When the concept of property rights is extended to include mutually advantageous transfer to government, it becomes apparent that the Pigovian approach is a special case of the more general property-rights approach. That is, Pigovian taxes are but one of many potential property rights solutions to externalities. The efficiency criterion tells us that choice between alternative property rights schemes depends on relative costs, including both market and institutional costs, but provides us with no other general prescription to handle all external effects. 6

FOOTNOTE
1. See Knight (1952) for an early criticism of Pigovian work.
2. Goldberg (1955) states that Dahlman considers only one type of transaction cost, trading costs, while another formulation, institutional transaction costs, is closer to Coase's intent. These institutional transactions costs would involve "the shortfall from what could have been achieved if institutions worked perfectly" (1955, p. 400).
3. Note that Goldberg's criticism of Dahlman does not change the conclusion that the existence of transaction costs, in whatever form, affects the costs of assigning property rights.
4. See Varian (1984, p. 254) for the derivation of the Samuelson conditions for a public good.
5. An interesting example of this approach is Drago?n (1985). Drago?n argues that institutional obstacles exist within Pigovian taxes that prevent their widespread use.
6. For a similar definition of property rights, see Chesnais (1979, p. 52).
7. Note that these characteristics of a property right are not independent—the restriction of the use right affects the flow of income and the stock value in transfer. We believe that the various forms of Pigovian taxes are not independent, and that the decision of whether to impose Pigovian taxes is affected by the characteristics of the property right.
8. This analysis has an analogy in corporate finance: the effect of the corporate income tax on a firm's risk. That is, the income tax makes the government a partner in the firm, sharing the risk, and returning the firm's risk when it is not previously given.
9. This argument is a generalization of Turvey who suggests that due to information costs "any general prescription of a tax to deal with external discontinuities is useless" (1972, p. 154).

REFERENCES


Models of Business Cycles: A Review Essay
Francis W. Ahking and Stephen M. Miller

INTRODUCTION
Macroeconomic theorists have been involved in major methodological debates over the last 15 years. One of the important, and most controversial, positions in these debates has been articulated by the "new classical" school. For those familiar with, but critical of, the new classical school, the Vej? Johnson Lectures by Robert E. Lucas, Jr. may contain a few surprises. For example, Lucas argues that "... I would like to consider the prospects for monetary business cycle models based on some kind of nominal price rigidity." (p. 89) Although this statement may be surprising, Lucas's arguments follow a coherent and consistent pattern. The reader may oppose his forcefully presented views, but they cannot be dismissed out of hand.

Before proceeding, we offer a few words about our own biases and points of view. One of us thinks of himself as quite eclectic in his approach to macroeconomics; his colleagues, however, label him a monetarist. The other is more clearly associated with the new classical school. We hope to be open-minded and fair in our review of Lucas's lectures (though some will question our objectivity). Those interested in an assessing evaluation of Lucas's positions are referred to Blinder (1987). Our review is divided into a summary of Lucas's lectures and our evaluation.

THE LECTURES
The lectures comprise eight Sections (Chapters). Section I introduces the subject matter. To begin, Lucas argues that the rational-expectations revolution should not be viewed as an outgrowth of the Keynesian-Monetarist debate. Rather, it is a development of a more fundamental method of economic analysis, which incorporates dynamic and stochastic elements into economic models. Moreover, he suggests that this method has permeated all fields of applied economics. Lucas states that "It is now entirely routine to analyze economic decision-makers as operating through time in a complex, probabilistic environment, trading in a rich array of contingent-claim securities, and to study agents situated in economies with a wide variety of possible technologies, information structures, and stochastic disturbances." (p. 2) While this statement is probably a bit overdrawn, it calls attention to an evaluation in economic modeling over the past 15 years. Thus, the lectures focus on business cycles in the context of new theoretical models of modeling dynamic behavior.

Lucas uses a real business-cycle model of the Kydland-Prescott (1982) variety as an illustrative case, not because the model is "true" in any absolute sense, but because he finds it to be representative of the current research in business cycles. He believes that monetary causes of the business cycle need to be integrated and conjectures that such a model would better explain observed events than any real business-cycle model.

