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Some Critical Points in Contemporary Econometric Modelling in the Caribbean

By

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Sheraton Grand Resort
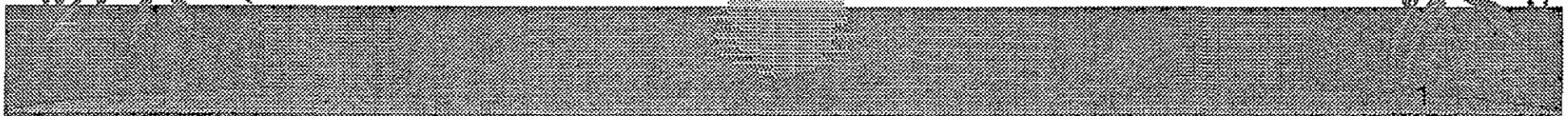Paradise Island, THE BAHAMAS

October 26 – 30, 1998

SOME CRITICAL POINTS IN CONTEMPORARY ECONOMETRIC MODELLING IN THE CARIBBEAN
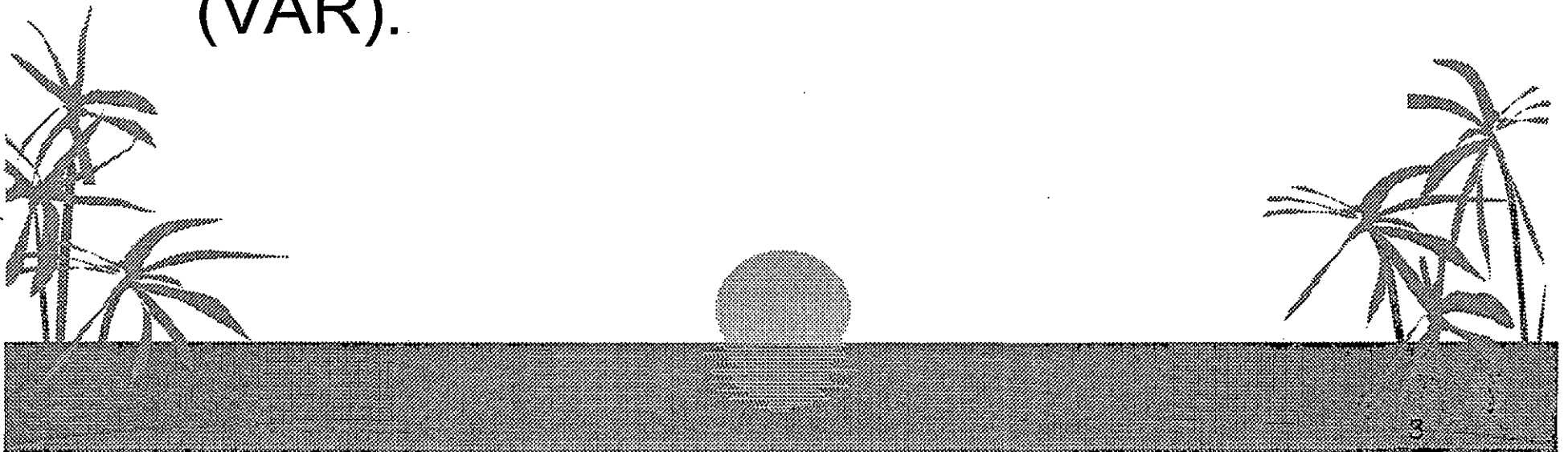
Terence D. Agbeyegbe

Hunter College and the Graduate Center, CUNY

The Range of Modelling Experience

▲ A selective survey.

▲ Emphasis on cointegration and unit root methodology.

▲ Emphasis also on vector autoregression (VAR).

The Range of Modelling Experience

▲ <u>Second generation models</u>

▲ Models specifically designed for forecasting

▲ Bahamas-Belchere (1998).

▲ Guyana- Ganga (1990).

▲ Jamaica- UNDP (1991), Robinson (1993).

▲ Trinidad and Tobago- Clarke and Watson (1992), St. Cyr and Charles (1992), Hilaire, Nicholls and Henry (1990).
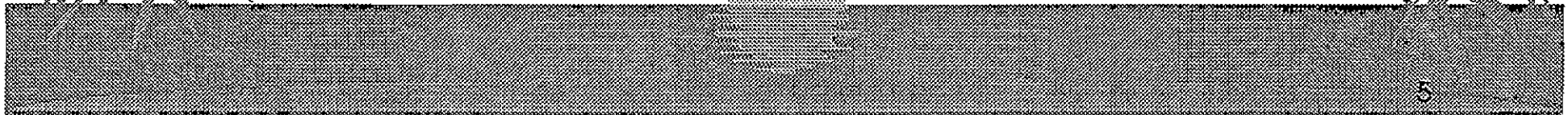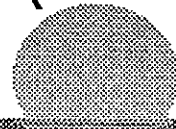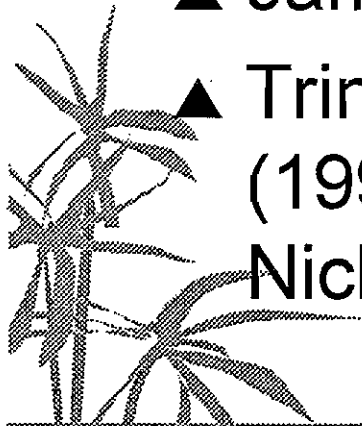
The Range of Modelling Experience

▲ <u>**Third generation**</u>

▲ Forecasting, impact analysis, employ cointegration and unit root methodology.

