Public Investment, The Rate of Return, and Optimal Fiscal Policy

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Enfin la révision profonde de Comptes Nationaux Français ainsi que le traumatisme subi en mai–juin 1968 par l'économie française appelent une réestimation du modèle, voire des révisions de structure.

L'apport principal de l'ouvrage de M. Evans est d'avoir mis en évidence la possibilité de rendre compte des fluctuations à court-terme. Ce travail de pionnier mérite d'être poursuivi dans le cadre d'un effort de recherche permanent et devrait constituer à l'avenir une base solide et un guide précieux pour la construction de modèles de prévision à court-terme pour plusieurs pays de l'Europe Occidentale.

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Introduction to Economic Statistics. By WILLIAM C. MERRILL AND KARL A. FOX. New York: John Wiley & Sons, 1970.

OVER THE PAST decades, the meaning of "economic statistics" has changed substantially. The book by Merrill and Fox reflects this change strongly and without compromise. The preface states that "this book is designed for use by undergraduate students majoring in economics and business administration;" the reader who might look for chapters on certain ratios or on quality control, however, would find no answer.

Nor has the book been written by statisticians for statisticians. All necessary notions of mathematical statistics are explained accurately, but as briefly as possible. All these notions serve an auxiliary function; they are treated as tools necessary for modern economic analysis.

This is the great value of the book. It abounds in examples; new and difficult notions are explained from well-chosen examples.

Brief chapters on "descriptive statistics," on index numbers, probability, and probability distributions are followed by the usual topics "sampling and estimation," "testing statistical hypotheses," "simple regression," and "multiple regression analysis." More than a hundred pages are then devoted to the main goals of the book: univariate analysis of time series, the structural analysis of economic time series, identification, causal ordering, and estimation in economic models.

In the appendix, considerable space is devoted to the elementary concepts of calculus and matrix algebra. Furthermore, there are even more tables than in most textbooks on mathematical statistics (five pages binomial, five pages Poisson distribution).

The book includes many exercises and many figures, most of them excellent, some inaccurate (see Figure 6.22 on page 200 depicting the chi-square distribution). The explanation and Figure 2.12 on page 32 describing kurtosis are wrong.

To summarize, if there is a king's way to econometrics, just broad enough to get there safely, but not so broad as to get lost en route, this book provides it.

University of Vienna GERHART BRUCKMANN

Public Investment, The Rate of Return, and Optimal Fiscal Policy. By KENNETH J. ARROW AND MORDECAI KURZ. Baltimore: The Johns Hopkins University Press, 1970.

THIS BOOK IS an excellent application of the Pontryagin maximum principle to an infinite horizon neoclassical growth model with a single output which can be consumed or used as government or private investment. The socially optimal growth path is obtained by maximizing a standard utility functional (additive in instantaneous, concave utility functions discounted at a constant rate) subject to continuous time, differentiable production functions for investment goods, assuming that the growth rate of output is less than the rate of interest on the balanced-growth path (technological progress is labor-augmenting and growing, along

with labor, at a constant rate). This optimal path is shown to be achievable under perfect capital markets and the private utility maximization of a single, representative consumer by a government policy of lump-sum (or equivalent) taxation and government expenditures. This familiar and classical result has been established in a very similar growth model by Phelps.[1]

When lending market imperfections lead to a constant consumption-income ratio, then, of course, the socially optimal policy is not generally attainable (or, "controllable" [*sic*]) with only the instruments of lump-sum taxation and government investment, for there is a generally inefficient distribution between private consumption and investment that such coarse policies do not directly alter. Government optimization must then settle for a second best, which is then characterized by Arrow and Kurz and which turns out to have the peculiar property (established in a 1966 paper of Arrow[2]) that the asymptotic marginal product of government capital equals the asymptotic rate of time preference but not generally the asymptotic marginal product of private capital. (One can, with much struggle and some help from the authors, come to understand this, but I cannot say the effort is worth it because of the inappropriate nature of the hypothesis of a constant propensity to consume out of real output, especially for a model of long-run consumption behavior.) The result perhaps has some relevance to the discussion of the optimal rate of discount to use in public investment decisions, but it should be understood as a wild special case of the well-known directive[3] that when market imperfections are present in a riskless world, discount each periods' net benefits by the weighted average of the private marginal product of capital and the (one period) marginal rate of time preference, where the weights are the reductions in private investment and consumption, respectively. Numerous related results, basically minor or familiar, are obtained.

The fact that no new and exciting theorems come out of this book is testimony to the high competence of the authors and worth of the book. For what is supremely accomplished is to increase the reader's faith in the relevance and reliability of optimal control theory by showing how naturally classical problems can be set up and solved with this relatively new mathematical tool. Unfamiliar results would certainly have obscured this fact. Arrow and Kurz obtain the results only by admirably setting up a macroeconomic model without making the usual economics errors of their contemporaries in setting up fiscal accounting relations and defining feasible policies and by carefully restricting their model so that only traditional questions arise. The book is excellent reading for a graduate mathematical economics class. It provides a useful presentation of dynamic maximization methods in a very readable fashion (except for Chapter II.7, on "Jumps in the State Variables," which represents a switching of models rather than the generalization it is supposed to be; I recommend Arrow's paper, "Optimal Capital Policy with Irreversible Investment,"[4] and a careful reading of pp. 91–93 as a substitute). The book also has a nice introductory discussion of some well-behaved neoclassical growth models and of some of the previous work on the optimal rate of discount for government investments. Most of all, the book will greatly serve prospective Ph.D. writers as a shining example of the benefits of carrying a simple, abstract model through to a multiplicity of implications.

