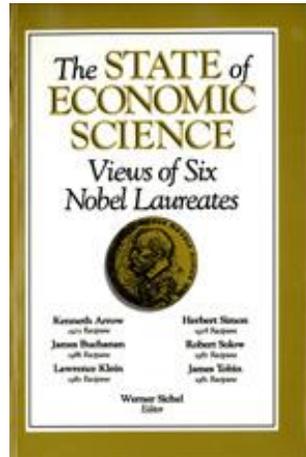

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Professor Klein earned a B.A. degree from the University of California, Berkeley, and a Ph.D. degree from MIT. He has been awarded about twenty honorary degrees from universities in the United States and several foreign nations. He has taught at the University of Pennsylvania for the past thirty years. Before joining the Pennsylvania faculty he was associated with the University of Chicago, the National Bureau of Economic Research, the University of Michigan, and Oxford University. While at the University of Pennsylvania he has served as visiting professor at several U.S. universities including the University of California at Berkeley, Princeton, Stanford, and City University of New York and at foreign centers of learning in Japan, Austria, and Denmark.

Dr. Klein is a past president of the American Economic Association, the Eastern Economic Association, and the Econometric Society. In 1959, he was awarded the John Bates Clark Medal by the American Economic Association. He is a member of the American Academy of Arts and Sciences, the American Philosophical Society, and the National Academy of Sciences. Dr. Klein has been a frequent adviser to U.S. government agencies including the Federal Research Board and the Congressional Budget Office. He has also been a consultant for U.S. research institutes such as the Stanford Research Institute and the Brookings Institution as well as many international organizations.

Professor Klein is the author or editor of more than 25 books, specializing in econometrics. He has also written in excess of 250 scholarly articles on economic subjects. Titles of Dr. Klein's books that are indicative of his work include: *The Keynesian Revolution*, *An Econometric Model of the United States, 1929-1951*, *The Wharton Econometric Forecasting Model*, *The Brookings Model: Perspective and Recent Developments*, *Econometric Models as Guides for Decision Making*, *The Economics of Supply and Demand*, *Industrial Policies for Growth and Competitiveness*, and *Capital Flows and Exchange Rate Determination*.



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Conceptual Issues

Econometrics blends the disciplines of economics, mathematics, and statistics. All too often the reciprocity of these three disciplines is neglected. It is my feeling that an appropriate combination of all three inputs can be extremely fruitful in gaining insight into the economy, and that concentration on one or two alone will be less useful for this purpose. I have spent more than 45 years looking at economic issues through the medium of econometrics: while I do not believe that this is the *only* approach, I do believe that it is the best approach for quantifiable matters. There are, of course, some important and interesting philosophical, historical, and qualitative problems in economics that do not lend themselves to the econometric method.

This essay is about the present state of macroeconomic theory and policy as it relates to econometrics. It will be concerned with the statistical basis for quantifying these subjects. The evolution and present state of techniques, applications, and the information set will be examined, and future tendencies will be indicated.

Econometrics is a broad subject, applicable to many specializations, but I shall limit this survey to macroeconometrics—the use of

econometrics for the study of the macroeconomy. Econometrics is a branch of quantitative economics, and the macroeconomic data base—particularly the structure and availability of data—is very important.

Macroeconomic Theory and Policy

Economic analysis of theory and policy are often confused, particularly with regard to the implementation of policy in the real world. The worst manifestation of this confusion appears in media discussions about business, finance, and economics, but it occurs also in more serious presentations. For example, Keynesian economics is said to be concerned only with deficit spending or classical economics only with financial orthodoxy. It is true that Keynesian economics examines fiscal policy and, under some conditions, advocates deficit spending, but for a very long time Keynesians have recognized the limitations of a simplistic approach. Classical economics does not rigidly support orthodox monetary control for every macroeconomic deficiency.

First, we must make a distinction between theory and policy. Macroeconomic theory involves the construction of a system of thought that describes *behavior* of the economy as a whole—the aggregate economy. One approach is to build that system up from the aggregation of microeconomic relationships. This approach is very attractive but not *unique*. Macroeconomic relationships also may be considered to have a life of their own and can be specified directly, without intricate appeal to microeconomics and the theory of aggregation. The resulting system is also not *unique*, as in the “adding-up” approach.

