Journal of Applied Sciences

ISSN 1812-5654

Journal of Applied Sciences 6 (4): 726-730, 2006
ISSN 1812-5654

Time Series Seasonality: Tourism in Mali

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Abstract: The purpose is to delimit, with seasonality (in part caused by weather) certain economic indicators in order to explain European demand for Malian tourist services: price, income and supply. These relevant indicators were included in a Structural Model to explain tourist demand. Modeling methodologies, allow apprehending tourist time series variability, were proposed. It is also suggested transfer function Model and Autoregressive distributed Lag Distribution. Final equations based on diagnostic checking were suitably fitted tourist demand. The estimated values of the flexibility of the demand are coherent in sign and in module with the economic theory.

Key words: Supply induced demand, seasonality, Basic Structural Model, Transfer Function Model Auto regressive Distributive Lag Model

INTRODUCTION

Tourism was maintained out of the great concerns of the authorities because suspect to only interest most rich people. The statistics of the OMT show with sufficiency the tourism place in the world trade. It seems one of the greatest creators of incomes by his capacity to generate employment.

The tourism is an important factor of the economy of Mali. This sector shows a strong seasonal behavior (the demand is concentrated in July, August, September months).

We want to come out again to rating of the seasonality some economic indicators to explain the demand addressed to the tourist industry of Mali: the price, the income, the supply.

As specification, I keep the structural model of basics with explanatory variables; the approach of Harkey (1990) to estimate the unknown parameters. The procedures based on the method of the maximum likelihood process of inference will be driven. From the diagnostic tests of AIC type procedure of selection and the estimated values of the variances of the different components permit us to identify these components nature.

For modeling the tourist demand we have considerate the transfer function model (MFT) and the specification 'Autoregressive with gradual lags (SARE). We use Malian and Europeans monthly tourism data from January1991 to December 2003 .

MATERIALS AND METHODS

Specification of the tourist demand: Favorable economic conjuncture, (y^o) auspicious political climate, the political authorities good willing.

Quantification of the tourist demand: Numbers of European tourist entries and how long they have stayed.

Determinants of the tourist demand: The demand (y^o) is closely bound to the price (P), to the income (R) and especially to the tourist supply: (y^o) (the natural wealth (climate), the capacity of the hotels).

Cost of the stay: Global recipe = Price×quantities ≡ (recipe of the night)×(number of nights).

Function of the demand: $y^d = y\ (P, R, y^o)$ with $\partial y/\partial P<0$; $\partial y/\partial R>0$; $\partial y/\partial y>0$ indicates that the supply induce the demand.

The seasonal unit roots process test by Hylleberg *et al*. (1990) and its application to the Malian tourist series, one admits extensively that the seasonal shapes fluctuate weakly in the time (Ouerfell and Pichery, 1998).

Construction of the sample

- Short interval of time

- Important size of sample
- Representative ness of the sample.

The sample is provided by the tourism office (156 monthly observations concerning the French tourists, Germans, English and Italian)

Function form
Structural Basic model

$$y_t = \mu_t + S_t + \varepsilon_t$$

Chronological series y_t; μ_t: trend; S_t: seasonal component

Global model

$$y_t = \mu_t + S + X'_t\,\delta + \varepsilon_t \qquad ; t = 1,....., T$$

X_t: Vector of k variables; and δ: vector of the unknown parameters associated to these variables

Specification

$$\begin{cases}\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \\ \beta_t = \beta_{t-1} + \xi_t\end{cases} \quad \eta_t \to N\left(0;\sigma^2{}_\eta\right) \;\; \xi_t \to N\left(0;\sigma_\xi\right)$$

$S_t = \sum_{j=1}^{s-1}\gamma_j D_{jt}$ where D_{jt} are seasonal indicator variables given by

D_{jt} = 1 if t = j, j+s,j+2s,……. .
D_{jt} = 0 if t≠ j, j+s, j+2s,……
D_{jt} = -1 if t = s, 2s, 3s,…..

if t = s, 2s, 3s,... $\sum_{j=1}^{s-1}\gamma_j D_{jt} = -\sum_{j=1}^{s-1}\gamma_j \equiv \gamma_s$ which implies that $\sum_{j=1}^{s-1}\gamma_j = 0$ or if γ_t is the seasonal effect at time t: $\sum_{j=0}^{s-1}\gamma_{t-j} = 0$

we suppose $\gamma_t = -\sum_{j=1}^{s-1}\gamma_{t-j} + \omega_t \qquad \omega_t \to N\left(0;\sigma^2_\omega\right)$

η_t, ξ_t are independent and non correlated to the component ε_t.

Kalman filter iterative procedure permits to estimate the values of the unknown parameters.

