

BARNETT HOUSE PAPERS

No. 12

THE FUNCTIONS OF
ECONOMIC ANALYSIS

BY

A. C. PIGOU, M.A., F.B.A.

Professor of Political Economy in the
University of Cambridge

SIDNEY BALL LECTURE

May 27, 1929

LONDON
OXFORD UNIVERSITY PRESS
HUMPHREY MILFORD

1929

Price One Shilling

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THE FUNCTION OF ECONOMIC ANALYSIS

TWO years ago Sir Josiah Stamp delivered on this foundation a stimulating and valuable address entitled 'The Statistical Verification of Social and Economic Theory'. In the course of it he said: 'It is my view that the analytical method on the lines of Ricardo, Mill, and Marshall has, for the time being at any rate, reached the limit of its usefulness. I believe that for the next advance we must depend upon realistic statistical investigation and verification, and that we stand on the threshold of a new method which is of general application.' These sentences are put in a challenging way; and one might imagine there springing up about them a new battle of rival schools, such as raged in days gone by between the advocates of induction and deduction, or between the historical school and the mathematical school. Those are barren wars; they centre often on differences about words rather than about meanings; they block, by needless controversy, the advance towards the goal of knowledge of those who are in truth allies. When, therefore, I cite that passage from Sir Josiah Stamp, I do not do so as the text for a polemic. I should not, indeed, myself have written in those terms. I should not have spoken of *the* analytic method, and, if I had, I should not have set it in contrast to 'statistical investigation and verification'. Rather I should have regarded these as instruments, now happily becoming much more perfect than they were, to be used to help analysis in its task. But there is nothing there of substance: it is an issue, not about ideas, but about ways of expressing them. I have cited Sir Josiah Stamp's address, not as a subject for criticism, but with, I fear, a too ambitious hope—for Sir Josiah combines in a unique manner the man of thought and the man of affairs—that my address may serve in some sense as a supplement and companion to his.

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By the term economic analysis, in the title of this lecture, I do not mean, as I have already implied, any particular method of analysis. I am not thinking of deduction versus induction, or of mathematical method versus literary method, but of something much wider. The contrary of analysis, from my point of view, is mere description of events as they have occurred in space-time. Any effort that seeks to explain events, to trace the sequence of causes and effects, to discover laws of wider or of narrower application, in short to dig below the surface of a field for the roots of plants that grow there, is for me analysis. With different problems and with different sets of data, different detailed methods are appropriate. Of these I shall say a little presently. But first there is a distinction to be drawn of a more fundamental kind. In handwork, as everybody knows, some men are primarily engaged in making tools, some in using them, and, even when both offices are performed by the same man, the offices themselves are quite different. It is the same with brainwork. There too tool-making stands in contrast with tool-using; the construction of machinery with the operation of that machinery to yield its appropriate product. Sometimes a machine will be made, so to speak, for its own sake, without any regard for what may be done with it; and, years afterwards, a workman other than the inventor, finding it to his hand, may employ it in the solution of some problem of which the inventor had no thought at all. In this way, if I am not misinformed, Einstein found to his hand a technique in pure mathematics designed by Riemann, and with the help of it built up his own great contribution to physics. Sometimes, on the other hand, an inventor, working at a current problem and finding the need of a tool, may himself build the tool with a special view to that problem. Newton's work on the differential calculus originated, I understand, in this way. Among persons interested in economic analysis there are tool-makers, tool-users, and those who play a double part. Edgeworth in his *Mathe-*

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matical Psychics was making tools: Sir Arthur Salter in his *Allied Shipping Control during the War* was using them: Marshall in his *Principles of Economics* was both making and using them. In the statistical field Professor Karl Pearson is predominantly a tool-maker: Dr. Bowley and Dr. Stamp predominantly tool-users. Tool-making is not necessarily more difficult work than tool-using, but it is generally of wider scope, because, when once a tool has been built, it may be used many times on many different problems.