Having established a macroeconomic theoretical framework and specified it mathematically, we may then confront it with relevant data, estimate the system, and use it for policy analysis. That is what macroeconometrics is all about. The use of such empirical systems for policy analysis results in conclusions that are very rich and encompass many more alternatives than manipulations of fiscal deficits or money supply alone. Such analysis need not be econometric, but noneconometricians tend to oversimplify, because they find it awkward to handle many complex interrelationships simultaneously. It is from this oversimplification and also from expository diagrams of pedagogical treatment of the

subject that popular writers have come to consider policy in terms of crude stereotypes—usually limited to two variables at a time.

Macroeconomic Theory

It is difficult for present-day students and research scholars to appreciate just how innovative the Keynesian theory of macroeconomics was some 50 years ago, when it provided an extremely simple explanation of the overall levels of activity and employment that seemed to correspond with the facts of the period. It is legitimate to criticize early practitioners for oversimplifying the relationships involving the fiscal multiplier and overemphasizing the concept of *effective demand*. It soon became clear that the Keynesian macro model needed supply and financial sectors. Financial relationships of an extremely simple sort were incorporated from the beginning, but the technological laws of production, marginal productivity, labor market clearance, and (absolute) price determination were inadequately handled. The outcome for theory development was that these neglected aspects were eventually incorporated into a system that became the *Keynesian-neoclassical synthesis*. That long-winded title is appropriate, since Keynes was truly a student of Marshall and reasoned strictly along the neoclassical lines that permeated economics in Cambridge, England. The extension of the crude Keynesian theory along neoclassical lines was appropriate but inadequate. There was only one price, one interest rate, and excessive aggregation in other markets. The explanation of workers' money illusion with respect to wage bargaining was contrived. In order to handle these problems, I developed the Phillips curve for the labor market and built larger theoretical systems that included many sectors of activity, culminating in the Keynes-Leontief model that has a full supply side. Aspects of income distribution and disaggregation in financial markets were also introduced, the latter through the term structure of interest rates and later through the analysis of the flow-of-funds accounts.

The distinction between classical economics *cum* monetarism and the Keynes-Leontief-neoclassical synthesis became clear through the treatment of the demand for money. The monetarists base their analysis on the *a priori* predictability of velocity (either a constant, simple trend,

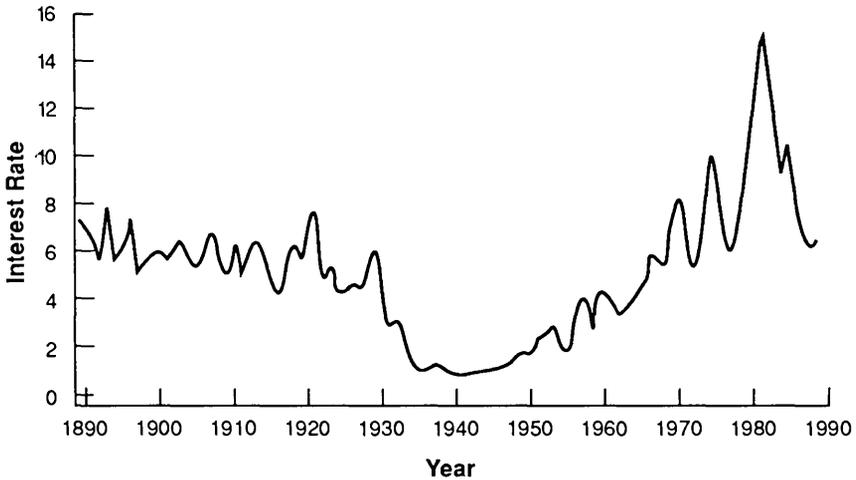
or function of smooth variables). The extended Keynesians argue, implicitly, that velocity depends on interest rates, which, we have learned, can be extremely volatile.

