instrument worth looking at is the composition of public spending between environmental-friendly and unfriendly goods and services. Indeed, approximately one-fifth of GDP is purchased directly by the government in most OECD countries. Admittedly, Bovenberg and van der Ploeg (1994) analyse the optimal composition of public spending between a clean and a dirty good, but both are produced with the same production technology.

In particular, a partial but environmentally-efficient measure to fight global warming would be to switch government spending from fossil fuel consumption to energy-efficiency expenditure: thermal insulation, energy-efficient boilers, lighting and appliances, etc. Furthermore, emissions associated with the production of goods and services purchased by the government could be reduced by introducing environmental criteria in the bidding process.

In this paper, we explore the macroeconomic consequences of such policies and show that they not only reduce the use of the natural resource (the first dividend), but that they also lead to benefits as measured in terms of higher employment. Furthermore, for the most likely values of the parameters, an energy-saving policy in the public sector leads to higher household consumption and welfare, provided that the level of public spending does not rise too much.

To demonstrate these results, we use a theoretical general equilibrium model which is presented in the third section. Its main peculiarity is a mixed industrial structure, with a composite good, produced with constant returns to scale, and a domestic natural resource (energy for instance), extracted with diminishing returns, which yields a differential (Ricardian) rent to its owners. The government purchases natural resources and composite goods from private firms. The present model builds heavily on Dixon and Hansen (1999) and Dixon and Pompermaier (1999), who study the effectiveness of monetary policy in presence of menu costs. It is described in some depth since it differs significantly from those used to assess ecological tax reforms.

Section 4 derives the equilibrium and analyses the consequences of the allocation of government spending on employment, private consumption and households' utility. Section 5 explores magnitudes for different parameter values, and section 6 concludes. Beforehand, section 2 provides some information on resource-saving policies in the government sector.

2. Resource- and Energy-saving programs in the Government sector in practice

One of the most direct ways a government can save energy and other natural resources is by cutting its own consumption. However, until recently, very few countries had concerted energy management programs for the government sector (Borg *et al.*, 1998). Since then, the situation has improved somewhat. In the U.S., an Executive Order[1] states that each federal agency shall reduce its greenhouse gas emissions attributed to facility energy use by 30 percent by 2010 compared to such emissions levels in 1990. The Federal Energy Management Program has been created to help Federal agencies increase energy efficiency, use renewable energy, and conserve water. In European countries, most national climate change programmes include provisions to reduce CO_2 emissions from the public sector, either with a quantitative target (e.g. Germany) or without (e.g. France). At last, the European Climate Change Program includes an initiative and a proposed directive on Energy-efficient public procurement, with the aim of saving 25 to 40 millions tonnes of CO_2 per year by 2005 compared to business as usual (European Commission, 2001).

Such a development is not surprising: to quote Borg *et al.* (1998), "Government-related facilities are often the largest energy users in a country and the single most important customers for energy-using products and services." Furthermore, technologies are available to cut significantly energy consumption in the public sector: thermal insulation techniques, efficient heating, ventilation and air conditioning systems, efficient appliances, boilers, motors and lighting systems, buildings energy management systems, etc.

[1] Executive Order 13123 (Greening the Government Through Efficient Energy Management), June 1999.

Nearly all public sector emissions relate to the buildings sector which, according to most engineering estimations, exhibits the highest potential CO_2 emission reduction for a given abatement cost (see Moomaw and Roberto-Moreira, ed., 2001, and references therein). Furthermore, most of these studies conclude that some reductions are available at a negative net cost – that is, the reduction in the energy bill is higher than the energy-saving expenditure. This raises the question of why this "energy-efficiency gap" exists (Jaffe and Stavins, 1994). Our paper, which exhibits some positive macroeconomic feedback from such policies, just makes the existence of such a "no-regret potential" more unexpected.

A detailed examination of this issue is well beyond the scope of the present paper. However, in the particular context of the public sector, it should be stressed that organisational barriers often play a prominent role: people in a position to save energy seldom have an incentive in making such decisions. For instance, departments are often not accountable for energy costs, nor are the actors responsible for purchasing equipment (Sorrell, ed., 2000).