Now, of course, an able man who is chiefly interested in tool-making will on occasion also use his tools; and one who is chiefly interested in tool-using will also on occasion make tools for himself. But, nevertheless, the difference between the bent of their minds inevitably shows itself in the general character of their work. During some thirty years until their recent deaths in honoured age, the two outstanding names in English economics were Marshall at Cambridge and Edgeworth here in Oxford. Their contrasted methods illustrate what I am saying very clearly. Edgeworth, the tool-maker, gloried in his tools. He would make them for the sake of making them; and he would, I suspect, have cherished more dearly a well-fashioned probe, for which no use whatever could be found, than a serviceable but clumsy blade. Marshall, on the other hand, had what almost amounted to an obsession for hiding his tools away. He would work out a problem, for example, by a mathematical technique, and would then spend endless trouble in burying the technique in language designed to sound as platitudinous as he could make it. In Edgeworth's work the student knew what he was up against; he might not be able to understand it, but, if he did not, there was little danger of his imagining that he did. In Marshall's work, on the other hand, there was great danger of this. Indeed, I have sometimes used as a means of sifting the sheep from the goats among economic novices the question 'Do you understand Marshall's *Principles*?' If they said 'No'

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they might, perhaps, be sheep; if they said 'Yes' they were beyond peradventure goats! Sometimes, being myself addicted to high places, I have been tempted to think of these two great men as contrasted types of mountaineer. I have imagined myself meeting them on the summit of a difficult Alpine peak. Edgeworth is there, festooned around with rubber shoes, crampons and all the paraphernalia of his craft, his hands torn and bleeding, his clothes in rags: Marshall is seated by his side dressed in an elegant summer suiting and—if I may plagiarize the late A. D. Godley—pretending with all his might to have stepped from a passing balloon! But a careful survey of the horizon shows that it was not in that manner that he arrived! No: these great twin brethren have both ascended by ice-slope and chimney and slab; but the one is more interested in the process, the other in the goal! To both types of mind economic science owes much.

Now, of course, the tools of which I have been speaking so far are, so to say, *public* tools—pieces of analytic machinery accessible to all. But these are not the only tools that students of any science in practice use. On the contrary, each of them in his work employs also further tools peculiar to himself. I do not mean that he has secret formulae like a maker of patent medicines. The tools of which I speak are private for separate individuals because they are built into their separate subconscious minds. They are not formal methods at all, but instincts, intuitions, what you will! Of two men of apparently similar knowledge and attainments, one, as everybody knows, will bungle round the edges of a problem, the other will go to the heart of it. Partly, no doubt, the quality of a man's private machinery depends on the extent to which he makes use of it and can be improved by practice and training. But in the main, as, for example, with that strange faculty which in business men we call shrewdness, it would seem to depend on original native endowment. However that may be, it is clear that in all kinds of work, whether mental or manual, private tools

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are needed. These are everywhere indispensable. But different sorts of work differ a great deal in respect of their dependence upon what I have called public machinery or public tools. For example, to take a trivial instance, in the art of climbing rocks, so far as the leader is concerned, no public tools are used: only the private machinery of a personal technique. In the art of ice-climbing, however, a public tool—whether an axe to cut steps or ice-claws for the feet—is essential: nobody in the world could lead up a steep slope without one. There is a similar distinction among intellectual pursuits. The machinery on which a literary critic relies is, I imagine, almost entirely the private machinery of a delicate and appreciative taste. The physicist, on the other hand, wields a tremendous public apparatus of formulated mathematical theorems. These differences have one very obvious practical consequence. Where the tools in use are chiefly private tools, persons with no training and no native aptitude frequently believe themselves fully qualified to form and pronounce judgement; but, where the use of public tools has to be mastered, such persons are relatively modest. For example, in this country a magistrate, who has perhaps never heard of Kant, will readily undertake to decide whether a particular book or picture has or has not an immoral tendency; but one who has never heard of Newton will hardly consent, even if ordered by the Home Secretary, to forecast the date of an eclipse! In this matter economics is in a somewhat delicate position. There is in it a considerable apparatus of public tools which experts employ, and without the help of which nobody except a genius can hope to accomplish much. But *something* can be accomplished without these tools; and, indeed, it may well happen that, just as a boy who relies on instinct often fights better than one who has half learnt to box, so a man with no pretence to economic training may see farther into an economic problem than one the free play of whose mind is hampered by a partially understood technique. Naturally, there-

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fore, the need for and purpose of public tools in economics is not realized by the general public as it is realized in physics; and the manipulation of them is sometimes regarded as a more or less harmless specialism without relevance to real problems. There is a misconception here which cannot be overcome by argument, and will only melt away as, by competent use of our tools, we succeed in elucidating these problems.