There is one other important aspect of Keynesian economic theory that needs to be examined. It was originally put forward as a macroeconomic theory for a closed economy. This is most peculiar, given Britain's deep economic involvement in the world and extreme openness. Also, Keynes was obviously deeply concerned about international economics at the time of his death, as he was one of the architects of Bretton Woods. It may have been the bad influence of North American Keynesians, who took the lead in the theoretical development of macroeconomics and reasoned, instinctively, in closed-economy terms. In the 1930s and the early part of the postwar period, the U.S. economy may have been approximately closed, but that characteristic gradually withered away. Most of the economic problems of this country in the last 30 years have been predominantly or wholly international. I believe that it is a grave deficiency of our elementary textbooks that they develop macroeconomics first as a self-contained explanation of a closed system, and then add international considerations as an afterthought, much in the form of an amendment. The international problems of an open economy should be introduced in the first chapter dealing with macroeconomics and pervade the analysis in a meaningful, essential way for the whole exposition. I find it unconscionable that authors of elementary American textbooks ("Principles") have not done this on a broad scale.

The problems that arose, in whole or in part, from crude Keynesian theory were early fascination with the stagnation thesis, acceptance of euthanasia of the rentier, introduction of an inflationary bias, and an exaggerated belief in accuracy of the model. Economists frequently generalize a few years of recent experience into decades or eras. In the graph of interest rates, it is evident that there was a brief spell, beginning in the early 1930s, when short-term interest rates were low—below 2 percent—but they soon picked up and reached astronomical heights in the United States. Rentiers who had the good perception to "lock-in" to the high rates on long-term debt securities which yielded returns

of 14-16 percent at the beginning of this decade realized *euphoria* instead of *euthanasia*.

4-6 Month Commercial Paper Rate (1890 – 1987)



The long-term demographic predictions were disastrous. The vanishing of the frontier and the maturation of technology were equally ill-conceived hypotheses. The baby boom, the jet engine, the spread of electronic devices, and fluctuations in financial market rates (not to mention many other pieces of evidence) quickly showed that there was no solid basis for applying the oversimplified Keynesian theory to medium- or long-run macroeconomic development.

The Keynesian theory was developed for European and North American economies, but there was a degree of generality about the system of thought. Some scholars may have made oversimplified applications to developing countries, but, fortunately, specialists on Third-

World development produced more appropriate systems. The Keynes-Leontief model is, indeed, quite suitable for study of developing countries where the data base is adequate.

The study of market-clearing and formation of relative prices by classical economics, supplemented by the quantity theory of money, provided the main alternative macroeconomic theory, under the title of monetarism. Strictly speaking, monetarism deals only with the aggregate relationships that determine money balances (and price levels), but implicitly it is associated with the classical model for the real economy. From a logical point of view the theory is consistent and self-contained, but does it work? This is an econometric question.

The fact that the builders of the St. Louis Model, a macroeconometric version of monetarism, must introduce the world oil price in order to get a satisfactory explanation of recent developments, indicates to me that strict monetarism does not fit the facts. The time curve of velocity does not exhibit steadiness or predictability, and I do find that velocity is significantly related to interest rates. Moreover, the most recent unpredicted (by monetarists) movements in velocity are generally related to the occurrence of *financial innovation*. Changes in hardware, software, and operational characteristics of financial markets have disrupted the underlying monetarist relationships. They have a low degree of *autonomy*.

Now, let us turn to the modern theory of macroeconomics. Among most recent developments are those associated with expectations formation and greater attention to supply considerations. Modern macroeconomic theory appears to be well aware of international dimensions, but the treatment has not yet reached the level of introductory textbooks.

In general, there is much more attachment to market processes, but that is mainly a matter of degree. If the Keynes-Leontief-neoclassical synthesis is fully pursued, all the supply-side characteristics are covered. While I endorse this approach, I reach the conclusion that a full realization of the power and implications of such a system must necessarily lead us to the realm of very large-scale models, with hundreds and—more likely—thousands of simultaneous relationships. Such intricate structures can only be handled by computer analysis of large-scale em-

pirical models. The modern generation, however, appears to be moving in another direction, namely, towards very compact, simplified systems. To some extent, they reason according to a law of parsimony. The smallest system capable of explaining the facts of life is the one to be chosen. The problem with this reasoning is that the “facts of life” are very narrowly prescribed. Little attention is paid to a very wide range of facts, especially potential future events that are not present at the time of the investigations. They are not ready for embargoes, droughts, OPEC power, financial innovation, debt default, or other contingencies. In place of the rule of parsimony, my preference is for:

the largest system that can be managed, given human and data resource limitations, and one that provides estimates of the main aggregates at least as good as those from any smaller system, since it also gives information on many other magnitudes.

