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MD INTERVIEW

AN INTERVIEW WITH WASSILY LEONTIEF

Interviewed by Duncan K. Foley
Barnard College of Columbia University

April 14, 1997

Wassily Leontief is one of the central creators and shapers of twentieth-century economics. He invented input-output theory and the techniques for constructing input-output tables from economic and technological data and was responsible for making input-output tables the most powerful and widely used tool of structural economic analysis. The theory of input-output matrices played an important role in the clarification of general equilibrium theory in the 1940's and 1950's as well. Leontief has also made fundamental and seminal contributions to the theories of demand, international trade, and economic dynamics. His research interests include monetary economics, population, econometric method, environmental economics, distribution, disarmament, induced technical change, international capital movements, growth, economic planning, and the Soviet and other socialist economies. Leontief has played a vigorous part in formulating national and international policies addressing technology, trade, population, arms control, and the environment. He has also been a well-informed and influential critic of contemporary economic method, theory, and practice. Leontief received the Nobel Memorial Prize for Economics in 1973.

I met Wassily Leontief on April 14, 1997, at his apartment high above Washington Square Park in New York City. Leontief reclined on a sofa in the living room, with Mrs. Leontief going about her business in the background, occasionally asking after Leontief's comfort. Leontief's voice on the tape ranges from an assertive *forte* to a whispery *piano*. He is by turns animated, thoughtful, puzzled, inspiring, and charming. A chiming clock marking the passage of quarter-hours and characteristic New York street noise occasionally obscure his words on the tape. I have edited the transcript for continuity and clarity.

Keywords: Leontief, Input-Output

Foley: There has been considerable discussion about the relation between input-output analysis and Marx's schemes of reproduction from Volume II of *Capital.*

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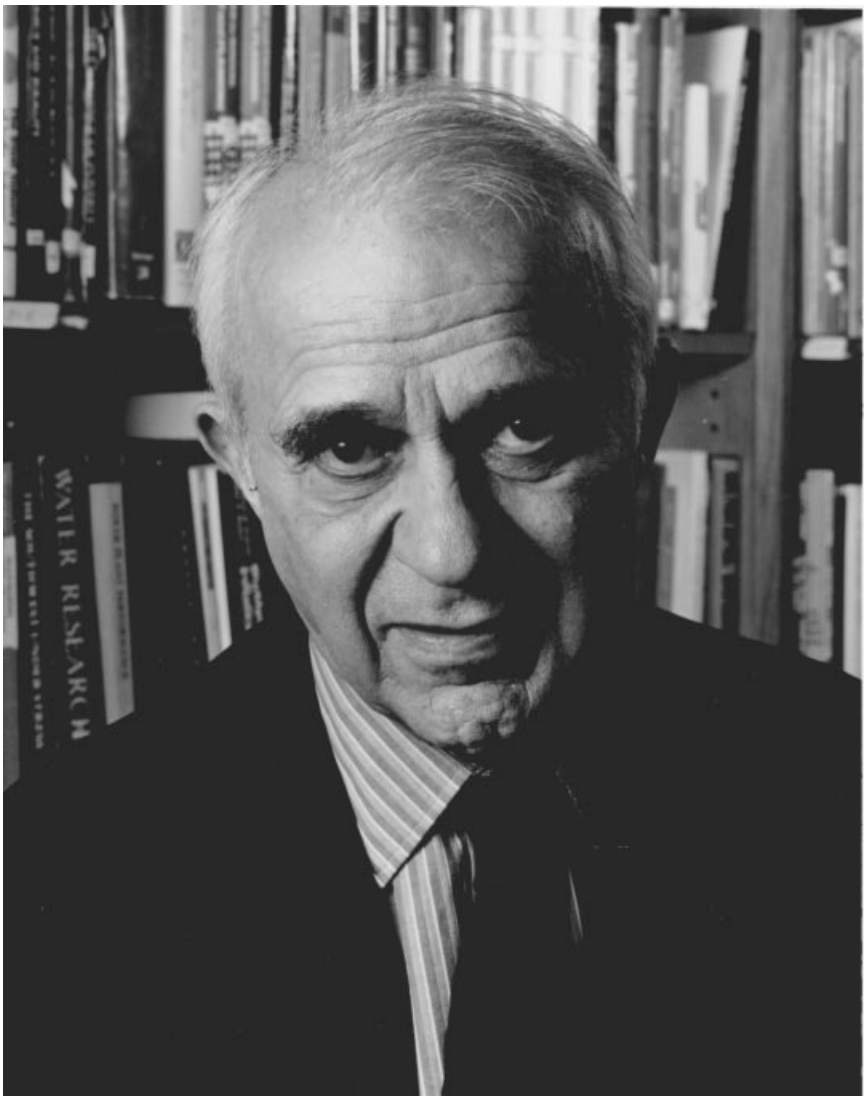


FIGURE 1. Wassily Leontief.