The principal tools in the economic workshop are ranged about the central idea of demand and supply—the idea, namely that values are determined by a balancing at a margin of the influences that determine how much of a thing people demand at different prices and how much of it at different prices they will supply. I do not in this connexion employ the familiar phrase ‘the law of demand and supply’ for the reason—I confess it to my shame—that I have never yet been able to understand what—if anything—that phrase means: often though it has done service with public men as an excuse for leaving unredressed some manifest inequity. There is, however, no question that, if one is investigating the value, or a movement in the value, of some commodity, the *method of analysis* by way of demand and supply is an extremely useful tool. In connexion with it there have been developed the important concepts of elasticity of demand and supply; consumers’ surplus; quasi-rent, to deal with complications due to the element of time; the distinction between internal and external economies; the distinction between private net product and social net product at the margin; and so on. Moreover, a considerable structure of a semi-mathematical kind has been built up, which enables us to express the quantitative effect to be expected from various sorts of taxation and of monopolist action in terms of the elasticities of demand and supply of the relevant elements; subject, of course, to reservations of a technical character that need not be considered here. Besides these and other tools which they themselves have contrived, economists are coming

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to employ more and more in their work tools constructed by statisticians: methods of sampling, methods of correlating different series, and so on.

Let us look next at economic tools more in detail. It is plain at once that the bulk of them are structurally very simple. For example, Marshall’s fundamental idea about the way in which the value of money is determined is simply this: that in given conditions people choose to hold in the form of ready purchasing power an aggregate real value which stands in some definite proportion to their real income. This conception enables him to build up a structure of monetary theory, which is not only completely coherent with his general theory of value, but can be successfully applied, with no fundamental modification, to elucidate the variegated happenings of the war and post-war periods no less than the more staid events prior to 1914. Thus, in general, economic tools are not elaborated buildings but rather keystones. Unlike the tools of physics, and like those of biology, when once they have been manufactured, their nature and significance can be understood without any great intellectual effort. For this reason there is a certain risk that the work of the men who made them may be undervalued; we are readily tempted to believe that what is easy to understand must have been easy to discover. That, I suggest, is a delusion. The great leaps of genius that set thought on a new track are often simple in that sense. Nothing could be simpler or easier to understand, when set out, than Mendel’s conception of the fundamental nature of inheritance. With Newton himself, the flash of vision that gave his master-thought was simple: that the movement of the apple to the earth and of the moon round it are manifestations of a single law. It was in this flash of vision—this simple thing—not in the elaborated technique of proof and verification that his transcendent genius spoke. Let us not, therefore, in economics imagine, merely because our tools are simple, that they could have been made for us by men of small minds.

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None the less, the thought-tools of the economist are, I think, in themselves and for their own sake of little interest or importance. The pure mathematician would protest—and rightly—if any one should regard his structures as merely tools for physics and other applied sciences. But then his structures—if one who knows them by repute alone may venture to speak—constitute immense and imposing triumphs of the human intellect. They are much more than tools: they are themselves works of art. No claim of that kind can be made for the structures of pure economics. These are tools only. Those of them that cannot be made to work in elucidating the problems of the real world must be scrapped: there is no place for them in the gallery of art. But, though they are only tools, as tools they are vital. No mountaineer regards an ice-axe as more than a tool; but any mountaineer who on a serious expedition neglected to carry one—would deserve no wreath at his funeral.

I pass now to the second division of my subject-matter. While, with Mill's claim to finality for his theory of value before us as a warning, few economists would venture to assert that the furniture of their tool-shop is as yet complete or nearly complete; and while, in accordance with what I have already said, it may well happen that a man who sets out to apply existing tools finds himself in the course of his work inspired to devise a new one, yet, for the majority of economists, economic analysis is likely to mean, not making tools for themselves, but using the tools already made by others. For what end do they use these tools? What is the function of economic analysis as handled by them?

