

# On the measurement of the utility of public works\*

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Legislators have prescribed the formalities necessary for certain works to be declared of public utility; political economy has not yet defined in any precise manner the conditions which these works must fulfil in order to be really useful; at least, the ideas which have been put about on this subject appear to us to be vague, incomplete, and often inaccurate. Yet the latter question is more important than the former; enquiries—be they ever so numerous—laws and ordinances will not make a road, a railway, or a canal useful if it is not so already. The law ought merely to confirm the facts demonstrated by political economy. How is such demonstration to be made? Upon what principles, upon what formula, does it rest? How, in a word, is public utility to be measured? Such is the object of our enquiry in this chapter.<sup>1</sup>

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† Editors’ note: As the forerunners of Jevons and Menger in respect of utility analysis, Cournot and Dupuit were both singled out for special mention by Marshall. While Cournot’s *Recherches sur les Principes Mathématiques de la Théorie des Richesses* was translated in Marshall’s lifetime, Dupuit’s essay, *De la Mesure de l’Utilité des Travaux Publics*, had, so far, found no translator. Edgeworth, in his article “Application of Probabilities to Economics” (*Economic Journal*, 1904), gives a free translation of isolated passages and regards Dupuit as “the earliest, and still, I think, the highest authority on the theory of discrimination.”

Twice in his paper Dupuit mentions that his article is part of a larger work entitled *Economie Politique Appliquée aux Travaux Publics*. This work was never published.

Dupuit does not give the source of his quotations from Say and McCulloch. The editors of this volume have thought it useful to include precise references, which are printed in *italic* footnotes; in so doing they are indebted to Mario de Bernardi’s annotations to his edition of Dupuit’s writings (Turin and Paris, 1934), and to the assistance rendered by the translator of this essay, R. H. Barnack, Lecturer in Economics, Canberra University College.

The passages Dupuit, somewhat inaccurately, quoted from Say, would appear to have been extracted from the 5th edition (1826) of *Traité d’Economie Politique*; they differ very slightly, and not in substance, from the 4th edition, which C. R. Prinsep has translated into English (Boston, 1821). One of the passages quoted comes from the Annex to Say’s *Traité*, which Prinsep did not translate; the translation of the others, for convenience’ sake, leans on Prinsep so far as strict accuracy permits.

<sup>1</sup> This article is taken from a work entitled *Political Economy Applied to Public Works*, which the author intends to publish in the near future. See editors’ note, above.

Utility and its measurement lie at the foundation of political economy; they have, therefore, been the objects of rigorous definitions. Let us see whether these definitions can serve as a basis for one of public utility.

J. B. Say says:

UTILITY. In political economy, utility is the power possessed by things of being able to serve man in some manner or other.

The most useless and even the most uncomfortable thing, like a Court cloak, has what is here called its utility if the use to which it is put, no matter what that use may be, is enough for a *price* to be attached to it.

This price is the measure of the utility which men judge the thing to have, of the satisfaction which they derive from its *consumption*; for they will not seek to consume this utility if, for the same price, they could acquire another which would yield them greater satisfaction.

Utility, thus understood, is the basis of the *demand* for products and consequently of their *value*. But this value does not exceed the *costs of production*, for beyond this amount it will pay anyone who needs a *product* to make it himself; or rather, he will never be reduced to the necessity of making it himself, because at that price it pays any *entrepreneur* to take it upon himself to produce the thing.<sup>2</sup> (Epitome.)

If one accepts these definitions without qualification and generalizes them, one may be led into grave errors in the measurement of the utility of many things which call for a different treatment. Let us give an example:

Some very capable engineers wanted to know what was the utility of the French roads, and starting from the datum that the prices paid by society for their use amounted to 500 million *per annum*, and applying J. B. Say's principles, they said that since society consents to pay 500 million for these transport facilities, their utility is 500 million; society would not give up this sum if it did not receive an equivalent satisfaction; 500 million, therefore, is the measure of this utility. A moment's reflection will suffice to show up the error in this reasoning. Let us suppose the introduction of some improvement in the means of transport—roads or carriages—and that it results in a fall in costs by one half, so that the same services for which society paid 500 million, will now be rendered for 250. Is it to be concluded that the roads are now only half as useful, as the principles set out above would require us to do? Is it not evident, on the contrary, that the utility of the roads, far from having diminished, would have increased by 250 million?

If society is paying 500 million for the services rendered by the road, that only proves one thing—that their utility is *at least* 500 million. But it may be a hundred times or a thousand times greater; we are left in ignorance of this. If you take the above figure as the measure—and not as the lower limit—of a quantity the exact magnitude of which you do not know, you are acting like a man who, wishing to measure the height of a wall in the dark and finding that he cannot reach the top with his arm raised, says: "This wall is two

<sup>2</sup> J. B. Say, *Traité d'Economie Politique*, article on Utility in the annexed *Epitome des Principes Fondamentaux de l'Economie Politique*.

meters high, for if it were not, my hand would reach above it". Now, if you say that the wall is at least two meters in height, then we are agreed; but if you go so far as to say that this is the actual measurement, then we are no longer agreed. In daylight, and equipped with a ladder, you will perceive that our alleged two-meter wall is fifty meters high.

