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The Economics of Disamenity

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While expert information on all relevant consequences of any hazard or disamenity is to be encouraged if only because it enables the citizen better to appraise the risks to which he is exposed, or is exposing himself, the determination by experts of norms of social tolerance is always suspect. Certainly the concept of a "tolerable degree" of noise, or for that matter, of stench or pollution or fume, is one that is not acceptable to the liberal economist. It may well be that a particular upper limit for the level of noise does preclude ascertainable physical damage, notwithstanding which, noise below that level can be highly irritating to a lot of people. If a man were subjected at frequent intervals to the gentlest tap on the back of his head, his mounting exasperation would not surprise us. Neither the fact that he was left without bruises nor the statement that this effect was, in some explicable way, an unavoidable by-product of the operation of modern industry, is likely to persuade us that the practice was reasonable. The occasional or frequent bombarding of a man's ears with noise differs only in our being more accustomed to it. If the liberal economist rejects the concept of a tolerance level then, it is not simply because such a level is subjective and necessarily arbitrary, scientific standards of measurement are also vulnerable in these respects, but because any adoption of norms of tolerance on behalf of society runs counter to the traditional liberal doctrine that each man is deemed to be the best judge of his own interest.

This doctrine is, however, more eagerly defended when a man is regarded as a consumer of the products of industry. The mere suggestion, say, that a certain number of luxury goods, admittedly not necessary to the good life, be withdrawn from production would provoke an outcry. Economists are well to the fore even if the issue is no more than that of offering the consumer a cheaper price by removing import restrictions. In contrast, when man is regarded as an agent of production he can be deprived of choice, impelled to switch to less congenial methods of work, or retired from his post, without the economist showing undue concern. And this despite the fact that a man's welfare is more heavily dependent on his circumstances as a worker than on his circumstances as a consumer. As a citizen, also, he can apparently be robbed of choice in things that matter crucially to his welfare without offering much resistance. An originally peaceful and pleasant environment can be eroded over the years without his consent and often without his protest. For men tend to view the

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surrounding environment much as they do the weather, as a phenomenon to which they can perhaps adapt but which, in itself, is outside their control.

Such an attitude is not justifiable. Some framework of law is necessary if markets are to function in an orderly fashion and trade is to flourish. But not all laws are equally effective in harmonizing the search for commercial gain with the welfare of society. The economist interested in social welfare or, more simply, in extending the area of choice to individuals, can do more than offer suggestions to promote a smoother functioning of economic mechanisms or to improve allocative efficiency. At a time of rapid deterioration of the environment he can suggest radical alterations of the legal framework itself as offering significant contributions to the social welfare.

The question of disamenities in general is pertinent here. They give rise to particular economic difficulties inasmuch as they are incidental to the production and consumption of ordinary goods while also being costly to avoid. If, notwithstanding these difficulties, something can be done about them within the existing system of laws, much more can be done about them by changing the system.

DEFINITION OF EXTERNAL EFFECTS

External effects, frequently referred to as "spillovers" or "spillover effects," first appear as external economics in Marshall's *Principles* in connection with a competitive industry's downward sloping supply curve. Put briefly, Marshall's argument was that if, as the industry expands, the economies made possible by an additional firm are enjoyed by all the intra-marginal firms also, the incremental cost of the output of the additional firm will be below the costs borne by that firm by an amount equal to the total saving of the intra-marginal firms. If the industry's output is determined at the point where market demand price is equal to average inclusive cost, it would be "too small." The correct output would be reached by constructing a supply curve marginal to the industry's supply curve, choosing an output at which demand price is equal to the marginal cost of the industry. This concept of external economies was extended to diseconomies, and both external economies and diseconomies were seen to apply not only as between firms within an industry, but as between industries within the economy. Moreover, these external effects were not confined to firms or industries; they could take place between persons or groups and, more pertinent to our inquiry, between industries or firms and persons.

Thinking in terms of the impact, say, of noise, or smoke on other firms or on the public at large, one is prone to describe an external

effect in terms of the response of a firm's production or a person's utility to the activity of others. But the statement that a firm's output or a person's utility can be influenced by the activity of others can apparently be true within the context of any general equilibrium system. The equilibrium set of prices that emerge from such a system is the result of the combined economic behavior patterns of individuals along with the distribution of given factor endowments and technical knowledge. Any exogenous change, say an alteration in the behavior of one or more persons, is able in principle to change the equilibrium set of prices, thereby affecting the utility levels of all people and the outputs of all products.

Notwithstanding this Walrasian interdependence, an equilibrium reached by universally perfect competition (possible with production functions that are everywhere homogeneous of degree one) is, it is believed, consistent with Pareto optimum. Any exogenous change in such a system simply moves the economy from one Pareto optimum to another, and these alternative optima cannot be ranked in the absence of some social welfare function.

In contrast, the equilibrium reached by universal competition in the presence of external effects is not, in general, consistent with a Pareto optimum. The equilibrium reached being non-optimal, implying that some can be made better off without others being made any worse, the economist feels justified in calling for the corrections necessary to attain optimum. One is, therefore, compelled to recognize that the essential condition for the existence of an external effect is not simply that the total output of a good or a person's total utility depends upon the behavior of others, which, as stated above, is true in all general equilibrium systems,[1] but that the shape of the relevant production function itself, or the consumption function itself, depends directly on the activity of others.

The necessary condition for an external effect on A to arise is, whether A is a person, or a firm or an industry, and whether the function is therefore a utility or a production function, the quantities absorbed or produced by others. For other writers, the definition of an external effect turns on welfare or production effects that are wholly or partially unpriced. For yet other writers, the definition is broader yet and comprehends any feature believed to deter the system from attaining optimality.

Definitions are, in the last resort, arbitrary, but they achieve currency as they serve the purpose of communication and as they facilitate analysis. My present position is that of adopting the notional

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1. Except in those special cases in which all production functions and all consumption functions are homogeneous and identical.

definition in which person A's utility function (or firm A's production function) is affected by variables over which B, but not A, has control. At the same time, and in accordance with the popular conception, I interpret it as an effect on A's welfare (or firm A's output) produced only incidentally by B in pursuit of some legitimate activity.

The external effect, or spillover, then, ceases to be one when it is no longer incidentally produced by B, and uncontrolled by A; i.e., when it becomes internalized either by a merger of A and B or through the pricing system. The question of "correct" pricing is still relevant if we are interested in optimal allocation. But we can still maintain that once taken into account, through the merger or through the price system, it ceases to be an external effect. It is taken into account by both A and B. To require that it be priced "correctly" before moving it from the category of external effects is to discriminate restrictively against such an effect. The value of any commodities and discommodities is also improperly priced, as a result of monopoly, monopsony, misinformation, and taxes. And clearly the fact will have a bearing on resource allocation. Yet these commodities and discommodities are generally regarded as being internal, or endogenous, to the economic system. They may then be somewhat over- or under-valued, notwithstanding which, they are bought and sold, and otherwise enter the calculus.

IMPLEMENTING THE OPTIMAL CONDITIONS

The economist's interest in spillover effects is directed in the main to those that *vary positively* with the outputs of specific sorts of goods. We shall confine this interest further to external effects running "one way," from one industry to another or from industry to the general public. We shall not elaborate the conclusions for reciprocal spillover effects, these arising from the activities of each of two groups, each spillover effect falling on the other group. Since we are concerned here with spillover effects arising from the operation of some industry on the public at large, we shall develop the analysis within the more popular context of non-reciprocal spillover effects that vary positively with output.

The "traditional" remedy for such spillovers is the tax-subsidy one, associated with the great work of Pigou. The simplest proposal is that of imposing an excise tax on the output, or of offering an excise subsidy for reductions of output, of a good that generates an adverse spillover effect. *Per contra,* for a good that generates a favorable spillover effect the proposal is for an excise subsidy on its output or for

an excise tax on all units beyond equilibrium by which output falls short of optimum.[2]

Several minor structures can be readily granted:

(1) There is the depressing second-best theorem which says that connecting one or several sectors for spillovers or other imperfections cannot be sure of improving the economic position as a whole—apparently it is "all or nothing." However, under realistic conditions, the curtailment of sectors generating substantial spillover effects can be justified.

