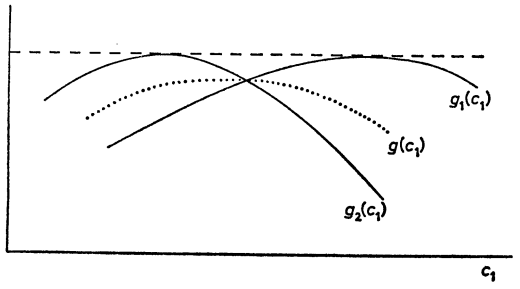

FIGURE 1

The general idea is that having to wait until the end of the period for the outcome to become known is bad enough in itself; not even knowing the exact distribution according to which the outcome will be determined is still worse. The following analogy should be familiar: I may be indifferent between teaching Course A and Course B next fall, but, in view of the preparations that must be made in the meantime, I would certainly not want the decision to be postponed until classes begin.

The example given above demonstrates the importance of the temporal aspect in risk-taking situations. As emphasized by Markowitz, the representation of preferences among probability distributions by means of a utility function is meant to apply to cases of *timeless* prospects, i.e., to situations where the outcome is determined at once, without any intervening decisions involving commitment of the outcome. For such prospects, the derivation of an indirect utility function for wealth from the solution of the allocation problem causes no difficulty (see [2]). For temporal prospects, however, representation of preferences in terms of a utility function for wealth may be inappropriate—and for reasons that are obvious once you think of it. On further reflection it is also apparent that in the real world *temporal* prospects, not timeless ones, are the rule rather than the exception. Even in a controlled experimental setting they seem difficult to avoid; in a gamble with payoffs depending upon the outcome of, say the next presidential election, subjects may easily be led to take the possibility of intermediate decisions into account. This should serve as a reminder of the constant need for caution in applying a utility function for wealth to the analysis of risk-taking behavior.

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EXTERNAL DISECONOMIES, CORRECTIVE TAXES, AND MARKET STRUCTURE

This note is presented as a contribution to the continuing dismantling of the Pigovian tradition in applied economics, defined here as the emphasis on internalizing externalities through the imposition of corrective taxes and subsidies. My central point is much more elementary than those advanced by some of the other contributors to the recent discussion. R. H. Coase [1] demonstrated the inherently bilateral aspects of any externality relationship, and he showed that applying the Pigovian policy norms in neglect of the two-sidedness of the account may reduce rather than increase efficiency. Davis and Whinston [2] concentrated on the impossi-

bility of determining the size of a corrective tax that would lead to an efficient outcome under conditions of reciprocal externalities when production functions are nonseparably related. Plott [3] called attention to the necessity of identifying properly the aspect of the production process that generates the externality. I shall demonstrate that (1) even if the directional gains-from-trade are such that an orthodox corrective tax would increase efficiency, and (2) even if production functions are separable, and (3) even if no changes in the input mix are technically possible, the imposition of a corrective tax (under external diseconomy) will often reduce rather than increase welfare in the Pareto-efficiency sense. Only when the industry generating the external diseconomy is competitively organized can the corrective tax be unambiguously hailed as welfare-improving, even in the presence of all of the other required conditions. Under monopolistic organization, the corrective tax may well lead to a reduction in welfare rather than an increase.

My criticism is aimed more at the "Pigovian tradition" than at Pigou himself. His whole analytics, and that of Marshall, was implicitly based on the assumption of competitive structures, as, indeed, some of the contributors to the externality literature seem to have recognized.[1] It is necessary to distinguish, however, between the relevance of market structure for the emergence of externality and the relevance of market structure for the application of the Pigovian policy norms. For example, Ellis and Fellner state that "the 'atomistic' character of one producer's output under competition, frequently thought to be crucial in the external economies-diseconomies context, is not decisive of itself" [5, p. 262]. Ellis and Fellner were referring here to the potential for the emergence of externalities, but it is relatively easy to see how this statement could be taken to imply that market structure also has little relevance to the application of the standard externality-correcting devices. And we know that the levy of corrective taxes under diseconomies and the provision of corrective subsidies under economies have been widely discussed without reference to market organization. This attitude is surely characteristic of modern treatments of pollution control. If, as I shall demonstrate, it is necessary to limit the Pigovian correctives on the tax side to situations of competition much of the current discussion on these problems requires substantial revision. As we recognize, most of the problems falling under "congestion" as a general category involve external diseconomies.

My argument can be presented geometrically in the simplest of models, one in which constant cost is assumed. More complex models are not needed. An industry demand curve is shown as D in Figure 1, with the cost curve shown by $MC(AC)$. If the industry is competitively organized, equilibrium output is Q_c, and price is P_c. Let us now assume that a "bad" is suddenly discovered to be inherent in the output of this industry, an external diseconomy that is directly related to the number of units produced and not to any particulars of the input mix or to the rate of output for any other industry. This external diseconomy does affect the production functions of all firms in a second industry, also assumed to be competitively

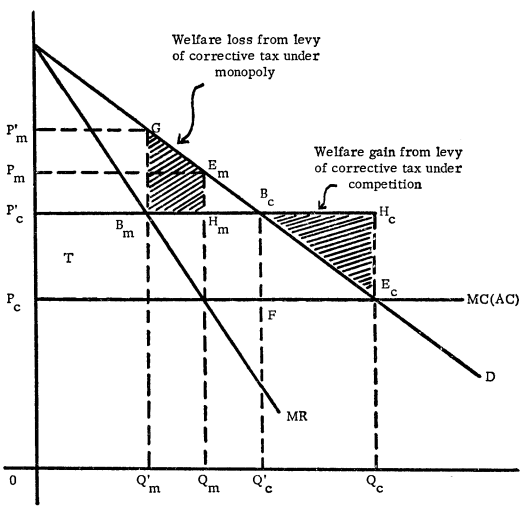

FIGURE 1

[1] Notably, Meade [4].

organized. The firms in the second industry have no legal claims to compensation for damages. Furthermore, for purposes of simplification, we assume that the costs of organizing firms in the second industry for the purpose of bribing firms in the first industry are prohibitive.