As the distinction which we are trying to establish rests upon considerations of some refinement, we must stress these preliminary notions and elucidate them by somewhat numerous quotations and examples:

J. B. Say says:

Although price is the measure of the value of things, and their value the measure of the utility imputed to them, it would be absurd to draw the inference that, by forcibly raising their price, their utility can be augmented. Exchange value, or price, is an index of the utility men recognize a thing to have only so long as human dealings are subject to no influence alien to that same utility.

In fact, when one man sells any product to another, he sells him the utility vested in that product: the buyer buys it only for the sake of its utility, for the sake of the use he can make of it. If, for any reason whatever, the buyer is obliged to pay more than this utility is worth to him, he pays for value which does not exist and which, consequently, he does not receive.

This is precisely the case when the government grants to a particular group of merchants the exclusive privilege of engaging in a certain trade, the India trade for instance; the price of the merchandise concerned is thereby raised, without any accession to its utility or intrinsic value. This excess of price is money transferred from the pockets of the consumers into those of the privileged traders, whereby the latter are enriched by exactly as much as the former are impoverished.

In like manner, when the government imposes a tax on wine, which causes to be sold for 15 sous a bottle which would otherwise have been sold for 10 sous, what does it else but transfer 5 sous per bottle from the hands of the producers or the consumers of wine to those of the tax collector? The merchandise is here only a more or less convenient means of reaching the taxpayer, and its current value is composed of two elements, *viz.* its real value based on its utility, and the value of the tax which the government thinks fit to levy upon its manufacture, transport, or consumption.<sup>3</sup>

It is beyond doubt that a tax can add nothing to the utility of a product; but when we look at it from the consumer's point of view we can say that its existence brings to light undeniably that the product has a utility greater than the cost of production. Why is the bottle of wine purchased at 15 sous? It is because the buyer finds at least an equivalent utility in it; for, in spite of the tax, he is at perfect liberty to buy it or not to buy it. It is not within the power of the state to make him pay, by means of the tax, anything more than the utility which he derives from this purchase.

This is how we see the situation: several individuals want to buy wine; but the need of each to acquire this good is different. Thus some of them, the rich,

<sup>3</sup> J. B. Say, *Traité d'Economie Politique*, 5th edition, Vol. 1, pp. 7-9; Prinsep translation pp. 5-7.

attach such a utility to it that they would be willing to buy even at 30 sous a bottle if that were the current market price; others, less rich, would not go above 15 sous; the less well-off would not pay more than 10 sous; others, in narrow circumstances, would only buy at 6 sous, and the poor only at 4 sous. On entering the market, they find that the price of the wine itself is 10 sous but, the government having imposed a tax of 5 sous, the commodity can only be supplied at a price of 15 sous.<sup>4</sup> What happens? All those who attach to the purchase of wine a value greater than 15 sous will buy, and will derive a kind of profit which will vary according to the significance which they put upon their acquisition; all those who would have bought wine at 10, 12, 13, or 14 sous will go without on account of the tax; and lastly those to whom the significance of such a purchase was less than 10 sous will not buy and would not have bought in any case. There is, then, only one single class of individuals to whom we can be certain that the utility is just 10 sous and that is the producers or sellers of the wine: they cannot derive a greater utility from it, no matter what the tax; for those who buy, it is greater than 15 sous, and for those who do not buy, it is less.

Thus, on examining the facts more closely, we have come to see that the utility of everything which is consumed varies according to the person consuming it. Nor is this all: each consumer himself attaches a different utility to the same thing according to the quantity which he can consume. Thus, a purchaser who would have bought 100 bottles at 10 sous might only buy 50 at 15 sous, and 30 bottles at 20 sous. Let us show this by an entirely different example, in order to demonstrate that it is a general phenomenon and one which, therefore, arises in the case of public works and must be taken into account when measuring their utility.

Consider the establishment of a water system in a town which, being situated at a high altitude, could previously procure water only at considerable trouble. Water then was so valuable that the supply of 1 hectoliter per day cost 50 francs, by annual subscription. It is obvious that each hectoliter consumed in these circumstances has a utility of 50 francs. With the installation of pumps this same quantity of water costs only 30 francs. What will happen? The inhabitant who was consuming 1 hectoliter will at first continue to do so and will derive a profit of 20 francs on this first hectoliter; but it is highly probable that the fall in price will induce him to increase his consumption; instead of using the water sparingly for personal purposes he will employ it also for less urgent and less essential needs, the satisfaction of which is worth more than 30 francs to him—since that is the sacrifice he makes to obtain the water—but less than 50 francs, since at that price this consumption was foregone. Thus, of these two hectoliters supplied to the same individual by the public pumps, one has a utility greater than 50 francs, while the other has a utility of between 30 and 50 francs. Suppose that by virtue of a technical

<sup>4</sup> For this to be the effect of the tax, it would have to have been in existence long enough to have diminished the quantity of wine produced.