Because the energy-efficiency gap is a matter of argument for energy engineers as well as economic theorists, we prefer not to make particular assumptions on this question. Thus, we do not model a public good production function. Rather, we look in turn at the effect of the *share* of resource in public spending, and at that of the *level* of public spending. This allows us to point out the relevance of the financial profitability of the government resource-saving policy for each of our results.

3. The model

3.1. Households

There is a continuum of households $i \in [0;1]$. They derive utility from leisure and from the consumption of a natural resource, C^R, and a composite good, C^C. The quality of the environment does not enter the utility function, nor does public spending. The former assumption is common in the double dividend debate and the latter in the literature on the effects of fiscal policy; cf. for instance Dixon and Lawler (1996). Formally

$$U(C_i^R, C_i^C, l_i) = \frac{(C_i^R)^{\beta}(C_i^C)^{1-\beta}}{\beta^{\beta}(1-\beta)^{1-\beta}} - \frac{\gamma}{\gamma+1} l_i^{\left(\frac{\gamma+1}{\gamma}\right)} \qquad \forall i \in [0;1], \tag{1}$$

The second term of the utility function is the disutility of labour (l). γ represents the real wage elasticity of labour supply.

The consumer price index is given by

$$P\left(P^R, P^C\right) = \left(P^R\right)^{\beta}\left(P^C\right)^{1-\beta} \tag{2}$$

The budget constraint of household i is

$$P^R C_i^R + P^C C_i^C \leq W l_i + \pi_i - \phi_i \equiv I_i \quad \forall i \tag{3}$$

Where W is the nominal wage, which is assumed to be the same in the two sectors, meaning that there is perfect labour mobility between the two sectors. π_i is the nominal rent received by household i and ϕ_i is a lump-sum tax. Total nominal net-of-tax income of households is denoted

$$I = \int_{i=0}^{1} I_i di \tag{4}$$

Maximising utility subject to the budget constraint and assuming that all households are identical yields aggregate private consumption and labour supply:

$$C^R = \beta \frac{I}{P^R} \tag{5}$$

$$C^C = (1-\beta)\frac{I}{P^C} \tag{6}$$

$$l_i = \left(\frac{W}{P}\right)^{\gamma} \tag{7}$$

The first two equations state that constant shares of income are spent on the natural resource and on the composite good. The third equation states that the labour supply is a function of the real wage and of the elasticity of labour supply.

3.2. Firms

All firms take the nominal wage W and prices P^C and P^R as exogenous. The production function of all firms in the composite sector is characterised by constant returns to scale, which is consistent with empirical estimates. For instance, Crépon et al. (1999) or Klette

(1994) obtain a scale elasticity around one for, respectively, French and Norwegian manufacturing industries.

The output is normalised to be equal to employment. Therefore we have

$$X^C = L^C \tag{8}$$

$$P^C = W \tag{9}$$

In the sector producing the natural resource there are constant or diminishing returns with

$$X^R = \frac{\left(L^R\right)^\alpha}{\alpha} \tag{10}$$

Where $\alpha \in \left(0,1\right]$ is the magnitude of decreasing returns in resource production. A corollary is that all deposits but the least productive yield a differential rent to their owners. The assumption of diminishing returns, which is crucial for our results, deserves some attention.

Such an assumption has a long pedigree, dating back to Ricardo (1821, chapter 3)[2]. Since then, it as been used and tested by various authors who have constructed so-called cumulative cost functions, by which cumulative extraction of a non-renewable resource determines its shadow cost of extraction. One of the most comprehensive treatments is the model by Nordhaus (1973, 1979) for several primary energy resources (oil, natural gas, coal, shale, uranium) and several regions of the world. He uses step-shaped extraction cost functions: marginal cost rises step-by-step with the stock extracted. Livernois and Uhler (1987) empirically demonstrate that, in the case of oil, the dependence of costs on cumulative extraction is twofold. First, low-cost reservoirs tend to be found first. As exploration progresses, increasingly inaccessible reserves are discovered, with correspondingly higher extraction costs. Second, by lowering the pressure of oil occurring in a natural petroleum reservoir, cumulative extraction raises the cost of further exploitation. For more references, see Epple and Londregan (1993) who survey this literature. In addition, note that some recent dynamic general equilibrium models feature a cumulative cost function in fossil fuel