What was the role, if any, of Marx in your education as an economist? Were Marx's schemes of reproduction an inspiration or influence on your development?

Leontief: I did my undergraduate work in Russia, and that's where I learned Marx, but I am not a militant Marxist economist. When I developed input-output analysis it was as a response to the weaknesses of classical-neoclassical supply-and-demand analysis. It was terribly disjointed essentially, I always thought. You read my Presidential address, I think? I felt that general equilibrium theory does

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not see how to integrate the facts and I developed input-output analysis quite consciously to provide a factual background, to register the facts in a systematic way, so it would be possible to explain the operation of this system.

Foley: So, did the structure of Marx's schemes of reproduction play any role in forming your ideas?

Leontief: No. Not really. No. Marx was not a very good mathematician. He was always mixed up in math, and the labor theory of value didn't make much sense, but essentially I interpret Marx and am interested in Marx only as a classical economist. And it is possibly Quesnay, the ideas of Quesnay, that influenced me. It is very difficult to say what influenced you. I got my training as an economist as an undergraduate. Already I read systematically all economists beginning with the seventeenth century. I just read and read, so I had a pretty good background in the history of economic thought, and my feeling is that I understand the state of the science.

Foley: You were in the Soviet Union in the very first years of the Soviet experiment?

Leontief: I left the Soviet Union in 1925. I got in trouble with the government, actually. I had to go away in order to be able to work.

Foley: Was anyone at that time thinking about a statistical basis for planning in the Soviet Union?

Leontief: No. The first thing which had some relation to it was essentially a national income analysis. Like all national income analyses, it was not very disaggregated. Everything gives you one figure, while I thought that to understand the operation of the system, one figure is not enough. You want to see how it disaggregates. I was not interested in improving the system; I was just concentrating on understanding how it works. Of course, it's nice to understand before you improve, but my feeling is that to understand the economic system is the first job of the economist.

Foley: Then, in 1925, you moved to Berlin?

Leontief: To Berlin. I got my Ph.D. very quickly, and I had two professors. I was research assistant of Professor Sombart, who was a quite interesting historical economist, and Bortkiewicz, who was a mathematical economist. But Professor Sombart didn't understand mathematics.

Foley: Were they particularly interested in the statistical side of input-output tables?

Leontief: No, and economists in their empirical efforts must be factual. But there is a tendency to be abstract, theoretical, particularly among the better economists.

Foley: How long did you stay in Berlin?

Leontief: About 2 years. I got my Ph.D. very quickly. Then I was in the Institute for World Economics—a big Institute in Kiel—and I was invited to be a member of the staff, and this is essentially where I developed my idea of the input-output approach.

Foley: Were there other scholars at Kiel working on that general line, or anything related to that type of thing?

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Leontief: No. I was isolated.

Foley: It must have been a tremendous job to do the statistical groundwork for input-output analysis.

Leontief: Yes, it was. I decided the only thing was practically to show how to do it, and I did this with one assistant. I was invited to the United States by the National Bureau of Economic Research. I received some foundation money and my assistant and I worked very hard, I mean, using all kinds of information—technological information, naturally, beginning with the Census. The U.S. Census was the best statistical record of an economy. From there I was invited to Harvard, where I spent 45 years. When the war began, interest in input-output analysis grew. I was kind of a consultant on economic planning. It was for the Air Force, which of course was very important during the war. The best input-output matrix was computed by the Air Force. They had also an input-output table of the German economy, because it enabled them to choose targets. Usually I'm not very pragmatic, but if you want to do something, you have to understand what you're doing, and for the Air Force that was the committed choice of targets and so on, so input-output analysis was very interesting to them.

Foley: What was your reaction to Keynes' work during the 1930's? Have you changed your mind since then?

