

# THE SOLUTIONS TO EXTERNALITIES: FROM PIGOU TO COASE

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*In this essay, Andrew Winterbotham provides a well researched account of the development of the theory of externalities, through an assessment of the work of Arthur Pigou and Ronald Coase. The global nature of externalities in the twenty first century is also highlighted, and the author concludes that the Coasean approach is a better solution to the vexing problem of global externalities.*

## Introduction

“...the essence of the matter is that one person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons C, D and E”

Arthur C. Pigou (1924: 161)

The concept of externalities is as relevant to the field of economics as when Arthur Pigou first postulated the idea in ‘The Economics of Welfare’ (1924).<sup>1</sup> Externalities have hugely significant effects on societal welfare. Take for example the positive externalities deriving from education, which not only lead to increased future output but have also been shown to reduce crime (Hillman, 2009). Moreover, it is essential that the negative externalities arising as a result of economic growth, the most fundamental way of improving living standards, are minimised. Paul Romer likens economic activity to cooking in The Concise Encyclopedia of Economics (2007):

“...most cooking in the economy produces undesirable side effects. If economic growth could be achieved only by doing more and more of the same kind of cooking, we would eventually run out of raw materials and suffer from unacceptable levels of pollution and nuisance”.

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<sup>1</sup> Externalities essentially arise as a result of one agents actions affecting the welfare of another. Put simply, every action taken by an individual or firm has consequences for others, either positive or negative, consequential or inconsequential.

The goal of this essay is to discuss and evaluate the solutions to externalities put forward by the two schools of thought; that of the public policy means of taxes and subsidies advocated by Pigou, and the private resolution approach, as advocated by Coase (hereafter referred to as the Pigovian and Coasean approaches respectively). Firstly, externalities shall be defined by way of some history, and then the modern formulation is outlined. The solutions to externalities are then explored. We then highlight the now global nature of externalities, and the suitability of the Coasean approach in dealing with it. At this point it is worth noting that the Coase theorem has drawn criticism from many, but this is beyond the scope of this paper. Nevertheless, as shall be demonstrated, Coase's propositions are still of some policy relevance.

### **The Marshall-Pigou Proposition**

The Marshall-Pigou formulation essentially views externalities as an example of market failure. Market forces, they argued, will lead to insufficient output by industries enjoying external economies and will cause industries with rising supply curves to overexpand. Hence, the Marshall-Pigou prescription is to harmonize private production decisions with government intervention. They advocated taxing the latter set of industries and subsidizing the former (Bator, 1958).

The Marshall-Pigou proposition can be unraveled by making a distinction between 'pecuniary' and technological externalities. A 'pecuniary' externality is said to exist where the actions of one firm inadvertently bid up the factor prices or lowers the price of the product of another (Goldin, 1975; Merewitz and Sosnick, 1971). Technological externalities exist when actions taken by one firm affect the production function of another (Holcombe and Sobel, 2001; Scivotsky, 1954).

Pigou's thoughts on technological externalities are correct, while his proposition on pecuniary externalities was fundamentally wrong. If an industry enjoys external economies, a subsidy should not be required. The implied gains in efficiency are adequately signaled by the input price, and profit-maximizing output levels by the A-firms are socially efficient (Bator, 1958). So unlike technological externalities, pecuniary externalities do not result in inefficiency, and thus do not warrant corrective action. In fact, it is the ability of firms to inflict pecuniary losses that generates efficiency in competitive markets. Efficiency merely requires that people have clearly defined property rights over the ownership of property but not over the market value of that property (Holcombe and Sobel, 2001). We may even rule out pecuniary externalities, as they ultimately arise from technological external economies from

somewhere within the system (Bator, 1958).

### The Modern Formulation

The modern notion of externalities involves “direct interaction”. This may take the form of producer-producer, consumer-producer or employee-employee interaction. Whatever form it takes, it consists of interdependencies which are external to the price system, hence unaccounted for by market valuations. Analytically, this implies the nonindependence of various preference and production functions and its effect is to cause digression between private and social costs (Bator, 1958). For example, if industrial activity degrades the environment, the true cost is not only the cost to the producer, but also the cost to the environment. It is precisely this divergence which leads to an inefficient market outcome.