(2) If an optimal excise tax is imposed on the output of a polluting industry and the tax proceeds are not handed over to the pollution victims, there is an incentive for the latter to bribe the owners of the industry to reduce output still further. If they do so, however, the resulting output becomes smaller than optimal. Clearly the government has to take measures to prevent this happening.

(3) Pigou, it is sometimes alleged, failed to make explicit the duality of the tax-subsidy remedy. It should be manifest, however, that the government, instead of imposing a tax on the production of each unit of a good equal to the cost of the damage arising from it, could just as well have offered an excise subsidy calculated in the same way but one paid to the industry for each unit withdrawn from production.

The duality of the negotiated solution should also be made explicit. In the absence of an injunction prohibiting the damaging spillover, the victims, as indicated above, have an incentive to bribe the industry to contract its output. If, however, such spillovers were instead prohibited by law (though being allowed by law if all parties affected agreed to bear with them) the firm could successfully bribe the victims with its profit per unit, thus enabling it to produce a smaller output than before, which, however, would also be an optimal output.

(4) Not enough attention was paid to the costs of collecting the information necessary to estimate the costs of the spillovers, and to make all the administrative arrangements incidental to securing the optimal output through taxes or subsidies. If such costs unavoidably incurred in attaining an optimal output happen to exceed the hypothetical (costless) net benefit obtained by the movement to optimal output, there will be in fact a residual loss in moving to the optimal output. Analogous remarks apply in the negotiated solution: the actual costs of reaching agreement may well exceed the hypothetical (costless) net benefit.

2. Actually, conventional tax-subsidy symmetries—reducing market output by excise subsidies; increasing market output by excise taxes—are not feasible in competitive industries, unless the government deals with each of the existing firms separately.

(5) Again, not enough attention was given to spillover reme-
dies other than that of correcting outputs. Preventive devices, the
movement of part of the industry, or part of the affected
populations, might well offer less costly alternatives.

Until recently the consensus among economists arising from
consideration of the above points was somewhat complacent and can
be summarized as follows:

(a) That the optimal position was uniquely determined irre-
spective of any legislation concerning the responsibility for
spillover. Whether the law was permissive with respect to the
specific spillover and the curtailment of output through an excise
subsidy was the more appropriate measure, or whether the
government frowned on spillovers and was therefore inclined to
impose excise taxes, was held to be a matter of indifference so far
as allocation was concerned. Similarly, in the absence of govern-
ment intervention, if the victims of spillover bribed the manufac-
turers to reduce output, or, alternatively, the manufacturers were
compelled to compensate the victims, the resulting output would
be the same, and optimal, in both cases—always ignoring the
possibility that the costs of agreement and administration might
exceed the net benefits. One concluded that the question of who
compensated whom in such conflicts of interest had no bearing on
the allocative problem.

(b) Nor apparently could this matter of who should compen-
sate whom be settled by considerations of equity. If, for example,
the smoke produced in the manufacture of soap damages the
interests of the inhabitants living within the locality of the soap
works, so also does the curtailment of soap output (or the
compulsory installation of anti-smoke devices) damage the inter-
ests of the manufacturer. The interests of the two parties are
mutually antagonistic, and only the misuse of semantics can
detract from the symmetry with respect to equity.[3]

(c) Whether the problem of compensation was to be resolved
one way or another, or whether a tax or a subsidy was deemed the
more appropriate corrective, made a difference only in the
resulting distribution of welfare. More controversial is the view
that a potential Pareto improvement—an excess of gains over
losses (using the market prices)—is a sufficient criterion for an
economic improvement. This criterion, however, is implicit in
cost-benefit analysis. The criterion implies that any alteration in
the distribution of welfare resulting from its implementation can

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3. This view seems to have arisen from too exclusive an attention to spillovers as between
firms, where it is more plausible, though it has been thoughtlessly extended to cases involving
disamenities.

only be the subject of political judgments from which the economist is absolved.

(d) Finally, whatever the legal position, the party suffering from damages, under permissive law, the spillover victims, and under prohibitive law, the manufacturers, has a clear interest in trying to bribe the other party (the law permitting) to modify the initial "uncorrected" output. It is plausible to believe that the costs of such negotiations are not strongly related to the size of the output produced or curtailed. At any rate, if we suppose this, the costs of such negotiations being in the nature of overheads, the attainment by negotiation of an optimal output requires that such costs be less than the maximum total bribe (equal to the hypothetical net benefit) that can be offered by either party. If such negotiating costs do, however, exceed this maximal bribe, no modification of the initial "uncorrected" output can take place. The consequent maintenance of the status quo is then to be justified on the grounds that the potential gains (the hypothetical net benefit) from the change to optimum is less than the total potential losses (the negotiating costs). Since these negotiating costs are real enough, inasmuch as they involve scarce time and other resources, the change in question would not be, over-all, a true potential Pareto improvement, but would in fact involve a residual real loss to the community.

By such reasoning, along with the perhaps inevitable reflection that the fact of no approach having been made by the victims of spillover to negotiate with the spillover-creating industry might be taken as *prima facie* evidence that potential costs exceed potential gains, economists found themselves perilously close to the ultra-conservative conclusion that what is, is best. For the rest, one was to await the advent of innovations, technical or institutional, which would reduce the costs of preventive devices or the costs of negotiation and administration.

These fairly widespread beliefs outlined above must now be subjected to critical examination, which process requires that we first clarify the economic concept of exact compensation.

THE CONCEPT OF EXACT COMPENSATION

The notion of a potential Pareto improvement, an economic change such that everyone, via costless transfers, can be made better off, is given precise expression by the algebraic summation of the compensation variations (CV's) of all persons affected by the change in question. If for example, person one benefits from the change to the extent that he would pay a maximum of $50 to secure it, his CV is measured as +$50. If at the same time some other individual, person

two, loses from the change to the extent that a minimum of $40 has to
be paid to him to restore his welfare to its original level, his CV is
measured as − $40. If only these two people are affected by the
change, the algebraic sum of their CV's is (+50 − 40) or +10, and the
change entails a potential Pareto improvement. For person one can
wholly compensate person two for his loss of $40, and yet himself
remain with a gain of $10, which net gain can of course be distributed
in any way. If now we suppose the reverse is true: if person one's CV
is only + $40 and person two's CV is − $50, the algebraic sum becomes
− $10, and the change entails a potential Pareto loss.

The CV is, therefore, defined most generally as a measure of the
money transfer, either to or from the individual, which, following
some economic change, maintains his welfare at the original level.

The rule that no economic change be allowed unless it realizes a
potential Pareto improvement, unless the algebraic sum of the CV's is
positive, is widely accepted among economists. Indeed, it is generally
believed that the operation of a good price system ensures that all
changes meet this condition. Suppose, however, that for one reason or
another, the price system is defective in the particular sense that an
economic change is brought into being which is not a potential Pareto
improvement, can we not discover this after the change and therefore
reverse the change?

To answer the question let us review the second example above in
which the economic change produces a CV of − $50 for person two
and a CV of + $40 for person one. The algebraic sum being − $10.
Clearly the change should not have been made. But if it has been
made, the economist reviewing the situation might expect to discover
that person two would now pay $50 to reverse the change and return
to the status quo ante. His expected CV for undoing the change would
be equal to + $50. *Mutatis mutandi* person one whose CV for the
change was + $40 might be expected to require no less than $40 in
order to forgo the change. Person one's CV for undoing the change
would be − $40. If the economist's expectations are correct, and this
sort of symmetry obtains, a return to the status quo ante produces an
algebraic summation of CV's of + $10 which entails a potential Pareto
improvement. In a partial analysis we might wish then to conclude
that the correct outcome is unambiguous: if a mistake does occur for
one reason or another, a careful review by the omniscient economist
will reveal the mistake and discover that the initial position was the
better one. In general, any optimal outcome we might wish to
conclude is unique, and any potential Pareto improvement (a
potential Pareto loss) is unambiguous.

This is true, however, only if the effects of the changes in question

on people's welfare is negligible or if the difference made to the CV by large changes in the level of welfare is negligible. Since the disamenities we are concerned with are those having large effects on people's welfare, we need only make the plausible assumption that people's CV responses to these large welfare changes are "normal" to destroy the desired symmetry of response, and therefore destroy the uniqueness of Pareto optimal outcomes and unambiguity of Pareto improvements.