Leontief: No, not at all. My attitude was rather critical because I felt that he developed his theory to justify his political advice. Keynes was more of a politician than an analyst. I never became a Keynesian, although I wrote some of the first criticisms of Keynes. If you look at my bibliography you'll find them. But I tried to do it systematically, that is, not so much the political side but just the approach, which was for me too pragmatic. Now, you improve the system, all right, but first describe the system in order to improve it.

Foley: Did you have an alternative theory of the Depression at that time?

Leontief: No. My feeling is that the fundamental theoretical understanding of economic fluctuations is as a dynamic process. I still believe, what explains the fluctuations of economies is some kind of difference, differential equations. Of course, structural change is very important, particularly now. It's always dynamic. It's a system of interrelationships, a system of equations, but still the quantitative approach is important. Since I paid so much attention to the relationship between observation and theory, at the same time I developed a theory of input-output analysis which is really mathematical, and tried myself to collect data. I think I influenced the course of economic statistics.

Foley: Yes. Input-output analysis and national income analysis are the two major systems that came into place in the 1940's and 1950's.

Leontief: Right. I don't think there is really a dichotomy. I think input-output analysis is just much more detailed. Stone, for example, who was commissioned to develop the statistical economic system for the United Nations, assigned a very great role to input-output analysis, as a foundation for the aggregation to national income.

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Foley: In a system of that kind, there's usually some attempt to model both supply-side effects and demand-side effects.

Leontief: I was always slightly worried about having demand analysis as a separate thing. My feeling is that households are an element of the system. In a good theoretical formulation, households are just a large sector of the economy.

Foley: This echoes the classical idea that the reproduction of the population is an aspect of the reproduction of the economic system.

Leontief: Exactly. This goes back to Quesnay.

Foley: I've also talked with Richard Goodwin about this theme of the interplay between structural change and fluctuations.

Leontief: Richard Goodwin was my student. He studied with me, he was my assistant. He couldn't get a permanent appointment at Harvard and then went to England. He was a good friend. He was very interesting.

Foley: I talked with Goodwin about this at one time. He did have a job at Harvard in the late 1940's, but it was an untenured job, right?

Leontief: Yes. He couldn't get tenure. And this was the reason why he went to England.

Foley: Yes, that's what he told me as well, but I was somewhat puzzled as to why someone who had been doing the kind of work he was doing in the late 1940's would not have been a shoo-in for tenure.

Leontief: I think possibly it was politics. He was on the left.

Foley: So that shaded the evaluation of his scientific work?

Leontief: Yes. That was it, frankly.

Foley: So you would still now look for the major cause of business-cycle fluctuations in lags, but the impulses in supply-side structural change?

Leontief: Yes, structural changes, but be very careful, because a system, a dynamic system, without structural change would have lags, and latent eigenroots that create fluctuations. Of course, at the present time, technological change is very important. Technological change is the driving force of economic change and the cause of social change.

Foley: To come to a slightly more technical issue, what about the question of whether the fluctuations are damped or undamped?

Leontief: They don't have from a mathematical point of view necessarily to be damped. This raises the problem, why don't we explode? And there are some forces which prevent them from exploding, including economic forces, such as policy and other nonlinear effects.

Foley: In the 1930's, you had a controversy with Marschak over demand analysis.

Leontief: Yes, now I do not remember the details, but I think there was a logical flaw in Marschak's position.

Foley: Did this have anything to do with the development of input-output analysis?

Leontief: That was already after I developed input-output analysis, which I really developed when I was in Kiel, and at the National Bureau. In the National

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Bureau, I was very subversive, because the National Bureau under Mitchell was extremely empirical, while I on the other side had a very strong theoretical intuition. To understand the process you have to have a theory. I organized an underground theoretical seminar in the National Bureau. It was underground, because it was against the principle of the National Bureau.

Foley: In the 1940's, there was a rather sharp controversy between the Cowles Foundation and the National Bureau around issues of empirical method and theory. Koopmans wrote a very sharp paper at that time.

Leontief: Since I thought mathematics plays a great, important role, I would of course be on the side of the Cowles Commission.

Foley: But you found yourself institutionally associated with the National Bureau.

Leontief: Exactly. Because I always felt, as I explained in my Presidential address, if you want to really understand an empirical science, you must have the facts. And the problem is how to organize the facts. Essentially, theory organizes facts.

Foley: So your position was a kind of synthesis of these two points of view.

Leontief: Yes. Right.

Foley: The Cowles Commission developed a very characteristic approach to econometrics and measurement problems in the 1940's. Did you find yourself sympathetic to that way of doing it?