▲ Barbados - Agbeyegbe (1996), Downes (1985), Downes, Holder and Leon (1990, 1991).

▲ CARICOM- Rambarran (1997), ECCB- Leon and Samuel (1994).

▲ Jamaica- Agbeyegbe (1996), Ghartey (1998), Williams (1997).

▲ Trinidad and Tobago - Maurin (1996), Maurin and Montauban (1997), Watson and Teelucksignh (1997).
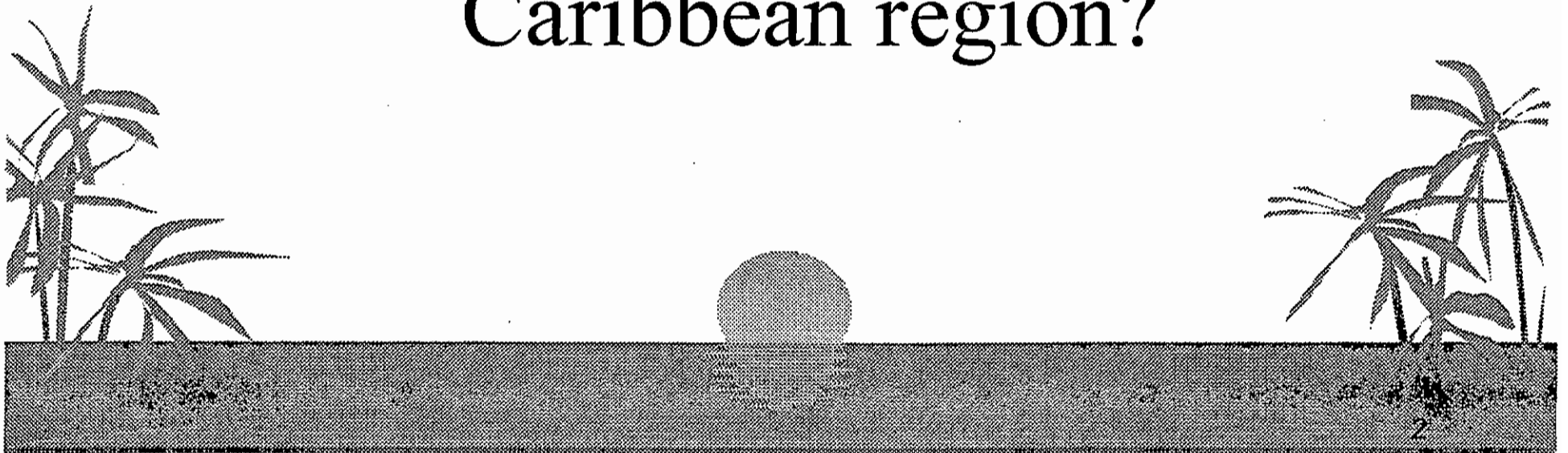
The Range of Modelling Experience

▲ <u>First generation models</u>

▲ Open Hicksian type IS-LM models.

▲ Jamaica- Carter (1970), Harris (1970), Manhertz (1971).

▲ Trinidad and Tobago-Gafar (1977), Persad (1975).
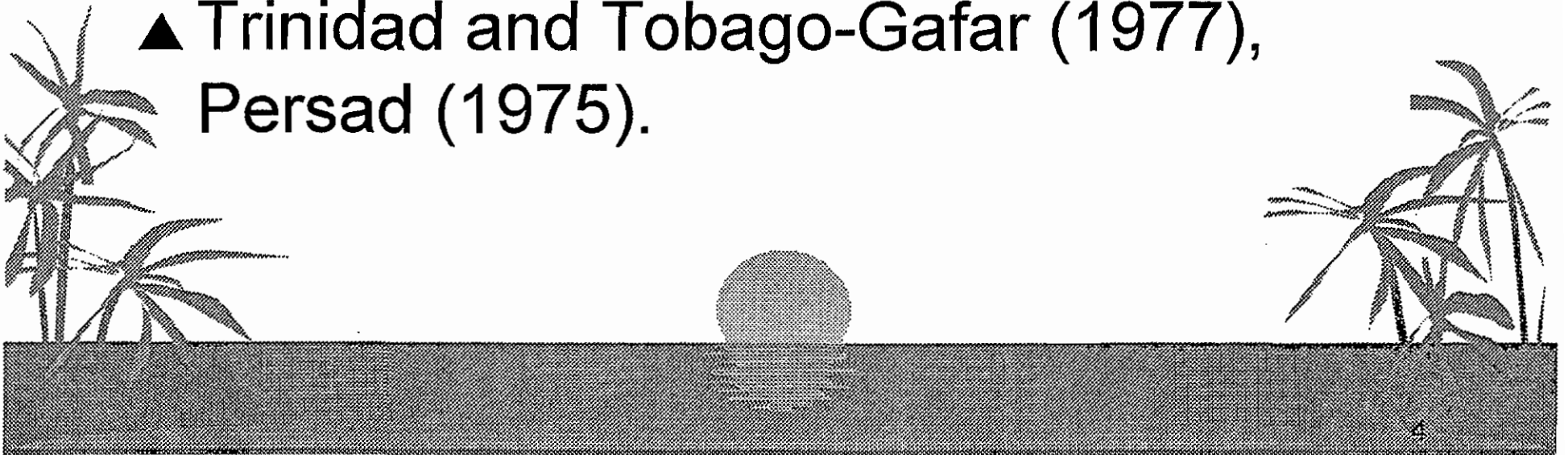
Question: What are some of the latest results in econometric modelling and what do they imply for econometric modelling in the Caribbean region?