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Section II outlines the types of dynamic models considered in the rest of the lectures. Individual agents optimize over immediate and long-run pay-offs in a stochastic environment, given the decisions of all other agents. Within this dynamic framework, Lucas walks the reader through his well-known critique of policy analysis. He acknowledges that even in the "correct" approach to policy simulation, preferences, technology, and the agents' information sets are assumed to be invariant to policy shifts, which cannot be guaranteed. That is, if preferences, technology, and/or the agents' information sets are affected by policy decisions, then Lucas is subject to the Lucas critique.

If forward-looking agents maximize utility over time, Lucas concludes that useful policy analysis must emerge from an economy viewed as a dynamic game rather than a standard Keynesian model that sets policy on a period-by-period basis.

In Section III, Lucas postulates a simple, constant-relative-risk-aversion utility function over aggregate consumption. The average consumer maximizes the discounted value of the utility derived from consumption. The mean consumption stream follows a deterministic trend, while deviations from trend are represented by a stationary stochastic process. Lucas uses post-WWII U.S. consumption data to compute the necessary parameters for his postulated utility function and then asks the following counterfactual question: How much would the average consumer be willing to pay in terms of consumption and for (i) an increase in the trend growth rate of consumption and (ii) a reduction in the variability of the cyclical component around the trend?

Although the answer to the first question is substantial, the answer to the second is unexpectedly small. Lucas, himself, is surprised by the smallness of the gain from reducing consumption variability. He attempts to magnify the gains through various assumptions (e.g., the sum of individual variabilities is necessarily larger than aggregate variability). But, none of the modifications leads to an important gain from reduced consumption variability. In sum, policy measures are probably insignificant.

Section IV develops the prototype model of the business cycle in the Kydland-Prescott style. Lucas begins with a model simpler than Kydland and Prescott to illustrate some possible problems. The model assumes infinitely-lived identical consumers and the only shocks to the system are exogenous stochastic shocks in the production technology. The question is whether parametric descriptions of technology and preferences can be found such that exogenous shocks to the model can generate the type of time-series movements observed in post-WWII business cycles.

Several problems emerge: when compared to actual time series, employment and investment variabilities are too low, consumption too high, Kydland and Prescott revise the model to include a gestation lag, and agents cannot distinguish permanent and transitory technological shocks. With these adjustments, the model does better but still is not convincing. The observed post-WWII business cycle.

Although Lucas believes that Kydland and Prescott mistakenly focus on real, to the exclusion of monetary, considerations in their model, he does state that "Kydland and Prescott have taken macroeconomic modeling into new territory, with a formulation that combines intelligible general equilibrium theory with an operational, empirical seriousness that rivals at least early versions of Keynesian macroeconomic models." (p. 46)

Section V diverts the reader from the general argument of the lectures into questions of unemployment, it is also the longest section of the lectures. Lucas contends that whether business-cycle research focuses on unemployment or other issues is a matter of research strategy, but that existing macroeconomic models, whether market-clearing or non-market-clearing, are not particularly useful for understanding unemployment. Lucas argues that unemployment should be viewed as an activity chosen by individuals. Thus, he rejects the Keynesian notion of involuntary unemployment, since it merely grafts non-market clearing onto what is basically a Walrasian model. In his view, Keynesian unemployment cannot confront the problems of unemployed individuals nor can it provide insight into potential solutions.

Lucas suggests that a good model of unemployment must address the following. First, it must examine the employer/employee relationship. Second, it must generate unilateral job separations ( quits, fires, lay-offs). Third, and most controversially, it must explain why individuals who are out of work frequently choose unemployment rather than temporary work on the spot market. Lucas offers McCall's search model (1970), which is constructed in the dynamic framework outlined in Section I of the lectures, as a prototype for examining unemployment. As stated earlier, Lucas considers the Kydland-Prescott model useful for analysis of business cycles. But, he also believes it is a mistake for Kydland and Prescott to ignore monetary considerations. Incorporating money as passively responding to real fluctuations is not a problem; the problem is to account for real fluctuations too large to be explained by technological shocks alone. In Section VI, Lucas introduces money into a dynamic neoclassical model similar to that discussed in Section II. Money has exchange, but not use, value. In this general cash-in advance economy, he derives in implicit form the quantity theory of money. Further, he discusses the real effect of the expected inflation tax.