Leontief: No. I criticized it very early.

Foley: Did you foresee that there would be a role for input-output analysis in guiding government policy after the Second World War? This is an interesting period because it set the pattern for the next decades.

Leontief: Not only in government, but also in industry. I remember when the question arose much later about the position of the automobile industry in the American economy, there was some kind of association of industrialists who said "go to Leontief," because I published some work using the example of the auto industry. I published empirical work, and my principle always, though I could not always adhere to it, was always, when I made some theoretical observation to use the data—not just to say it, but really to see how it works.

Foley: And so you used input-output analysis, say, to study the future of the auto industry or prospects for specific industries?

Leontief: Right, right. During the Cold War, there was an economist by the name of Hoffenberg. He did a lot of empirical analysis. In constructing an input-output table of the United States, he played a very important role. He was a really excellent intuitive statistician. And, you must understand, it takes a particular knack to understand statistics. When I constructed the first input-output table, which was very early, I often used the telephone. I called up industries, particularly firms which were engaged in the distribution of commodities, and got the data from them.

Foley: So you would ask the distributors what their customers' proportions were in terms of the sectors?

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Leontief: Exactly! I just went straight to them.

Foley: Did the U.S. government have a functioning input-output table in 1946?

Leontief: Yes, yes. In the Department of Commerce, in the Bureau of Economic Analysis. National income computations were conducted in the Bureau of Economic Analysis, and they had an input-output table. Although the best input-output table was constructed by the Department of Labor. Roosevelt's Secretary of Labor, Frances Perkins, wrote to me that the President had asked her the question, what will happen to the American economy after the war? She said, we don't know how to do it. We tried to look at the literature, but we don't know how to study this type of thing, and then one of my first articles appeared and they said, all right, we thought possibly you could tell us how to do it. They sent a representative, and I said, get the facts and good theory; and, as a matter of fact, at that time under Roosevelt the government was very active and intelligent. Yes, they told me, all right, collect the facts. Come to Washington and collect the facts. I said, no. One cannot collect facts in Washington. I must do it at Harvard. And they opened a division of the Bureau of Labor Statistics at Harvard, at the Littauer School, and I hired people, not many economists, mostly engineers, and we constructed an input-output table. The next detailed input-output table was constructed with the money of the Defense Department. And they had a lot. Without money it's very difficult to construct an input-output table; it's a resource-intensive activity.

Foley: After the war, was there a competition between Keynesian demand management and a more structurally oriented input-output approach to economic policy?

Leontief: Oh, I think the Keynesian approach definitely took over. I don't think there was much competition. Keynes took over.

Foley: Why did that happen?

Leontief: Because Keynes was very pragmatically oriented. In spirit, he was very much a politician, an excellent politician. I think he developed his theory essentially as an instrument to support his policy advice. He was incredibly intelligent.

Foley: Well, it sounds as if you had your political contacts, too, in the Labor Department and the Defense Department, and the Commerce Department.

Leontief: Oh, yes, but you know it was different. It was much more modest. The Labor Department studied the problem of the supply of labor, different skills and so on. It was much more technical. They still have an input-output division in the Labor Department—the Bureau of Labor Statistics.

Foley: The late 1940's, as we look back on it, seems to be the time when a methodological synthesis took place in economics. How did you view the relation of input-output to the developing methodological consensus in economics and econometric theory? Did you see it as part of it or as a different path?

Leontief: You see, I was somewhat skeptical of the whole curve-fitting notion. I thought of technological information. The people who know the structure of the economy are not statisticians but technologists, but of course to model technological information is very difficult. My idea was not to infer the structure indirectly from econometric or statistical techniques, but to go directly to technological and

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Figure 2. Members of Professor Leontief's seminar of the August 1948 Salzburg Seminar in American Studies. 1, Friedrich G. Seib (Germany); 2, Bjarn Larsen (?) (Norway); 3, Helge Seip (Norway); 4, Leendert Koyck (?) (Holland); 5, Gérard Debreu (France); 6, Paul Winding (Denmark); 7, Robert Solow (USA); 8, Mrs. Robert Solow (USA); 9, Mario Di Lorenzo (Italy); 10, Arvo Puukari (Finland); 11, Jacques D. Mayer (France); 12, Odd Aukrust (Norway); 13, Prof. William G. Rice (USA); 14, Joseph Klatzmann (France); 15, Unknown (Germany); 16, Bjarke Fog (Denmark); 17, Prof. Leontief Wassily (USA); 18, Per Silve Tweite (Norway).

engineering sources. I had some proposals to this effect, which could not be realized because there was no money. Empirical analyses are extremely expensive.