The Range of Modelling Experience

▲ <u>Survey and critical appraisal</u>

▲ Watson (1994)- An excellent critical appraisal of macroeconometric models in the Caribbean region.

▲ Forde (1994) - Data issues in forecasting.

▲ Nichols (1990)- Monte Carlo approach to overcome problems with short-data sets.

▲ Leon (1989)- background on modelling issues.
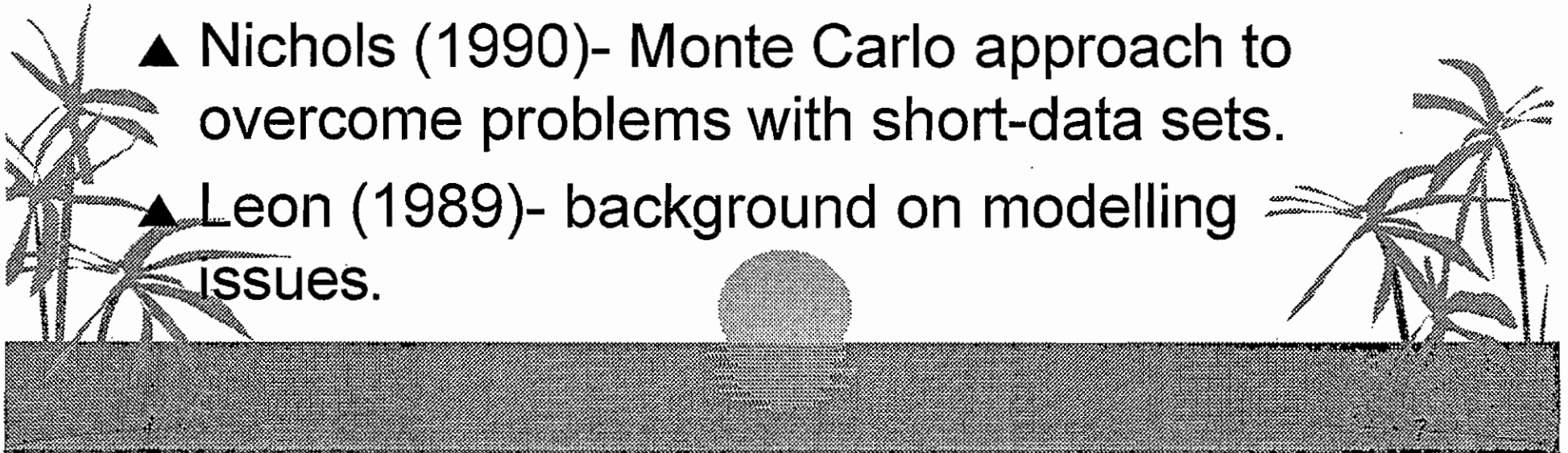
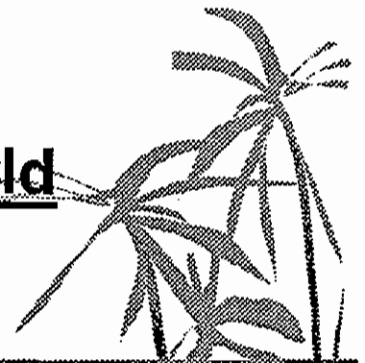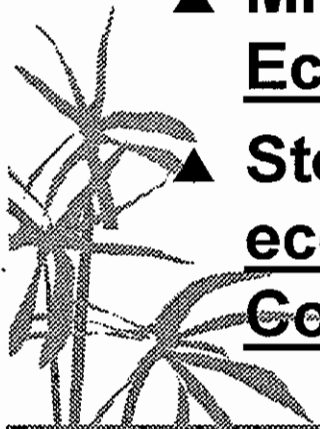# Explaining Econometric Modelling

▲ <u>Three problems:</u>

▲ Test of unit root when sample size is small.

▲ Test of non-cointegration when sample size is small.