improvement in the pumps, or by the very fact of increased consumption, the price is now reduced to 20 francs; it may well be that the same individual would take 4 hectoliters in order to be able to scrub his house every day. Let him have them at 10 francs each, and he will demand ten to water his garden; at 5 francs he will demand 20 to keep up the level of his pond; at 1 franc he will want 100 to keep a fountain going, and so on. If you look at this situation and ask what is the utility of the water supplied by the public pumps to this consumer, you must not say that it is 50 francs per hectoliter, because that is the price of the one he formerly consumed, before the installation of the pumps. There is only one hectoliter for which this figure is the measure of utility. That of the second hectoliter is between 30 and 50 francs; of the next two, between 20 and 30 francs; of the next six, between 10 and 20 francs; of the next ten, between 5 and 10 francs; and of eighty more, between 1 and 5 francs.

If you want to verify this, raise the price of the water. A tax of 4 francs per hectoliter, when the price is 1 franc, will immediately reduce consumption from 100 hectoliters to 20; a tax of 9 francs, from 20 hectoliters to 10; a tax of 19 francs, from 10 hectoliters to 4; and so on, until the price is brought up to 50 francs and only 1 hectoliter is consumed. By going further, you would eventually discover the utility of this last hectoliter, which you do not at the moment know.

Thus every product has a different utility not only for each consumer but for each of the wants for the satisfaction of which he uses it: we shall see this at every turn when we come to deal with the measurement of public utility. But first we must lay stress once again on those general notions, which are fundamental to the method which we shall presently expound.

At the outset, too, we feel it needful to deal with the objection which might be raised about our use of the word *utility*; it might be said that we have deviated from its scientific meaning and used it in a completely new sense in order to unfold a method of mensuration which, at first sight, is rather complicated. We shall merely recall that the distinction which we are expounding is to be found in Doctor Smith, who recognizes two values in an object—its *value-in-use*, which is its utility as we understand it, the value to him who has a need to consume the product; and its *value-in-exchange*, which is the value of the same product to him who has a need to sell it. McCulloch, who has annotated Smith, sets out this important distinction in a note:

“The word *value*”, he says, “has been frequently employed to express, not only the exchangeable worth of an article, or its capacity of exchanging for other things obtainable only by means of labour, but also its utility, or its fitness for satisfying our wants, and contributing to our comforts and enjoyments. But it is obvious that the utility of commodities—that the capacity of bread, for example, to appease hunger, or of water to quench thirst—is a totally different quality from their capacity of exchanging for other commodities. Dr. Smith perceived this difference, and showed the importance of distinguishing between the utility, or, as he expressed it, the *value-in-use* of



knowing full well that there will be buyers at that price? Not in the least, for he also knows full well that there would not be very many of them—say a hundred perhaps, which will only yield him 9,900 francs profit; and that by reducing the price to 20 francs he might have a thousand buyers, which would give him a profit of  $1,000 \times 19$  francs = 19,000 francs. Nor is that all. He knows, too, that of these thousand purchasers many would have been willing to pay a higher price—some would have been willing to pay 25 francs, others 30, 50, 80, or 100 francs—and that these buyers thereby derive a kind of gain of 5, 10, 30, 60, and 80 francs, respectively; and therefore he has recourse to a great variety of devices to secure the payment to him by each one of the buyers of as large a part as possible of this gain, which he considers is made at his expense. The same commodity in various guises is very often sold in different shops at quite different prices to the rich, the moderately well-off, and the poor. The fine, the very fine, the superfine, and the extra fine, although drawn from the same barrel and although alike in all real respects other than the superlative on the label, sell at widely different prices. Why? Because the same thing has a widely differing utility depending on the consumer. If there were only one medium price, there would be a loss to those who did without the product because its utility to them was less than that price, and a loss to the seller who, from many buyers, would be receiving payment for only a fraction of the utility of the service rendered. God forbid that we should try to justify all the frauds that go on in business; but it is well to study them because they are founded on a close knowledge of human nature, and are often found to be more equitable and fairer than one might expect at first sight and, indeed, they might be good examples to follow. We shall return later to this subject in the article on "Tolls", because this same consideration of a varying utility for the same object is the basis of pricing for all things the production costs of which are composed of two parts—one, a large outlay, made once for all or at least for a good many times; and the other, a small outlay, incurred for each object produced. Thus when a bridge is built and the state establishes a tariff, the latter is not related to cost of production: the heavy cart is charged less than the sprung carriage even though it causes more wear to the timber of the carriageway. Why are there two different prices for the same service? Because the poor man does not attach the same value to crossing the bridge as the rich man does, and raising the charge would only prevent him from crossing. Canal and railway tariffs differentiate between various classes of goods and passengers, and lay down markedly different rates for them although the costs are more or less the same. In drawing up these tariffs in advance the legislator merely defines certain features and characteristics which seem to him to indicate a greater or lesser degree of utility in the same service rendered to different people. In business, the merchant—who is in direct contact with the purchaser—goes further, he sets traps for the buyer's vanity and his credulity; but the aim is always the same, and that is to make the payment for the service rendered equal not the cost but what the buyer thinks it is worth. If, therefore, this