Econometrics in the Midst of Analytical and Social Turmoils

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Introduction

I would like to begin this tribute to my old friend Herman Wold by expressing how thoroughly I am in agreement with him when he insists on the necessity of placing econometrics and its laws and regularities and statistical procedures *in a broad philosophical setting*. He has stressed this point of view over and over again in a number of publications. In a nutshell his point of view is well described by the following heading he once used: "A Plea for more Contact between Philosophy of Science and Subject Matter Sciences." In this chapter he says inter alia: "My own studies in the problem area extend over some 30 years; at the outset I was confronted with the problem of 'choice of regression' and other technical problems; rather soon I found that these problems are closely linked up with fundamental matters of scientific method and philosophy of science, first of all the definition and meaning of causal concepts, and the distinction between experimental and nonexperimental situations; I consulted the philosophical literature for information about such fundamental matters, but was disappointed not to obtain much guidance; hence to consolidate my ideas about model building I tried to systematize the arguments ..."[1]

The problem of a "cause" is, of course, not essentially a terminological one. Indeed whether we call a certain thing "a cause" or "a straw hat" is epistemologically completely uninteresting. What is interesting are certain *operative* aspects and certain questions of *stability* in regularities, which it is natural to associate with the concept of cause.

While I am in perfect agreement with Wold in the general point of view that we need more contacts between philosophy of science and subject matter sciences, there will be specific points in the classification of concepts and in the logical structure where I would prefer to proceed along lines different from those followed by him.

I had originally planned to write a rather extensive and systematic paper on these questions as my contribution to the Wold-Festschrift. Unfortunately

a number of factors (among them a fractured thighbone) prevented me from following this intention. I have, however, been able to put down some ideas that occupy a central position in my general view on these matters. These points will concern: The question of *cause*, the place which *originality* holds in our research, and the place occupied by the little analysed, but all the more phrenetically voiced concept of *freedom*, which we encounter whenever we try to apply econometrics to economic planning at the national level.

1. *A Purely Observational Material*

(Statistics of Unhampered-with Observations)

Let me begin by considering a small 2×2 table giving relative frequencies of observations where each observation is characterized by two features A and B, with a and b standing for non A and non B respectively. See Table 1.0 where I have entered the relative frequencies that were observed in a series of observations.

For my present purpose it does not matter whether we consider empirical relative frequencies or probabilities. For simplicity let us consider empirical relative frequencies.

Table 1.0. A purely observational material (an unhampered-with material).

	B	b	Row sums
A	P_{AB}	P_{Ab}	$P_A = P_{AB} + P_{Ab}$
a	P_{aB}	P_{ab}	$P_a = P_{aB} + P_{ab}$
Column sums	$P_B = P_{AB} + P_{aB}$	$P_b = P_{Ab} + P_{ab}$	Sum total $= P_A + P_a = P_B + P_b$ $= P_{AB} + P_{Ab} + P_{aB} + P_{ab}$ $= 1$

In order to pass to a regressional viewpoint we would have to subdivide the A characteristic in more than the two cases indicated. Perhaps we would even have to consider a continuous range of the A characteristic. And similarly for the B characteristic. For reasons of simplicity I shall continue to consider the simple table 1.0.

I shall first consider how the concepts necessary and sufficient conditions and irrelevancy may be defined within the universe given by the table. The cases considered in (1.1)–(1.6) are so selfexplanatory that hardly any comments are needed. For instance the small matrix in (1.1) indicates that the uppermost

cell to the left contains some number p—which we assume different from 0—and the lowermost cell to the left contains the number 0, while nothing is as yet said about the two numbers in the second row, apart from the fact that the sum total of all the four numbers is to be equal to unity.