[2] "Mines, as well as land, generally pay a rent to their owner […]. If there were abundance of equally fertile mines, which any one might appropriate, they could yield no rent; the value of their produce would depend on the quantity of labour necessary to extract the metal from the mine and bring it to market. But there are mines of various qualities, affording very different results, with equal quantities of labour. […] The return for capital from the poorest mine paying no rent, would regulate the rent of all the other more productive mines. This mine is supposed to yield the usual profits of stock. All that the other mines

production (e.g., Bovenberg and Goulder, 2000).

From (10), when α <1, profit maximisation leads to the demand for labour in the resource sector: [3]

$$L^R = \left(\frac{W}{P^R} \right)^{\frac{-1}{1-\alpha}} \tag{11}$$

When α =1, output is demand determined, since the labour demand curve is infinitely elastic.

3.3. The State

The government consumes natural resources and composite goods supplied by private firms[4] and financed by lump-sum taxes. The government's budget is always balanced. The share of natural resource in public spending is λ . Government's demand functions in real terms are

$$G^R = \lambda \frac{\phi I}{P^R} \tag{12}$$

$$G^C = (1-\lambda) \frac{\phi I}{P^C} \tag{13}$$

Where $\phi = \int_{i=0}^{1} \phi_i di \Big/ I$ is the ratio of public spending to households' revenue. The two equations above state that government real spending in each good is an exogenous part of its revenue deflated by the price of the goods.

4. Equilibrium and comparative static

Solving for equilibrium, we find that the relative price of the composite good and the natural resource is given by

$$\frac{P^C}{P^R} = \left[\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\phi\lambda)} + 1 \right]^{\frac{1-\alpha}{\gamma\beta(1-\alpha)+1}} \tag{14}$$

Total employment is

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produce more than this, will necessarily be paid to the owners for rent."

[3] All demonstrations of the results below are presented in an appendix available from the author.

[4] Direct employment in the public sector would be equivalent to public consumption of composite goods.

$$l = \left[\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\phi\lambda)} + 1 \right]^{\frac{\gamma\beta(1-\alpha)}{\gamma\beta(1-\alpha)+1}} \tag{15}$$

with employment in the resource sector

$$L^R = \left[\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\phi\lambda)} + 1 \right]^{\frac{-1}{\gamma\beta(1-\alpha)+1}} \tag{16}$$

A "balanced" variation of the nominal level of public spending, i.e. when $\lambda = \beta$, is neutral on employment[5]:

$\frac{\partial l}{\partial \phi} = 0$ when $\lambda = \beta$.

More interesting is the employment effect of the share of the natural resource in public spending

$$\frac{\partial l}{\partial \lambda} = -\frac{(1-\alpha)\beta\gamma\phi(1+\phi)\left(1+\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{\frac{-1}{\gamma\beta(1-\alpha)+1}}}{\alpha\left(\beta\gamma(1-\alpha)+1\right)\left(\beta+\lambda\phi\right)^2} \tag{17}$$

The effect is null in case of constant returns in natural resource production ($\alpha = 1$) or when labour supply is fixed ($\gamma = 0$) and strictly negative in every other case. There is thus what we may label a "public spending employment dividend" from saving natural resources in the public sector.

The explanation is straightforward: a decrease in public consumption of the natural resource stops the production from the least efficient deposits. Hence, the price of the resource, which is set by the least efficient deposit, decreases, raising real wage thus employment.

Since the level of public spending is neutral, this result holds irrespective of the financial profitability of such a programme, i.e., would the lessening in natural resource bills exceed the

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[5] This would not hold if public spending or leisure entered households' utility function in a non-additive way, if public spending entered production functions (as in Turnovsky and Fisher, 1995, for instance), or with distortionary taxation (as in Heijdra *et al.*, 1998). We have ruled out these well-known mechanisms in order to disentangle the effects of the *level* of public spending from those of its *composition*.

expenditures needed to decrease this bill? This result is interesting since the potential for financially profitable energy-efficient investments is highly debated (see section 2 above).