▲ VAR- impulse response functions-measures the time profile of the effect of shocks at a given point in time on the (expected) future values of variables in a dynamic system.
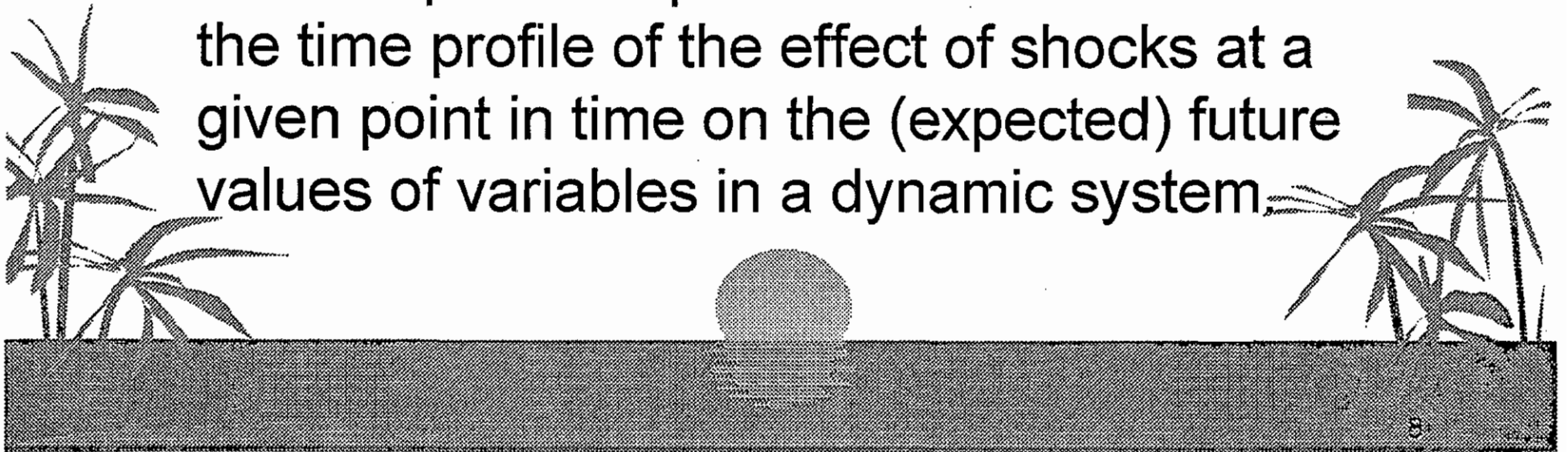
Explaining Econometric Modelling

▲ <u>Background reading</u>

▲ **Banerjee, Dolado, Galbraith and Hendry (1993)- Text on <u>Cointegration, Error correction and the Econometric Analysis of Non-Stationary Data</u>.**

▲ **Hamilton (1994)-<u>Time Series Analysis</u>**

▲ **Mills (1998)- Survey article on VAR in <u>Journal of Economic Survey</u>**

▲ **Stock (1997) Survey article in <u>Advances in economics and econometrics: Seventh World Congress</u>**
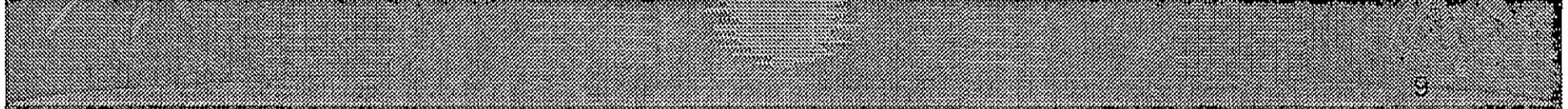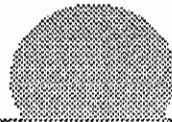
Explaining Econometric Modelling

▲ Definition and brief review of cointegration and unit root methodology.

▲ Designed to overcome spurious regression problem.

▲ Designed to ascertain permanent and transistory component of economic series.

▲ Designed to provide information on long-run equilibrium relationships.
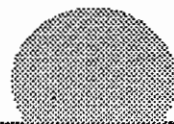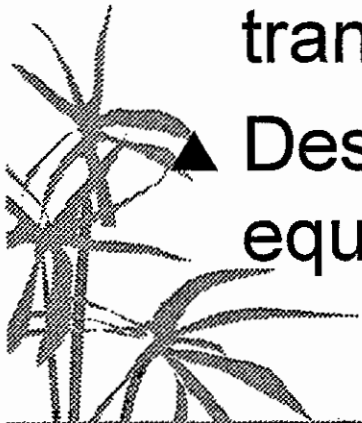
Explaining Econometric Modelling

▲ <u>Definitions</u>

▲ Stationary.

▲ Trend.

▲ Trend Stationary.

▲ Random walk.

▲ Difference stationary.

▲ Unit root.