Apart from using smaller systems with less comprehensive coverage of detail and less attention to the intricacies of the data problem, modern macroeconomic theory pays a great deal of attention to expectations. On the surface this is eminently desirable and potentially constructive. Expectations have for years and years been the subject of copious research in macroeconomic theory. Keynes devoted an entire—and insightful—chapter to the subject.² G. L. S. Shackle, who admired the Keynesian theory, wrote a book on the subject in order to advance knowledge by building on established lines.³ Macroeconomic analyses of wage flexibility, especially in recessionary conditions, used implicit reasoning about expectations to refute the reliance on this feature of the labor market to guarantee return to full-employment equilibrium when the economy was deflected from that state. Macroeconometric modeling always relied heavily on the use of expectations, and results from sample surveys of households and firms were consistently brought to bear on the measurement of expectations.

Modern theorists then turned to own-model-generated expectations, misleadingly called *rational* expectations, to generate results by a purely hypothetical intellectual process without even considering whether they have any behavioral meaning. From a statistical point of view, they

require the unknown model to provide estimates of expectations data based on parameter estimates that also depend on the expectations data. They surely overwork the sample, asking it to provide both the extra data needed and the parameter estimates based on those data.

The estimates can be computed, if the model is identified, which is not always the case, but the estimates may not even be unique.⁴ Models that are so estimated give different response characteristics, in general, but they have not been tested to see if they provide more accurate extrapolations than mainstream models. I doubt that forecast tests will show that such different models are superior. Direct empirical tests of so-called rational expectations are not kind to the concept; adaptive expectations appear to stand up better to the data.⁵

An advocate of own-model-generated expectations is R. Lucas, who has argued on occasion that economic decisionmakers and policymaking authorities will be using the same model and coming to the same conclusion about expected values; therefore policies set by the latter will already have been taken into account by the former, thus making policy interventions futile. There are many arguments against this view besides the unreality of own-model-generated expectations. Models differ widely among the population, and noise elements obscure common signals.

In another line of argument, Lucas asserts (without testing) that parameters in macroeconomic models are functions of policy instruments: when instruments are changed, people's reactions will automatically change and possibly negate the intended changes sought by the policymakers. Of course, variable parameters have long been investigated in macroeconomic models. Either they contribute to nonlinearities, which can be unfolded back to stable parameters, or they are random parameters, or they vary according to a wide range of factors that are not necessarily closely related to policy instruments.

Lucas' approach is a contrived theory that is known, in advance, to recommend noninterventionism. It is not known, however, to be related at all to the actual formation of expectations.

A difficulty with the modern approach is that if it does not automatically make policy intervention futile, it does make it very indefinite depending on just how the expectations are generated by the own-model.

A verifiable theory of expectations can, however, be measured, estimated for model use, and studied for policy response that turns out to be more definite, apart from the fact that the findings are subject to error and should be surrounded by confidence intervals.

Macroeconomic Policy

Keynesian macroeconomic theory was originally developed as a basis for policy intervention to save the Western market economies that had lapsed into severe recession in the late 1920s and 1930s. Apart from the ill-considered stagnation thesis and other longer-range perspectives, the theory was reasonably well conceived for the recovery policies promoted through fiscal stimuli. Classical-minded economists warned against inflation, but that concern was not actually realized until the major economies had recovered to high employment levels for a sustained period—during the reconstruction phase after the Second World War. Both tax and expenditure policies were actively used, and monetary policy was introduced as interest rates were allowed or encouraged to rise. An early bias in favor of fiscal rather than monetary policy for stabilization, among Keynesians, was soon abandoned, and both were used in tandem. In addition, econometric simulation of models soon gave evidence that fiscal policy needed to be accommodated by monetary policy; otherwise a fiscal stimulus or restraint would peter out or turn perverse. There was no problem among neo-Keynesian theoreticians and econometricians in developing the analysis in this direction and seeking *balanced* policies in which fiscal and monetary policies reinforce each other.