Foley: And the input-output type is more expensive than the indirect statistical investigation.

Leontief: Oh yes, much more. It was indirect statistical methods that were used. I think I have a very strong theoretical streak. I am essentially a theorist. But I felt very strongly that theory is just construction of frameworks to understand how real systems work. It is an organizing principle, while for many economists theory is a separate object.

Foley: Some economists think of theory as predictive or behavioral.

Leontief: Yes. I think if one knows, or one agrees, what the formal nature of a mathematical system is, one can do certain predictions because of the general nature of the system. I published a couple of articles on prediction. There are short-run problems and long-run problems in quantitative analysis, and I have a feeling that conventional prediction is good for short-run problems; but technological change, which is the driving force of all economic development, is a long-run process.

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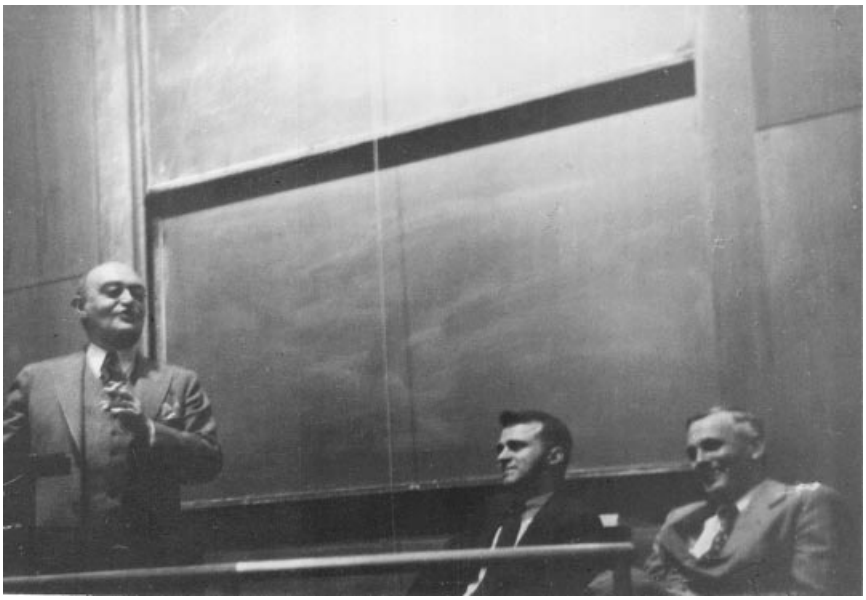


Figure 3. Joseph Schumpeter, Wassily Leontief, and Paul Sweezy at Harvard in the late 1940's.

Foley: So, from this point of view, specific hypotheses about human behavior, or expectation formation, or preferences would play a subsidiary role.

Leontief: A subsidiary role. I think so, because my feeling is that, particularly under a market system, a capitalist system, the big industrialists play a really big role, and they try to make profits, to choose technologies which maximize profits—essentially in the short run. Of course, national policy has to be taken into account, but business is certainly a short-term type of system.

Foley: In sectors like transportation or power generation where you have long-term investments, this can create problems.

Leontief: I agree. There you need long-run engineering, power generation, and—I suppose—environment, which is important now.

Foley: You talked about the money and resource problem. Was there a competition for resources between national income approaches and input-output approaches in the United States during the 1950's?

Leontief: I have a feeling that, at least in the Department of Commerce, they realized input-output was very useful for national income computations. As a matter of fact, there was a period of time—possibly even now—when the national income computation essentially summarized the results of the input-output analysis. Funding is always a problem. For input-output analysis, particularly analysis of technological change, we need more of an engineering understanding, because scientific progress is now the driving force in technological change.

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Foley: Do you see any feedback in the other direction, to the priorities in scientific research from economic bottlenecks?

Leontief: Oh, no doubt, no doubt. First of all, it was always true of the war industry. Scientific progress helped the military.

Foley: In the 1960's and early 1970's, there was another major change in economic doctrine, a shift from a Keynesian consensus to what's now called rational-expectations models and the notion of market clearing and perfect foresight. You were a professor at Harvard at that time. How did you see that happening in the profession? What factors determined that change?

