A Short-Run Forecasting Model of the United States Economy



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Ray C. Fair Princeton University

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Table of Contents

	List of Tables and Figures	ix
	Preface	xiii
Chapter 1	Philosophical Considerations	1
1.1	Introduction	1
1.2	Structural versus Forecasting Models	2
1.3	The Present Model versus Other Forecasting	
	Models	4
1.4	Further Philosophy Behind the Construction of the	
	Model	11
1.5	Outline of the Model	11
Chapter 2	Econometric Considerations	17
2.1	Introduction	17
2.2	The Technique Used to Estimate the Money GNP	** 1
· ·	Sector	18
2.3	The Data Used for the Money GNP Sector	24
2.4	The Periods of Estimation Used for the Money GNP Sector	26
Chapter 3	Consumption	29
3.1	Introduction	29
3.2	Consumer Sentiment, Consumer Buying Expecta-	
	tions, and Short-Run Consumption Functions	29
3.3	Consumption of Durables	31
3.4	Consumption of Nondurables	37
3.5	Consumption of Services	40
3.6	Summary	43
Chapter 4	Plant and Equipment Investment	45
4.1	Introduction	45
4.2	The OBE-SEC Survey of Expected Investment	
	Expenditures	45
4.3	A Simple Realizations Function	48
4.4	The Equation Estimates	49
15	The Effect of Manetary Policy on Investment	51

Chapter 5	Housing Investment	53
5.1 5.2	Introduction Determining Housing Investment from Housing	53
	Starts	53
5.3	The Results	55
Chapter 6	Inventory Investment	59
6.1	Introduction	59
6.2	The Four Approaches	59
6.3	The Results	64
6.4	Summary	69
Chapter 7	Imports	71
Chapter 8	Monthly Housing Starts	73
8.1	Introduction	73
8.2	A Model of the Housing and Mortgage Market	73
8.3	The Estimation Technique	79
8.4	The Data	82
8.5	The Results	83
8.6	The Use of the Housing Starts Equations for Fore-	
	casting Purposes	86
Chapter 9	Employment and the Labor Force	89
9.1	Introduction	89
9.2	The Short-Run Demand for Employment	89
9.3	The Labor Force and the Unemployment Rate	100
9.4	Summary	106
Chapter 10	Prices	109
•	Intro duction	109
10.1	Introduction The Concent and Measurement of Potential	109
10.2	The Concept and Measurement of Potential Output	110
10.3	The Price Equation	116
10.3	Predictions of Real GNP	121
10.4	FIGUREOUS OF REAL GIVE	121

Chapter 11	Tests of Different Versions of the Model and the Properties of the Final Version	123
11.1	Introduction	123
11.2	The Procedure Used to Test Each Version	123
11.3	The Error Measures Used	128
11.4	The Results of Testing Each Version	129
11.5	The Final Version of the Model	134
11.6	The Properties of the Final Version	136
Chapter 12	The Stability of the Estimated Relationships and the Outside-Sample Forecasts	155
		155
12.1	Introduction	155
12.2	Stability Results	155
12.3	Results of Forecasting Outside of the Sample Period	179
Chapter 13	Sensitivity of the Forecasting Results to Errors Made in Forecasting the Exogenous Variables	197
13,1	Introduction	197
13.2	Forecasting the Exogenous Variables	197
13.3	The Forecasting Results	204
13.4	Annual Forecasting Results	220
Chapter 14	Comparisons of the Forecasting Results of this	
•	Study with the Results of Other Models and Techniques	227
14.1	Introduction	227
14.2	Comparisons with Noneconometric Techniques	227
14.3	Comparisons with the Wharton and OBE Models	228

Chapter 15	Summary and Conclusions	241
	Appendix A	247
	Appendix B	253
	References	257
	About the Author	261
	Index	263