Approach of Box and Jenkins (1976)
Specification 1: (Transfer Function Model with seasonal indicatory variables V.I.S.)

$$y_t = \gamma_0 + \sum_{j=1}^{11}\gamma_j D_{jt} + \sum_{i=1}^{k}\frac{\beta^i L^i}{1 - L\lambda_i}x_{it} + \frac{b(L)}{a(L)}\varepsilon_t$$
$$\varepsilon_t \to iidN\left(0;\sigma^2\right)$$

$\sum_{j=1}^{k}\frac{\beta^i L^i}{1 - L\lambda_i}$ retrace the dynamics of the model

$\frac{b(L)}{a(L)}$ describe the dynamics of the disruptions

$$a(L) = 1 - a_1L - a_2L^2 - .... - a_pL^p$$
$$b(L) = 1 + b_1L + b_2L^2 + ... + b_qL^q$$

The D_{jt} is the 11 V.I.S. and λ_t represent the coefficient of the auto regressive lag associated to the transfer term of i. Li indicates the lag that precedes the impact of the exogenous value x_i.

Specification 2: Detects the two aspects of the seasonality: stochastic and deterministic aspect according to Franses (1991).

$$a(L)\tilde{y}_t = \gamma_0 + \sum_{j=1}^{11}\gamma_j D_{jt} + \tilde{x}_t\beta + \varepsilon_t \quad \varepsilon_t \to iidN\left(0;\sigma^2\right)$$

where y_t and x_t are series gotten after elimination of all unit roots to the existing frequencies. a(L) is an auto-regressive polynomial which general expression is given over and β' = (β_1, β_2, β_3) the vector of the coefficients of the explanatory variables.

Specification 3: (Auto regressive distributed Lag Model)

$$A(1)y_t = B(L)x_t + \varepsilon_t \quad \varepsilon_t \to iidN(0;\sigma^2)$$
$$A(L) = 1 - A_1L - A_2L^2 - .... - A_pL^p$$
$$B(L) = 1 + B_1L + B_2L^2 + ... + B_qL^q$$

We used (RATS 4.2 software)

Preliminary results and comments
Basis Structural Model estimation
Final equation: (STAMP, version 5.0 program: structural

time analyzer modeler and predictor) elaborated by Koop man

$$y_t = \mu_t + S + X'_t\,\delta + \varepsilon_t \qquad t = 1,\ldots\ldots, T$$

The criteria of selection permitted to keep the specification with a stochastic trend and a seasonal deterministic component. It has been estimated while using Kaman filter iterative procedure

$$y_t = \mu_t + \gamma_t + \delta_1\,CME_t + \delta_2\,P_{t-12} + \delta_3\,R_{t-1} + \varepsilon_t \qquad t = 1,\ldots, T = 156$$

μ is a random walk with $\mu_t = \mu_{t-1} + \beta + \eta_t$ and $\gamma_t = -\sum_{j=1}^{s-1}\gamma_{t-j}$ is relative to the coefficient of month t. (the variables are expressed in logarithm).

Shart: Basic Structural Model

Structure	Statistics				
Components	Hyper variables			Diagnostics	
Variances	Trend $(\hat{\sigma}^2_\eta)$	0.0030	77.6	R^2_D	0.9250
	Stationarity $(\hat{\sigma}^2_\omega)$	0.0000	8.62*	R^2_S	0.2362
	Erreur $(\hat{\sigma}^2)$	0.0042	–	V.E.P $(\hat{\sigma}^2)$	0.0086
Elasticities	CME $(\hat{\delta}_1)$	0.9131	2.89[c]	AJC	-4.5211
	P $(\hat{\delta}_2)$	0.1029	-2.22	JB	6.9640
	R $(\hat{\delta}_3)$	0.4955	1.61	Q*(11.1299)	2.72 (1.86)[d]

-VEP: Variance of Prevision Error

-[a]: Like hood ratio statistics [RV = 143Log (0.0148/0.0086) for the tendency, RV = 0.144Log (0.0091/0.0086) for the seasonality

-[b]: The critical value of χ^2 (1) table at the significance level of 5 %

--[c]: The value of the statistic t-Student at T-s-k-1 degree of freedom

[d]: The critical value of Fisher table for F (11; 125) at the significance level 5%

A more refined analysis of these aspects detected for the different components (i.e., the stochastic aspect of the tendency and the seasonality deterministic aspect conduct to the following interpretations:

Knowing that the tendency represents some psychological factors, its stochastic feature implies a volatility of Malian products preferences.

With regard to the seasonality, the deterministic character explains an important part of the variance of the set. The detected deterministic aspect proves that the effort of the professionals of tourism in order to promote a better exhibit of the tourist activity on the year remains henceforth insufficient to the level of the hotel.

Results of the models 1, 2, 3: The evaluations are done while adopting strategies of different selections depending on if about the transfer function model (specification 1) of the specification 2, or of the specification 3.