Total private consumption is

$$C = \frac{\left(1 + \frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{1-\beta(1-\alpha)}{1+\beta\gamma(1-\alpha)}}}{\alpha(\beta+\lambda\phi)} \tag{18}$$

The effect of the level of nominal public expenditure is given by

$$\frac{\partial C}{\partial \phi} = -\frac{\left(\beta(1-(1-\alpha)\beta)(1+(1-\alpha)\gamma\lambda)+(1+(1-\alpha)\beta\gamma)\lambda(1-(1-\alpha)\lambda)\phi\right)\left(1+\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{1-(1-\alpha)\beta}{1+(1-\alpha)\beta\gamma}}}{\left(\alpha(1+(1-\alpha)\beta\gamma)(\beta+\lambda\phi)^2(1-\beta(1-\alpha)+\phi(1-\lambda(1-\alpha)))\right)} \tag{19}$$

which is negative: an increase in public spending crowds out private consumption, as usual in a model without increasing returns or nominal rigidities. The effect on private consumption of the share of natural resource in public expenditure is given by

$$\frac{\partial C}{\partial \lambda} = -\frac{(1-\alpha)\phi\left(1+\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{1-\beta+\alpha\beta}{1+\beta\gamma(1-\alpha)}}\left((\beta-\lambda)\phi+\gamma\beta\left((1-\beta(1-\alpha))+\phi(1-\lambda(1-\alpha))\right)\right)}{\alpha(1-\beta\gamma(1-\alpha))(\beta+\lambda\phi)^2\left(1-\beta(1-\alpha)+\phi(1-\lambda(1-\alpha))\right)} \tag{20}$$

which equals zero in case of constant returns in natural resource production ($\alpha = 1$). When $\alpha < 1$, because the denominator and the first term of the numerator are positive, the above expression is strictly negative if and only if

$$\lambda < \beta + \frac{\beta(1-(1-\alpha)\beta)\gamma(1+\phi)}{(1-(1-\alpha)\beta\gamma)\phi} \tag{21}$$

Since the second part of the RHS is positive, this inequality means that if the initial share of natural resource in public expenditure is not greater than that of private consumption ($\lambda \leq \beta$), then (i) a decrease in λ unambiguously increases private consumption; (ii) an increase in λ reduces private consumption, up to a certain point which depends on parameters. This last non-monotonic response proceeds from the combination of two antagonistic effects. First, real wage and employment decrease with λ, lessening purchasing power of households. Second, abstracting from the first effect, the consumer price index decreases as soon as the allocation of public spending λ departs from that of households β, improving purchasing power of households. Simulations of section 3 using French data indicate that condition 21 is likely to hold for a public-sector energy-saving program in this country.

However, remember that from (19), public spending crowds out private consumption. Hence, if the energy-saving program is not financially profitable and if the government wants to maintain the supply of public goods, the level of public spending will rise and private consumption may fall.

Let's turn to environmental effectiveness. Formally

$$X^R = \frac{\left(1+\frac{1-\beta+(1-\lambda)\phi}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{\alpha}{1+(1-\alpha)\beta\gamma}}}{\alpha} \tag{22}$$

$$\frac{\partial X^R}{\partial \lambda} = \frac{\phi(1+\phi)\left(1+\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{\alpha}{1+\beta\gamma(1-\alpha)}}}{(\beta+\lambda\phi)(1-\beta\gamma(1-\alpha))(1-\beta(1-\alpha)+\phi(1-\lambda(1-\alpha)))} \tag{23}$$

which is positive. Intuitively, a decrease in public demand for natural resources reduces the relative price of the resource and raises private demand for the resource. However, this 'rebound' effect is never sufficient to cancel out the 'first dividend', i.e. resource extraction decreases nevertheless. This is easily understandable with a reductio ad absurdum: if the aggregate demand for the resource were to rise, so would its supply hence its price in terms of labour; real wage and employment would then decrease, which we know is false (equation 17).