Leontief: In the earlier times, Keynes dominated economic thinking. I do not know to what extent the whole expectations revolution made any headway. It is a very delicate thing mathematically, and I do not follow the literature closely now, but I think there was not so much analysis about expectations. There was just talk about it. I did not see any material contribution to the theory of expectations, except the very short run, naturally, for the business cycle, which is important.

Foley: So you don't think that was the result of any empirical superiority of this new approach?

Leontief: No, I don't think so.

Foley: Was it just that Keynesianism ran out of steam?

Leontief: I think so.

Foley: You said that you were not that taken with the Keynesian point of view to begin with, so I suppose you observed this with some equanimity.

Leontief: Yes. I'm not a monetary economist, but I think that deeper analysis of the flow of money might give a little more meat to this field.

Foley: There has been the development of the flow of funds accounts.

Leontief: Yes, but it was very aggregative. For our understanding how the economic system works, disaggregation is very important.

Foley: Would it make sense to try to link flow of funds with input-output analysis at the same levels of disaggregation?

Leontief: Oh, yes, but I didn't see anybody try to do it. Of course, there's no money there, but I think the money flows are important. I sometimes suggested the possibility of aligning money flows from micro up rather than from macro down, because I think in every corporation there is some high functionary who is in charge of money flows—budgets, credit, and so on—and he has to make a plan. The only planning that exists is for money flows, and there is his counterpart in a bank, who is close to operations and, if I'm not mistaken, there is a cooperation between the official in the company who sees to it that they have enough credit, and the credit manager in the bank, who is very often in charge of separate corporations. I made a couple of proposals to work on this. The interesting thing is to have the same figures from two points of view. It might be very helpful to understand how they interact to determine the short-run path of investment.

Foley: There's not been a lot of economic theorizing in that area. Most of the models assume some kind of equilibrium conditions, but you said that it was a mistake to start from equilibrium as opposed to explicit dynamics.

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Leontief: Exactly, exactly.

Foley: When you resigned from Harvard in 1974, soon after you received the Nobel Memorial Prize, you sharply criticized the direction of economics as a discipline and called for a reevaluation and redirection of research methodology in economics. Do you think that redirection has taken place?

Leontief: No.

Foley: Would you have the same view on the success of economics as a science now?

Leontief: Yes. My feeling is we require patient, practical economic advice. Our basis of understanding how the economy works is not very strong. Practical advice could and should be more based on understanding how the system works.

Foley: We've mentioned several times this afternoon the role of mathematics. Some people argue that economics has become too dominated by mathematical formalism.

Leontief: I completely agree. Very many mathematical economists were simply mathematicians who were not good enough to become pure mathematicians, so mathematical economics, which had always been dull, gave them a marvelous pretext to become economists.

Foley: But on the other hand, you've strongly supported the role of mathematics in theory in economics. When is mathematics fertile and when does it become just a formalism?

Leontief: My feeling is that mathematics is simply logic. The general insights are the most important. For example, I think mathematics gives us good reason to feel that all fluctuations are due to lags—it's dynamics. This is a real mathematical insight. Mathematicians know it. As a matter of fact, one of the problems I had in my theoretical work was how to avoid explosive fluctuations, because there are so many eigenvalues in those big matrices, and some explode.

Foley: What was your own training as a mathematician?

Leontief: I took mathematics courses, but I tried to improve my range of mathematics very early, when I realized that mathematical argument was of great importance for economics. I read a lot. I took basic courses in the university. My tendency was always to combine the empirical and theoretical. In economics that combination requires mathematical concepts, such as systems analysis.

Foley: But you're also saying that the vision of the economic structure and relations has to come first.

Leontief: I think, together, because if we have only that vision, it never adds up to anything. When I developed input-output analysis before going to the National Bureau of Economic Research, I felt it terribly important to have a good insight into the mathematical relationships. I think that the mathematics which economics used are not of a particularly high order. For example, those who translated neoclassical economics into mathematics didn't develop any very interesting insights. They obviously developed some things, but didn't come to any very interesting insights into how the economic system works, and they were, on the whole, not interested in empirical analysis.

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Foley: From having talked with other people about that, I think there were very high hopes that the formalization of economics would yield some substantive insights.

Leontief: Without data you couldn't do it. Absolutely, without data it couldn't work. It can just establish certain principles of equilibrium and nonequilibrium.

Foley: You think that more or less exhausted the real scientific contribution of the program?