Specification 1: The valued equation is the following:

$$NT(t) = \gamma_1 + \sum_{j=2}^{12}\gamma_j D_{jt} + \beta_1 CME(t) + \beta_2 P(t-12) + \beta_3 R(t) + \nu_t$$

Where $(1-\rho_1 L - \rho_2 L^2)\ \nu_t = \varepsilon_t$ and ε_t is white noise

Specification 2: The valued equation is given by:

$$\left(1-a_1L-a_2L^2\right)\left(1-L^2\right)NT(t)=\gamma_1+\sum_{j=2}^{12}\gamma_jD_{jt}+\beta_1\left(1-L^2\right)CME(t)+\beta_2(1-L^2)P\left(t-12\right)+\beta_3\left(1-L^2\right)R\left(t-1\right)+\varepsilon_t$$

ε_t is a white noise

Specification 3: The equation 3 has the following expression:

$$\left(1-\varphi_1L-\varphi_2L^{12}-\varphi_3L^{13}\right)NT(t)=\alpha_0+(\alpha_1+\alpha_2L)CME(t)+(\beta_1+\beta_2L^9+\beta_3L^{10}+\beta_4L^{12})P(t)+\gamma R(t-7)+\varepsilon_t$$

ε_t are a white noise
The variables are expressed in logarithm

Shart equation 1

coefficients	Estimated values	Elasticities	Estimated values		
γ1	2.4178	***(1.44)***	Supply(β1)	0.5892	***(0.14)***
γ12.2	2.5394	***(1.44)***	Price(β2)	-0.1040	***(0.04)***
γ3	2.9977	***(1.44)***	Income(β3)	0.5052	***(0.14)***
γ4	3.3088	***(1.45)***	Autoregressive coefficients	QLB(30) = 11.82	
γ5.10	3.3659	***(1.46)***	ρ1	0.5120	***(0.09)***
γ6	3.3966	***(1.46)***	ρ2	0.2777	***(0.09)***
γ7.9	3.5321	***(1.46)***	R2	0.98	
γ8	3.8323	***(1.46)***	J.B	2.5498	
γ11	2.8263	***(1.45)***	—	—	
Errors of structures	$\hat{\varepsilon}_t=(1-0.5120L-0.2777L^2)\hat{v}_t$				

- The coefficients γ_{ij} reflect the specific effect of the two dummy variables indicated by i and j, $D_{ij}=D_i+D_j$ in other words the effect of the two months i and j
- The coefficients γ_j reflect the specific effect of the month j
- Bold and italic values are significantly different from zero at the threshold of 10

Shart equation 2

Coefficients	Estimated values	Elasticities	Estimated values		
γ1	-0.1537	*(0.07)*	supply(β1)	0.3389	*(0.15)*
γ3	0.5069	*(0.04)*	Price(β2)	*-0.0746*	*(0.04)*
γ4	0.5658	*(0.07)*	income(β3)	*0.5074*	*(0.28)*
γ5	0.1664	*(0.07)*	Auto regresive coefficients	QLB(30) = 28.94	
γ6	0.1091	*(0.05)*	a 1	0.3892	*(0.08)*
γ7	0.2601	*(0.04)*	a 2	*-0.1922*	*(0.05)*
γ8	0.3608	*(0.04)*	R2	*0.97*	
γ9	-0.1729	*(0.04)*	J.B	1.3974	
γ10	-0.3507	*(0.04)*	$\tilde{F}_{123}$	7.53	
γ11	-0.5752	*(0.05)*	—	—	
γ12	-0.6703	*(0.06)*			

Shart equation 3

Elasticities	Estimated values			Coefficients	Estimated values	
α1	Supply	0.3339	*(0.16)*	α0	0.1549	*(0.75)*
α2		-0.2351	*(0.16)*	φ1	0.6594	*(0.06)*
β1		-0.1380	*(0.06)*	φ2	0.6819	*(0.05)*
β2	Price	0.2067	*(0.05)*	φ3	-0.4994	*(0.06)*
β3		-0.1153	*(0.05)*	Statistics	QLB (30) = 24.97	
β4		-0.1035	*(0.05)*	R2	0.97	
γ	Income	0.1761	*(0.08)*	DW	2.26	
$\tilde{F}$		6.0732		J.B	1.2459	

- The numbers into brackets represent the estimated gaps
- The missed variables in the equation are not significant at the threshold of 10
- $\tilde{F}$ is an estimation of statistic test elasticity significant ness the values which are significantly different from zero at threshold of 5 are bold

CONCLUSIONS

The gaps in brackets indicate that the explanatory variables coefficients are significant. The estimated values of the flexibility of the demand are coherent in sign and in module with the economic theory. These variables seem to explain an important part of the dependent variable, having captured the deterministic seasonality, which explains the weak value of the flexibility of the price presumably. This aspect of seasonality presence is distinctly shown by the significant coefficients of the seasonal indicatory variables even while considering the filtered series. These results confirm the mixed character of the seasonality that characterizes the tourist demand and bring up the advantage of the seasonal models esteemed on raw series as suggested by several authors.

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