If we are among those who like to contemplate a high-sounding programme, we may perhaps answer in some such strain as this. The function of economic analysis—that part of it which is not tool-making—is to build up, as far as may be, a conceptual working model of the body economic as it lives and moves: to display its anatomy and physiology, the interaction of its several parts, the

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process of its growth, the response it tends to make to various kinds of stimulation, and so on. This kind of statement is perhaps useful as a stimulus. But it does not at all picture the everyday work of the general body of economists. That work is much more a piecemeal affair—attacks on particular problems or bits of problems rather than sweeping studies of the economic world as a whole. By what mechanism in existing conditions is the real income of a community distributed among its members and as between the various factors of production that they severally wield? How far are classical doctrines on this matter modified by the growth of collective bargaining between large groups of workpeople and employers? In what ways does the garment of money, which enwraps trade and industry, alter as well as veil these processes? What are the influences that regulate the terms of interchange between our imports and our exports: why is it that a given volume of exports now brings in a much larger volume of imports than it used to do before the war? How in various circumstances does a particular kind of tax or system of taxes react upon the price level? In our attacks upon these various problems there is, indeed, a certain unity of *method*, because, while related to quite different subject-matters, they are all particular instances of the general problem of value. But there is not, I think, any great intellectual interest in this kind of unity. It is very different from Newton's unity of the apple and the moon. We are much more excited to know that these two things move in accordance with the same formula than to know *exactly how* either of them moves. This is not so in economics. Nobody cares a great deal that fluctuations in the real wages of bricklayers and fluctuations in the purchasing power of money are *kindred* events: we are not interested in their kinship, but in each event for itself. That is what I meant by saying that the main part of an ordinary economist's work is piecemeal; the piecemeal study of particular parts and aspects of economic life.

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It is of this part of economic analysis, the using of economic tools for the elucidation of defined and limited problems that, as I imagine, Sir Josiah Stamp was chiefly thinking in the lecture to which I have already referred. For plainly, if tool-making be conceived as I have conceived it, there is little scope in that field for statistical studies; whereas in the use of tools for the purposes I have been trying to describe there is large scope for it. The phrase '*statistical verification of economic theory*' does not, however, seem to me well adapted to bring clearly to light the nature of the service which statistical studies can render. This is, I think, twofold. On the one hand they may in certain circumstances enable us to pass from what Marshall called qualitative to what he called quantitative analysis: to pass from merely saying 'this kind of cause will have that kind of effect' to saying 'so much of this kind of cause will have so much of that kind of effect'. On the other hand, when different time-series are brought into relation with one another, whether by means of charts or by the device of correlation, they may provide valuable suggestions about causal relations and thus open up fruitful lines of study.

Of the first of these services I need not say much. It is well known that the effect on prices that may be expected to result from the imposition of a tax, from the introduction of monopolistic action and so on, can be determined by means of formulae in which the functions of demand and supply, or, more roughly, the elasticities of demand and supply, are involved. If the numerical values of these elasticities were known, numerical answers to the question by how much would the imposition of such and such a small tax on such and such a commodity raise its price, provided that other things remained the same, would result. Thus the numerical determination of elasticities would enable our treatment of problems of taxation—and, it is easy to see that the same thing is true of many other problems—to be enormously improved. But the numerical determination of elasticities is obviously only

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possible through statistical studies of prices in relation to quantities purchased and quantities supplied. There are very great technical difficulties in the way of these studies. I do not propose to discuss them now. Very little has hitherto been accomplished in this field; but I am not among those who believe that the difficulties are insuperable.

The second way in which statistical studies can help in using economic tools, namely comparisons of the movements of different series with a view to elucidating causal relations, has recently been brought into great prominence by a distinguished group of American workers. The simplest form of this technique is to set out the several series to be compared—say, the percentage of unemployment and some index of general prices for successive years or months—in the form of graphs, and to examine by the eye the way in which the movements of the two or more curves are related to one another. It may be found that upward movements of one of them are usually associated with upward movements of the other; or with downward movements of the other; or that the two curves move similarly—or inversely—but that one tends to lag in a regular manner behind the other. Plainly, if the relation between the curves is fairly clear cut, we have reason to suspect that there is some causal connexion, either direct or indirect between them.