If a person has "normal" or positive welfare effect for a good, a rise in his welfare raises his demand for that good which, in turn, implies that the maximum sum he will pay for any given amount of it, or, alternatively, the minimum sum of money he will accept to forgo this amount of it, will increase. This proposition has the further and crucial implication that the maximum sum as CV he will pay for a thing is generally less than the minimum sum as CV that will induce him to part with it, at least this is true if he comes into possession of it without having to pay the maximum sum for it (since in that case the level of his welfare with possession is above that he enjoys without its possession).

In the light of the above information let us return to the above example which can be made more specific by identifying person one as an inveterate cigarette smoker and person two as a non-smoker allergic to cigarette smoke. The two persons have the misfortune of having to share a one-roomed cabin for the night and the change contemplated is (a) that of an agreement not to smoke if, initially, the law permitted smoking, or (b) that of an agreement to smoke if, initially, the law prohibited smoking in the absence of consent by all in the cabin. Consider situation (a) first. The information about CV's is summarized in the first row of Table I below:

	State of Law	Smoker's CV	Non-Smoker's CV	Algebraic sum of CV's
(a)	Permissive	−50	+40	−10
(b)	Prohibitive	+45	−50	− 5

Since the law permits smoking, it is up to the non-smoker to try to bribe the smoker who is willing to refrain for a sum not less than 50. Since he is to receive this sum as compensation for the change, his CV is entered as − 50. But the maximum the smoker will pay to change the smoke-permissive situation is 40, and his CV is accordingly + 40. The algebraic sum of these two CV's is − 10, which is to say that the non-smoker's offer falls short by $10 of the $50 demanded by the smoker. It follows that the change should not be made. It is not possible to make either as well or better off without making the other

worse off. We conclude that the existing smoke-permissive arrangement is optimal.

Now suppose the Government changes the law to one of no smoking in the absence of agreement of all parties. Initially the smoker's welfare is increased, that of the non-smoker decreased, and their respective CV's are revised accordingly. The non-smoker will not be persuaded to give up his new right to clean air for less than $50, hence – 50 for his CV is entered in the (b) row. The smoker, who is worse off inasmuch as he has lost his right to smoke, will offer to pay only $45. The algebraic sum of the two CV's is now – 5, and we are impelled to conclude that the existing non-smoking situation is optimal.

The apparent triviality of the example and the deliberate exclusion of any alternative arrangements[4] or compromises[5] do not detract from its allocated significance, namely, that what is optimal depends upon the law. If in a market economy the law placed no checks on spillover effects, it may be possible to show that the losses suffered by the victims as judged by the maximum sums they are willing to pay to remove some given quantum of spillover, their CV's under the spillover permissive law, is smaller than the gains to the manufacturer as judged by the minimum sums they are willing to accept. But, as indicated in the preceding example, a change to a spillover-prohibiting law benefits the erstwhile victims and causes their CV's (as minimal sums they are willing to accept) to be revised upward, may reveal that manufacturers of that amount of goods, along with their spillover effects to be uneconomical. The relevance of this thesis grows with the range and magnitude of adverse spillover effects produced by economic activity.

There is another feature of this concept that calls for greater care than has hitherto been exercised in this interpretation. The CV is a partial concept. It measures the worth of a single change or combination of changes in a person's welfare in terms of money or commodities. The CV is then properly regarded as a function of the availability and/or the prices of the substitutes for the good in question. The maximum a man will pay for a license to buy as much as he wants of, for example, electricity at a given price becomes larger the higher the prices of other things, in particular those of gas

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4. Such as the conditions under which separate facilities for groups with opposing tastes are preferable to an optimal arrangement within a single precinct or area. This separate areas argument is developed in my *Costs of Economic Growth*, (1967).

5. By breaking up the total length of time into smaller and smaller intervals we can, under familiar assumptions, determine an optimal "output" interval of smoking, but again under a smoke-permissive law this optimal time interval will be larger than that under a law that required unanimity before smoking were permitted.

or oil. Similarly, the maximum sum a man will pay for a motor car will increase as public transportation becomes less efficient. His CV appears largest if all alternative modes of travel have disappeared. It becomes possible, therefore, for an increase in a motorist's CV or "consumer's surplus" to be associated with a reduction in his welfare as other forms of travel, say public transport, become less efficient or become unavailable. If quietness, specifically the absence of engine noise, is disappearing over the whole country, the maximum a person will pay to move to a location free of noise-infestation (as also the minimum he will accept to give up the location) will therefore grow. *Per contra,* as there are ready substitutes in the shape of accessible villages and small towns free of noise, his consumer's surplus appears smaller. Similarly for the case of aircraft noise, the magnitude of the spillover, as measured by compensatory payments, appears smaller if there are available to the victim of aircraft noise assured havens of quiet.

This transparent, though often neglected consideration, makes one sceptical of the value of any scheme that would calculate the social costs of disamenities by reference to differences in property values. Assume for the present that people's response to aircraft noise is uniformly sensitive. The difference in property values, say house values, normalizing for type of house and for site advantages (other than quiet) within zones, will depend on their accessibility to quiet areas. For example, we can suppose there was a time when all aircraft noise was evenly spread and localized within a circle (or ellipse[6]) of one mile across. Houses that had already been built within the circle depreciate in value once the airport is established. The difference in the value of houses within and outside the circle could then be taken as an exact measure of the CV,[7] the minimum sum the exposed family will require to maintain its welfare at the level enjoyed before the construction of the airport.

If, with the passage of time and the build-up of the airport, noise increases and spreads out in concentric circles of diminishing intensity then, assuming that, noise apart, people are indifferent to location, differences in the market values of houses can still be used as an exact measure of required compensation. But if now aircraft noise extends so that no house in the region is free of it, then the houses that are least exposed will command the highest market value even though the

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6. The actual shape depends on a variety of factors which, though they complicate the calculation, make no difference to the argument in the text.

7. The removal of the assumption of identical tastes does not alter the broad conclusions, although the quantitative estimates will obviously depend upon the differences in reaction to noise. If practical considerations require a system of uniform compensation, some families may receive too much and some too little.

noise is appreciable, whereas, when there had been a completely quiet zone, such houses were valued at but a fraction of the highest market value. Once quiet zones disappear and noise spreads, the differences in market values become smaller notwithstanding the decline in general welfare.

Thus the volume of noise in each of the bands separated by concentric circles could double without any alteration of the differences in market value. Furthermore, as the volume of noise moves out uniformly, the differences in market value can tend to zero.

Under such developments differences in market value cannot be used as a basis for estimating the cost of aircraft noise to society. The true social cost can only be calculated by reference to the hypothetical noise-free situation. An exact measure of the social cost of aircraft noise is the sum of the CV's,[8] an aggregate of the minimal sums acceptable to all persons affected, to persuade each of them to bear with the noise experienced when the alternative offered is no noise at all.

If these costs of aircraft noise, so calculated, cannot be covered by the maximum net revenues of the relevant airlines[9] after aircraft have been fitted, where possible, with anti-noise devices, the continued operation of the airlines is untenable on the Pareto criterion. The search to meet the Pareto criterion without abandoning the air services would involve experiments in curtailing the noisier planes and re-routing others over less densely populated areas in the endeavor to reduce social costs to the level at which they could be covered by the revenues.

There are obviously practical difficulties in attempting to estimate this exact measure of noise-infestation, even if the authorities are prepared to engage in sample surveys. But we shall not discuss them here.[10]

TRANSACTION COSTS

The preceding sections served to illustrate how an alteration in the law, from being permissive of noxious spillover effects to being

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8. To be pedantic, one should say the *algebraic* sum of the CVs to include any persons whose welfare is enhanced by the noise.

9. This maximum annual net revenue may be taken roughly as the area between the demand curves and the long run marginal cost curves of the airline corporations less annual costs of the air terminal they incur.

10. If one can convince the person interviewed (a) that if people are ready to *pay* enough something definitely will be done about aircraft noise, and (b) that whatever the formula reached it will be applied impartially on a per capita or income basis, one could hope for useful estimates of the maximum sum people are ready to pay. Such sums must be regarded, nonetheless, as being underestimates (i) because it is reasonable to expect that something more than these declared maximum sums could be squeezed out of any person, and (ii) because even if they were accurate, such maximum sums are smaller than the minimal amounts they would be prepared to receive. And it is the latter sum that is the compensating variation we are after.

prohibitive of them, acts to redistribute welfare among the opposing groups thereby altering the values of their respective CV's and making possible a reversal of the conclusion about optimality. In particular, if the law is tolerant of spillover, the establishment of a spillover-creating project, say a highway or airport, can be shown to be a Pareto improvement whereas if the law discountenanced spillovers. Then the establishment of such a project emerges as a Pareto loss.[11]

So far the costs of bringing about economic changes have been deliberately ignored. Once we take cognizance of negotiating, administrative and other costs that are unavoidably incurred in effecting economic changes such as correcting a situation or an output for spillover effects, the position of the law with respect to spillovers becomes of critical importance.