We may prove this using a simplified variant of the famous production model of bees and apples suggested by Meade (1952), as is contained in Bator (1958). Let us assume a world of perfect competition where a single purchasable and inelastically supplied input, labour (L), is used to produce two homogenous (of degree zero) and divisible goods, honey (H) and apples (A), at nonincreasing returns to scale. The output of A is dependent only on  $L_A$ :  $A = A(L_A)$ . Honey production also depends on the level of apple output:  $H = H(L_H, A(L_A))$ . When we solve the usual constrained maximisation problem for the production possibilities curve, it can be shown that Paretian production efficiency implies:

$$(1) \quad p_H \frac{\partial H}{\partial L_H} = w$$

$$(2) \quad p_A \frac{dA}{dL_A} + p_H \frac{\partial H}{\partial A} \frac{dA}{dL_A} = w$$

where  $p_H$ ,  $p_A$  and  $w$  represent the prices, respectively, of honey, apples and labour<sup>2</sup>

Equation (1) is consistent with profit maximizing and efficiency. Each competitive honey producer will hire labour until the value of its social as well as marginal product equals the wage rate. The apple producer will be inefficient, unless  $\frac{\partial H}{\partial A}$ , that is the cross effect of apples on honey, is zero. Concretely, if apples have a positive external effect on honey output, the market-determined level

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<sup>2</sup> The maximization of  $p_A A + p_H H$  subject to the production functions and the supply of labour, is equivalent to finding the critical value for a Lagrangian expression.

of apple output, will be less than is socially desirable.<sup>3</sup>

Pigou touched on this topic a quarter of a century earlier, arguing that this divergence was sometimes necessary, for the maximization of societal welfare. He used the example of the postponement of the construction of an electric utility to protect a gas utility. If the technological improvement had been allowed proceed, the gain in consumer welfare would offset the loss in the capital value of the gas utility.

## Solutions

### 1. The Coasean Approach

Coase's powerful article 'The Problem of Social Cost' (1960) revolutionized the way the economics profession viewed externalities. In this groundbreaking article, he argued that the Pigovian approach would "lead to results which are not necessarily, or even usually, desirable" (Coase, 1960: 2). The alternative that Coase proposed is perhaps best described using the real life example involving a doctor and a confectioner<sup>4</sup>. The doctor's business was impeded by machinery used by the confectioner and the court forced the confectioner to compensate him.

Coase argued that the same optimum result could have been achieved through private bargaining between the two parties. The ruling dictated that the doctor had the legal right to prevent the confectioner from using his machinery. Intuitively, the doctor would have been willing to receive a payment from the confectioner for him to continue using his machinery, so long as this was greater than the cost to the doctor of moving premises, or building a wall etc. This relates to the fact that Pigou failed to take into account the concept of opportunity cost. If the shoe was on the other foot i.e. the confectioner had the legal right to use his machinery, the outcome would be analogous. The doctor would simply have to pay the confectioner to stop using his machinery. If the doctor's income would have fallen more through continued use of this machinery than it added to the income of the confectioner, then there would clearly be room for bargaining.

Such rearrangement of legal rights through the market would take place whenever this led to an increase in the value of production. When we take transaction costs into account, this will only take place if the increase in production is greater than the cost involved in bringing it about (Coase, 1960). More precisely (despite Coase never explicitly mentioning it), the Coase theorem states the following:

<sup>3</sup> For a more detailed analysis of the private and social costs of these externalities, see Bator (1958)

<sup>4</sup> *Sturges v. Bridgman* 11 Ch. D. 852 (1879)

1. Externality problems are efficiently resolved by assignment of legal rights.
2. The efficient resolution of an externality is independent of who has legal rights.

(Hillman, 2009: 325)

Coase argued, in some respects anticipating the current ‘NIMBY’ culture, that the Pigovian approach is inherently wrong in assuming that building construction is necessarily “anti-social”. It may or may not be. It is necessary to weigh the harm against the good that will result. He claims “nothing could be more “anti-social” than to oppose any action which causes any harm to anyone” (Coase, 1960, 35). Put simply, this would erect barriers that would make any sort of construction work nigh on impossible. The reciprocal nature of externalities had also never been acknowledged beforehand. If the confectioner mentioned above had been using his machinery for years before the doctor set up his practice, then which party deserves compensation becomes more ambiguous.

Coase also alluded to the idea of government failure. He purports that externalities that a government tries to solve are actually caused by governmental action itself (Coase, 1960). Wolf (1987) expands on this argument, labeling them ‘derived externalities’. On the other side of the debate, Grand (1991) argues that government organizations should not necessarily be singled out as being subject to the ‘derived externality’ problem. Any activity, whether undertaken in the public or private sector, has the potential to cause unintended side effects. The effects of certain actions cannot always be adequately predicted, a fact of life to which private organizations are as subject as public.