Results on welfare are less clear-cut. Formally:

$$U = \frac{\left(1+\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{1-\beta(1-\alpha)}{1+\beta\gamma(1-\alpha)}}}{\alpha(\beta+\lambda\phi)} - \frac{\gamma}{\gamma+1}\left(1+\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{\gamma\beta(1-\alpha)}{1+\beta\gamma(1-\alpha)}} \tag{24}$$

Since government spending does not enter households' utility function, a "balanced" rise in ϕ, i.e. when $\lambda = \beta$, reduces households' utility:

$$\frac{\partial U}{\partial \phi} = -\frac{\left(1+\frac{1-(1-\alpha)\beta}{\alpha\beta}\right)^{-\frac{1-(1-\alpha)\beta}{1+(1-\alpha)\beta\gamma}}}{\alpha\beta(1+\phi)^2} \text{ when } \lambda = \beta \tag{25}$$

which is negative. The impact of a decrease in λ is ambiguous since consumption rises – as long as condition (21) holds – but leisure declines:

$$\frac{\partial U}{\partial \lambda}=\frac{\partial C}{\partial \lambda}+\frac{(1-\alpha)\beta\gamma^2\phi(1+\phi)\left(1+\frac{1-\beta+\phi(1-\lambda)}{\alpha(\beta+\lambda\phi)}\right)^{-\frac{1}{1+\beta\gamma(1-\alpha)}}}{\alpha(1+\gamma)\left(1+\beta\gamma(1-\alpha)\right)(\beta+\lambda\phi)^2} \tag{26}$$

Simulations laid out in section 3 show that the consumption effect is likely to outweigh the leisure effect, i.e., utility closely mimics consumption and is likely to raise when condition (21) holds.

5. Results of the simulations

Four scenarios are generated by varying two key parameters: the elasticity of labour supply γ and the magnitude of decreasing returns in resource production α (table 1):

Table 1 here

Graph 1 below displays the values of *C* (private consumption), *U* (welfare), *l* (employment) and *Xr* (natural resource production) for θ=0.2, β=0.05 and λ ranging from 0.01 to 0.1. The particular value of β reflects the share of fossil fuels (coal, oil and gas) in households' budget in France (INSEE, 1998). To improve the clarity of the presentation, every curve is normalised at 100 for λ=0.05, so that variations of the endogenous variables are displayed as a percentage of their initial value.

Graph 1 here

Let's first focus on the two variables that respond to a variation in λ in a non-monotonic way: *C* and *U* (graphs 1.a and 1.b). For the high elasticity of labour supply scenarios, a decrease in λ raises both variables even if the initial share of resource in the public sector is twice that of the private sector. In the low elasticity of labour supply scenarios, however, a decrease in λ slightly harms consumption and welfare if the initial value of λ is at least 50% higher than β, and is beneficial in terms of consumption and welfare otherwise. The "real" values of λ and β of course depend on the country and on the resource, but taking as an illustration the final consumption of fossil fuels in France (INSEE, 1998), we have $\beta \approx 0.05$ and $\lambda \approx 0.047$. This means that according to our model, an energy-saving program in the French public sector would raise consumption and welfare, on top of employment.

Are our results quantitatively significant? U.S. and European public sector energy saving programs generally aim at a 20 to 30% reduction – meaning approximately a change in λ from 0.05 to 0.035 or 0.04. At best, it would bring a 0.1% rise in employment and a 0.05% rise in consumption and welfare. This may seem at first sight modest, but one cannot expect a huge side effect from what is only a partial climate change mitigation measure. Macroeconomic evaluations of the more ambitious carbon/energy tax proposals typically predict an employment impact of +0.1% to +0.7% and an unclear effect on welfare (Majocchi, 1996). Furthermore, the environmental effectiveness of the policy, admittedly reduced by the macroeconomic feedbacks, remains significant. For example, a 30% cut in λ, with the government initially consuming 20% of the resource, would ex ante lead to a 6% resource saving (30% * 0.2). Ex post, it still yields to a saving of 3.4% (for α=0.5) or 5% (for α=0.75).