List of Tables and Figures

Tables		
2–1	List of Description of the Variables Considered in the Money GNP Sector	25
8–1	List and Description of the Variables Used in the Monthly Housing Starts Sector	83
91	List and Description of the Variables Used in the Employment and Labor Force Sector	93
9–2	Estimated Values for M_t^d	100
10-1	List and Description of the Variables Used in the Price Sector	111
10–2	Estimates of Potential Real GNP (billions of 1958 dollars)	115
10-3	Values of PD_t , $PD_t - PD_{t-1}$, and $GAP2_t$	118
11–1	The Equations Tested in this Chapter	130
11–2	Comparison of Equations (6.15) and (6.18)	133
11–3	Variables of the Model in Alphabetical Order by Sector	134
11–4	Equations of the Model by Sector	137
11–5	Errors for the Final Version of the Model Computed for the Same Prediction Period	140
11–6	Actual and Forecasted Changes for Selected Variables of the Model	142
11–7	Errors in Forecasting HSQ_t	151
11-8	Actual and Forecasted Levels of HSQ_t	152
12 –1	Coefficient Estimates of Equation (3.1) for Eighteen Sample Periods	157
12–2	Coefficient Estimates of Equation (3.7) for Eighteen Sample Periods	158
12–3	Coefficient Estimates of Equation (3.11) for Eighteen Sample Periods	160
12–4	Coefficient Estimates of Equation (4.4) for Eighteen Sample Periods	161
12–5	Coefficient Estimates of Equation (4.7) for Eighteen Sample Periods	162
12–6	Coefficient Estimates of Equation (5.5) for Eighteen Sample Periods	164

12–7	Coefficient Estimates of Equation (6.15) for Eighteen Sample Periods	165
12–8	Coefficient Estimates of Equation (7.3) for Fourteen Sample Periods	166
12–9	Coefficient Estimates of Equation (9.8) for Eighteen Sample Periods	168
12–10	Coefficient Estimates of Equation (9.10) for Eighteen Sample Periods	170
12– 11	Coefficient Estimates of Equation (9.11) for Eighteen Sample Periods	172
12–12	Coefficient Estimates of Equation (9.12) for Eighteen Sample Periods	173
12–13	Coefficient Estimates of the Price Equation for Eighteen Sample Periods	175
12-14	Coefficient Estimates of Equation (8.23) for Eighteen Sample Periods	177
12–15	Coefficient Estimates of Equation (8.24) for Eighteen Sample Periods	178
12–16	Comparisons of the Within-Sample and Outside-Sample Forecasts	182
12–17	Outside-Sample Errors Computed for the Same Prediction Period	184
12–18	Actual and Forecasted Changes for Selected Variables of the Model	187
12–19	Comparison of the Within-Sample and Outside-Sample Forecasts of HSQ_t	192
12–20	Outside-Sample Forecast Errors of HSQ_t Computed for the Same Prediction Period	193
12-21	Actual and Forecasted Levels of HSQ,	194
13–1	Quarterly Changes in the Exogenous Variables of the Money GNP Sector for the 602-694 Period	198
13–2	Quarterly Changes in the Exogenous Variables of the Price Sector and of the Employment and Labor Force Sector for the 602-694 Period	200

13–3	Monthly Values of $DHF3_t$, $DSF6_t$, and ΔRM_t for the January 1965–December 1969 Period	201
13–4	Assumptions Made in Forecasting the Exogenous Variables	203
13–5	Comparisons of Forecasts Based on Actual and Extrapolated Values of the Exogenous Variables	206
13–6	Errors Computed for the Same Prediction Period for the Forecasts Based on Extrapolated Values of the Exogenous Variables	208
13–7	Actual and Forecasted Changes for Selected Variables of the Model	209
13–8	Comparisons of the January et al. and March et al. Forecasts	214
13–9	Comparison of Forecasts of HSQ_t Based on Actual and Extrapolated Values of the Exogenous Variables	216
13–10	Errors Computed for the Same Prediction Period for the Forecasts of HSQ, Based on Extrapolated Values of the Exogenous Variables	217
13–11	Actual and Forecasted Levels of HSQ,	218
13–12	Actual and Forecasted Annual Changes for Selected Variables of the Model	222
13–13	Actual and Forecasted Annual Changes for Selected Variables of the Model	224
14–1	Root Mean Square Errors of the Within-Sample Forecasts of the Present Model, the Wharton Model, and the OBE Model	229
14–2	Comparisons of the Outside-Sample Forecasts of Money GNP from the Present Model, the Wharton Model, and the OBE Model	230
14–3	Comparisons of the Outside-Sample Forecasts of Real GNP from the Present Model, the Wharton Model, and the OBE Model	234
A-1	Data for Selected Variables Considered in the Money GNP Sector	247