Just as there was little concern about inflation as long as there was significant excess supply during the 1930s, there was little concern about international economic affairs—particularly exchange-rate movements—as long as the Bretton Woods agreements were in effect during the 1950s and 1960s. Inflation and flooding the world with dollars as a result of poor policy implementation of Vietnam War finance caused the Bretton Woods system of fixed parities to break down. During the 1970s, policymakers had to cope with supply-side shocks from food and fuel prices, general inflation, and fluctuating exchange rates. A major policy

prescription was to control inflation through the use of social contracts—incomes policies. Here we came to a standoff in terms of economic analysis of policy. The monetarists argued that strict control of the money supply was the *only* way to deal with inflation, while many Keynesians argued for incomes policies.

Monetarists argued that incomes policies never worked, and, at the end of the 1970s, policies of orthodox monetary tightening were adopted, both in the United States and in Europe—in Germany on the continent, and in Britain. It should be noted that Austria had successfully used an incomes policy and held inflation in check while growing nicely.⁶

Monetarism prevailed and brought down inflation, but the cost was very high. The world went through the severest recession of the postwar period. Apart from the fact that incomes policies were not given a proper trial, the blunt application of monetarist policy failed to give appropriate note to the decline in commodity prices that began in 1981-82. The United States and other countries had adjusted to the change in the terms of trade for energy. Conservation was impressive, new discoveries were made, and interfuel substitution relieved many shortages. These developments started to break the power of OPEC. Grain supplies became ample and commodity prices, besides fuel and food, leveled off or declined. Belatedly, the U.S. Secretary of the Treasury and Federal Reserve governors recognized that inflation is closely related to world commodity price movements, but not in time to save the world from overkill in 1981-82.⁷

Economic policy in the 1970s and 1980s became much more market-oriented. Economists became conservative, turning away from intervention, along the lines of Lucas and the monetarists, and towards deregulation. The point was repeatedly made that the market process led to better judgments than could be implemented by government policymakers. This stalled and eventually killed an effective energy policy. It was used as an argument against industrial policy, which had been so successful in the expansion of the Japanese economy during the 1960s. In general, the economics profession rejected indicative planning or industrial policy and argued for deregulation. There was near-complete deregulation of airlines and partial deregulation in the financial sector,

particularly in banking. While there have been some impressive gains from deregulation, there also have been some very serious side effects. A lax attitude towards regulation, encouragement of deregulation, and implicit faith in the power of the market have contributed to a severely weakened financial sector, hundreds of bank failures, excessive activity in mergers and acquisitions, large debt structures to burden corporations, and an atmosphere that culminated in Black Monday (October 19, 1987).

It is not difficult to see why politicians might be willing to take risks and expose the economy to increased variability and fluctuation. They come and go, according to voter preference, but it is not easy for me to understand why professional economists have become so tolerant of policies that lead to social risk.

The macroeconomy is presently functioning well in terms of GNP growth, unemployment, inflation and other indicators. The laity and politicians claim that it is, in fact, a period of prosperity. But the economy has reached this position amid serious problems—the internal and external deficits, widely fluctuating exchange rates, an exposed banking system, debt burdening some of our most important trading partners in the Third World, and high-level unemployment in Europe. These foreign problems loom large for us because the United States is so involved in the world economy. In making projections of the ability of our government to overcome the internal fiscal deficit position, steady growth at a modest level is assumed to occur, year after year, as though the business cycle had been outlawed. Such presumptions have proved to be disastrous in the past, yet economist advisors to policymakers are loathe to forecast cyclical downturns, in spite of the fact that they have occurred with a fair degree of regularity for more than 100 years.

Keynesian macroeconomic theory was designed to deal with a cyclical depression, and dynamic extensions of the theory generated regular cycles. It was recognized at an early stage that credible forecasts would have to be made in order to implement the theory's policy recommendations. The forecasting techniques are difficult, frustrating, and tedious, so much so that practitioners frequently give up and profess to "feel their way" blindly in reacting to events. I agree that forecasting is dif-

ficult, but I feel that it cannot be avoided. The reactive procedure will consistently be too slow to be effective. Both contemporary policy (one year or shorter horizon) and medium-term policy (up to 10 years ahead) require a forward look in order to make policy fit the factual situation when it is realized. It is true that unreliability remains, but econometric forecasting methods are our only tools, and they do work at least as well as personal judgment. In the short run, they provide fairly accurate guidelines. In the longer run, two procedures come to our assistance. Rolling forecasts should be made for the medium-term horizon. Every quarter or year, forecasters should update a new look-ahead for an extended horizon. The medium-term outlook will change, but this procedure should enable policymakers to stay in touch with the changing situation.