Lucas states that the integration of his dynamic monetary model with the Kydland-Prescott model is not technically possible at the moment. So, in Section VII, he conjectures about a modified Kydland-Prescott model. First, he considers the possible contribution of the real effect of anticipated inflation on the business cycle, that is, the expected inflation-tax effect on intertemporal substitutions between consumption, leisure, and investment. This channel is rejected as a possible explanation of business-cycle movements.

Second, and possibly surprisingly, Lucas argues that monetary business cycles result from some sort of price rigidity. By price rigidity, he means a prediction error, the difference between actual price movements and those predicted by the classical model. The failure of prices to move in accordance with the classical model is, according to Lucas, an information problem. That is, the appropriateness of modeling price rigidity as the result of nominal price contracts is rejected.

Lucas gives two examples of information problems. In one, agents have heterogeneous information sets while in the other, agents have complete local, but incomplete global, information. In the first case, monetary shocks play no role; thus, the model probably replicates the results from the Kydland-Prescott real business-cycle model. The second case holds more promise as a monetary business-cycle theory in Lucas's judgment, since agents can mistake monetary shocks as signaling changes in preferences and technology. Thus, the errors resulting from monetary shocks generate dynamic adjustments of the type generated by technological shocks in the Kydland-Prescott model.

The lectures' conclusions are given in Section VIII. First and foremost, examining macroeconomic questions within a dynamic stochastic model of the type outlined in Section I alters dramatically our view of macroeconomic policy. Dynamic modeling forces us to consider how economic agents form their expectations about future events. Policy discussions need to be
forward-looking as well. A period-by-period account of policy changes is inappropriate and threatens the stability of the economy. Instead, policy analysis must look to policy rules. That is, Lucas argues that in a democracy an "economic constitution" as suggested by Buchanan and Wagner (1977) becomes a necessity.

Second, the post-WWII business cycle was not important in terms of individual welfare. Policies to address individual problems can be designed without reference to the business cycle. In other words, social-welfare policy should be macroeconomic, rather than microeconomic. For Lucas social problems and the business cycle are separable issues. He does not however argue, as have others, that post-WWII monetary and fiscal policy have exacerbated social problems.

Third, society can attain any level of inflation it desires through its monetary and fiscal policy. And, as long as this rate stays below 10%, the cost of such a decision is minimal.

Fourth, if the business cycle partly results from monetary instability, then stabilizing money growth will contribute to stabilizing the business cycle. But, the gains will be small.

**ANALYSIS AND CRITIQUE**

Our analysis and critique begins by examining the controversial assumption of rational expectations and the controversial conclusion that post-WWII business-cycle experience is unimportant from a social-welfare viewpoint. We argue that the emergence of the rational-expectations hypothesis has generated an evolution in economic modeling. The hypothesis, however, is not universally accepted. A substantial amount of econometric evidence is emerging that fails to support the hypothesis, including Laidler (1986) and Muth (1985).

The accumulated evidence on direct tests of rational expectations should not be ignored. But, this evidence should be viewed with skepticism, since direct tests use survey data which may be unreliable. An alternative, one can test the implications of rational expectations rather than the hypothesis itself. The problem here is that this approach involves a joint test of rational expectations and a structural model. For example, Hoffman and Schaler (1983) test the monetary model of exchange-rate determination under rational expectations. Thus, evidence from testing the implications of rational expectations should also be viewed with equal skepticism.

In sum, the validity of the rational-expectations hypothesis is an open question; Lucas needs to address this issue directly.

Perhaps the most controversial passage in the lectures is the conclusion that the post-WWII business cycle is not important from a social-welfare perspective; thus, the potential marginal gains from advances in business-cycle theory are probably insignificant. Two issues emerge here: the plausibility of Lucas's empirical experiments and the role of monetary and fiscal policies in the economy.

To begin, why should the focus be on the variability of consumption rather than real GNP? Lucas's response may be that the discounted value of consumption is the driving force in the system. Or, he may argue that he has considered these contingencies by introducing additional degrees of variability in the consumption stream in Section III. But, Blinder (1987) confronts this issue with some important questions. Consumption is, according to the life-cycle or permanent-income model, smoothed by household decisions. If the business cycle is measured by real GNP, then greater variability in the business cycle emerges because movements in investment and net exports are greater than consumption.

Further, the specific utility function as well as a deterministic growth rate for consumption contribute to Lucas's results. A different utility function (Blinder, 1987) suggests a logarithmic function with substitution consumption that generates a linear-expenditure system can lead to different gains from reduced consumption variability. The assumption of a stochastic-trend consumption process can lead to increased variability of the underlying trend series (Beveridge and Nelson, 1981, p. 150), a point acknowledged by Lucas.