A-2	and Labor Force Sector	249
A-3	Data for Selected Variables of the Monthly Housing Starts Sector	250
A-4	Seasonal Adjustment Coefficients for HSQ_t	251
B-1	Comparison of the Expenditure Equations of the Model Estimated by the Technique Described in Chapter 2 (TSCORC), by the Cochrane-Orcutt Technique (CORC), and by Ordinary Least Squares (OLSQ)	254
Figure		
9_1	Output Per Paid-for Man Hour	94

Preface

The model that is described in this book was developed during 1968 and 1969. The money GNP sector was developed in early 1968, and the other sectors were developed during 1969. At the time of this writing, the model in one form or another has been used as an actual forecasting tool for about two years. Data through the fourth quarter of 1969 have been used for the results presented in this book.

The computations were performed on an IBM 360-91 computer at Princeton University. All of the estimation techniques that were used in this study were programmed into the TSP regression package program. The TSP program was originally designed by Robert E. Hall and has since been expanded by J. Philip Cooper, Dwight M. Jaffee, and the present author, among others.

I am indebted to a number of people for their help and advice throughout the course of this work. These include Stanley W. Black, William H. Branson, Stephen M. Goldfeld, Dwight M. Jaffee, and Richard E. Quandt. I would particularly like to thank Stephen Goldfeld and Dwight Jaffee, who read the entire manuscript in rough draft form and made many helpful suggestions. I, of course, assume responsibility for all errors.

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References

- [1] Adams, F. Gerard. "Consumer Attitudes, Buying Plans, and Purchases of Durable Goods: A Principal Components, Time Series Approach." Review of Economics and Statistics 46 (November 1964): 347–355.
- [2] Black, Stanley W., and R. Robert Russell. "An Alternative Estimate of Potential GNP." *Review of Economics and Statistics* 51 (February 1969): 70-76.
- [3] Bonin, Joseph M. "Seasonality and Economic Analysis." Southern Economic Journal 34 (October 1967): 383-391.
- [4] Branson, William H. "A Disaggregated Model of the U.S. Balance of Trade." Staff Economic Studies, Board of Governors of the Federal Reserve System, 1968.
- [5] Cochrane, D., and G. H. Orcutt. "Application of Least Squares Regression to Relationships Containing Auto Correlated Error Terms." Journal of the American Statistical Association 44 (March 1949): 749-809.
- [6] Crockett, Jean, and Irwin Friend. "The Integration of Business Investment Plans and Other Anticipatory Data into Short-Term Forecasting Models." Paper presented at the C.I.R.E.T. Conference, 10 May, 1967.
- [7] Darling, Paul G., and Michael C. Lovell. "Factors Influencing Investment in Inventories." In [9], pp. 131-161.
- [8] de Leeuw, Frank, and Edward M. Gramlich. "The Channels of Monetary Policy." Federal Reserve Bulletin 55 (June 1969): 472-491.
- [9] Duesenberry, James S., Gary Fromm, Lawrence R. Klein, and Edwin Kuh, eds. The Brookings Quarterly Econometric Model of the United States. Chicago: Rand McNally, 1965.
- [10] The Brookings Model: Some Further Results. Chicago: Rand McNally, 1969.
- [11] Eisner, Robert. "Realization of Investment Anticipations." In [9], 95–128.
- [12] Evans, Michael K. Macroeconomic Activity. New York: Harper & Row, 1969.
- [13] Evans, Michael K., and Lawrence R. Klein. The Wharton Econometric Forecasting Model. Studies in Quantitative Economics No. 2, Economics Research Unit. Philadelphia: University of Pennsylvania.
- [14] Evans, Michael K., Yoel Haitovsky, and Goerge I. Treyz. "An Analysis of the Forecasting Properties of U.S. Econometric Models." Paper presented to the Conference on Research in Income and Wealth, Cambridge, Massachusetts, 14-15 November 1969.
- [15] Fair, Ray C. "The Determination of Aggregate Price Changes." Research Paper No. 25, Econometric Research Program, Princeton University, Feb., 1970.
- [16] Fair, Ray C. "The Estimation of Equation Systems with Restrictions Across Equations and Serially Correlated Errors." Mimeographed.
- [17] Fair, Ray C. "The Estimation of Simultaneous Equation Models with Lagged Endogenous Variables and First Order Serially Correlated Errors." Econometrica 38 (May 1970): 507-516.
- [18] Fair, Ray C. "Excess Labor and Aggregate Employment Functions." Research Memorandum No. 110, Econometric Research Program, Princeton University, August, 1969.
- [19] Fair, Ray C. The Short-Run Demand for Workers and Hours. Amsterdam: North-Holland Publishing Company, 1969.

