THE ECONOMETRIC ANALYSIS OF SEASONAL TIME SERIES

ERIC GHYSELS DENISE R. OSBORN

2

6.0





ţ

Contents

.

يتين

Fo	rewor	d by Th	iomas J. Sargent	<i>page</i> xiii
Pro	eface			XV
Lis	t of S	ymbols	and Notations	xix
		3.		
1			on to Seasonal Processes	1
	1.1		Illustrative Seasonal Economic Time Series	1
	1.2	Seaso	nality in the Mean	4
		1.2.1	Deterministic Seasonality	4
		1.2.2	Linear Stationary Seasonal Processes	7
		1.2.3	Nonstationary Unit Root Processes	10
		1.2.4	Unobserved Component Models	12
	1.3	Period	lic Processes	12
	1.4	Seaso	nality in Higher Moments	15
		1.4.1	Stochastic Seasonal Unit Roots	16
		1.4.2	Seasonal GARCH	16
		1.4.3	Periodic GARCH	17
2	Dete	erminis	stic Seasonality	19
	2.1	Introd	uction	19
	2.2	Repre	sentations of Deterministic Seasonality	<i>•</i> 20
		2.2.1	The Dummy Variable Representation	20
		2.2.2	The Trigonometric Representation	21
	2.3	Stocha	astic and Deterministic Seasonality	24
		2.3.1	Stochastic Seasonal Processes	24
		2.3.2	The Seasonal Random Walk	26
		2.3.3	Deterministic Seasonality versus Seasonal	
			Unit Roots	28
		2.3.4	Unobserved Components Approaches	29
	2.4		g Deterministic Seasonality	30
		2.4.1		31

ţ

x Contents

		2.4.2	The Caner Test	36
		2.4.3	The Tam–Reinsel Test	37
		2.4.4	Some Comments	39
3	Seas	onal U	nit Root Processes	42
	3.1	Introd		42
	3.2		rties of Seasonal Unit Root Processes	43
	0.12	3.2.1		43
		3.2.2	The Seasonal Random Walk with Seasonally	
			Varying Drift	45
		3.2.3	More General Stochastic Processes	45
		3.2.4	Transformations and Seasonal Unit Roots	47
		3.2.5	Asymptotic Distributions	50
	3.3		g Seasonal Integration	52
	\$	3.3.1	Dickey–Hasza–Fuller Test	52
		3.3.2	Testing a Unit Root of -1	54
		3.3.3	Testing Complex Unit Roots	56
		3.3.4	HEGY Test	60
	۹.	3.3.5	The Kunst Test	64
		3.3.6	The Osborn-Chui-Smith-Birchenhall Test	66
		3.3.7	Multiple Tests and Levels of Significance	68
	3.4	•Exten	sions	70
			Additional Dynamics	70
		3.4.2	L	71
		3.4.3	0	72
		3.4.4	· · · · · · · · · · · · · · · · · · ·	74
			Higher Order Nonstationarity	75
	3.5		e Carlo Studies	76
			Comparisons of Test Procedures	77
		3.5.2	6	
		-	Breaks	79
	3.6		nal Cointegration between Variables	80
			A Single Equation Approach	81
			The Vector Approach	84
		3.6.3	1 0	88
	3.7	Some	Remarks on Empirical Results	90
4	Sea	sonal A	djustment Programs	93
	4.1	Introd	luction	93 _j
	4.2	Decor	mpositions	93

.•

.

Contents

....