Lucas's conclusions concerning stabilization policies hinge on the key assumption that the trend and cyclical components of real (consumption) activity are uncorrelated. Relaxing this assumption may alter the conclusions. Further, a positive relationship between inflation-rate and real-growth-rate variability may exist. (Lump and Sweeney, 1981, Sweeney (1987) argues that the trend real growth and its variability are probably negatively related. If true, then a reduction in real (consumption) variability could lead to an increase in its trend growth rate, where, according to Lucas, the gain in social welfare is significant.

A question not discussed in the lectures, but which needs consideration, is why the post-WWII business-cycle experience differs from previously recorded business-cycle data. Keynesians or others might argue ad hominem that the smaller variability in the business cycle in the post-WWII period is testimony to the effectiveness of macroeconomic policymaking. Of course, it could also be a chance occurrence. Turning the question topsy-turvy, Lucas can be asked counterfactually if stabilizing money growth during the 19th century or during the Great Depression would have led to a small gain in individual welfare.

We agree, in general, with Lucas that existing macroeconomic models are not particularly useful for understanding the causes of, or offering cures for, unemployment. But, many would dispute, at least on semantic grounds, that all unemployment is voluntary by definition. Lucas argues that individuals who are unemployed have chosen this state by not taking employment in the spot market. Is an unemployed engineer who refuses employment as a taxi driver voluntarily unemployed? Lucas says yes; others would strongly disagree.

Finally, we regret the failure to discuss the rest of the world. This omission has two dimensions. First, even in the United States, we can no longer model only the domestic macroeconomy and ignore the rest of the world. Policy rules take on a new and more complex meaning in an open-economy macroeconomic model. Moreover, the exchange-rate regime influences the effectiveness of monetary and fiscal policy. Some conjectures about the business cycle in an open-economy framework would have been interesting. The absence of such conjectures leaves the set of lectures incomplete.

Second, Kydland and Prescott type models can be subjected to further tests based on other countries' experiences. Is the specification robust across countries? If the model successfully explains events in a number of countries, then the methodology will have taken a giant step toward credibility; more economists will be inclined to take this modeling strategy seriously.

So far, we have focused chiefly on certain assumptions and conclusions in the lectures. Before closing, we address some general issues. Lucas's research strategy argues for analyzing macroeconomic fluctuations in a dynamic, stochastic environment of optimizing economic agents. This argument is powerful, but less explicitly articulated here than in other sources. A better account is found in Lucas and Stokey (1987), where they state "...to interpret empirical distributions of macroeconomic aggregates one needs an explicitly stochastic theoretical model, a model that permits the calculation of a predicted theoretical joint distribution of shocks and endogenously determined variables that can be compared to observed distributions." (p. 492) To argue against the logic of this statement is difficult. Acceptance, however, means a radical change from the mostly static, conventional IS-LM, aggregate supply-aggregate demand approach to macroeconomic modeling. Wide-spread adoption of Lucas's research strategy is unlikely in the foreseeable future, not because of fundamental flaws in the methodology but...
because old habits die hard. Much human capital is invested in the IS-LM aggregate supply-aggregate demand framework.

Although Lucas's research strategy appears to imply a dramatically different macroeconomic modeling procedure, nonetheless, there appears to be an important convergence of views concerning price rigidity. Both Lucas and contract theorists [e.g., Taylor (1980)] agree that some explanation for price rigidity is necessary, bearing in mind that Lucas's price rigidity is defined in the prediction-error sense. Lucas rejects nominal price and wage contracts as the appropriate explanation. He views price rigidity as the result of temporary confusion between nominal and real shocks by economic agents. He sees price rigidity as an information problem, which is perfectly consistent with his model of optimizing agents in a dynamic, stochastic environment. It remains to be seen, however, whether Lucas's model of price rigidity can generate the kind of real-world fluctuations that are observed.

Lucas provides a well-argued, thought-provoking case for his positions. We have attempted to present a basic outline of his point of view. But, of course, something is lost in the translation. Even for those predisposed to reject Lucas's position out-of-hand, his lectures should be read. His arguments need to be understood before his conclusions can reasonably be disputed.

REFERENCES


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