- [20] Fair, Ray C. and Dwight M. Jaffee. "Methods of Estimation for Markets in Disequilibrium." *Econometrica* (forthcoming, 1972).
- [21] Ferber, Robert, ed. *Determinants of Investment Behavior*. New York: National Bureau of Economic Research, 1967.
- [22] Friend, Irwin, and Robert C. Jones. "Short-Run Forecasting Models Incorporating Anticipatory Data." In Models of Income Determination, National Bureau of Economic Research, 1964, pp. 279–307.
- [23] Friend, Irwin, and Paul Taubman. "A Short-Run Forecasting Model." Review of Economics and Statistics 46 (August 1964): 229-236.
- [24] Fromm, Gary, and Paul Taubman. *Policy Simulations with an Econometric Model*. Washington, D.C.: Brookings Institution, 1968.
- [25] Green, George R., Maurice Liebenberg, and Albert A. Hirsch. "Short- and Long-Term Simulations with the OBE Econometric Model." Paper presented to the Conference on Research in Income and Wealth, Cambridge, Massachusetts, 14-15 November 1969.
- [26] Griliches, Zvi. "Distributed Lags: A Survey." *Econometrica* 35 (January 1967): 16-49.
- [27] Howrey, Philip, and H. H. Kelejian. "Simulation Versus Analytical Solutions." In Thomas H. Naylor, ed. The Design of Computer Simulation Experiments. Durham: Duke University Press, 1969.
- [28] Jaffee, Dwight M. "An Econometric Model of the Mortgage Market: Estimation and Simulation." Mimeographed.
- [29] Jorgenson, Dale W. "Anticipations and Investment Behavior." In [9], pp. 35-92.
- [30] Katona, George, et. al. 1960 Survey of Consumer Finances. Ann Arbor, Michigan: Survey Research Center, Institute for Social Research, University of Michigan, 1961.
- [31] Katona, George, Charles A. Lininger, and Richard F. Kosobud. 1962 Survey of Consumer Finances. Ann Arbor, Michigan: Monograph No. 32, Survey Research Center, Institute for Social Research, University of Michigan, 1963.
- [32] Katona, George, Eva Mueller, Jay Schmiedeskamp, and John A. Sonquist. 1966 Survey of Consumer Finances. Ann Arbor, Michigan: Monograph No. 44, Survey Research Center, Institute for Social Research, University of Michigan, 1967.
- [33] Klein, L. R. An Essay on the Theory of Economic Prediction. Helsinki: The Academic Book Store, 1968.
- [34] Lovell, Michael C. "Sales Anticipations, Planned Inventory Investment, and Realizations." In [21], pp. 537–580.
- [35] Maisel, Sherman J. "Nonbusiness Construction." In [9], pp. 178-201.
- [36] Malinvaud, E. Statistical Methods of Econometrics. Amsterdam: North-Holland Publishing Company, 1966.
- [37] Mincer, Jacob. "Labor-Force Participation and Unemployment: A Review of Recent Evidence." In R. A. Gordon and M. S. Gordon, eds., *Prosperity and Unemployment*. New York: John Wiley, 1966, pp. 73-112.