Naturally, the further ahead one tries to forecast, the less certain is the *point* forecast. The error band may grow substantially—enough to discourage the policymaker—but all economic choices must be made in an environment disturbed by “noise” in the economy. The situation can be made more manageable by discounting both the point projection and the error or confidence bands back to the present. If the discount factor is, let us say, 10 percent and if the error bands grow no faster than 10 percent annually, the margin of uncertainty can be restrained to a manageable interval that is not so large as to render the policymaker uncomfortable.

Will economic forecasts ever improve? Paul Samuelson once remarked that we have perhaps reached the asymptotic level of precision that we can expect to attain.⁸ This may be true, but Stephen McNees has indicated that the precision of macroeconomic forecasts has gradually improved between the 1950s and 1980s, with a detour during the turbulent 1970s.⁹ No other systematic study over such a long time has ever been made, but the record for macroeconomic forecasts does look promising; that is another reason why I say that this is our only tool.

We have tried using sample surveys, quarterly instead of annual data, time series models (ARIMA or VAR), but nothing has shown the decisive power of a breakthrough. I do not think that models with own-generated expectations will produce impressive results. There is, however, some

hope in this information age. The use of high-frequency data, which are becoming plentiful at daily, weekly, and monthly intervals, looks promising. There is inherently much serial dependence in economic data, and this can be exploited for short-run forecasts, from one to six months ahead. These short-run forecasts can then be used to calibrate or adjust quarterly econometric models of the economy as a whole. An objectively adjusted model that combines time series information at high frequency with the customary frequency of prevailing models may well lead to significant improvement of forecasts.¹⁰ Further use of sample survey information in connection with modeling may enhance such improvements. This is the most promising lead at the moment for improving economic forecasts and making policy formation sounder.

I noted earlier that the Keynesian theoretical model was fully compatible with both monetary and fiscal policy, although early on there was an emphasis on fiscal policy. By contrast, classical monetarism would rely exclusively on monetary policy and use the tax system simply to collect enough revenue to pay for necessary government expenditures, which, according to their tastes, should be as small as possible.

The Keynesian mixture of monetary and fiscal policy should aim for balance. In this way the economy is not disturbed, and the burden of macroeconomic adjustment is equitably distributed.

At the beginning of the 1980s a new brand of economic policy came on the scene, labeled "supply-side economics." The theoretical base for this policy was simply conventional, neoclassical economics. The theoretical base was not at fault, but it was carelessly applied to the problems at hand. Proponents claimed that if tax rates were lowered, there would be a surge of activity that would bring in more taxes and keep fiscal policy in budgetary balance. On the supply side it was argued that people would save more and work harder if marginal tax rates were lowered. Another aspect of this brand of supply-side economics was the assertion that deregulation would improve economic efficiency. The end result of supply-side fiscal policies would be to avoid a recession and implement an anti-inflation program. As a novel theory for accomplishing all these fine macroeconomic objectives, this populist type of supply-side economics has been fully discredited. Savings did not

rise; federal budgets were not balanced; productivity did not improve more than usual; and, as was mentioned already, the quality of deregulated services deteriorated—so much so that financial services' activity nearly brought on a world crisis of enormous dimensions.

Another consequence of ill-considered applications of supply-side economics was that policy became seriously unbalanced. The strong reduction in tax rates created such a fiscal deficit that monetary policy was the only viable tool for maintaining economic order. This pressure on the application of monetary policy led to extremely high interest rates, which imposed a severe burden on the housing market and on borrowers in the developing world, not to mention bank lenders both abroad and at home—particularly in sensitive markets such as Oklahoma, Texas, and California.

These unbalanced policies induced a recovery from the recession, and the ensuing deficits were so large that the ordinary Keynesian stimulus of deficit spending led the U.S. economy into a decent revival in the real sector. Financial sectors remained in disarray in the aftermath.

