Environmental tax design with endogenous earning abilities (with applications to France)

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Abstract

This paper develops an optimal tax system à la Mirrlees with two novel features. First, earning abilities are determined endogenously; second, energy, a polluting good, is used both as a factor of production and a final consumption good. The model is calibrated for the French economy. The imposition of the optimal general income tax is redistributive towards the poor and increases social welfare by an equivalent of 500 to 1,200 euro per household. Turning to energy taxes: (i) The current energy consumption taxes in France should be cut, the optimal tax is less than the marginal social damage of emissions and turns into an outright subsidy when the inequality aversion index is high. (ii) The optimal tax on energy as an input is always equal to its marginal social damage. (iii) The social welfare gain due to lowering the current energy taxes to their optimal levels, with the general income tax being set optimally in both cases, is between 17 to 32 euro per household. This hurts the rich and benefits the poor. (iv) A one-consumer representation yields poor and misleading results.

JEL classification: H21; H23; D62

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redistributive implications, must be based on some underlying social welfare function. We use an iso-elastic social welfare function for this purpose. Moreover, in choosing the value of the inequality aversion index for our optimal tax calculations, we will be guided by the observed degree of redistribution in the existing French tax system. Specifically, based on a recent study by Bourguignon and Spadaro (2000), we shall use 0.1 and 1.9 to be the limiting values for the inequality aversion index.

2 The private sector

Consider an open economy which uses three factors of production to produce two categories of consumption goods. The factors of production are labor, capital and energy. Labor is heterogeneous with different groups of individuals having different productivity levels. All types of workers are immobile so that labor is neither exported nor imported. All capital and energy inputs are rented from outside. There are two sources of emissions in the economy. On the production side, the use of labor and capital entail no emissions but the use of energy inputs does. On the consumption side, consuming one category of goods is non-polluting, but consuming the other category (energy) generates emissions.

Specifically, we assume that there are four groups of individuals with differing productivity levels and tastes. All persons, regardless of their type, are endowed with one unit of time. Denote a person's type by j $(j = 1, 2, 3, 4)$, his productivity factor by n^j, and the proportion of people of type j in the economy by π^j. Normalize the population size at one, and define the Preferences of j-type person over his labor supply, L^j, consumption of a "non-polluting" good, x^j, a "polluting good", y^j, *and* total level of emissions in the atmosphere, E.

reasons. First, the optimal policy entails a cut in taxes on energy-related consumption goods thus boosting their demand. Secondly, the increased efficiency of the tax system as a whole encourages production and with it energy use and consumption. Note that the introduction of taxes on energy inputs, on the other hand, has a dampening effect on the use of energy and thus works to mitigate the increase in emissions.

On the redistributive front, the tax system becomes much more progressive. The implied EV figures, and the associated social welfare changes, are reported in Table 4. The magnitude of the changes are extremely large. When $\phi = 0.016$ and $\eta = 0.1$, the loss in Type 1's welfare amounts to as much as 6,528 euro. Type 2 loses by 379 euro and Types 3 and 4 gain by 2,458 and 2,066 euro. These translate into a social welfare gain of 405 euro. Similar results hold when When $\phi = 0.040$ and $\eta = 0.1$. Moreover, as one might expect, the gains to the poor and the losses of the rich increase with η. The increase in social welfare is also more pronounced for the higher value of η.

These changes come about as a result of the change in the whole structure of the tax system, and particularly the change in the income tax structure. To isolate the effects of environmental taxes per se, we also find the tax equilibrium of the economy while only setting the income tax optimally keeping the energy taxes fixed at their current values. Then compare the resulting equilibrium with the previously calculated optimal system. Any difference must be due solely to the change in environmental taxes. The procedure for the determination of the new equilibrium is the same as problem (16)–(20) above, with some adjustments. This requires one to impose two additional constraints on the problem. They are, given the current 40.32% average energy consumption tax relative to other goods and zero energy input taxes,

$$q = 1.4032, \tag{21}$$

$$\boldsymbol{O}_D\left(L, K, D\right) = 1. \tag{22}$$

The first constraint implies that we no longer optimize with respect to q; the second constraint enters as an additional term in the Lagrangian expression. The interesting

In the case of environmental taxes, the paper has shown that the optimal tax on energy inputs is Pigouvian and equal to its marginal social damage. The optimal tax on the consumption of energy, on the other hand, is less than its marginal social damage. In fact, in three out of four cases, energy consumption should be subsidized. This is in marked contrast to the current tax system in France which taxes energy consumption over 40% relative to non-energy related goods. The reason for this is the fact that the poor spend proportionally more of their income on energy consumption than the rich. To gauge the welfare implications of environmental taxes per se, we have compared the optimal general income tax equilibria at the current environmental taxes and at their optimal values. The results indicated substantial losses for the rich (Type 1) and substantial gains for the poor (type 4). In comparison, the effects on Types 2 and 3 were rather marginal.

Finally, we compared our findings with those that result if one models the economy in terms of a representative household. The comparison shows that a most significant aspect of energy consumption taxes is missed in a one-consumer representation of the economy. The redistributive aspects of such taxes, while quite important, are naturally masked in such an analysis. Moreover, this may lead the government to levy taxes on energy while in fact a subsidy is required. This is just one indication of why we believe that in calculating optimal income and consumption taxes, including environmental taxes, one should go beyond the traditional Ramsey tax framework. The methods of this paper can be used to compute optimal tax structures for other countries. Better data may allow for a greater number of types. It should also allow for a more disaggregated set of goods and better parameter estimates. Another extension would be to consider non-homothetic preferences directly. The current paper should be viewed more for its methodological contribution to this endeavor, rather than the exactness of the reported numbers. Nevertheless the numbers are very interesting even if only indicative.

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