Beginning from a situation under the existing law, we have seen that an economic change can be regarded as a Pareto improvement if the algebraic sum of the CV's of all affected parties is positive. If it is positive, its magnitude will be identified as the net benefit (NB) of the change in question. Being the sum by which the gains of one group exceed the losses of the other group, it represents a net dividend which, assuming costless transfer payments, can be shared among the members of the community in any way which would make all of them better off.

Obviously, the NB depends upon the particular Pareto improvement reached which in turn depends upon the law and, to some extent, the bargaining between parties. Although the NB is positive in moving from an original position toward a Pareto improvement, a positive NB is not a sufficient condition for recommending such a movement. Since real costs are involved in negotiating and maintaining the improved position, it is worthwhile incurring them only if they amount to a sum smaller than the NB. The criterion which warrants a movement to a new position is, therefore, that the residual benefit (RB) be positive, where RB is defined as NB – G.

Transactions costs (G) will vary *inter alia* with the number of firms and people involved, with the type of spillover, with the method of moving to a new position, in particular whether the government is to regulate output through a tax-subsidy scheme or whether it is reached through mutual agreement. What is of more concern here, however, is that transactions costs can vary with the law. And even where they do

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11. We also mentioned in passing that if the project in question was not an all-or-nothing offer but one providing a variable output, the existence of a pollution-permissive law would lead the economist to conclude that the optimal output was smaller than it would be under a pollution-prohibiting law.

not vary with the law, they can be large enough to wipe out the net benefits of a Pareto improvement. Their magnitude in such cases is then such as to allow for only polar solutions. Whichever law is in force, the existing situation appears optimal in the sense that the transactions costs exceed the Pareto gains; i.e., NB is positive, but RB, equal to (G − NB), is negative.

Although for heuristic reasons I shall concentrate on the negotiated solution, it should be pointed out that the difficulties pertaining to a governmentally imposed solution via taxes or subsidies has been exaggerated for two reasons: (1) Because of a propensity to deal with the problem in connection with two firms or industries, each of which is assumed to suffer from the spillovers of the other, and (2) because it is taken for granted that continual changes in the conditions of demand and supply over time will require continual revisions of the optimal tax or subsidy.

With respect to (1), however, once the focus of concern shifts from the firm to the public, these reciprocal effects do not arise. The relevant spillover effects move in one direction only: from industry or its products to the public in general, or to the inhabitants of a locality. As for the second difficulty (2), much depends upon whether the government wishes to use taxes or subsidies rather than direct controls on output and upon the degree of refinement anticipated in calculating optimal outputs.

There is something of a law of diminishing returns connected with the latter option which renders it uneconomic to aim for refinement beyond a certain degree. In the case of significant public disamenities, initial reductions of the economic activity promise the greatest benefit. As we reduce the activity further the benefits become smaller and the costs of greater accuracy become larger. One can reasonably expect substantial net benefits by reducing spillover-output up to a point that may be, for example, 20 per cent or even more on either side of the optimal output. Rough comprehensive calculations will serve to capture the greater part of the potential improvement, and just because there is a margin of error, they will not warrant frequent revision.

Since one of the pet propositions of laissez-faire exponents is that, if there is a mutual gain in moving to an optimal output from any initial position, or in having preventive devices installed, there is always an incentive for the parties to arrange to do so. Therefore, government intervention is unnecessary. We shall concentrate mainly on the costs of reaching mutual agreement. For if such costs of negotiation exceed the potential gains (if NB is negative), laissez-faire exponents will

further argue that there is no economic justification for a change from the existing output position.

These transaction costs (G) can be broken down into sub-categories. Let G_1 stand for the costs of negotiating agreement between the parties having conflicting interests over adverse spillover effects. Let G_2 stand for the costs of administration and supervision that are necessary to maintain the mutually agreed solution. And let G_3 stand for the capital outlays, if any, required to implement the agreement in question.

The G_1 costs would appear to be the more significant of the three, and those more likely to vary with the law on legal liability, at least for the case of environmental spillovers suffered by the public at large. Under the existing pollutant-permissive or L law these costs would include for the public, (a) the costs associated with taking the initiative, plus the costs (b) of identifying the victims of the spillover effects in question; (c) of communicating with each of them; (d) of persuading enough of them to agree to the idea of making a joint offer to the spillover-generating industry; (e) of reaching agreement among themselves on the sums to be offered to that industry; and also on the contribution toward these sums to be made by each of them, and (f) the costs of negotiation with the industry.

Once the representatives of the public approach the industry, a favorable response will involve it in a parallel breakdown of expenses. Thus, there will be the costs (b') of identifying the firms responsible; (c') of communicating with each of them; (d') of persuading the firms to consider accepting an offer from the public; (e') of reaching agreement between the firms concerned about the sums acceptable for their cooperation, and also about the formula on which any agreed sum is to be shared among them; and (f') of negotiation with the representatives of the public.

It would seem that such costs are much higher for the public than they are for the industry. For instance, the costs (b), (c), (d) and (e) for the public will increase rapidly with the numbers of spillover victims and with their dispersion over the affected area, whereas, for the industry the costs (b'), (c'), (d') and (e') will not increase so rapidly with numbers. For the numbers involved are small (it may be only a single firm), and they tend to be concentrated within an area rather than dispersed over it. Moreover, reaching decisions on behalf of their stockholders is a routine matter for business executives.

This difference in the G_1 costs as between the public on the one hand, and the spillover-generating industry on the other is, however, of incidental interest. The relevant question is whether, taken

together, they are likely to be any less under a pollutant repressive or $\bar{L}$ law than they are under the existing L law.

Under the $\bar{L}$ law, the initiative has to be taken by the spillover-generating industry, and the sequence is reversed. The breakdown of the costs incurred by the industry in preparation for an approach to the public is in the order (b'), (c'), (d') and (e'), and they now have reference to the industry's making an offer, rather than to its accepting one. Once it is approached by the industry, the public has to incur costs (b), (c), (d) and (e), before being ready to negotiate. This breakdown of costs now having reference to the acceptance of offers made to them.

Ignoring for the moment the costs of initiative (a), it is hard to give convincing reasons for expecting that any of these items should be markedly different under one form of law as compared with the other, an exception being item (d). The cost of persuading a large enough number of spillover victims to accept the idea of *making* a joint offer to the industry under the L law is sure to be much heavier than that of persuading them under the $\bar{L}$ law to accept the idea of *receiving* a joint offer from the industry. In contrast, for (d') the cost of persuading each firm under the $\bar{L}$ law to accept the idea of making a joint offer to the public is virtually nil, and it is likely to be the same for persuading them under L law to accept the idea of receiving a joint offer from the spillover victims. For the firms' financial interests are foremost in the minds of their business executives, and virtually no persuasion is required to ensure receptivity to a scheme, under either law, which may add to their profits. If this argument is valid, the G_1 costs will be heavier to some extent under the existing L law than they would be under an $\bar{L}$ law.

The question of initiative in (a) has been left to the last because of its crucial importance. If initiative were a good having a supply price, or at least a determinable cost, there could be no argument for intervention so long as the existing law were accepted as a datum. And the fact that a potential Pareto improvement has not been negotiated might be regarded as prima facie evidence that RB was negative. Since this notion of a supply price for initiative is untenable, any inference that known methods of correcting existing polluting economic acitivities must have a negative RB, is in this circumstance unwarranted.