A is necessary condition for B: $\begin{vmatrix} p & \\ 0 & \end{vmatrix}$ (1.1)

A is a sufficient condition for B: $\begin{vmatrix} p & 0 \\ & \end{vmatrix}$ (1.2)

A is a necessary but not a sufficient condition for B: $\begin{vmatrix} p & \neq 0 \\ 0 & \end{vmatrix}$ (1.3)

A is a sufficient but not a necessary condition for B: $\begin{vmatrix} p & 0 \\ \neq 0 & \end{vmatrix}$ (1.4)

A is a necessary and sufficient condition for B: $\begin{vmatrix} p & 0 \\ 0 & 1-p \end{vmatrix}$ This is the diagonal matrix. (1.5)

A is irrelevant for B: $\begin{vmatrix} p & p \\ & \end{vmatrix}$ (1.6)

In practice we will as a rule not find *exactly* 0 cells as indicated in the above cases, but the cells in question may show only *very small* frequencies (small as compared to unity). If they are really small, one can typologically classify the cases in the same categories as the above ideal cases (1.1)–(1.6).

By interchanging rows and columns in (1.1)–(1.6) we get a description of the cases where B is a necessary, respectively, sufficient condition for A etc. The case (1.5) is at the same time the case where A is necessary and sufficient for A and B a necessary and sufficient condition for A. This diagonal matrix is an extremely limiting case, and thoughts of this limiting case have produced much unsatisfactory handlings of statistical and philosophical problems.

From the cases (1.1)–(1.6) we can easily derive the concept of *predictability* (within the unhampered-with material described by Table (1.1))—or as I would prefer to call it *dictability* since the prefix pre in this case wrongly carries the idea of *before in time*. This time direction is foreign to the idea now considered.

Dictability is defined simply by the case (*1.2*). When we say that B is dictable from A we simply mean that if we segregate the observations that show A, we will find that all these observations also have the characteristics B. A is a sufficient condition for B. It should be remembered that the case (1.2) is taken with the cum grano salis convention that the *type* of the distribution structure is retained even if the exact 0 in (1.2) is replaced by a *very small* number.

It may well be that B is dictable from A and at the same time A is dictable from B. This will occur in the case (1.5), and only in this diagonal case.

Example: In an automobile with a technically well constructed speedometer a series of observations would show that the speed of rotation of the wheels—let it be A—is dictable from the positions of the needle of the speedometer—let it be B. And here also vice versa we see that B is dictable from A.

2. *An interventional Material (A Hampered-with Material)*

So far I have not mentioned the concept of cause. It is customary to think that we may pass from the concept of dictability to that of a *cause* simply by introducing the concept of a controlled variable. If a particular variable say B is dictable from some other variable say A, and if A is controlled, it is customary to say that A is the cause of B. This point of view is clearly expressed in the following words by H. Feigl: "Perhaps what we mean ... by 'cause' (independent variable) and 'effect' (dependent variable) simply hinges upon which of the variables are open to active control, accessible to intervention" [2].

In my view this is an oversimplified and erroneous way of thinking. To explain what I mean I must first say some words about the concept of a controlled variable. I am all for this concept. It is essentially the same as the parameter of action which I have used in many previous papers. Essentially it is the same as the concept of stimulus in laboratory experiments and in other types of experiments. Essentially it is also the same as Jan Tinbergen's concept of instrument in economic planning. I do accept the concept of instruments taken by itself. But I am vigorously opposed to the usual procedure of considering this concept jointly with—so to speak on the same logical level as—the concept of *targets*. The concept of instruments can be derived from the *core* of the model (i.e. the system of equations and/or bounds) supplemented by considerations on which one of the variables is accessible to direct government action (tax rates for instance). The concept of targets on the contrary cannot be derived from the core of the model. To express the preferences of the politicians through specific values of some of the variables is ill-considered because this procedure raises a lot of admissibility considerations that exceeds the vision of the policy maker, and furthermore the fixation of one set of targets does not exclude the possibility that there may be some other set of targets which would give a much closer approximation to the real desires of the decision maker. A logical system of targets can only be arrived at by first

constructing the decision maker's preference function [3], then proceed to an optimal solution and from this solution simply read off the targets. In this postoptimal (and only logical) sense of targets, *all* the variables could be looked upon as targets. I think it is unfortunate that the useful concept of instruments is nearly always mentioned together with the very dubious concept of targets.