- [38] President's Committee to Appraise Employment and Unemployment Statistics (Gordon Committee). *Measuring Employment and Unemployment*. Washington, D.C.: U.S. Government Printing Office, 1962.
- [39] Sargan, J. D. "The Maximum Likelihood Estimation of Economic Relationships with Autoregressive Residuals." *Econometrica* 29 (July 1961): 414-426.
- [40] Sparks, Gordon R. "An Econometric Analysis of the Role of Financial Intermediaries in Postwar Residential Building Cycles." In [21], pp. 301-331.
- [41] Suits, Daniel B., and Gordon R. Sparks. "Consumption Regressions with Quarterly Data." In [9], pp. 202-223.
- [42] Tella, A. J. "Labor Force Sensitivity to Employment by Age, Sex." *Industrial Relations* 4 (February 1965): 69–83.
- [43] Tella A. J. "The Relation of Labor Force to Employment." Industrial and Labor Relations Review 17 (April 1964): 454-469.
- [44] U.S. Bureau of the Census. Consumer Buying Indicators. Current Population Reports, Series P-65, 28 February 1967.
- [45] U.S. Bureau of the Census. Consumer Buying Indicators. Current Population Reports, Series P-65, 29 September 1969
- [46] U.S. Bureau of the Census. Consumer Buying Indicators. Current Population Reports, Series P-65, 9 December 1969.
- [47] Wimsatt, Genevieve G., and John T. Woodward, "Revised Estimates of New Plant and Equipment Expenditures in the United States, 1947-69: Part II." Survey of Current Business 50 (February 1970): 19-39.
- [48] Zarnowitz, Victor. An Appraisal of Short-Term Economic Forecasts. New York: National Bureau of Economic Research, 1967.



About the Author

Ray C. Fair was born in 1942 in Fresno, California. He received a B.A. degree in economics from Fresno State College in 1964 and a Ph.D. degree in economics from the Massachusetts Institute of Technology in 1968. Since 1968 he has been an Assistant Professor of Economics at Princeton University. His primary fields of interest are econometrics, macro-economics, and income distribution. He is the author of *The Short-Run Demand for Workers and Hours* (North-Holland, 1969) and various journal articles.



Index

Adams, F.G., 34, 257 aggregation, 11, 13, 55, 50 annual results, 220-225

Black, S.W., xiii, 102, 115-116, 257 Bonin, J.M., 14, 257 Branson, W.H., xiii, 71, 257 Brookings model, 6, 29, 54, 109 Bureau of Labor Statistics, 92, 101, 104

Cochrane, D., 20, 257
Cochrane-Orcutt iterative technique, 19-20, 24, 85, 105, 253-256
consumer buying expectations, 30-31
consumer sentiment, 29-31
consumption expenditures
durable, 31-37
nondurable, 37-40
services, 40-43
Cooper, J.P., xiii
Council of Economic Advisers, 115, 121
Crockett, J., 4, 36, 257

Darling, P.G., 63, 257 de Leeuw, F., 63, 257 disequilibrium markets, 73, 76, 79-82, 85 Duesenberry, J.S., 6, 257

Economic Indicators, 82, 101
Eisner, R., 45, 257
employment, 89-100
error cancellation, 107
error measures, 128-129, 131, 238
Evans, M.K., 5, 8-9, 45, 151, 228-229, 238-239, 246, 257
excess labor, 90-95
exogenous variables, 197-202
expectational variables, 2-3, 29-31, 37, 45-48, 63-64, 66-67