▲ I(0) and I(1).
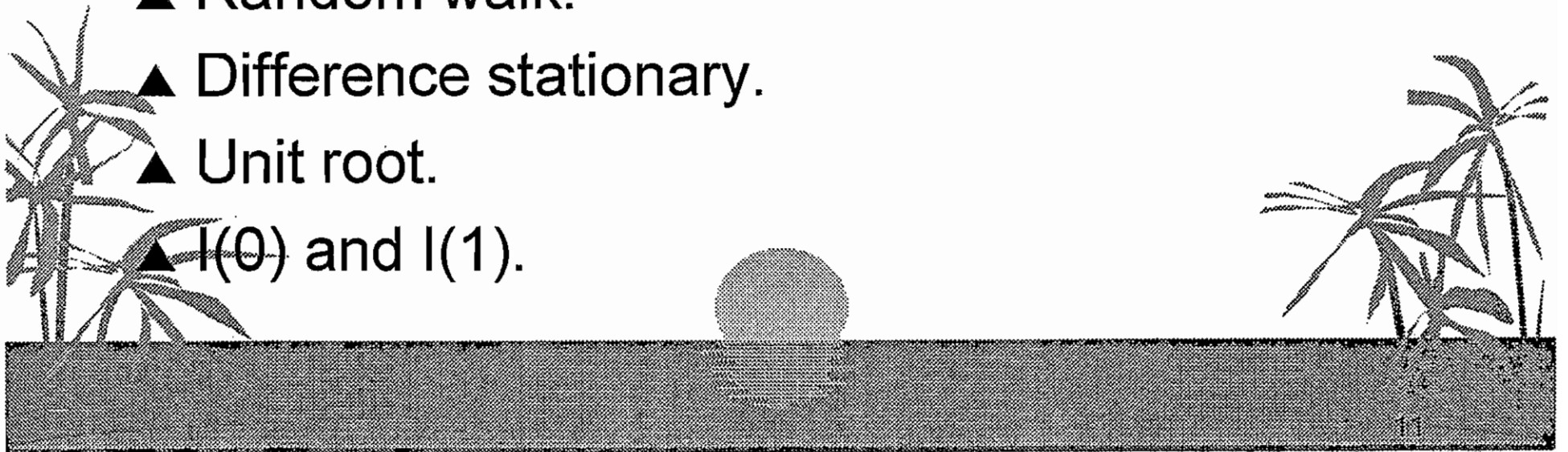
Unit Root and Econometric Modelling

▲ <u>Definitions</u>

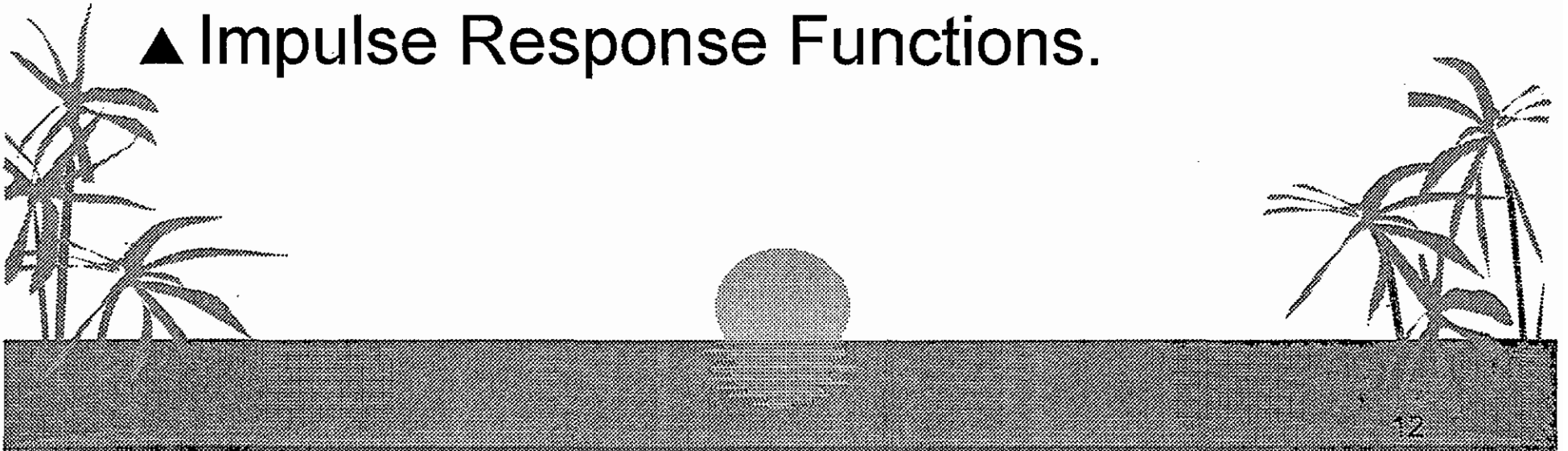▲ Cointegration.

▲ Vector Auto Regression (VAR).

▲ Error- correction.

▲ Impulse Response Functions.

Unit Root and Econometric Modelling

▲ <u>Several tests for unit root and cointegration</u>

▲ Dickey-Fuller (1981).

▲ Phillips and Perron (1988).

▲ Sargan and Bhargava (1983).

▲ Engle and Granger (1987).

▲ Johansen (1988), Johansen and Juselius (1990).

Unit Root and Econometric Modelling

▲ <u>Unit root procedure</u>

▲ The test depends on whether there is a constant term, trend term or not.