6. Concluding remarks

We have shown that a switch in public spending away from a natural resource (energy for instance) and towards a composite good increases employment, real wage and workers' utility. It also raises private consumption and welfare under two conditions. First, the initial share of energy in public spending must be smaller than that of private consumption, or the difference must be small enough. Simulations show that it is likely to be the case at least for energy. Second, it must not entail too high a rise in the aggregate public spending. This last question is a matter or argument for energy engineers as well as economic theorists and is outside the scope of this paper.

Furthermore, even if the private demand for the resource rises following the switch in public spending, this ‘rebound’ effect is never sufficient to cancel out the ‘first dividend’, i.e. resource extraction decreases nevertheless.

Hence, there is always an "employment dividend" from saving energy in the public sector, and also a "welfare dividend" if such policy is not too costly. Admittedly modest in quantitative terms, these macroeconomic effects are not trivial when compared to those predicted for ecological tax reforms.

Such policy is not Pareto-improving: households earning only rents are worse off (since real rents decline) while those earning only wage income are better off (because real wage rises). It can be seen as a (small) step towards what Keynes (1936, chapter 24) calls "euthanasia of rentiers" – the latter being, in the present model, the owners of the natural resource.

The crucial assumption here is that marginal returns are decreasing in the natural resource sector and constant in the composite sector. The rationale for the former assumption is that low-cost reservoirs tend to be found first. As exploration progresses, increasingly inaccessible reserves are discovered, with correspondingly higher extraction costs. This assumption is in line with empirical modelling of exhaustible resource supply and with the dynamic general equilibrium models that distinctively model fossil fuel supply. In the composite sector, the constant returns assumption is in agreement with empirical estimates.

The other important modelling choices are those that purposively entail the neutrality of the level of public spending on employment: neither public spending nor leisure enter households' utility function in a non-additive way, public spending does not enter production functions, and lump-sum taxation is available. We have ruled out these mechanisms in order to disentangle the effects of the *level* of public spending, which is highly debated and covered by a large literature, from those of its *composition*.

The mechanisms we have formalised in this paper are best thought of as long term effects. In the short run, various rigidities may hold. On the one hand, labour (and also capital) mobility is obviously not perfect. Hence, a decrease in public demand for the natural resource might harm employment and private consumption in the short term[6]. On the other hand, price rigidities may occur. If prices were sticky, a decrease in the share of energy in public expenditure would also raise real wage and employment, through a different mechanism than in our model. Simply, since all the turnover of the composite sector is used for hiring labour while a part of that of the resource sector is distributed as rents, employment intensity of the former is larger than that of the latter.

Up to now, the bulk of the literature on macroeconomic effects of environmental policies has focused on tax reforms. Furthermore, it has typically neglected the technical heterogeneity between the sectors behind the environmental externalities and the rest of the economy. Our results constitute an invitation to devote more attention to other environmental measures than

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[6] However this adverse consequence cannot be taken for granted. Indeed Ramey and Shapiro (1998) analyse the effects of sector-specific changes in government spending in a model with two symmetric sectors. Following an increase in government

ecological tax reforms and to the modelling of the specific features of environmental-friendly and unfriendly sectors.

spending in one sector, real wage and employment are higher when the reallocation of capital across sectors is costly.

References

Borg, N., E. Mills, N. Martin, and J. Harris, 1998, "Energy Management in the Government Sector: An International Review", *Proceedings of the 1997 ECEEE Summer Study*, Prague, Czech Republic. Panel 4, ID 150, 1-24. (European Council for an Energy-Efficient Economy, Copenhagen, Denmark)

Bosello, F, C. Carraro and M. Galeotti, 2001, "The double dividend issue: Modelling Strategies and Empirical Findings", *Environment and Development Economics*, 6(1), 9-45