From now on I shall leave the concept of targets out of the picture and only consider the concept of controlled variables, parameters of action, instruments, stimuli or whatever terms you like for this important concept.

In a first approach to the concept of a controlled variable we usually think of it as variables that have been fixed at will *by a human being*. He may be the organizer of an agricultural experiment, who ceteris paribus fixes the values to be used of certain stimuli. Or he may be a political authority that fixes certain tax rates or other parameters in the institutional set up.

But in a more general sense the concept of controlled variables or stimuli etc. must be considered only as variables that on a specific occasion have been fixed *in some way*, either by a human being or a group of human beings or by certain facts in the exterior world which we can single out as having the character of stimuli.

For instance in the strawberry market on a certain day in a certain city the *quantity* brought to the market may be thought of as a stimulus that has been fixed by nature itself (temperature, humidity etc.). In this case the response is given by the highling and bargaining of a free market that adapts the price to the stimulus which is given by the quantity brought to the market. The demand elasticity depicting such a situation would be obtained by taking (in logarithmic units) the regression of price on quantity. A monopolistic strawberry sales organization that tried (say by refrigeration or other means) to distribute in an optimal way the quantities put on the market each day, would have to base its computations on *this* kind of demand elasticity.

On the other hand in the case of, say, an industrial product whose price is fixed by a more or less monopolistic producer, the demand elasticity characterizing this situation would have to be statistically determined by taking (in logarithmic units) a regression of quantity on price.

These two examples lead us into the time honoured problem of the choice of regression. I shall not go any further with that particular problem here. The two examples were given only to illustrate that the "controller" of an

instrument, or if you like of a parameter of action, need not be a human being or a group of human beings.

Since we should avoid the too simplified idea of a human being as controlling the variable, it would be useful to introduce a general term instead of the specific terms controlled variables, instruments, parameters of action, stimuli etc. I suggest that we speak of an *interventional variable*. This term would cover all the various other terms.

The term interventional variable will indicate that the essence of the situation is that there has been injected an element which is *new* in relation to the unhampered-with material which we possessed previously, and which we used as a gadget for defining dictability.

Is the introduction of such a new element—in addition to the concept of dictability—sufficient to pass to the concept of a cause?

I believe not. To arrive at the cause concept we must *intercalate* between dictability and the concept of cause, an other important concept, namely that of *transmission* and more particularly that of the *reliability* of a transmission. This means that we are moving from the observational, or if you like kinetic field, into that of the *dynamics* which describe *how* the effect is transmitted from the interventional variables to the response variables. We now consider the *genesis* of observations in the new situation produced by the intervention, a genesis that may be different from that which determined the unhampered-with material.

Take again the example of the speedometer in the automobile. In a strictly observational (unhampered-with) statistical material we have seen that A= speed of rotation of the wheel, and B=position of the needle on the speedometer are mutually dictable. At the same time we note that any of these two variables is interventional in the sense that I can control it in a direct way. I can increase the speed of rotation of the wheels by giving more gas, and I can, if I want to, with my finger push the needle of the speedometer. The fact that A is dictable from B, and B can be controlled directly, is not sufficient to characterize the position of the needle as the cause of the rotation of the wheels. We must consider the reliability of the transmission. When we think in the direction from B to A, the reliability of the transmission is for all practical purposes 0. But when we think in the direction from A to B, the reliability of the transmission is perfect. Hence: The rotation of the wheel may be considered as the cause of the position of the needle of the speedometer. *But not inversely.*

In laboratory work and other types of experimental work that proceeds according to the stimulus-response pattern taken in its primitive and narrow sense, the transmission analysis *is included automatically* because the response is here observed as it actually emerges under the impact of a stimulus as it is technologically construed. For instance: If in the automobile example we had *discarded all previous statistics* and proceeded directly to an experiment of the stimulus-response type, using the position of the needle as stimulus, we would quickly have discovered that we cannot make the wheels turn by pushing the needle on the speedometer.