On the negative side, the economic rationalizations which Arrow-Kurz used to motivate their models were typically inadequate. As one small example, the reasons given for government production are externalities created by the production of such an output or the breakdown of competitive markets through the increasing returns to scale resulting from the presence of a social overhead factor. Now it is well known that externalities do not justify government

[1] E. Phelps, *Fiscal Neutrality Toward Economic Growth.* New York: McGraw-Hill, 1967.

[2] K. J. Arrow, "Discounting and Public Investment Criteria," *Water Research*, Ed. A. V. Kneese and S. C. Smith, pp. 31–32. Baltimore: The Johns Hopkins Press for Resources for the Future, 1966.

[3] See, for example, W. F. Baumol, "On the Appropriate Discount Rate for Evaluation of Public Projects," Hearings before the Subcommittee on Economy in Government of the Joint Economic Committee, Congress of the U.S. 90th Congress, 1st Session, U.S. Government Printing Office, Washington, D.C., 1967.

[4] K. J. Arrow, "Optimal Capital Policy with Irreversible Investment," *Value, Capital, and Growth*, Ed. J. N. Wolfe, pp. 1–20. Edinburgh: Edinburgh University Press, 1968.

production; they merely justify possible interference of some sort. Subsidization may be superior to government production. More basically, social overhead factors generating returns to scale do not imply decreasing costs because the perfectly competitive price (not the efficiency price) to a firm of such a factor varies with the use of other factors *exactly* so that average production costs remain constant under perfect market conditions.[5] The efficiency of government production implies positive transaction or taxation costs for some private allocations, so such costs should appear somewhere in the model. As another example, the Arrow-Kurz rationalization for using a constant consumption-income ratio regardless of interest rates to represent a relevant capital market imperfection is that studies of the long-run consumption function indicate such a constancy, which is indeed irreconcilable with perfect markets and intertemporal utility maximixation. But I thought my paper,[6] which is similar in structure to the Arrow-Kurz model of perfect markets, showed that these studies, which *in fact* have consumption-income ratios varying with interest rates, are consistent with perfect markets and intertemporal utility maximization over an infinite horizon. (Also illustrated in this paper is that once we derive a current consumption function from a consistent intertemporal utility function, we can use familiar calculus to compute the entire dynamic path and have no apparent need for optimal control theory. This is an alternative method to that sold so well by Arrow-Kurz, but it is not mentioned in the book.)

But perhaps nowhere is the book's lack of firm economic foundation so apparent as it is in the discussion of the discount rate to be used in "government" investment projects. A rational individual who bears the costs and returns resulting from his activity should indeed be presented with prices equalling opportunity costs. But, in a correct model of property rights, a government worker or decision maker is—by definition—not such an individual. For example, a government bureaucrat supplying ancillary services to a project may be rationally lazy and careless in the face of his true reward-penalty structure. But if he is made to think his job is sufficiently socially important by a certain systematic "overvaluation" of his true social output, partly based on an "artificial" lowering of the discount rate, he will be induced to work the socially efficient amount. This need not distort the allocation of resources toward his kind of activity when his agency is on a fixed investment budget. And using some "artificially" low discount rate may simultaneously prevent the allocation of resources from being distorted away from the futuristic projects under his agency's control; this is because an individual who estimates benefits in the agency can collect little or nothing for benefiting future generations (although the government as a whole may, at least in principle, sell their capital to these generations) but can collect some favors and graft for benefiting his contemporaries, and therefore he tends to overestimate the "benefits" to his contemporaries relative to the unborn. (An opposite argument, one producing an "artifically" high discount rate such as the 20 per cent to 50 per cent rates which are forced upon investment men in large private companies, is that individuals in large private companies tend to rationally overestimate the benefits of investment projects because they sell financial and management services complementary with their investment projects and generally do collect their worth to the firm.)

The brilliant and fundamental economic contributions of Arrow during 1948 to 1954 were made possible by his allowing fundamental economic considerations to guide his mathematical models. In the current contribution of Arrow and Kurz, mathematical conveniences guide the economic models. The result is a unified development and application of a new and possibly important mathematical technique in which the relevant and difficult problems in fundamental economics are consistently pushed aside.

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[5] E. Thompson, "The Perfectly Competitive Production of Collective Goods," *Review of Economics and Statistics*, 50 (1968), 1–12.

[6] E. Thompson, "Intertemporal Utility Functions and the Long-Run Consumption Function," *Econometrica*, 35 (1967), 356–361.