Bovenberg, A.L. and F. van der Ploeg, 1994, "Environmental Policy, Public Finance and the Labour Market in a Second-Best World", *Journal of Public Economics*, 55(3), 349-90

Bovenberg L. and L. Goulder, 2000, *Neutralising the adverse industry impacts of CO_2 abatement policies: What does it cost?*, Fondazione Eni Enrico Mattei Working Paper 68.2000

Crépon, B., R. Desplatz and J. Mairesse, 1999, *Estimating price cost margins, scale economies and workers' bargaining power at the firm level*, INSEE/DESE working paper G 9917, Malakoff, France

Dixon, H.D. and C.T. Hansen, 1999, "A mixed industrial structure magnifies the importance of menu costs", *European Economic Review*, 43, 1475-1499

Dixon, H.D. and P. Lawler, 1996, "Imperfect Competition and the Fiscal Multiplier", *Scandinavian Journal of Economics*, 98(2), 219-31

Dixon, H.D. and A. Pompermaier, 1999, "A comparison of menu costs in open and closed economies with a mixed industrial structure", *Open Economies Review*, 10, 365-384

Epple, D. and J. Londregan, 1993, "Strategies for modelling exhaustible resource supply", Chapter 22 in A. Knees and J. Sweeney, *Handbook of natural resource and energy economics*, Volume III, North-Holland

European Commission, 2001, *European Climate Change Programme Report*, June, Brussels

Goulder, L.H., I.A.W. Parry, R.C. Williams and D. Burtraw, 1999, "The cost-effectiveness of alternative instruments for environmental protection in a second-best setting", *Journal of Public Economics*, 72, 329-360

Heijdra, B.J., J.E. Ligthart and F. van der Ploeg, 1998, "Fiscal policy, distortionary taxation, and direct crowding out under monopolistic competition", *Oxford Economic Papers*, 50, 79-88

INSEE, 1998, *Comptes et indicateurs économiques – Rapport sur les comptes de la Nation 1997*, Paris, France

Jaffe, A.B. and R.N. Stavins, 1994, "The energy-efficiency gap - What does it mean?", *Energy Policy*, 22(10)

Keynes, J.M., 1936, *General theory of employment, interest and money*, Collected Writings of John Maynard Keynes, Macmillan, London

Killingsworth, M., 1983, *Labour supply* (Cambridge University Press, Cambridge)

Klette, J., 1994, *Estimating price-cost margins and scale economies from a panel of micro data*, Discussion Paper 130, Statistics Norway

Livernois, J.R. and R.S. Uhler, 1987, "Extraction costs and the economics of non-renewable resources", *Journal of Political Economy*, 95(1), 195-203

Majocchi, A., 1996, "Green Fiscal Reform and Employment: A Survey", *Environmental and Resource Economics*, 8(4), 375-397, December

Montague, P., 2000, "Steps Toward A Corporate State", *Rachel's Environment & Health Weekly*, 694

Moomaw, W. and J. Roberto-Moreira, ed., 2001, "Technological and Economic Potential of Greenhouse Gas Emissions Reduction", Chapter 3 in Intergovernmental Panel on Climate Change, Working Group III, *Climate Change 2001 – Mitigation*, Cambridge University Press

Nordhaus, W.D., 1973, "The allocation of energy resources", *Brookings paper on Economic Activity*, pp. 529-70

Nordhaus, W.D., 1979, *The efficient use of energy resources*, Cowles Foundation Monograph 26, Yale University Press, New Haven, CT

Ramey, V. and M. Shapiro, 1998, "Costly capital reallocation and the effects of government spending", *Carnegie-Rochester Conference Series on Public Policy*, 48, 145-94

Ricardo, D., 1821, *On The Principles of Political Economy and Taxation*, Third edition, John

Murray, Albemarle-Street, London

Sorrell, S. (ed.), 2000, *Barriers to Energy Efficiency in Public and Private Organisations*, Report to the European Commission, September, Brighton, U.K.