## **2. The Need for Government and the Means of Public Policy**

The failure of the Coasean approach in certain circumstances (e.g. if a market for Coasean trading simply does not exist or is illegal) is the primary reason for the survival of the Pigovian approach. Civil societies, in a way, efficiently allocate the resources of government, by limiting the sources of externalities that can be declared within the domain of public policy. For example, personal freedoms can be taken away only in cases threatening public health or security i.e. for the containment of a contagious disease. People speaking with a certain accent say do not meaningfully impinge on the welfare of others and so corrective action here is neither desirable nor necessary.

The motivation for Pigovian taxes stems from the belief that a corrective

tax on producers forces them to internalize the external cost. This therefore causes them to produce at the point which cost-benefit analysis has deemed to be the level of output that corresponds to an efficient outcome for society i.e. where societal welfare is maximized. Changing the behavior of the firm through a Pigovian tax however may give rise to the substitution effect, creating a deadweight loss; the sum of the lost producer and consumer surplus. In its defense however, it has been argued that technological innovation may occur as a result of a Pigovian tax on producers, encouraging or even forcing them to innovate (Hillman, 2009). This will arguably even generate positive externalities. For example, it may lead to the discovery of breakthrough technologies that facilitate greater productivity, along with reduced pollution. Furthermore, recent research has proven that that a federal tax on alcohol in the US reduced deaths by 4.7%, or almost 7,000, in 1991 (Cook and Durran, 2011).

### **3. Other Means**

Approaches other than the aforementioned are of limited policy relevance and by no means offer a 'catch-all' solution. The confectioner described above, for example, may decide to be incredibly considerate and moderate his use of the machinery. Conversely, the doctor may be considerate and allow the confectioner free rein over the use of his machinery. If either occurred, the externality would then be non-existent. This would impose a cost to the considerate party though, and so would be difficult to envisage in reality. In addition, people may behave in a certain way, creating positive externalities, either to gain personal satisfaction or social approval. Either way, utility is gained by the individual who creates the positive externality. Finally, social norms play a role in deterring certain actions that create negative externalities. By and large, people conform to these social norms, causing some to behave differently than they would otherwise. This may go some way towards explaining the problem of crime in areas where violence and drug and alcohol abuse is widespread; disadvantaged youths are particularly prone to replicating this sort of behaviour.

### **Global Externalities**

Globalisation has dampened the effect of national and regional policy actions in counteracting externalities. International consensus has been incredibly difficult to achieve however. With the absence of a so called 'world government' it is likely that little progress will be made (O'Hagan and Newman, 2008). Yet achieving this has never been so imperative. An example of this

difficulty in gaining compliance to international agreements is the Montreal Protocol of 1987, which attempted to phase out emissions of ozone depleting substances. Compliance was uneven on account of the difficulties faced by poorer nations (Hillman, 2009).

This problem may be illustrated using a simple prisoner's dilemma payoff matrix, assuming democratic governments.<sup>5</sup> It can be shown that an inefficient Nash equilibrium will be reached, whereby neither country in the game co-operates. The prisoner's dilemma of international externalities is thus a case of the tragedy of the commons, where the "commons" refers to the global environment where each government only internalizes the externalities on its own population. The case of a common field being depleted by overgrazing is an analogous example. This can be relatively easily solved; privatization forces the farmer to internalize the costs of overgrazing.

The inefficient Nash equilibrium in this case however can only be escaped by the Coasean trading of emissions rights. Efficiency is achieved as the Coasean approach allows firms which can profitably take advantage of emissions rights to purchase rights from producers anywhere in the world who have lower demands for the rights. The Pigovian approach of taxes and subsidies is not feasible in this case because the global demand function expressing willingness to pay for emissions rights cannot be known with certainty (Hillman, 2009).

## Conclusion

This essay has sought to examine and compare the various solutions to negative externalities, namely those put forward by the two schools of thought; the Pigovian and Coasean approaches. Firstly, we evaluated Pigou's propositions, and concluded that his failure to distinguish between 'pecuniary' and technological externalities somewhat limited his belief that all externalities require government intervention. We then formally proved the modern definition of externalities, i.e. that they essentially represent a divergence between private and social costs. We then examined the solutions to externalities by firstly exploring the Coasean approach and emphasizing its prevailing relevance. We conceded that the Pigovian approach is desirable in certain circumstances, however, particularly when a market for Coasean trading is simply non-existent. Finally, the pressing issue of global externalities was highlighted, where it was concluded that the Coasean approach is the only feasible means of dealing with the problem.

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<sup>5</sup> Dictatorships have a notoriously poor record of complying with international agreements and so their inclusion here would not be conducive to any sort of meaningful analysis.

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