To conclude, from an observation that no agreement has been negotiated, that no agreement *can* be negotiated is a *non sequitur.* If such an invalid argument is accepted there will be an obvious reluctance to admit intervention in the market outcome. One then justifies the absence of mutual arrangements in such cases on the

grounds that the RB must be negative, and the presence of mutual arrangements on the grounds that the RB must be positive. The import of this way of thinking is to rationalize the status quo, and to encourage complacency rather than to draw attention to methods whereby initiative might be made available at a cost by institutional changes. If, for example, a government agency were set up empowered to investigate instances of widespread disamenity arising out of the activities of industry or its products, it might well be able to cover the cost of its maintenance in negotiating optimizing agreements on behalf of the public, whereas in the absence of this agency such agreements might never take place.[12]

Under an $\bar{L}$ law, in contrast, the necessary initiative could be expected to appear. Even if there were resource costs of initiative that could be identified they would not be likely to add much to the costs of routine decision making by a firm. The risks are smaller since under an $\bar{L}$ law the firm can be assumed not to venture into a market without first having reasonably reliable information on the extent of the damages it would inflict on the public. Indeed, a firm under an $\bar{L}$ law is unlikely to invest in plant and machinery for the manufacture of certain goods unless it has reason to expect that, after all economic preventive devices have been installed, it can afford to pay compensation for the residual damages.

Although, in view of the above considerations, it may be thought improper to talk of the resource costs of initiative, in order to remind ourselves of the decisive importance of the asymmetry revealed under the two types of law, we could include it with the other G_1 costs by attributing to it a hypothetical figure. That figure would be the minimum sum that would induce someone to take the initiative and to bear the risks of failure such initiative entails. We can then continue to associate the larger G_1 costs with a movement toward optimality under the L law as compared with the $\bar{L}$ law.

The neglect of this association of greater difficulty, or larger transactions costs, in reaching optimality under an L law than under an $\bar{L}$ law would appear to be another of the consequences of the common addiction of confining examples of spillover to those between

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12. Allowing that the idea of making an approach to the industry in question occurs to a private individual, or to a number of them, the risk of failure at any of the stages (b) to (f) grows with the numbers of the victims and their dispersion. Apart from the sense of civic satisfaction and the change of gain from publicity, the benefit to the initiating party is no more than the difference between the maximum he (or they) would pay to reduce the spillover and what he (or they) actually pay(s) including his share of all costs in trying to reach agreement. This limited benefit has to be set against the risk of irrecoverable loss of expenses and the certain loss of time and effort until such time as he succeeds, if he does, in setting up a representative organization to reimburse his expenses, after which the organization itself and the wider membership have to risk losing their money.

firms or industries. For such cases, the tacit belief that the magnitude of G would not be much affected by a change in the law may be justified. Such a belief would not be justified, however, in those instances where the spillover generated by private industry falls on the public at large. For such instances, there are reasons for believing that the magnitude of G is larger under the L law than under an $\bar{L}$ law. The significance of this proposition, along with the recognition of the practical importance of the magnitude of G under any sort of law, may now be indicated for the three cases that exhaust the possibilities.

First, the case under which either kind of law, L or $\bar{L}$, the RB is positive. In such instances a Pareto optimal arrangement emerges under either law. If output is variable, we may infer that (assuming "normal" welfare effects) the optimal output will be smaller under the $\bar{L}$ law.

However, the relative size of the RB is significant only if we start from the same non-optimal output in the two cases. Here, we reach an optimal position by starting from different bases: from a larger than optimal output under the L law, and from a zero output under the $\bar{L}$ law. If we are indifferent as between the L law and $\bar{L}$ law optimal positions, the only remaining considerations are the transaction costs which are likely to be heavier under the L law than under the $\bar{L}$ law. For such cases, therefore, there is a presumption in favor of $\bar{L}$ law.

The second case is that for which the RB is negative under one type of law and positive under the other. Thus, it is possible that under existing L law, the RB is negative while under the $\bar{L}$ law the RB is positive. The reverse, however, is no less possible, even though transactions costs are assumed to be lower under $\bar{L}$ law. In the absence of empirical knowledge nothing can be said in favor of either law for this second case.

The third case is that for which under either kind of law the RB of a movement to a potential optimum output is negative. Accepting the L law as it is, one can do little more than wait for those innovations in technology or administration which allow of a reduction in the costs of preventive devices or in negotiation costs, etc. If, however, we have a choice between adopting L law or $\bar{L}$ law, we have in effect the choice between "too much" of the spillover or "too little" respectively. But allocative considerations apply here also. Since the magnitude of the G costs prohibits an optimal output under either law, we have now to compare the two polar solutions realized under the alternative states of the law. These solutions are the unconstrained market output of the spillover-generating product under the L law and a zero output under the $\bar{L}$ law.

If the NB of moving from an unconstrained market output to a zero output was positive (using familiar economic geometry if, for the demand and supply curves appropriate to each law, the triangle to the right of the optimum point were larger than that to the left), the $\bar{L}$ law is better. If, however, the reverse is the case, the L law is the better.

In the absence of information on the costs placed by people on spillovers there can be no firm reason to suppose that, at any moment of time, one type of law is superior to the other for this third case. However, there is one general consideration which tends to favor the view that, over time, the changeover to $\bar{L}$ law would result increasingly in potential Pareto gains. Output per capita in the West is rising over time. Included are goods whose use and/or production generate noxious spillovers. Apart from changes in technique which, under the existing L law, may raise or lower spillovers, we could say that spillovers are increasing in at least the same proportion as GNP, but probably in greater proportion, since the "growth industries," automobiles, plane travel, chemical products, tourism, nuclear power, motorized lawn-motors, diesel saws, pneumatic drills, motor boats, etc., are all prolific generators of spillovers. The additional goods per capita produced by the economy taken as a whole are subject to diminishing marginal utility. Although an x% increase of both goods and spillovers cannot be expected at all times to make a person worse off than he was before, the point will come when, if he has the choice of either the consumption of the good (along with the spillover generated by everyone's consumption of it) or going without both the good and the spillover, he will opt for the latter.

We may conclude then that there is, on balance, a presumption in favor of $\bar{L}$ law on allocative grounds alone.

The presumption in favor of $\bar{L}$ law gains strength in passing from a partial analysis to a more general one in which the repercussions of "incorrect pricing" owing to the L law is felt throughout the economy. To illustrate, suppose Pigou's smoky factory initially produces an output that can be optimally corrected under either law, though in fact the L law is in operation. One element in the costs of spillover is the cost to the victims of additional soap. If soap is now produced by an industry that disposes of its waste products in an adjacent stream, the output and price of the soap may remain uncorrected under the L law because of the magnitude of the G costs. However, as in our second case above, we may assume that output and price can be corrected under an $\bar{L}$ law. Under an $\bar{L}$ law there will be a positive RB in reducing soap output to an optimal amount with its price raised to equal its social marginal cost. As a result of the

higher price of soap under the L̄ law, the optimal output of the smoky factory will be smaller than what it is under an L law.

Nor need we stop there, for there may be intermediate products which enter into the production of goods manufactured by the smoky factory, into the production of soap, or into the production of any goods in the economy, that compared with the optimal situation under L̄ law are under-priced. If so, the outputs of such goods remain larger than their potential optimal outputs under an L̄ law, whether or not they generate spillovers themselves. In so far as any number of intermediate products are under-priced under an L law compared with an L̄ law, not only are the outputs of such products themselves too large, so also are the outputs of all the other goods into which they enter as intermediate products. So also are the outputs of goods which use these former goods as intermediate products, and so on. Thus an "ideal" allocation under the L law (in the RB sense) is consistent with widespread mis-allocation of resources by the lights of an L̄ law.[13]

To sum up, the state of the law affects the optimal position in two ways. In the preceding section we demonstrated that, ignoring all transactions costs, the optimal output of goods having adverse spillover effects differs according to the law. Positing normal welfare effects the optimal output of those goods generating adverse spillovers will be greater with the L law than with the L̄ law, regardless of the bargaining between the parties. In the present section we have argued also that the magnitude of the transaction costs can vary with the law and can be such that an optimal output having a positive RB may be reached under either type of law, under neither type of law, or may be reached under an L̄ law but not under an L law. We concluded that there is a presumption of greater social gain under the L̄ law, and that an ideal allocation in the RB sense under the L law is consistent with a widespread potential mis-allocation under the L̄ law.