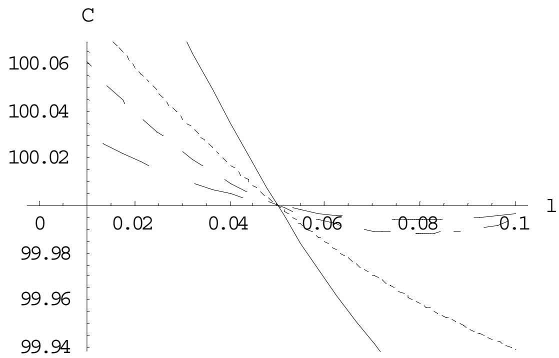
Turnovsky, S.J. and W.H. Fisher, 1995, "The composition of government expenditure and its consequences for macroeconomic performance", *Journal of Economic Dynamics and Control*, 19(4), 747-86

Table 1. Definition of the scenarios

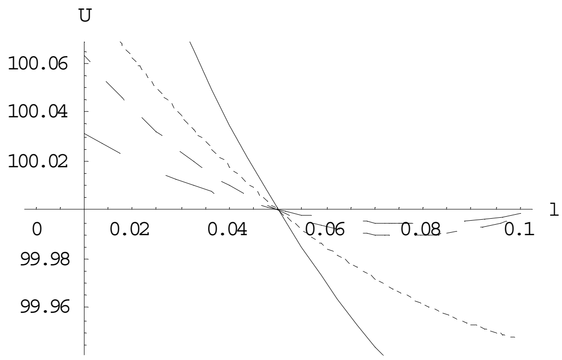
Common features: θ=0.2, β=0.05		**magnitude of decreasing returns in resource production**	
		High (α=0.5)	Low (α=0.75)
elasticity of labour supply	High (γ=0.4)	Solid line	Short dashing
	Low (γ=0.1)	Intermediate dashing	Long dashing

Graph 1. Impact of λ on the main macroeconomic variables

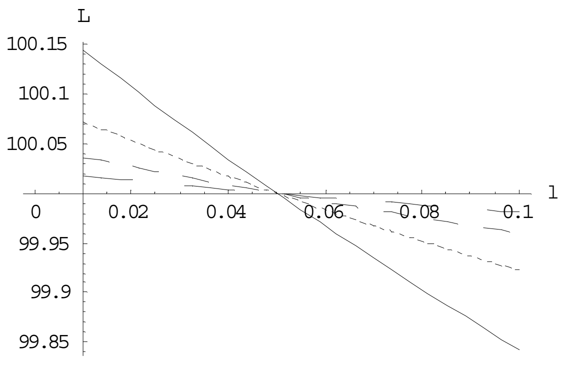
a. Private consumption



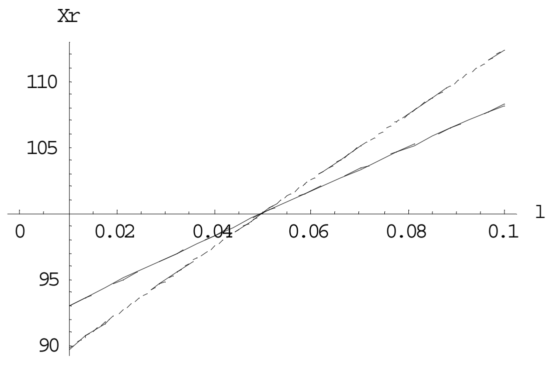
b. Welfare



c. Employment



d. Resource production



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(xliii)This paper was presented at the International Workshop on "Voluntary Approaches, Competition and Competitiveness" organised by the Fondazione Eni Enrico Mattei within the research activities of the CAVA Network, Milan, May 25-26,2000.
(xliv) This paper was presented at the International Workshop on "Green National Accounting in Europe: Comparison of Methods and Experiences" organised by the Fondazione Eni Enrico Mattei within the Concerted Action of Environmental Valuation in Europe (EVE), Milan, March 4-7, 2000
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(xlvii) This paper was presented at the RICAMARE Workshop "Socioeconomic Assessments of Climate Change in the Mediterranean: Impact, Adaptation and Mitigation Co-benefits", organised by the Fondazione Eni Enrico Mattei, Milan, February 9-10, 2001
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