Leontief: I think so. They would have made more progress if they really had good, very detailed, empirical information. For example, it would be very interesting to see how modern technological change has affected the demand for labor. It might reduce the demand for labor, and even create a social problem, because labor isn't just one more factor of production. Then you will have to support labor. My speculative intuition is that the government now has to support a large part of income through education expenditure, health expenditure, and of course social security—and possibly a kind of welfare—but social security is more important. My feeling is that ultimately the transfer of income so as to provide people money to buy consumers' goods will become part of social security. It's already very large—I'm amazed how large my family social security is.

Foley: This is a Keynesian theme, the support of demand through government subsidies.

Leontief: Yes, Yes, but it's not only supporting demand. Keynes was supporting employment, which this does not do. Just demand. You feed people. Technology will reduce employment, or certainly not increase employment. Certainly I think that technology competes with labor, ordinary labor: If you produce everything automatically naturally you're not going to employ so much labor.

Foley: So this is an example of your sense that there should be a substantive foundation for the investigation in the real structure of what's going on?

Leontief: Yes. Technological change was always the driving force for economic development beginning in prehistorical time, but now, when technological change has become propelled by scientific investigation, this type of analysis is extremely important. Economists attempted to do it, but mostly by making general statements. The moment energy becomes cheaper, technological change becomes important. Production now requires much more energy.

Foley: Do you think the establishment of the Nobel Memorial Prize in Economics has, on the whole, fostered a better atmosphere for research in economics?

Leontief: You know, there's a problem. I think they'll soon run out of candidates for Nobel Prizes in economics. I think we have already problems now.

Foley: Did the Nobel Prize have any particular impact on your work or your life as a scientist?

Leontief: On my life, some. Not on my work. Naturally, it was easier to get jobs. Not necessarily easier to get financing. Now, for example, I cannot get any financing. So, I suppose my academic life got easier, but, as I said, there is a problem how the Nobel committee can continue. I think they have already begun to shift from theoretical to institutional economists. Now there is a problem because in

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technical economics at least you can point out some hierarchy, and also major steps forward, breakthroughs, while in institutional economics I don't really see any large breakthroughs. As a matter of fact, I am concerned that economists are not sufficiently interested now in institutional changes brought about by the development of new technologies, which I think is definitely the driving force.

Foley: There's been a lot of discussion about whether economics should take any other science as its model, in particular physics or biology, and, if so, which one. Did you ever think in those terms, that economics should be like a physics of society or a biology of society?

Leontief: I think it doesn't help much. Naturally, mathematical economists like to look to physics. I think it was the Darwinian approach that was really interesting, and I think that in one way the great intellectual revolutionary was Darwin. Incredible revolution, not only in biology, but in the analysis of all living processes. I think Darwin—it was Newton and Darwin who I think were the great contributors to the understanding of social change. Darwinism is very important, although, of course, it is interesting that Darwin was influenced by Malthus. What are you interested in?

Foley: One of the things I've been spending some time on recently is evolutionary modeling of technical change. The issue of global warming evolves over the kind of very long timescale on which changes in technology will be decisive.

Leontief: Oh, yes. I completely agree. Technology is terribly important.

Foley: If you look over a shorter time horizon, substitution of existing technologies might be important, but I think over a long time period, it's going to be the direction of technological change, and the bias of technological change. The question is whether there's any way to control it.

Leontief: Exactly. Not necessarily consciously, but . . .. Now, of course, there is a much closer link between scientific change and technological change. One hardly even can visualize technological change without science, and, with global warming, these things are terribly important. And what can we do? We can do many things. Slow down, for one.

Foley: That's not popular in a world anxious to develop as fast as it can.

Leontief: It is remarkable how technologically backward many less-developed economies are. Once you begin to cut trees, you can do it very quickly.

Foley: If you were encountering a younger scholar who had some innovative but expensive idea like input-output, how would you recommend that person proceed?

Leontief: He has to publish something. I do not know who gets money nowadays. I haven't been following the development of the field recently. I'm, after all, over 90 years old, but, of course, big money is spent not on research, but on data collection. Some people have good ideas and can really do something with the data, but economics has come closer and closer to technology now. To exploit the influence of technological change on economic change, you just can't compute some supply curve; you must really have a mass of information. I wrote up how it can be done, and I nearly succeeded in getting money to do it. My feeling is one could even do some anticipation, prediction, if one had really detailed data. I got in touch with

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engineering societies, the society of mechanical engineers, and they were ready to provide information. I think this is the future of the work, in the interaction between economics and engineering, science, and the substructure of production.