Federal Home Loan Bank, 78, 83, 86, 199, 201, 246
Federal National Mortgage Association, 86, 246
Federal Reserve Bulletin, 83
Ferber, R., 258
fine tuning, 8-9
fiscal policy, 6-7, 245
forecasting models, 4-10
Friend, 1., 3, 4, 36, 45, 63, 257, 258

Goldfeld, S.M., xiii Gordon Committee, 92, 259 Gramlich, E.M., 73, 257

Fromm, G., 6, 109, 257, 258

Green, G.R., 10, 258 Griliches, Z., 11, 258

Haitovsky, Y., 8-9, 151, 228-229, 238-239, 246, 257
Hall, R.E., xiii
Hirsch, A.A., 10, 258
hours
paid-for, 90-95, 113-114, 116
standard number, 90-96, 113-114
worked, 90-95, 113-114, 116
housing starts, 53-56, 73-88
Howrey, E.P., 124, 258

imports, 71-72 instrumental variables, 27-28, 57, 104-105 investment housing, 53-57 inventory, 59-69 plant and equipment, 45-52

Jaffee, D.M., xiii, 1, 73, 79, 82, 258 Jones, R.C., 3, 4, 258 Jorgenson, D.W., 45, 258

Katona, G., 30, 34, 258 Kelejian, H.H., 124, 258 Klein, L.R., 5-10, 17, 45, 125, 257, 258 Kosobud, R.F., 30, 34, 258 Kuh, E., 6, 257

labor force, 100-106 lag structure, 11, 31, 50-51, 62, 71 Liebenberg, M., 10, 258 Lininger, C.A., 30, 31, 258 Lovell, M.C., 60, 63, 257, 258

Maisel, S.J., 53-54, 73, 258
Malinvaud, E., 258
Michigan Survey Research Center, 12, 25, 30, 32, 43, 129, 241
Mincer, J., 102, 105, 171, 258
monetary policy, 51-52, 86, 245
Monthly Labor Review, 92
mortgage market, 73-79
Mueller, E., 30, 258
multiplier, short-run, 153
Mutual Savings Banks, 78, 83, 199

Naylor, T.H., 258 nonlinear techniques, 119-120

OBE model, 2, 8-9, 151, 228-240, 244, 246 Orcutt, G.H., 20, 257 output expectations, 96 periods of estimation, 26-27, 83 potential output, 110-116 price equation, 116-121 production function, short-run, 91

Quandt, R.E., xiii

realizations function, 48-49
reduced form equation, 153
results
annual, 220-225
outside sample, exogenous values known,
179-195
outside sample, exogenous values unknown,
204-220
stability, 155-179
within-sample, 136-153
R-squared, 23-24, 32, 42, 50
Russell, R.R., 102, 115-116, 257

sales expectations, 60-61 Sargan, J.D., 21-22, 259 Savings and Loan Associations, 78, 83, 199, 201, 246 Schmiedeskamp, J., 30, 258 seasonal adjustment, 13-14, 77 serial correlation, 1, 10, 17-24, 71, 241 simultaneous equation bias, 1, 17-24, 241 Sonquist, J.A., 30, 258 Sparks, G.R., 29, 40, 259 strikes, 26-27, 83, 127 structural models, 2-4, 44, 240 Suits, D.B., 29, 259 Survey of Current Business, 45-47, 63, 92-93,

Taubman, P., 4, 45, 63, 109, 258
Tella, A.J., 104, 259
test procedures, 123-128, 155-156, 202-204
Treyz, G.I., 8-9, 151, 228-229, 238-239, 246, 257
t-statistic, 23, 32

unemployment rate, 100-106 U.S. Bureau of the Census, 25, 30, 33, 34, 43, 129, 241, 259

Wharton model, 2, 5-10, 151, 228-240, 244, 246 Wimsatt, G.G., 46-47, 259 Woodward, J.T., 46-47, 259

Zarnowitz, V., 2, 227, 259