These conclusions matter even if a governmentally imposed optimal solution or the installation of preventive devices is being contemplated. A cost benefit analysis showing that a particular project yields a positive algebraic sum of CV's under the L law might also reveal a negative algebraic sum under the L̄ law. Again, although optimal outputs may be economically feasible under either type of law, there is still the question of which optimal output to aim at, the one under an L law, or the smaller one under an L̄ law. There is still a

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13. Beneficial spillovers, which do not entail mutual conflict, remain unaffected by a change from L to L̄ law. Nevertheless our conclusions in the text would need further qualification where the industries involved produced both damaging and beneficial spillovers and the latter were not fully "exploited".

decision to be made, and we must consider it further on other than purely allocative grounds.

FURTHER IMPLICATIONS OF THE LAW

Having established the proposition that the state of the law is a factor in the determination of the optimal output and in the feasibility of its attainment, the question naturally arises, what state of the law, if either, should the economist favor? For although the issue of which law, L or $\overline{L}$, is not within the immediate control of the economist engaged in some cost-benefit study, his choice of which law ought to apply will determine his estimate of the compensatory payments that must be compared with the "profits" of the enterprise, or alternatively with the cost of preventive devices or other methods of reducing the disamenity. In cases where the impact on people's welfare is substantial, as with aircraft noise, the difference between the maximum sum a man is willing to pay in order to rid himself of some economic "bad" and the minimum amount he is prepared to accept to put up with it can also be substantial.[14]

A. Research into Preventive Devices

On allocative grounds we have argued that there is a general presumption in favor of $\overline{L}$ law, law that is prohibitive of spillover unless there is mutual agreement to the contrary.[15] There is, however, a more dynamic allocative argument favoring $\overline{L}$ law. Once the burden of full compensation for spillovers enters into the cost of production or use of a good on a legal par with all other costs incurred in compensating members of the community for disutilities borne, the manufacturer will be immediately concerned with seeking out opportunities of reducing these spillover-compensation costs, as well as reducing his resource costs. For if he does come up with preventive devices that are lower in cost than the compensatory payments they displace, he effects a real saving in the economy at large. A given output is produced at smaller real (social) cost. Under the L law, in contrast, there is little incentive to switch part of his resources from current research into ways of raising quality or reducing product costs, to research into ways of curbing the spillovers that are incidentally produced. Thus the existence of the L law imparts a bias to the allocation of his funds for research and development against

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14. An extreme example brings this out. A man dying of thirst in the middle of the Sahara could offer for a bottle of water that would save his life, no more than his existing assets plus his prospective earnings (above some efficient subsistence level). But this sum would be infinitesimal compared with the sum of money needed to induce him to forego the bottle of water and fatally reduce his chance of survival.

15. This qualification may be removed in particular examples, as we shall see later.

research into spillover-reducing innovations, which implies that, over
time opportunities for substantial social gains would go ignored under
the L law. In other words, accepting the formal assumption that the
entrepreneur allocates his research funds among alternatives accord-
ing to an equimarginal principle, he will under the L law ignore all
the opportunities for social gains which could be made by directing
research funds into the improving of preventive devices. So long as he
is not accountable for spillovers, any allocation of funds into research
to discover better methods of curbing them serves only to reduce his
profits.

B. *Separate Facilities*

In those cases where it remains costly under existing technological
conditions to reduce spillover effects by taxes on goods or by
preventive devices, the establishment of $\bar{L}$ law, which puts the burden
of compensation on the producers of spillovers, provides greater
incentive to promote a separate-areas solution. If there were no
feasible economic alternative under $\bar{L}$ law other than compensating
the victims of aircraft noise, privately owned air lines would seek to
re-route their flights away from well-populated areas. In addition,
they may be able to reduce compensatory payments to some or all of
the remaining victims by offering to offset their costs of movement to
the quieter zones by their re-routing of flights.

If the sales of private planes for business and amusement continue
to expand, as they are sure to do under the existing legislation, a
change to $\bar{L}$ law would provide a greater incentive to industry to
promote the purchase of large areas within which private flying, at
least for amusement, would be confined. For business purposes it
would obviously be uneconomic for private planes to fly outside the
scheduled routes negotiated by the air companies.

Moreover, this notion of a separate areas solution as a superior
alternative to an optimal solution that is effected within a single
larger area is not irrelevant to a cost-benefit study examining a large
variety of alternatives. If the technical possibilities of reducing
aircraft noise are small, there may appear to be no economic case
under an $\bar{L}$ law for permitting a limited number of flights, or even for
the establishment of an airport, other than in some remote part of the
country. For given the distribution of the existing population, the
compensatory payments required from the airline companies to offset
the welfare losses of the population affected may be prohibitive. In
such circumstances, an economic case might be made for more of
such flights, or for a less remote airport, only if the government were

disposed first to set aside reasonably large and viable areas to be designated as noise-free areas and to offset the costs of movement into them.

The separate-areas concept has much wider applications. Prior to a change in the law, any government at all concerned with the welfare of its citizens can take the initiative in a number of fairly radical but realistic experiments. It can, for instance, make a start by promoting a scheme for a number of large residential areas through which no motorized traffic would be permitted to pass and over which no aircraft would be permitted to fly. It may be true, although not likely, that only a minority would care to live in such amenity areas. But the market under existing legislation will never present it with the choice, if only because legislation would be required to prevent aircraft flying within hearing distance of such areas and to prevent motorized traffic from entering them. Municipalities in their turn could do much to improve the pleasantness of the environment simply by keeping motor traffic away from some large shopping centers, narrow roads, cathedral precincts and other places of beauty or historic interest that can be enjoyed only in a traffic-free setting.

C. *Distribution of Welfare*

There may also be a case for $\overline{L}$ law in terms of the distribution of welfare, if it can be shown that the goods which generate spillovers largely earn incomes for, and are purchased by, groups that have higher incomes on the average than the rest of the community. Even in the absence of evidence for this not implausible hypothesis, it is undeniable that the rich have less need of protection from the disamenity created by others. The richer a man is the wider is his choice of residence. If the locality he happens to choose appears to be sinking in the scale of amenity, he can move to a quieter area. He can select a suitable town house, secluded perhaps or made soundproof throughout, and spend his leisure in the country or abroad at times of his own choosing. *Per contra*, the poorer the family, the less opportunity it has for moving from its present locality. To all intents it is stuck in the area and must put up with whatever disamenity is inflicted upon it. And, based on observations during the last decade or two, it is obvious that it will be the neighborhoods of the working and lower middle classes that will suffer most from the increased construction of fly-overs and fly-unders and road-widening schemes designed to speed up the accumulating road traffic. The establishment of $\overline{L}$ law would not only promote a rise in the standards of environment generally, it would raise them most for the lower income

groups which have suffered more than the rest of the population from the unchecked "development" and the growth of motorized traffic since World War II.

D. *Equity*

More important than the distributional implications is the inequity of law that countenances the inflicting of a wide range of damages on others without ready and effective means of redress. In the absence of comprehensive sanctions against trespass on the citizen's environment, existing institutions lend themselves inadvertently to a process of blackmail, insofar as they place the burden of reaching agreement on the person or group whose interests have been damaged. Although the disabilities inflicted on innocent parties may be judged with less severity when they are generated as a by-product of the pursuit of gain under existing laws than when they are produced for the sole purpose of exacting payment, a Pareto improvement is met in either case by a "voluntary" agreement to pay by the party whose rights, liberties or interests, are under threat. Indeed, the virtue of the Pareto principle resides in its alleged neutrality. If person A amuses himself by throwing smoke bombs through B's window but agrees to desist on payment of $10 a week, both are made better off if person B chooses to pay it rather than to continue to suffer these depredations. And though all existing law is directed to preventing calculated blackmail and victimization, there is still this hiatus in the law that enables incidental damage, albeit increasingly severe and lasting damage, to be inflicted on people unless they discover a means effectively of bribing the perpetrators to desist.

It is all the more imperative, then, to perceive a distinction within the notion of ethical neutrality. It is conceived on the one hand as a disregard of ethical implication (which is the sense in which the Pareto principle is neutral), and on the other hand as impartiality between the alternative ways of giving effect to the principle (which is, though mistakenly, the sense usually attributed to it). Thus, whether A successfully compensates B, or whether instead B successfully compensates A, a Pareto improvement is effected. Such interaction is all too frequently believed illustrative of the cardinal virtue of an economic principle that is thought to be above and independent of the law. If the non-smoker's enjoyment is reduced by the smoker's freedom to smoke, so also, it is argued, is the smoker's enjoyment reduced by abstaining for the better comfort of the non-smoker. The freedom of each to pursue his enjoyment necessarily interferes with the enjoyment of the other. It is concluded, therefore, that the conflict of interest is symmetric in all relevant respects, and

the determination of which of the parties ought, if possible, to compensate the other is held either to be of no concern to economics or else something to be settled by reference to the distributional implications.