Macroeconometric methods monitored this policy path quite well; that is why Stephen McNees' findings show improved forecasts in the 1980s. These methods also indicated at the very beginning that tax coefficients associated with saving, labor supply, and investment would not be strong enough to bring about the gains being sought for savings and work effort.

The deregulation aspect of supply-side economics, as it is being practiced, relies increasingly on the market mechanism. This is not necessary for emphasis on the supply side, for industrial policy provides a supply-side approach to policy, without being free-market-oriented. Similarly, the structure of centrally planned and developing economies focuses on the supply side, but the presence or absence of free markets is irrelevant. In their treatment of the debt problem in the Third World, U.S. authorities since 1980 have tied concessionary treatment to the ideology of free-market economics. Although this approach has not yet been successful, many economists support the free-market emphasis.

In official negotiations with centrally planned economies in Europe and Asia, both the United States and other Western countries have strong-

ly supported economic reforms that introduce more market mechanisms. These events have much to do with political economy, but they are also related to the subject of this paper, namely, developments in macroeconometrics. Macroeconometric model building is very much alive in China and is used to throw light on the reform process. It is also used in Eastern Europe—especially in Poland and Hungary—although the effort there is academic rather than oriented towards official policy. The macroeconometric modeling of the USSR was originally done in the United States and Japan, but it does seem to be gaining ground now in the Soviet Union as a result of reform efforts.¹¹

These models track the economy well and show the inflationary pressures. In North America and Europe, as well as in Japan, Australia, and New Zealand, the paradigm model is in the IS-LM framework, with the usual challenges from the monetarist side. Small macro models can be constructed directly from aggregative data to produce IS-LM graphics, or large scale models can be reduced to *maquettes* that show the same kinds of core features. It is my contention that in a statistical context, the IS-LM paradigm crowds out the monetarist paradigm for industrial countries.¹²

It is difficult to specify the corresponding paradigm for the centrally planned or developing economy, but it does appear that the two-gap model shows great promise. Chinese colleagues have succeeded in constructing small two-gap econometric models of China. This is interesting because China covers, simultaneously, the centrally planned and the developing country cases. Oddly enough, the two-gap model with a monetarist-type equation for price-level determination seems to fit the Chinese data very well and deal with the present tendency towards high inflation rates. This paradigm can be used to analyze Chinese economic policy by showing the effects of importing, exporting, and exploiting technical progress for growth. It could be extended to deal with such financial matters as foreign-exchange-reserve position, debt-service burden, and other problems related to financial capital flows. Model building was feasible in the Soviet Union and Eastern Europe before the onset of price reform. Technological relationships, choice subject to given prices, and foreign trade fit well into regular statistical patterns,

but liberalization in Hungary opened the way for more extensive macroeconometric work. Under *perestroika* this development should be accelerated. Since 1978, China has been liberalizing, producing more meaningful data, and starting to construct usable models. Early versions were built by Lawrence Lau, but by now Chinese econometricians have acquired the capability, and macroeconometric models of China are likely to be as much in evidence as those of Poland, Hungary, and Yugoslavia. Since many of the China models will be built in state agencies, they will have the potential for use in macroeconomic policy formation.

Some Methodological Developments

There are two modern tendencies in macroeconometrics. One is the fascination of a younger generation with model-consistent expectations, that is, expected values are generated by the very models that are being estimated. This is being done on a large scale, but we have yet to see how such values stand up under the stern test of forecasting ability. They have no "track-record," and this must be established in order to gain credibility. Many U.K. models now have model-generated expectations and will eventually build up a track record.

A second tendency is to turn to time series analysis without much input from economics. I stressed earlier that econometrics is based on three disciplines, one of which is *economics*. When Tjalling Koopmans wrote his celebrated review of Burns and Mitchell's treatise on business cycle analysis, he meant by "theory" both economic and statistical theory.¹³ The modern reliance on time series analysis leans heavily on statistical theory but is nearly empty in the field of economics.

Time series analysis can be interesting in searching for and describing relationships or hypotheses about the macroeconomy, but it is awkward to apply this methodology to scenario or policy analysis. The VAR versions assume that all variables are endogenous. How well will this kind of theoretical specification serve us when there is an oil embargo or similar supply-side shock? Will it survive an event like the breakdown of Bretton Woods? This is not to say that the mainstream structural model can foresee such momentous events, but once an event

occurs, the structural model is readily capable of analyzing its effects.