▲ A random walk with a constant term is a unit root with drift.

▲ Different critical values are obtained under the various specifications.

▲ ADF specifies model in terms of constant, distributed lags and trend component.

Unit Root and Econometric Modelling
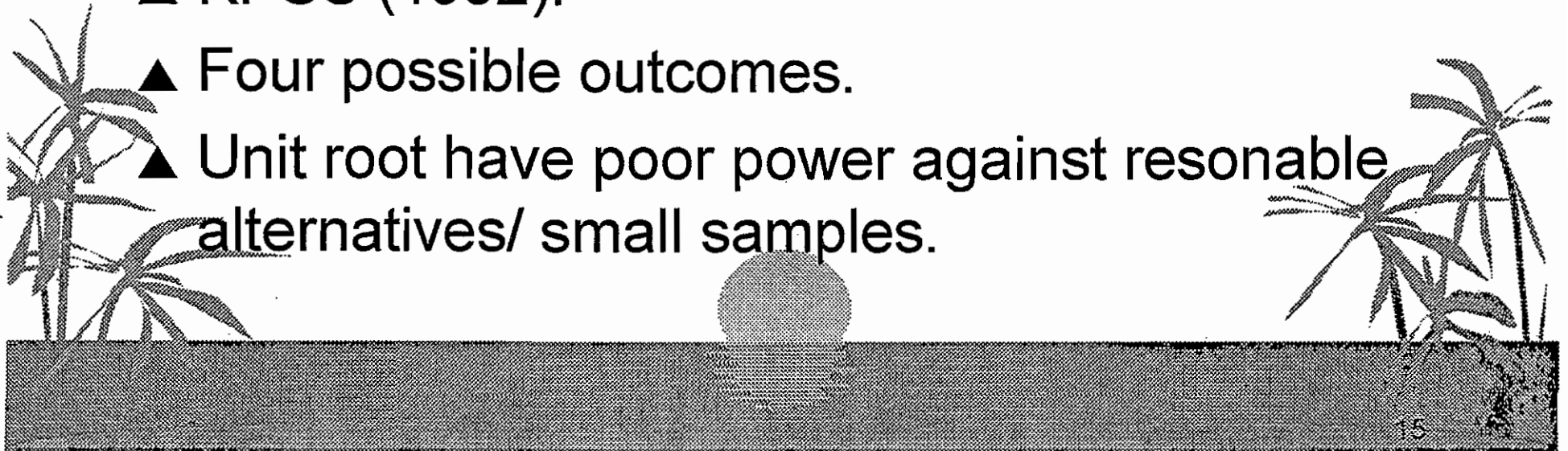
▲ <u>Comments</u>

▲ Failure to reject the null of a unit root does not imply the process is a unit root.

▲ Consider test for stationarity.

▲ KPSS (1992).

▲ Four possible outcomes.

▲ Unit root have poor power against resonable alternatives/ small samples.

Unit Root and Econometric Modelling

- ▲ Small sample size distortions exist so consider simulation method to derive critical values.
- ▲ Jeong and Maddala (1993), and Vinod (1993) have survey articles on bootstrapping in econometrics.
- ▲ Blangiewicz and Charemza (1990).
- ▲ Harris (1992).
- ▲ Harris suggests bootstrapping the ADF statistics. Bootstrapping is helpful here.

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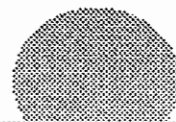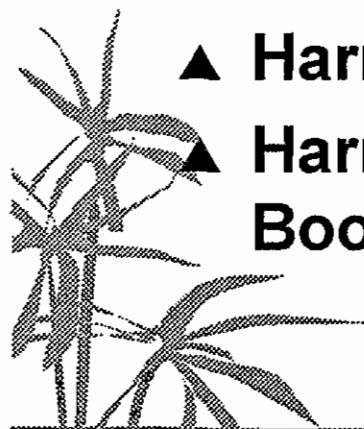
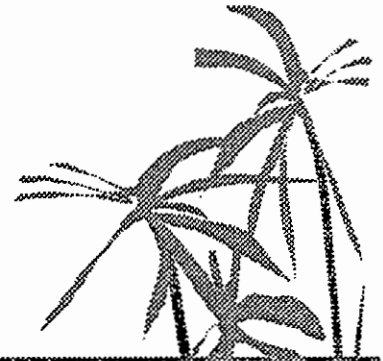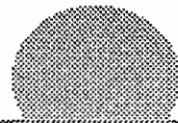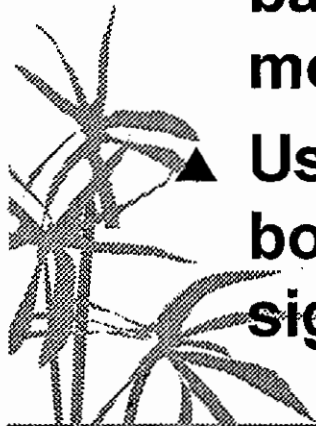# Unit Root and Econometric Modelling

▲ <u>Harris' Procedure</u>

▲ Use restricted model to generate residuals.