But a situation may be Pareto symmetrical without being ethically symmetrical. In other words, with respect to the mutuality of conflict it is symmetrical, but it is not symmetrical with respect to the equity. In accordance with the liberal maxim, the freedom of any man to smoke what he chooses, when he chooses, and where he chooses, would indeed be conceded, but with the critical proviso that his smoking take place in circumstances which do not reduce the freedom or welfare of others. In so far as it does reduce the freedom or welfare of others, the freedom of the smoker to smoke is not symmetrical with the freedom desired by the non-smoker, since the freedom of the latter does not go beyond the breathing of fresh air. Unlike the freedom of the smoker, it does not reduce the amenity enjoyed by others. Similarly, the benefits enjoyed by any person as a result of operating noisy vehicles, lawn-mowers, or airplanes do incidentally damage the welfare of those who wish to live quietly. In contrast, living quietly does not of itself inflict any damage on the operators of noisy vehicles. Thus a conflict of interest does not imply equal culpability, at least not when it arises, as it always does in the case of spillovers onto the public, from the damages inflicted by only one of the parties on the other. Unless the law is altered so as to provide comprehensive safeguards for the citizens (which is implied by the establishment of $\overline{L}$ law), any voluntary agreements that might be concluded within the existing L legal framework cannot be vindicated, at least not on ethical grounds, by invoking simple allocative arguments.

Where the welfare effects involved are substantial, it is even more difficult to vindicate on grounds of equity the workings of the market or the implementation of cost-benefit studies. The outcome of such institutions or techniques does not entail voluntary agreements among all persons affected. At this point, it is important to stress the turn in the argument away from allocation toward equity.

In the preceding sections we have confined ourselves primarily to allocative considerations. We have shown how projects admitted as economically feasible under L law could be rejected by $\overline{L}$ law, and vice versa, as a result of both differences in welfare effects and differences in transaction costs. Also we have indicated arguments which lead to a presumption in favor of $\overline{L}$ law. But the principles of resource allocation realized by universal perfect competition in the absence of spillovers and by unambiguous cost-benefit calculations

amount only to the criterion that the algebraic sum of all compensa-
tory variations pertinent to an economic change be positive. Only a
potential Pareto improvement, or hypothetical compensation test, is
met in moving from a sub-optimal to an optimal position, in moving
from one non-optimal position to a "better" non-optimal position, or
in meeting an acceptable investment criterion. Such allocative rules,
or project criteria, are acceptable only so long as their fulfillment does
not alter the pattern of welfare in a regressive or unjust way. In the
absence of spillover effects, a perfectly competitive price system
would meet this condition, if resource costs were constant for changes
in the conditions of demand and supply. Project criteria would also
meet this condition provided the tax system was egalitarian. But in
the presence of spillover effects having a substantial impact on
people's welfare, the condition is not met regardless of horizontal cost
curves or of egalitarian tax systems. Feasible cost benefit studies
which take full account of spillover effects would admit as unambig-
uously feasible projects which inflict on some groups large losses of
welfare without compensation. Those adversely affected could in fact
be a majority. They could be among the poorer income groups. They
could simply be the hypersensitive persons in the community. But
whatever their composition, there is little consolation for them in the
economists' assurance that others are profiting from the project to
such an extent that they, the victims, *could* fully be compensated,
although, in fact, they will *not* be compensated.

Now many new investment projects are of this nature, especially
those involving air and ground transport. The welfare effects are
large, often regressive, and certainly inequitable. I see no reason why
ecomists should feel bound in such circumstances to attach more
importance to allocation than to equity. It is about time we
recognized our strong professional bias in favor of allocative merit
which arises mainly from the historical development of the subject,
and from the intellectual interests vested in elegant mathematical
notation. An era that is witnessing, in the world's most economically
advanced country, the weird spectacle of apparently unlimited
(man-made) goods pressing relentlessly against limited needs is as
good a time as any to promote the primacy of equity as an essential
ingredient of the good life. The guiding maxim I would offer is that it
is more important to prevent avoidable suffering than to create
further opportunities for self-indulgence. For this reason I favor the
enactment of a charter of amenity rights of the citizen, inspired by
the slogan "No pollution without compensation." Once such constitu-
tional changes in the law are enacted and no man can be deprived of
his elementary rights to peace and quiet and clean air without his

explicit consent, then and only then should we be reconciled to the voice of prudence that bids us move cautiously and talks of the prior need for extensive research.[16]

E. Incomplete Information

A change from L to L̄ law transfers the weight of inertia from one side of the economic calculus to the other; from being a force acting to maintain current spillovers to one acting to repress them. If, for a number of significant spillovers, the costs of negotiating and regulating appears to be so great under either law that the RB is negative (the third case in the preceding section) the effective choice boils down to having the market output of the good along with the accompanying spillover under the existing L law, or going without the good and without the spillover under the L̄ law. Because in practice we have to face such all-or-nothing choices, it is worth considering whether the fact that in economic life we have to take decisions without complete information adds further to the presumption in favor of L̄ law.

The increasing pace of technological advance results in a growing time-lag between the appreciation of the immediate and commercially applicable consequences of any innovation and the awareness of additional consequences which come to the public notice only gradually. Some of these latter consequences may far exceed in social damage the initial benefit reaped from commercial exploitation. We are only beginning to consider the cumulative effects on man's health and his chances of survival of the continued use of chemical pesticides and of a large number of pain-killing drugs, of the growing pollution of the atmosphere and of lakes, rivers, and seas with sewage and oils and of radiation hazards from the atomic wastes of peaceful nuclear energy-generation. Even with so common a spillover as noise the effect on people's physical and emotional health is thought to be more serious than the mere nuisance effect usually attributed to it. It is one thing for the medical practitioner to identify and classify an increasing number of bronchial, cancerous, coronary, nervous and psychic disorders. It is another to discover clear quantitative relationships between specific disorders and specific spillovers, even though there is little doubt that spillovers broadly defined do create or aggravate many such disorders. Insofar as the group concerned underestimates the effects on itself of a number of spillovers, the negotiated solution, even where practicable, is not satisfactory. But if,

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16. However, no citizen need incur any expense by bringing charges against a private concern since it will be an offense against the state to produce any of a specified range of spillovers without an official permit (issued say annually).

because of this tendency to underestimate the damage inflicted by current spillovers, economists are able to infer that the resulting outputs under $\bar{L}$ law would still be too large, they cannot, in the absence of quantitative evidence, specify exactly the size of an ideal output. All they may say is that the ideal outputs should be smaller than those being realized, and that in view of the ultimate consequences the ideal outputs of some goods may in fact be zero.

F. *Spillover Effects on Posterity*

Another consideration reinforces the belief that spillover effects tend to be underestimated. Many of the important spillover effects are irreversible. The destruction of the scenic beauty, the poisoning of rivers, streams or the atmosphere may be regarded as permanent in terms of man's life span. The sort of calculation discussed so far places the gains to industry against the loss of amenities suffered by the *existing* population only. If spillovers cause permanent damage the losses suffered by *future* generations must also be brought into the calculus. Once brought in they strengthen the case for government intervention, rather than for negotiation between opposing groups, and for total prohibition of the more suspect spillovers, rather than for their reduction.[17]

SUMMARY AND CONCLUSIONS

(1) Although information about the feasibility and costs of noise-control by engineers and information about the short- and long-term effects of noise on the human condition by psychologists and others is to be encouraged for obvious reasons, the decision to leave to "specialists" the determination of a norm in respect to noise-tolerance constitutes an arbitrary infringement of individual choice. Even if such a norm is determined through the political process, by reference to what is "reasonable" under a variety of circumstances, it deprives people of choice without redress at least as much as if they were to be "reasonably" deprived of a range of currently produced goods on the grounds that they were not essential to people's welfare. I say *at least* simply because the dependence of a person's welfare on amenity, on

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17. Although the thesis of this article has been the economics of adverse spillovers, very little modification is required once the possibility of beneficial spillover effects are introduced. The correction of each type of spillover on its own, at least in conditions under which second-best problems do not pose insurmountable obstacles, makes a separate allocative contribution. Only in those cases in which the production or use of certain goods simultaneously generates both adverse and beneficial spillovers, do we need to modify our results in an obvious way. We must remind ourselves that spillovers are used in the sense originally defined, and do not therefore include benefits that are, in the ordinary way, priced through the market. The major adverse spillover effects, however, would appear to be "pure" cases.

quiet, clean air and a more spacious environment, is likely to be greater than the dependence of his welfare on a good deal of modern gadgetry. Apart from equity, the allocation of "bads" is as much a part of the economic problem as the allocation of goods; and the precondition to any liberal solution of an allocative problem is that people be free to exercise choice.