This simple technique has been developed and elaborated into an imposing structure. When one or more of the series to be compared has a pronounced upward or downward trend, it is sometimes necessary to eliminate this trend before the relation between the short-period movements of the series can be clearly seen. For doing this sometimes a rough and ready device, sometimes a complicated one is employed. Again, whether or not trends have to be eliminated, it is becoming common to supplement inspection by the eye by working out correlation coefficients; and to use these as a means of testing how much, if at all, movements in one series lag behind

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movements in another. Yet again, it is sometimes found that movements in one series, which do not seem to have any obvious relation to *movements* in another, bear a close relation to *rates of change* in movements of the other. This relation, like the simpler direct relation, can, at choice, be depicted on a graph or summarized in a correlation coefficient.

I shall not, I hope, be suspected of undervaluing this technique or the services of those who are engaged in elaborating it and applying it to economic problems if I suggest that persons handling it rashly may easily become entrapped. It is extremely tempting, when one sees two curves moving together, particularly if the second lags slightly behind the first, to jump, without further inquiry, to the conclusion that its movements must be caused by the movements of the first. When the issue is set out in abstract form it is obvious that this inference is not secure, because the movements of both series may be the joint effect of some third factor by which both are determined. But, when wrapped up in the garments of real life, this is not so obvious. When it is argued, for example, that inoculation against plague in India cannot possibly have accomplished any good because, as statistics show, in the very districts where inoculation is most largely practised plague is most severe, not everybody, perhaps not even everybody here, would instantly see through the sophism! But there is another trap much more subtle than the trap of the suppressed third cause. When it has been shown that, if a causal nexus, direct or indirect, were *not* present, the odds would be, say, 10,000 to 1 against two series being related in the way in which in fact they are related, it is extremely tempting to step on and say: '*therefore* the odds are 10,000 to 1 that a causal nexus *is* present'. But this is a fallacy in the logic of probability. It is an incredible number of millions to one against anybody dealing himself at bridge by fair means three hands containing four aces, four kings, and four queens all in the same evening; but, were

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the Archbishop of Canterbury to accomplish that feat, it would not be that number of millions to one that the Archbishop had employed unfair means! It was on account of this point of logic that I was careful, a little while ago, to say that correlations between series may render service in *suggesting* causal connexions: I did not say in proving, or even in making probable, such connexions. When a striking correlation suggests a causal nexus, we must not stop at that. We must set our economic tools to work and try to discover by what process it is plausible to suppose that our two series are bound together. If we can discover no such process, if, on the basis of our general knowledge and experience, it seems to us incredible that any such process exists, we must suspend judgement. It is extraordinarily improbable that the Archbishop should by accident deal himself in one evening three hands each containing four aces, four kings, and four queens: but it is also extraordinarily improbable that so eminent a son of Oxford should cheat at cards! Statistical correlations—if I may sum up the gist of my argument—can give invaluable indications as to where our economic tools may be usefully employed; they can also confirm and corroborate; but they do not and cannot warrant us in leaving the tools behind.

After so much that has been negative, I should perhaps attempt to illustrate by some positive example the kind of work that economic analysis has to do. Consider the assertion 'a falling price level benefits the wage-earning classes'; and the contrary assertion 'a rising price level benefits the wage-earning classes'. An economist is requested, let us suppose, to make a report on the matter at issue. What will he do? First, I imagine, he will collect, over as long a period as the data allow—for simplicity I suppose that he is instructed to confine his researches to this country—the facts about the general price level, money rates of wages, the prices of the things wage-earners buy, and the fluctuations of employment.

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The statistical material available is, he will find, very inadequate and unsatisfactory; but he must make shift with it as best he can. A very short study of it reveals a pitfall. The conception of rising or falling prices is not simple and definite, but covers two distinct types of event. When a curve is drawn out on the basis of Jevons's and Sauerbach's figures, to illustrate the movement of general prices in the United Kingdom during the last hundred years, the curve is found to be complex in character; it contains both a succession of four principal long-period trends and, superimposed upon these, a number of shorter 'cyclical' movements. Thus from the end of the Napoleonic wars till 1850 the trend was downwards, from 1850 to the early 'seventies upwards, from then till 1896 downwards, and from 1896 till the outbreak of the war again upwards. These facts are brought out very clearly by Mr. Layton in the following table:

Quinquennial Average Index Numbers and the Turning point in the Price Curve.¹

		<i>Percentage change in the period.</i>
1821-6	154	
1846-50	116	-25 per cent.
1871-5	138	+20 "
1894-8	82	-40 "
1906-10	102	+25 "

During these several periods, however, the movement was not continuous. It proceeded in a series of waves, so that, when the general trend was falling, a high point on a later wave might nevertheless be higher than a low point on an earlier wave, and, when the general trend was rising, a high point on an earlier wave might similarly be higher than a low point of a later one. In view of this complex character of the price curve it becomes apparent that the

¹ *An Introduction to the Study of Prices*, p. 23.