But in many other instances the situation is different. This applies particularly to big planning systems. Here we *have to* use previous statistics as a help in orienting our further work. Frequently this statistical material may have emerged in an unhampered-with situation. Or, at least it may have emerged under a system of interventional variables that are different from that which one is going to apply *now* in a steering procedure. In such cases some sort of transmission analysis becomes of paramount importance. This applies not only in applied econometrics but also in other fields, such as medicine, the steering of irreversible chemical processes etc. It leads to considering *structural* rather than *confluent* relations.

This need for some sort of transmission analysis in addition to the concept of dictability as derived from previous statistics, constitutes probably the most signal difference between experimental and nonexperimental sciences. But if principles and techniques of transmission analysis are successfully developed, the difference between the two types of sciences will to a large extent disappear.

There is nothing sensational in the concept of reliability of a transmission as here developed. It is only a formalization of facts and points of view regarding the concept of cause, that—through all the philosophical ups and downs of this concept—has retained an ineradicable position in the minds of practically working scientists nearly everywhere.

We ought to draw the consequences from this also in our econometric work.

3. *Originality*

If we throw a glance at the really important discoveries that have been made in the natural sciences and in humaniora, we must be struck by the fact that in all these cases the discoverer started to think in a way which was *different*

from that in which most of his contemporaries were thinking. This is what we call originality.

In what does it consist and how is it produced this peculiar thing which we call originality?

I must relate an episode from my younger days. It throws a flash of light on what originality is.

There was a certain period when on and off—in fact nearly constantly—I was thinking of a certain point in the theory of value were I felt that I had an important and very original idea. I wanted very much to work it out in all details and in all its glory. I got more and more impatient because there were so many other duties and tasks which pressed on and for the time being prevented me from realizing my great intention.

One day when I was looking through my bookshelves in order to find a book I needed in another connection, my hand fell by pure chance on a book "Gode og daarlige tider" (Good and Bad Times) by the Norwegian economist Einar Einarsen. He was the father of Johan Einarsen who later became my first research associate when the Institute of Economics in Oslo was established (here Johan Einarsen wrote his "Reinvestment Cycles"). Later Johan Einarsen held for a long period the post of head of our department.

The book by Einar Einarsen was a most excellent book. It was indeed an innovation at the time when it was written. It combined in a very constructive way economic theory and a penetrating use of whatever statistics we had at that time. Einar Einarsen may well be looked upon as a forerunner of econometrics. In my student days I had read this book avidly. As I now turned over its pages at random I discovered to my horror a page where my brilliant and original idea was expressed with a precision and clarity that left nothing to be desired.

But this was not all. On the same page I found a pencil-note in my own hand-writing. It said (in Norwegian): "An excellent idea. This I must try to utilize."

Over the years this page and this note had been forgotten to a point where I began to believe that this was my own idea.

From where did Einar Einarsen get this brilliant idea? It is no use trying to pursue this problem. We can safely say that however hard we would try, we would never be able to follow to the very end the complex ramifications of the ancestry of our ideas.

The only thing we can do is to accept with joy and thankfulness and hand over to others for further use whatever riches of ideas that may come our way. We should, of course, give exact references whenever a specific indebtedness is clear in our mind. But we must also know that we will never be able to give a full account of what we owe to others.

When we have pondered over this for a while, it will little by little dawn upon us that it is a giant misunderstanding to believe that a successful thing which we may have achieved in life *is performed by ourselves*. To believe this would be as if the tap on a cask of exquisite wine would say: "Look what delicious wine I can produce!"

Everyone of us is only a tap which can pass on values that come streaming from some other place. Not pride but thankfulness should therefore be our feeling. Thankfulness for the fact that we have been found worthy of functioning as a tap.

Domine, da quod jubes et jube quod vis said St. Augustin. "Lord, give me what you expect to require from me, and then request whatever you want."