Structural model builders in macroeconometrics should not ignore the powerful contributions of time series analysis, but they should not replace structural models by pure empirical analysis. The combination of high-frequency time series analysis with mainstream structural quarterly models, cited above, is but one way of combining time series with structural models. In fact, E. Philip Howrey of the Michigan Model group recommends forming a weighted average of a small monthly (VAR) time series model with a structural (Michigan) econometric model. There are other fruitful possibilities for drawing on time series analysis, such as the updating of parameter estimates as a sample evolves through time.

Concluding Remarks

Early in my professional career, I was impatient with the resistance to the introduction of Keynesian macroeconomics. I also enjoyed confrontation with established nonmathematical economists who resisted the introduction of mathematical methods and econometrics for the study of our subject. Eventually, the quantitative approach triumphed, and econometrics *cum* mathematical economics became common practice.

I feel uncomfortable now resisting some changes in macroeconometrics. Much of the new work is very good, although I find it hard to perceive a true breakthrough in the vast volume of research material that is being published. My problem is with the sterility of those aspects that have become very popular and enthrall young, fertile, productive minds without offering clear advancement of the science.

NOTES

1. L. R. Klein, "The Supply Side," *American Economic Review* 68 (March 1978), 1-7.
2. J. M. Keynes, *The General Theory of Employment, Interest and Money* (London: Macmillan, 1936).
3. G. L. S. Shackle, *Expectation in Economics* (Cambridge: Cambridge University Press, 1952), 2nd ed.
4. M. Hashem Pesaran, *The Limits to Rational Expectations* (Oxford: Blackwell, 1987).
5. Morten Jensen and Morten Jonassen, *The Formation of Household Expectations—A Test on Norwegian Cross-Sectional Survey Data*. The Bank of Norway, July 1986.
6. Alois Guger, "Einkommensverteilung und Verteilungspolitik in Osterreich," *Handbuch der Osterreichischen Wirtschaftspolitik*, ed. by H. Abele, E. Nowotny, S. Schleicher, G. Winckler (Wein: Manz, 1989), 1-17.
7. Wayne D. Angell, "A Commodity Guide to Monetary Aggregate Targeting" presented to the Lehrman Institute of New York, Federal Reserve Board, Washington, DC, December 10, 1987. At the annual meetings of the IMF and World Bank, Secretary Baker had recommended use of commodity price monitoring for exchange rate stabilization.
8. P. A. Samuelson, "Art and Science of Macromodels over 50 Years," *The Brookings Model: Perspective and Recent Developments*, ed. Gary Fromm and Lawrence Klein (Amsterdam: North-Holland, 1975), p. 7.
9. Stephen McNees, "The Accuracy Keeps Improving," *New York Times* (January 10, 1988), p. F2.
10. E. P. Howrey, "New Methods for Using Monthly Data to Improve Forecast Accuracy," to be published in a volume by Oxford University Press, 1989. L. R. Klein and E. Sojo, "Combinations of High and Low Frequency Data in Macroeconometric Models," to be published in a volume by Kluwer, 1989. Carol Corrado and Jane Haltmaier, "The Use of High-Frequency Data in Model-Based Forecasting at the Federal Reserve Board," paper presented at the AEA meetings, Chicago, December 29, 1987 (together with versions of the cited papers by Howrey and Klein-Sojo).
11. Donald W. Green and Christopher I. Higgins, *SOVMODI, A Macroeconometric Model of the Soviet Union* (New York: Academic Press, 1977). Haruki Niwa, "An Econometric Analysis and Forecast of Soviet Economic Growth," *The Prediction of Communist Economist Performance*, ed. P.J.D. Wiles (Cambridge: Cambridge University Press, 1971), 339-72.
12. Lawrence R. Klein, Edward Friedman, and Stephen Able, "Money in the *Wharton Quarterly Model*," *Journal of Money, Credit and Banking* 15 (May 1983), 237-59.
13. Tjalling C. Koopmans, "Measurement without Theory," *Review of Economics and Statistics* 29 (August 1947), 161-72.