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issue is a more difficult one than our imaginary disputants had supposed; that upward (or downward) movements in the trend of prices may affect the fortunes of wage-earners in one way and upward (or downward) oscillations about the line of trend in a different way. Clearly an attempt must be made to study first trends apart from oscillations and, secondly, oscillations apart from trends.

For the investigation of trends, though not for that of oscillations, we may properly leave out of account variations in the percentage of workpeople who are unemployed, and use as a measure of the fortunes of the wage-earning classes index numbers illustrating the course of *rates* of real wages. Such index numbers, though very insecurely based, are available for the United Kingdom since 1850; and, for earlier years, though no index number of wages has been constructed, we have a certain amount of general information. It will be remembered that from 1820 to 1850 the trend of prices was downward, from 1850 to the early 'seventies upward, from the early 'seventies till the middle 'nineties downwards, and from the middle 'nineties till the outbreak of the Great War upwards. The state of real wages in these four periods may be summarized as follows. During the first period of falling prices, from the end of the Napoleonic wars till about 1850, the wage-earning classes were very badly off, and the rate of real wages was at best rising slowly. During the first period of rising prices, from the early 'fifties to the early 'seventies the rate of real wages was rising fast. During the second period of falling prices, the early 'seventies till about 1896, this rate continued to rise substantially. During the final period from 1896 to the outbreak of the war, when prices were again rising, the upward movement in the rate of real wages was checked, and, at all events if we ignore the shifting of workpeople from lower-paid to higher-paid occupations, this rate actually fell. From these facts it is impossible to establish any sort of statistical connexion between

price trends and the rate of real wages. The witness of the first two periods suggests that rising prices are associated with greater benefit to that rate than falling prices: the witness of the second two periods suggests an exactly opposite conclusion.

A little disappointed with this result, our investigator turns to the study of oscillations in the price level about the line of trend. In attempting to elucidate the relations between this movement and the fortunes of the wage-earning classes he is, of course, no longer free to ignore fluctuations in the percentage of unemployment; real wages corrected to allow for these fluctuations have to be used. If a graph representing real wages so corrected is set beside a graph of prices, it is seen that during the last trend period, from 1896 onwards, there is a marked positive correlation between oscillations about the trend of corrected real wages and of prices; periods of high (relative) prices being also periods of good fortune for wage-earners and periods of low (relative) prices periods of bad fortune. If, however, we extend our view so as to cover also the two preceding trend periods, this definite relationship is no longer to be found. We are entitled to conclude in a broad general way that upward price oscillations tend to be associated with improvements in the fortunes of wage-earners and conversely; but there are important exceptions to this tendency, and corrected real wages are often found oscillating in one direction while the price level is oscillating in the opposite direction. Thus a statistical study of oscillations, though it does not, like a study of trends, lead to a completely blank wall, cannot be said to help us very much.

The inconclusive character of these results must suggest to our imaginary inquirer that, even when he has distinguished between trends and oscillations, the issue which he has been trying to adjudicate is still not properly stated. He will then recall that upward (or downward) movements in the price level are not isolated events, but are themselves consequences of causes; and that these

causes may consist in changes in the productivity of industry; in changes of the supply of money; in changes of the supply of credit; or in certain other more complex sorts of change which I need not now specify. Hence, when prices rise, there is brought to bear upon the fortunes of wage-earners not only the price change itself but also the causes underlying it. So soon as this fact is grasped, it becomes obvious that a knowledge of the historical associations between price movements and movements in real wages cannot possibly reveal the effects which price movements, considered by themselves, tend to bring about; and that the effects of the total situation of which price movements are a part are very unlikely to be similar when the causes of the price movements are different. Thus the first section of our investigator's report will conclude that the issue which he has been asked to adjudicate is a false issue; that it embodies, not a single question to which a single answer 'yes' or 'no' can be given, but a confused jumble of several questions, which are quite distinct and to which separate answers are needed. He will end this part of his report by tabulating in a careful manner what these questions are, announcing that in the second part he will attempt to answer them; and at this introductory stage—for we are here concerned with generalities, not with a particular problem—we may bid him a polite farewell.