▲ Generate 5000 samples based on centered residuals

▲ For each sample obtain a bootstrapped estimates based on ADF statistics of the unrestricted model.

▲ Use the 5000 data points to construct bootstrapped distributions and obtain the significance levels.

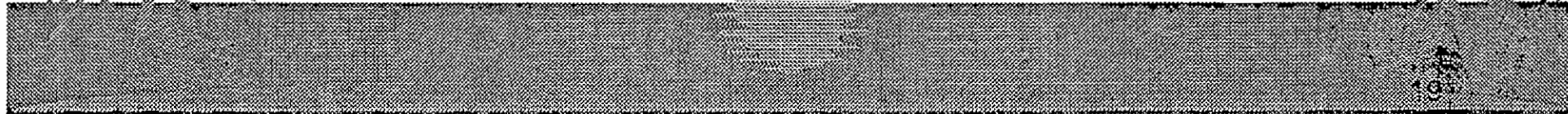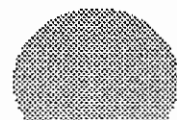# Cointegration, VAR and Econometric Modelling

▲ Similar approach can be used for Johansen critical values.

▲ Harris and Judge (1998) argue that the bootstrap test statistic has poor size properties.

▲ Cheung and Lai (1993)- Johansen's tests are biased towards finding cointegration than what asymptotic theory suggests. Proper correction for critical values are essential.

Cointegration, VAR and Econometric Modelling

▲ <u>VAR and cointegration</u>

▲ Model selection in VAR.

▲ Simultaneous approach to the selection of the order of the lagged difference term, the number of cointegrating vectors and the order of the trend term.

▲ The sequential approach is inappropriate.

▲ Also AIC is inferior to BIC and PIC.
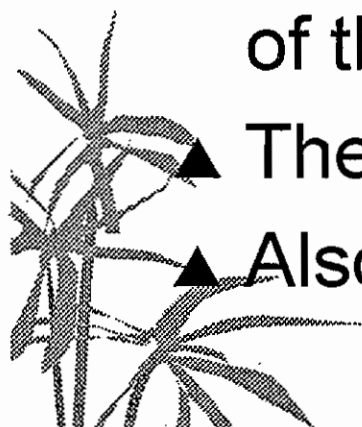
Cointegration, VAR and Econometric Modelling

▲ $AIC(p,r,l) = \ln|\sum| + (2N/T)$.

▲ $BIC(p,r,l) = \ln|\sum| + (N \ln T/T)$ where $N= n(r+(p-1)n) + l + 1$ is the number of fitted parameters and is the estimate of the covariance matrix obtained from OLS of the VAR.

▲ $PIC(p,r,l) = \ln|\Xi| +$ $(\ln|\Xi|/T)$ where Ξ the penalty function depends on the observed data as well as the dimension of the model.

Cointegration, VAR and Econometric Modelling

▲ <u>**VAR and impulse response functions**</u>

▲ **Sims (1980)- atheoretical econometrics**

▲ **Sims approach requires orthogonalization of shocks and it is not invariant to the ordering of variables in the VAR.**

▲ **Pesaran and Shin (1998) propose the use of generalized impulse response analysis which does not have the above short comings.**

▲ **They show that markedly different results can emerge from the use of both approaches.**
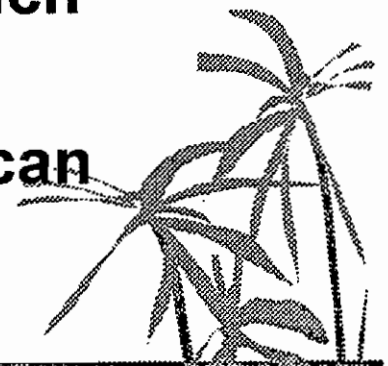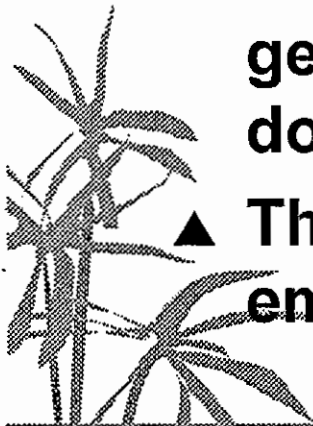
Cointegration, VAR and Econometric Modelling

▲ Impulse response or dynamic multipliers can be obtained from infinite moving average representations of a VAR .

▲ They trace out how a variable responds over

▲ time to a single surprise increase in itself or any other variable.

▲ Correlation among disturbances in a system means a shock to one equation will impact other equations.

▲ Orthogonalization of the covariance matrix reduces this problem but the decomposition is not unique and depends on the ordering of variable in VAR.

Cointegration, VAR and Econometric Modelling

▲ Generalized impulse response takes into account the historical pattern of correlation between observed shocks.

▲ Generalized impulse response functions take into account the properties of data generating the process into account.

▲ Generalized impulses can be used in the derivation of forecast error variance decompositions.
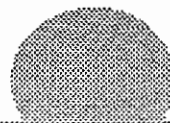
Conclusions

▲ In general, econometric modelling of macro issues in the Caribbean have become more sophisticated.