Given these restrictions, it is possible to indicate the size of a per unit tax to be imposed on the firms in the externality-generating industry. The orthodox Pigovian analysis suggests that the levy of this tax will induce behavioral changes that will move the economy to the efficiency locus. Let us suppose that the external diseconomy per unit is $P_c'P_c$, generating the unit tax T in Figure 1. Price will rise to P_c', and industry output will fall to Q_c'. How can the subsequent increase in welfare be measured? The rectangle $P_cP_c'B_cF$ represents a true "cost" that was previously treated as if it were consumers' surplus by the buyers of the first industry's product. If the proceeds of the tax are transferred to firms in the damaged industry, this now becomes consumers' surplus to the buyers of the product of this industry. If the proceeds are generally expended in the economy, these become diffused among all persons. Welfare gains and losses occur only with respect to the change in relative industry outputs. The buyers' evaluation of the quantity that was produced before the tax in the externality-generating industry but which quantity is eliminated by the tax is shown by the area under the demand curve over the range $Q_c'Q_c$, or by the area, $Q_c'B_cE_cQ_c$. The "cost" of this quantity to the community is indicated by the rectangle $Q_c'B_cH_cQ_c$. Hence, the welfare gain is shown by the shaded triangle, $B_cH_cE_c$.[2]

To this point, no problems are encountered given the restrictions initially placed on the model. However, let us now assume that the industry that generates the external diseconomy is organized as a monopoly, with a single profit-maximizing firm. Before the levy of any corrective tax, monopoly output is Q_m and price is P_m. As in the competitive case, Pigovian analysis suggests the levy of a corrective tax of T per unit of output. Monopoly output falls to Q_m' and price increases to P_m'.

It is easy to show that, under the conditions as shown in Figure 1, welfare has *decreased*, not increased as a result of the levy of the corrective tax. The cost of the change in quantity is measured as before, by the rectangle $Q_m'B_mH_mQ_m$. The evaluation of the quantity is measured as before, by the area under the demand curve, or by $Q_m'GE_mQ_m$. Since the latter area clearly exceeds the former, welfare has been reduced as indicated by the shaded area. The geometry makes clear that, in this simple case, this result must hold so long as the corrective tax, which we assume to have been estimated properly, is less than the difference between price and marginal revenue at the initial monopoly output.

As I have indicated, the point is a very elementary one. It is a particularly clear example of the theory of second-best. The monopolist simultaneously imposes two external diseconomies, at least in a general sense. He "pollutes" and hence increases costs of firms in the damaged industry. Also, however, he holds down output and hence increases costs of his product to buyers. So long as the second diseconomy is more highly valued than the former, any levy of a per unit tax on the monopolist's output will decrease total welfare. There are gains-from-trade here in two opposing directions, and there is no means of determining a priori which set of "trades" is potentially the more efficient. Conceptually, and ignoring costs of organizing, the firms in the damaged industry could bribe the monopolist to reduce output and thereby to reduce "pollution." At the same time, again ignoring the costs of organizing, the buyers of the monopolist's product could bribe the monopolist to in-

[2] If the damaged industry is identical in size to the industry that is generating the externality, and if demand and cost relationships are similar in the two industries, the welfare gain to the community can also be represented by the appropriate "welfare triangle" in a diagram depicting the situation of the other industry. The danger to be guarded against is double-counting of the same welfare gain in this procedure.

crease output. In some costless three-way negotiation process, the ultimate outcome under conditions such as those depicted in Figure 1 is the corrected equilibrium output at Q_c'.

As the construction as well as the discussion indicates, there is an important asymmetry between external diseconomies and external economies with respect to the possible offsetting welfare effects of market structure. With external economies, the provision of corrective subsidies reinforces the directional change in output that reforms in market structure would indicate to be desirable. In this case, buyers of the monopolist's own product could join forces with firms in an externally benefitted industry to bribe the monopolist to increase output.

As Coase has correctly emphasized, the whole approach of the Pigovian tradition is responsible for many confusions in applied economics that are slowly coming to be clarified. This approach involves an undue concentration on the decision-calculus of the firm or individual that is observed to be generating the external effects. Even if we disregard all problems of measurement, making the marginal private cost as faced by the decision-taking unit equal to marginal social cost does not provide the Aladdin's Lamp for the applied welfare theorist, and the sooner he recognizes this the better.

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A MODIFIED GOLDEN RULE: THE CASE WITH ENDOGENOUS LABOR SUPPLY

I. *Introduction*

The important question of the optimal savings strategy for growth has occupied the minds of economists for some time and has been discussed repeatedly. Of course, any such study is based on a highly aggregated view of an economy with some facets of the real world emphasized and others ignored, but despite the long list of economists who have considered economically determined population growth, this feature has for the most part been ignored. This note is an attempt to rectify this omission by studying optimality when the growth rate of population is allowed to respond to economic factors.

In the standard neoclassical growth model the savings ratio does not affect the equilibrium rate of growth of output (which is equal to the exogenously given growth rate of labor) but rather determines the level of per capita income. Hence, an increase in the savings ratio has two effects on per capita consumption: it both reduces current consumption and increases future output which in turn allows an increase in future consumption. As is well known [4], a savings ratio equal to the share of output going to capital balances these effects and thus defines the highest sustainable level of per capita consumption among all balanced growth paths. But, if population growth responds to economic variables, in particular to per capita income, a change in the savings ratio has a third effect: per capita consumption is altered through the induced change in the