Up to this point I have described economic analysis—the part of it other than the tool-making part—as concerned with the elucidation of certain facts or groups of facts from the standpoint of causation; with the disentangling and proper labelling, backed, if possible, by statements of quantity, of the various influences by which given situations and given movements have been brought about. This is, everybody agrees, one very important department of the economist's work. But there is also another and complementary department. In that department a central place is occupied by the old notion of

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maximum satisfaction; and situations and movements are studied with a view to discovering how far the influences in operation tend to make the actual state of this diverge from the *optimum*. Such issues have to be set out carefully, because the optimum, with which the actual can usefully be compared is seldom, so to speak, the absolute optimum, but an optimum *relative* to certain conditions. For example, in problems relating to the distribution of labour among various industries, the optimum relative to the real costs involved in movement from one industry to another is much more significant than the superior optimum which emerges if these costs are ignored. In this type of work use is made of the distinction between private cost and social cost, and of the fact that, whereas unhampered self-interest tends to equate marginal demand-price to marginal private cost, this result is not the best obtainable except where, at the margin, private cost and social cost coincide. A surprisingly wide range of problems is open to exploration by this method; and many instances, in which Adam Smith's 'invisible hand' falters in moulding the world, can be set by means of it into an orderly and convenient grouping. That there is nothing in physics or chemistry to correspond to this way of approach need not cause us to look on it askance. For it is only in sciences which deal with conscious life that such a notion as maximum satisfaction can, in the nature of things, have relevance.

There is yet one thing to say. In every field of inquiry the function of the student, as of the methods he employs, is to help forward the upbuilding of knowledge. But, whereas in some fields knowledge is an end alone, in others it is both an end and a means. However intimately we learn to understand the courses of the stars, we can never in any degree control them; but, where the processes of human society are concerned, knowledge may carry with it power. Thus, though the primary function of economic analysis ends with the provision of know-

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ledge, it has, in company with many branches of natural science, a secondary function also. The knowledge that it provides may help in some measure—not in great measure, because many factors of a non-economic character are often also relevant—to guide practice. There is, indeed, a long time-lag between the attainment of knowledge in economic affairs and its entry into the halls of authority. I do not accept the view, which I have somewhere lately read, that the practical man is one who practices the theories of 200 years ago. The time-lag is not so long as that. But it may well be thirty years or even half a century. The chief reason for this is not, I think, the obvious one that statesmen and politicians, fully occupied as they are with administration and debate, cannot keep abreast of current knowledge. For there is always at their call a brilliant Civil Service, and they may, if they choose, summon outside experts. The reason rather is that the effects which a given line of policy will produce often depend in large measure on the degree of economic knowledge possessed by the general body of the public. For example, every economist knows that in a world of economists it would be easy to set up a monetary machine much superior to the gold standard: but in the world of actual men with their prejudices and ingrained beliefs, where perhaps not one in 100,000 understands the nature of money, it may well be held that an attempt to do this would lead to disaster. Thus, in order that economic analysis may render the full service of which it is capable in helping to guide practice, we need more than the education of statesmen or the provision of an economic general staff: we need also that the main body of the people shall have some training in economics—sufficient training at least to perceive that they do not possess complete training. This level of attainment is already achieved in the natural sciences. As a consequence chemistry and physics can render their full service to the world of practice—and that with very short time-lag—so long as the experts in them continue to advance

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the borders of knowledge. There skilled leaders are all we need. Economics cannot render its full service—perhaps not at all, certainly not without an enormous time-lag—unless the nature of the subject-matter with which its experts deal is understood, not only by their colleagues, but also in some measure by the general body of educated men.

PRINTED IN GREAT BRITAIN AT THE UNIVERSITY PRESS, OXFORD
BY JOHN JOHNSON, PRINTER TO THE UNIVERSITY

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