Foley: Did you ever have any personal or scientific contact with Piero Sraffa, the Anglo-Italian who worked on linear models?

Leontief: No. I never met him. But I think he was a very interesting man. His vision was interesting. In general, I think the input-output analysis is not necessarily linear. I would interpret it as an outgrowth of neoclassical theory. Sraffa was interested in something slightly different, the indirect relationships. I don't insist on linear relationships, only I'm conscious of the fact that dealing with nonlinear systems is terribly complicated; and even in computations, what do mathematicians do? Linearize the system in pieces, and then put it together. This is the way most of us use mathematics in a field in which data is important.

Foley: I was going to ask you about the relationship between production-function analysis and input-output. Production functions seem to have taken over the economics of production.

Leontief: Oh, yes. The production function is too flexible. First of all, continuity is silly. I visualize different methods of production as cooking recipes, including even such things as temperature and so forth, and what must be known in order to be able to cook the dish. This approach might enable us to analyze technological change. The technological production function was essentially an attempt not to go into empirical analysis. You see, given production functions, you don't need that. You guess at a few parameters, instead of having to look in detail at what's happening, and if you try to generalize production functions, it's dangerous, very dangerous.

Foley: What are your thoughts on the advantages and disadvantages of linking sectoral and establishment- or firm-level data?

Leontief: I think the institutional organization of production through the establishment in some way reflects technology, but it is a very delicate situation, because it's not very simple, how economic activities are distributed to different human organizations. It has some relation to what is actually being done, but it's very delicate. Human organizations are very complicated. You can accomplish this linkage in some respects and not some other respects, but I agree with both approaches, particularly since the establishment is not enough. Even establishments are now institutional organizations.

Foley: One practical problem is that, as you disaggregate the input-output structure, you find that one firm begins to appear in several different sectors. This also touches on the theme you were talking about earlier of finance. Finance comes at the firm level.

Leontief: I completely agree, and here, we agree with the need for continuity. Institutional organizations change very easily. So far as top management is concerned, the firm doesn't reflect technology at all. You can have the same corporation making ice cream and making steel. This is, I think, unavoidable, but, possibly because of my interests, I would rather favor establishments first, and

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then corporations, because the establishment is a homogeneous concept. It is quite an interesting problem.

Foley: Where do you think the future of economics, and macroeconomics in particular, lies?

Leontief: I think problems of income distribution will increase in importance. As I mentioned before, labor will be not so important, and the problem will be just to manage the system. People will get their income allocated through social security—already now we get it through social security, and we try to invent pretexts to provide social security for people. Here, I think, the role of the government will be incredibly important, and those economists who try to minimize the role of the government, I fear, show a superficial understanding of how the economic system works. My feeling is if we abolished the government now, already there would be complete chaos. Now, planning plays a role, naturally, but I don't emphasize just planning as a role for the government, which is I think extremely important, and its importance is bound to increase because of technological change. If one asks oneself, what will happen to the system if we abolished completely the government, it would be horrible.

Foley: But you think that's particularly true because of the pressures technological change in capitalism are putting on the social fabric, and a weakening of the nexus between labor and income?

Leontief: Oh yes. Absolutely. The labor market is not a sufficient instrument to move from production to consumption.

Foley: I'm just going to ask you one more question. You've been a lifetime participant observer in the subculture of American economics and the larger world of American science and politics. If you were an anthropologist, how would you characterize economists as a tribe or a culture compared to the physicists or biologists?

Leontief: It depends what economists you have in mind. Academic economists are just part of the academic establishment, but I suppose we economists are as indispensable as accountants. In managing a system, you have to have represented the point of view and principle which managers have, and economists are just a particular type of management, if you disregard academic economists, who are a special type.

Foley: Within academics, do you see any difference between economists and their counterparts in science or the engineers that you work with?

Leontief: You see different tendencies in economics. Some prominent economists have just proved a couple of theorems, or codified classical and neoclassical textbooks.

Foley: You're suggesting that economists value classificatory or formal contributions more than finding out something about the world itself?

Leontief: Yes. My observation was a critical one. Particularly since I am interested in society, I see economics as a social science. Certainly economists should contribute something to understanding how human society developed, and here, economists have to cooperate with anthropologists and others.

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[Items are listed under the date of their first publication, but cited in the most conveniently available form.]

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