(2) Within the economist's universe of discourse, disamenities are treated for all allocative purposes as adverse spillover effects that fall on the public. The distinguishing feature of such spillover effects is that they are produced incidentally along with marketable goods. If we ignore "psychic" external effects ("interdependent utilities"), which are in any case left out of all project selection criteria, the remaining tangible spillovers, in so far as they fall on the public, can be shown to be formally equivalent to a collective (negative) good, though one unavoidably produced at zero cost along with private market goods. Like a non-optional collective good, every one sharing a collective "bad" is compelled either to bear with the amount that falls to him or to incur costs in a bid to reduce its incidence. For there is no technical means whereby "property rights" in the relevant amenities can be conferred on each person, and therefore no decentralized market dealing with the transfer of such rights can emerge. An ideal pricing system requires, however, that the marginal cost of these spillovers to society be added to the commercial marginal cost in employing the standard pricing rule.

(3) Until very recently the consensus among economists was that the optimal output of any industry generating spillover was uniquely determined either in a partial or in a general equilibrium setting. The optimal output could be attained by negotiation between the affected parties, by government taxes or subsidies or by direct controls. The choice of tax or subsidy, like the issue of which party in the conflict of interest was to compensate the other, was held to have distributive welfare effects only, but no effect on the optimal outcome or output. However, the costs of negotiating and maintaining an agreed solution, and costs incurred by governments (either in imposing direct controls, or else in calculating and imposing a set of optimal excise taxes or subsidies) involve real resource costs which may exceed the net benefit of a movement from the uncorrected market output to an optimal output. In such cases, the residual benefit is negative, and the already existing position under the prevailing law is Pareto optimal.

(4) However, because of the existence of welfare effects (mis-named "income effects"), which can be significant in cases of disamenity, we have to acknowledge that the maximum sum a person will pay for the acquisition of a good (or for the removal of a "bad") is

less than the minimum sum he will accept to forgo the good (or to bear with the "bad"). Under either type of law the problem of compensation arises whenever a proposed economic change is such that some people's CV's are negative. A proposed change for which the algebraic sum of the CV's is positive entails a potential Pareto improvement under either law.

Caveat—The measure of CV is, *inter alia,* a function of the availability of prices of substitutes. Particular care must be exercised in using differences in the market values of property as a proxy for the measure of compensation, since the growth of disamenity itself is likely to reduce these differences.

The traditional view of the spillover problems, summarized in para. 3 (above), can now be challenged.

(5) Ignoring transaction costs (G), whether or not an NB is possible, and the (optimal) size of the NB where it is possible, depend upon the existing type of law which determines the party in the conflict that is liable to pay for the change in question and the party that is to receive compensation. Even though compensation is hypothetical, its direction, and therefore the optimal outcome, depend upon the type of law.

(6) In moving from a non-optimal to an optimal output, or to one that is closer to optimal, a positive NB is measured as being equal to the algebraic sum of the CV's. But we must now take account of the real transaction costs (G) in reaching an optimal or improved position, whether this improvement is to be brought about through direct negotiation between the parties or through government intervention. Subtracting these G costs from the NB yields the RB, and this can obviously be negative while the NB is positive.

Now these real transaction costs (G) and also the measure and sign of the RB vary with the type of law. In cases of widespread disamenities reasons are given for sometimes expecting the RB of a number of outputs to be lower, if not negative, under $\bar{L}$ law, as compared with the RB under L law. In important cases we can expect the RB of a change to an optimal output to be negative under either law. In that event, an unchecked market output plus its accompanying spillover is Pareto justified under the L law, while under the $\bar{L}$ law the zero-output and zero-disamenity outcome is also Pareto justified.

(7) Since, for the purpose of economic calculation, the adoption of one kind of law or the other can make a substantial, and possibly critical, difference to the outcome of any cost-benefit study, the economist cannot hope to remain neutral. A number of considerations, allocative, distributional and ethical, speak strongly for $\bar{L}$ law as against L law, and are reinforced by the community's growing

awareness of some of the ecological consequences of the by-products of modern industry and transport, and also by the irrevocability of certain forms of social damage.

Returning to the social losses arising from noise and other adverse side effects, there is little to add to what has been said. Some of the pitfalls in their calculation have been uncovered. The principle of estimating compensation to the victims of any residual disamenity as a minimum sum required to restore their welfare has been stressed.[18] But nothing has been said about practical methods for ascertaining the numbers affected by any specific side effect and for estimating the compensatory sums, other than a brief note on the possible uses of a sample survey for obtaining an underestimate of the exact compensation.

For spillovers that elude calculation, or for forming some rough idea prior to making estimates, one can always have recourse to contingency calculations. To illustrate with an extreme example, if the cost benefit study of an airport produced an excess benefit over cost of some $10 million per annum, only by ignoring aircraft noise and the possible increase in loss of life, one could still impress the authorities with the importance of these factors by making hypothetical estimates of losses based on rough calculations of the number of victims affected. Thus (a), if it were reckoned that about half a million additional families could suffer in varying degrees from aircraft noise as a result of a newly located airport, an *average* sum of as little as $20 per annum per family in compensation would wholly offset the excess benefit. Again (b), if the new airport became responsible for added road congestion in the vicinity of the airport, an average additional delay of one hour per week affecting one million motorists would, if valued at 20 cents an hour, wholly offset the estimated excess gain. Similarly for loss of life and other side effects.

Even though the estimate of the number of people affected is speculative, provided it is not implausible, the calculation of the resulting compensatory sums necessary to offset the excess gains may be such as to cast doubt on the economic feasibility of the project. There would be enough doubt at any rate to delay a decision until estimates of these less tangible factors can be made with greater assurance.

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18. It goes without saying that a government which, notwithstanding a negative cost-benefit result, wishes to go ahead with an airport, or wishes to maintain an existing airport or airroute, on the grounds of national defense or "the national interest" would be able to placate any opposition and meet economic principle if it gave evidence of properly valuing the "national interest" to the extent of being willing to compensate all victims of aircraft noise. Equity is also served by this policy, for taxpayers as a whole are made to shoulder the costs of aircraft noise rather than the burden being borne wholly by the victims.

EPILOGUE

There is always a strong temptation for those engaged in cost-benefit studies to come up with firm quantitative estimates, even if it means neglecting the estimation of the more difficult spillover effects which can fairly claim to be significant enough to alter the conclusions, if it were indeed possible to bring them into the calculus. And since these less measurable effects are likely to be adverse spillovers, the common response to this temptation, to yield to it, imparts a strong bias toward favoring commercially viable projects irrespective of their ability to withstand more searching criteria. In the new Establishment such "positive" decisions are unfortunately apt to meet with more approval than a verdict of "not proven." The growth-favored atmosphere of the postwar era does exert a pervasive influence, one favoring "action" in order to meet a "challenge." The challenge generally being the vague feeling that we must push into the future. This influence the economist should resist, both as a matter of professional pride and of obligation to the community he elects to serve.[19]

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19. There are ample opportunities for over-stating gains as well as understating losses especially in connection with swifter means of travel. But one important consideration is to be borne in mind when estimating gains. With the passage of time much of the apparent gains based on the usual calculations will turn out to be illusory. There is no evidence that faster speeds or more available transport results in more leisure. The evidence points the other way. Today people spend more time commuting to work than at any other period in history. There is a marked propensity to over-respond to faster travel facilities, to raise one's expectations unduly, and consequently to become increasingly impatient at inevitable delays. Again, business firms may at first welcome faster travel facilities only to discover later that, like increasing expenditure on competitive advertising, no firm ends up having a secure advantage over the other. All have to spend more to maintain their relative shares of the market.