4. *The Dilemma of Freedom*

When speaking about planning and particularly about planning through econometric methods and the use of electronic computers, we will always be confronted with the uncomfortable question: How can planning be reconciled with freedom?

What is freedom? Obviously it is something which everybody likes to have as much as possible of for himself. But on scrutiny we will find that freedom may take on *many different forms*, some laudable and others twisted to a base form of selfishness which we cannot respect.

For instance is freedom the same as freedom of the strong to subdue the weak? Some facts and arguments from the field of big business seem to indicate that *this* is what some people mean by freedom. Most of us would be opposed to such a definition of the concept.

Or again, is freedom the right of everybody in the traffic to push along recklessly as best he can, disregarding what this would mean to the others? Here too most of us would say no. This method would be *ineffective* from the viewpoint of the traffic as a whole, and it would also be *unjust* in the extreme.

We must always remember that freedom for some means restriction of freedom for others. Freedom is like a priceless good that nature has made available

to us in scarce supply. Hence it must be rationed with wisdom and justice. We must always think of the *motivation* behind the rationing. Do we respect this motivation? Here we are at the essence of the matter. This raises far reaching problems both intellectually and morally.

In my personal experience I have a vivid impression of the first days of the German occupation of Norway in 1940. Suddenly we were told a number of things that we were not allowed to do, for instance we were not allowed to listen to broadcasting from other countries etc. etc. In those days it grieved me to think of the possibility that my daughter (who was two years at the beginning of the occupation) should grow up in what I—more or less vaguely—thought of as an unfree country. And thousands and thousands of my compatriots felt the same way. When we thought of the *motivation* behind this sort of restriction of freedom, we quickly came to the conclusion that our craving for freedom was of the understandable and respectable kind.

But in many other cases the cry for freedom is far from respectable. Sometimes the cry for freedom is nothing more than a shrewd propagandistic trick for selfish purposes.

Most of us would recognize an adult person's right—if necessary by force—to take a small boy away from a danger spot on the riverside where the boy was playing. Other persons who *did not like* the boy-saver, may take advantage of the situation by starting a cry for freedom in order to make the boy-saver unpopular. And many people, not very much used to independent thinking, may be lured into joining in the cry for freedom.

Examples of such situations on a bigger scale may be found in international politics.

I do not propose to give a catalogue of all the cases and the corresponding "correct" solutions. This would lead us deep into subjective evaluations of many sorts. But I do want to issue a warning: Always be sceptical whenever a cry for freedom is raised without specifying *freedom for whom* to do *what* and for what *purpose*.

To conclude I would like to suggest a general optimality problem for organizing society.

The essence of a feeling of freedom is, of course, that *there exist certain things* which the individual thinks are important to him and which he knows that he has the right to determine himself. The wider the field of these things, the more perfect the feeling of freedom.

To arrange a social, economic and legal order where the field of these things is as wide as possible, and *at the same time* the ensuing *behaviour* of the individuals will lighten the task of the government in steering the social and economic development in that particular direction that has been decided upon by the responsible political authorities (with the help of the econometricians)—is a *formidable task*. We are facing the formidable problem of finding a set of optimal institutions and optimal administrative rules.

Also in this field I believe econometrics is called upon to play an important role. I believe that in the future this will be one of the most important areas of study in econometrics. The analogy with an optimum, determined by maximizing a quantity produced under alternative sizes of the budget constraint (leading to the concept of substitumal), is obvious.

References

[1] Wold, Herman, "Mergers of Economics and Philosophy of Science", Symposium of Papers in *Synthese*. Here quoted from a photo-copy of the galley proofs, December 1969.

[2] Feigl, H., "Notes on causality" in H. Feigl and May Brodbeck: *Readings in the Philosophy of Science*, p. 417, New York, 1953. Here quoted from Herman Wold: "On the Definition and Meaning of Causal Concepts" in Entretiens de Monaco en Sciences Humaines. Session 1964, p. 285.

[3] Frisch, Ragnar, "From Utopian Theory to Practical Applications: The Case of Econometrics." in *Les Prix Nobels en 1969*.