▲ This sophistication comes with a price.

▲ Inappropriate application will fail to provide acceptable statistical inference in important applications. For example, in applications involving impulse response analysis of VAR systems.
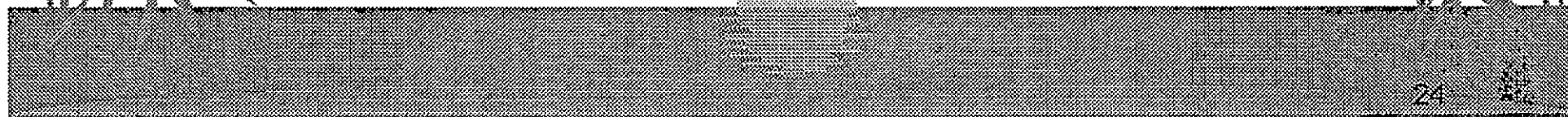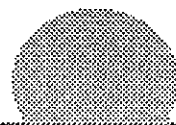
Conclusions

▲ **Close examination of the third generation models leaves one with the impression that the models have not adequately addressed some important statistical issues.**

▲ **Great care should be taken when using new methodologies (e.g., cointegration and unit root methodology).**

▲ **Given the relatively small sample size of annual macro data frequently encountered in models dealing with the Caribbean region, it is recommended that bootstrap procedures should be implemented for calculating critical values.**
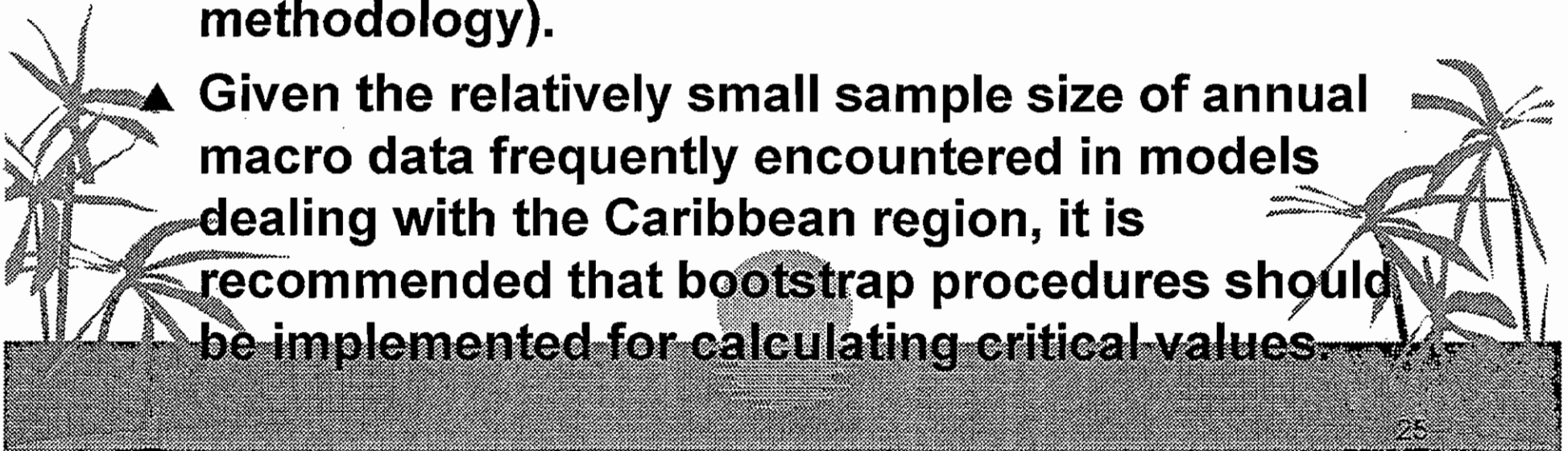
SELECTIVE REFERENCES

Blangiewicz and Charemza, W.W., (1990), "Cointegration in small samples: Empirical percentiles, drifting moments and customized testing," <u>Oxford Bulletin of Economics and Statistics</u>, 52, 3 , 303-315.

Harris, R, I, D., (1992), " Small sample testing for unit roots" <u>Oxford Bulletin of Economics and Statistics</u>, 54,4, 615-625.

Harris and Judge, G., (1998), "Small sample testing for cointegration using the bootstrap approach," <u>Economic Letters</u>, 58, 31-37.

Leong, J, and Maddala, (1993)," A perspective on application of bootstrap methods in econometrics," chapter 21 in <u>Handbook of Statistics</u>, vol. 11, editors G.S. Maddala, C. R. Rao and H. D. Vinod, 573-609.

H. Hashem Pesaran and Shin, Y., (1998), "Generalized impulse response analysis in linear multivariate models," <u>Economic Letters</u>, 58, 17-29

H.D. Vinod, (1993), "Bootstrap methods: Applications in econometrics," chapter 23 in <u>Handbook of Statistics</u>, vol. 11, editors G.S. Maddala, C. R. Rao and H. D. Vinod, 629-659.