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Tryphon Kollintzas (Ed.)

The Rational Expectations Equilibrium Inventory Model

Theory and Applications

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To my mother Florentia

ACKNOWLEDGEMENTS

This volume would not have been possible without the International Society for Inventory Research. The Society gave me the opportunity to organize two sessions on aggregate inventory behavior in its First North American Meeting at Wesleyan University, June 1987. The sessions were as follows:

Session I:

Chairman:	Robert M. Solow
Paper:	Sophia P. Dimelis and Tryphon Kollintzas: "A Linear Rational Expectations Equilibrium Inventory Model for the American Petroleum Industry."
Discussants:	Alan S. Blinder
	Martin Eichenbaum
Paper:	Jeffrey A. Miron and Stephen P. Zeldes: "Seasonality, Cost Shocks, and the Production Smoothing Model of Inventories."
Discussants:	James A. Kahn

Session II:

Chairman:	Alan S. Blinder
Paper:	Lawrence J. Christiano and Martin Eichenbaum: "Temporal Aggregation and Structural Inference in the Inventory Stock Adjustment Model."
Discussants:	John C. Haltiwanger
	Robert M. Solow
Paper:	Kenneth D. West: "Unfilled Orders and Production Smoothing."
Discussants:	Louis Maccini
	Jeffrey A. Miron

The last four chapters of this volume contain the papers given in these sessions. I am therefore most grateful to the participants in these sessions as well as the organizers and especially Attila Chikan and Michael Lovell. I am likewise grateful to Econometrica for giving me permission to reprint the paper by Miron and Zeldes. Last but not least I am grateful to Karen Troiani for expert and tireless word processing. She also helped me proof read the material. My quest to

finish the book in time for publication in 1988 became hers and for this I could never repay her.

Over the last two years, during which this volume was put together, I have visited the Athens School of Economics and Business, the Federal Reserve Bank of Minneapolis and the University of Minnesota. Also, during these years I have received support from the National Science Foundation and the University of Pittsburgh.

TK

PREFACE

This volume consists of six essays that develop and/or apply "rational expectations equilibrium inventory models" to study the time series behavior of production, sales, prices, and inventories at the industry level. By "rational expectations equilibrium inventory model" I mean the extension of the inventory model of Holt, Modigliani, Muth, and Simon (1960) to account for: (i) discounting, (ii) infinite horizon planning, (iii) observed and unobserved by the "econometrician" stochastic shocks in the production, factor adjustment, storage, and backorders management processes of firms, as well as in the demand they face for their products; and (iv) rational expectations. As is well known according to the Holt et al. model firms hold inventories in order to: (a) smooth production, (b) smooth production changes, and (c) avoid stockouts. Following the work of Zabel (1972), Maccini (1976), Reagan (1982), and Reagan and Weitzman (1982), Blinder (1982) laid the foundations of the rational expectations equilibrium inventory model. To the three reasons for holding inventories in the model of Holt et al. was added (d) optimal pricing. Moreover, the popular "accelerator" or "partial adjustment" inventory behavior equation of Lovell (1961) received its microfoundations and thus overcame the "Lucas critique of econometric modelling." More recently, there has been a number of studies that seek to test the rational expectations equilibrium inventory model and, in particular, to examine whether this model is consistent with the stylized facts identified by Blinder (1986): (α) the variance of production exceeds that of sales, (β) the covariance between sales and inventory investment is positive, and (γ) "speed of adjustment" estimates from partial adjustment investment equations are unrealistically slow.

In Chapter III of this volume, Christiano and Eichenbaum investigate whether temporal aggregation bias can account for (γ). Temporal aggregation bias occurs when the economic agents' decision interval is smaller than the data sampling interval. First they develop a continuous time linear rational expectations equilibrium inventory model and then they develop its discrete time counterpart. By linear rational expectations equilibrium model I mean a rational expectations equilibrium model where the objective functions of

economic agents are quadratic, the transition constraints they face are linear, and conditional expectations are taken to be the corresponding minimum mean square error predictors. Christiano and Eichenbaum estimate both continuous and discrete time models and after a series of tests conclude that temporal aggregation bias may significantly distort "speed of adjustment" estimates.

In Chapter IV Dimelis and Kollintzas develop a linear rational expectations equilibrium inventory model to characterize the behavior of refineries in the American petroleum industry and they couple this with a somewhat similar model of exhaustible resource supply to characterize the behavior of crude petroleum producers in this industry. Their empirical results suggest (a) despite evidence of significant technology shocks (iii) and they find evidence contrary to (γ). Further, their results suggest that crude and refined petroleum product inventories behave quite differently. So that serious aggregation biases may arise when those inventory series are aggregated.

In Chapter V Miron and Zeldes investigate whether the apparent inability of models that incorporate only reason (a) for holding inventories to account for (α) is due to failure to take into consideration observed and unobserved stochastic shocks to the production technology of firms and/or failure to estimate the model on seasonally unadjusted data. Shocks of this kind create a motive to hold inventories in order to smooth sales rather than production. Seasonal fluctuations in sales are the kind of fluctuations that firms should most easily identify and thus accommodate by smoothing production. After a number of ingenious tests they conclude that shocks to the production technology and failure to estimate the model on seasonally unadjusted data cannot account for this model's inability to explain (α).

In Chapter VI, West investigates whether the apparent inability of linear rational expectations equilibrium inventory models that do not incorporate reason (d) for holding inventories and ignore the technology shocks in (iii), to account for (α) and (β) is due to ignoring backlogs. That is, although in these models the nonnegativity constraint on inventories is ignored and backlogs are considered to be

negative inventories, in practice, inventories are only physical inventories. His results suggest that when inventories are physical inventories minus backlogs (α) and (β) are reversed and the models he addressed can account for that reversal.

The first two chapters are more theoretical in nature. In Chapter II, Aiyagari, Eckstein, and Eichenbaum develop a version of the rational expectations equilibrium inventory model which incorporates the above mentioned nonnegativity constraint on inventories. They examine the cases of a competitive industry and of monopoly. They find that the nonnegativity constraint will be occasionally binding under both market structures depending on the relationship between a "reservation" and the actual price. Further, they provide a linear rational expectations equilibrium example whereby they calculate the equilibria under both market structures and they investigate their comparative dynamics properties. In Chapter I, which is meant to serve as an introduction to the other papers in this volume, I develop a linear rational expectations equilibrium inventory model. The necessary conditions and the sufficient conditions for its solution are derived. Further, the stability, cycling, and comparative dynamics properties of the solution are investigated.

This volume should be primarily of interest to researchers in business cycle phenomena and applied industrial organization. However, it should also be useful to students in applied dynamic economics and econometrics, in general.

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