	4.3	The X-11 Program	95
		4.3.1 The Linear X-11 Filter	95
		4.3.2 On Potential Sources of Nonlinearity	100
	4.4	The X-12 Seasonal Adjustment Program	106
		4.4.1 RegARIMA Modeling in X-12-ARIMA	107
		4.4.2 X-12 Diagnostics	108
	4.5	The TRAMO/SEATS Programs	108
		4.5.1 Unobserved Component ARIMA Models	
		and Seasonal Adjustment	109
		4.5.2 Model-Based Approach versus X-12	112
	4.6	Seasonal Adjustment and Other Data Transformations	115
5	Esti	mation and Hypothesis Testing with Unfiltered	
	and	Filtered Data	121
	5.1	Introduction	121
	5.2	Linear Regression with Misspecified Seasonal	
		Nonstationarity	122
	5.3	The Classical Linear Regression Model and Filtering	124
	5.4	Filtering of ARIMA Models	126
		5.4.1 Filtering of Unit Root Processes	128
		5.4.2 Filtering Stationary ARMA Processes	129
	5.5	Finite Sample Approximations of Filtering Effects	131
	5.6	Filtering and Cointegration	134
	5.7	Bias Trade-Offs and Approximation Errors	136
6	Peri	Periodic Processes	
	6.1	Introduction	139
	6.2	Some Simple Periodic Processes	140
		6.2.1 Periodic Heteroskedasticity	141
		6.2.2 Periodic MA(1) Process	142
		6.2.3 Periodic AR(1) Process	143
	6.3	Representations and Properties of Periodic	
		Processes	144
		6.3.1 The VAR Representation	144
		6.3.2 Properties of Stationary PAR Processes	146
		6.3.3 The Constant Parameter Representation	
	-	of a PAR Process	148
	6.4	Nonstationary Univariate PAR Processes	152
		6.4.1 Types of Integration in a PAR Process	153
		6.4.2 The Role of Intercept and Trend Terms	155
		6.4.3 Testing for Seasonal Integration in a PAR Process	157

_,

xi

Ŧ

xii Contents

.

.*

		6.4.4	Cointegration Approaches to Testing Seasonal	
			Integration	160
		6.4.5	Testing Periodic and Nonperiodic Integration	164
		6.4.6	Extensions: Augmentation and Deterministic	
			Components	166
	6.5	Period	lic Cointegration	168
		6.5.1	Some Issues in Periodic Cointegration	168
		6.5.2	Vector Approaches to Periodic Cointegration	171
		6.5.3	Nonperiodic, Periodic, and Seasonal Cointegration	174
		6.5.4	The Boswijk-Franses Test for Periodic Cointegration	176
		6.5.5	Generalizations	179
	6.6	Some	Comments on Empirical and Monte Carlo Analyses	180
7	Som	ie Nonl	inear Seasonal Models	182
7	Som 7:1		inear Seasonal Models luction	182 182
7		Introd		
7	7:1	Introd Stoch	luction	182
7	7':1 7.2	Introd Stoch	luction astic Seasonal Unit Roots nal ARCH Models	182 183
7	7':1 7.2	Introd Stoch Seaso 7.3.1	luction astic Seasonal Unit Roots nal ARCH Models	182 183 185
7	7:1 7.2 7.3	Introd Stoch Seaso 7.3.1 7.3.2	luction astic Seasonal Unit Roots nal ARCH Models The Class of Models	182 183 185 185
7	7:1 7.2 7.3	Introd Stoch Seaso 7.3.1 7.3.2 Period	luction astic Seasonal Unit Roots nal ARCH Models The Class of Models The Effects of Filtering on ARCH Models	182 183 185 185 185
-	7 [*] :1 7.2 7.3 7.4	Introd Stoch Seaso 7.3.1 7.3.2 Period Period	luction astic Seasonal Unit Roots nal ARCH Models The Class of Models The Effects of Filtering on ARCH Models dic GARCH Models	182 183 185 185 185 188 194
Ep	7 [:] 1 7.2 7.3 7.4 7.5	Introd Stoch Seaso 7.3.1 7.3.2 Period Period	luction astic Seasonal Unit Roots nal ARCH Models The Class of Models The Effects of Filtering on ARCH Models dic GARCH Models	182 183 185 185 185 188 194 198
Ep Bii	7:1 7.2 7.3 7.4 7.5 vilogu	Introd Stoch Seaso 7.3.1 7.3.2 Period Period	luction astic Seasonal Unit Roots nal ARCH Models The Class of Models The Effects of Filtering on ARCH Models dic GARCH Models	182 183 185 185 185 188 194 198 203

-

.

ţ