McAleer, Michael; Shareef, Riaz; da Veiga, Bernardo

Working Paper
Risk Management of Daily Tourist Tax Revenues for the Maldives

Nota di Lavoro, No. 137.2005

Provided in Cooperation with:
Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: McAleer, Michael; Shareef, Riaz; da Veiga, Bernardo (2005) : Risk Management of Daily Tourist Tax Revenues for the Maldives, Nota di Lavoro, No. 137.2005, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:
http://hdl.handle.net/10419/74130

Terms of use:
Documents in EconStor may be saved and copied for your personal and scholarly purposes.
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.
If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

www.econstor.eu
Risk Management of Daily Tourist Tax Revenues for the Maldives
Michael McAleer, Riaz Shareef and Bernardo da Veiga

NOTA DI LAVORO 137.2005

NOVEMBER 2005
NRM – Natural Resources Management

Michael McAleer, Riaz Shareef and Bernardo da Veiga,
School of Economics and Commerce
University of Western Australia

This paper can be downloaded without charge at:
The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:
http://www.feem.it/Feem/Pub/Publications/WPapers/default.htm
Social Science Research Network Electronic Paper Collection:
http://ssrn.com/abstract=855924

The opinions expressed in this paper do not necessarily reflect the position of
Fondazione Eni Enrico Mattei
Corso Magenta, 63, 20123 Milano (I), web site: www.feem.it, e-mail: working.papers@feem.it
Risk Management of Daily Tourist Tax Revenues for the Maldives

Summary

International tourism is the principal economic activity for Small Island Tourism Economies (SITEs). There is a strongly predictable component of international tourism, specifically the government revenue received from taxes on international tourists, but it is difficult to predict the number of international tourist arrivals which, in turn, determines the magnitude of tax revenue receipts. A framework is presented for risk management of daily tourist tax revenues for the Maldives, which is a unique SITE because it relies entirely on tourism for its economic and social development. As these receipts from international tourism are significant financial assets to the economies of SITEs, the time-varying volatility of international tourist arrivals and their growth rate is analogous to the volatility (or dynamic risk) in financial returns. In this paper, the volatility in the levels and growth rates of daily international tourist arrivals is investigated.

Keywords: Small Island Tourism Economies (SITEs), International tourist arrivals, Tourism tax, Volatility, Risk, Value-at-Risk (VaR), Sustainable Tourism-@-Risk (ST@R)

JEL Classification: G18, C32, L83, D81

The first author is most grateful for the financial support of the Australian Research Council, the second author wishes to acknowledge a UWA Research Fellowship, and the third author is most grateful for the financial support of an International Postgraduate Research Scholarship and University Postgraduate Award at UWA.

This paper was presented at the Second International Conference on "Tourism and Sustainable Economic Development - Macro and Micro Economic Issues" jointly organised by CRENoS (Università di Cagliari and Sassari, Italy) and Fondazione Eni Enrico Mattei, Italy, and supported by the World Bank, Chia, Italy, 16-17 September 2005.

Address for correspondence:

Michael McAleer
School of Economics and Commerce (M251)
University of Western Australia
35 Stirling Highway
WA 6009 Crawley
Australia
Phone: +61 0 8 6488 3400
Fax: +61 0 8 6488 1016
E-mail: Michael.McAleer@uwa.edu.au
Risk Management of Daily Tourist Tax Revenues for the Maldives

Michael McAleer, Riaz Shareef and Bernardo da Veiga

School of Economics and Commerce
University of Western Australia

June 2005

Corresponding author:

Michael McAleer
School of Economics and Commerce (M251)
University of Western Australia
35 Stirling Highway
Crawley
WA 6009
Australia

Tel: +61 (0)8 6488 3400
Fax: +61 (0)8 6488 1016
Email: Michael.McAleer@uwa.edu.au

Michael McAleer: Professor of Economics (Econometrics) at the University of Western Australia; Adjunct Professor, Department of Economics and Department of Mathematics and Statistics, University of Canterbury, New Zealand; and Adjunct Professor, Faculty of Science, Australian National University. He has published widely in theoretical and applied econometrics, theoretical and applied statistics, time series analysis, financial econometrics, empirical finance, methodology, integrated environmental modelling, intellectual property, and tourism research.

Riaz Shareef: Post-doctoral Research Fellow in the School of Economics and Commerce, University of Western Australia. His research interests are in applied econometrics, time series analysis, and tourism modelling, and he has published in Mathematics and Computers in Simulation and Tourism Economics. He is a member of the International Association for Mathematics and Computers in Simulation, Modelling and Simulation Society of Australia and New Zealand, and International Environmental Modelling and Software Society.

Bernardo da Veiga: PhD candidate in the School of Economics and Commerce, University of Western Australia. His research interests are in financial econometrics, risk management, and tourism research. He is a member of the International Association for Mathematics and Computers in Simulation, Modelling and Simulation Society of Australia and New Zealand, International Environmental Modelling and Software Society, Association for Investment Management and Research, and Professional Risk Managers' International Association.

*The first author is most grateful for the financial support of the Australian Research Council, the second author wishes to acknowledge a UWA Research Fellowship, and the third author is most grateful for the financial support of an International Postgraduate Research Scholarship and University Postgraduate Award at UWA.
1. Introduction

International tourism is widely regarded as the principal economic activity in Small Island Tourism Economies (SITEs) (see Shareef (2004) for a comprehensive discussion). Historically, SITEs have been dependent on international tourism for economic development, employment, and foreign exchange, among other economic indicators. A unique SITE is the Maldives, an archipelago of 1190 islands in the Indian Ocean, of which 202 are inhabited by the indigenous population of 261,000 and 89 islands are designated for self-contained tourist resorts. The Maldivian economy depends entirely on tourism, and accounts directly for nearly 38 per cent of real GDP. Employment in tourism accounts for 20 per cent of the working population and 65 per cent of foreign exchange earnings.

Any shock that would adversely affect international tourist arrivals to the Maldives would affect earnings from tourism dramatically, and have disastrous ramifications for the entire economy. An excellent example is the impact of the 2004 Boxing Day Tsunami, which sustained extensive damage to the tourism-based economy of the Maldives and reduced dramatically the number of tourist arrivals in the post-Tsunami period. Therefore, it is vital for the government of the Maldives, multilateral development agencies such as the World Bank and the Asian Development Bank who are assisting Maldives in the Tsunami recovery effort, and the industry stakeholders, namely the resort owners and tour operators, to obtain accurate estimates of international tourist arrivals and their variability. Such accurate estimates would provide vital information for government policy formulation, international development aid, profitability and marketing.

A significant proportion of research in the literature on empirical tourism demand has been based on annual data (see Shareef (2004)), but such analyses are useful only for long-term development planning. An early attempt to improve the short-term analysis of tourism was undertaken by Shareef and McAleer (2005), who modelled the volatility (or predictable uncertainty) in monthly international tourist arrivals to the Maldives. Univariate and multivariate time series models of conditional volatility were estimated and tested. The conditional correlations were estimated and examined to ascertain whether there was specialisation, diversification or segmentation in the international tourism demand shocks from the major tourism source countries to the Maldives. In a similar vein, Chan et al. (2005)
modelled the time-varying means, conditional variances and (constant) conditional correlations of the logarithms of the monthly arrival rate for the four leading tourism source countries to Australia.

In this paper, daily international arrivals to the Maldives and the number of tourist in residence are analysed for the period 1994-2003. The data are obtained from the Ministry of Tourism of the Maldives. In the literature, there does not seem to have been any empirical research using daily tourism arrivals data. One advantage of using daily data is that it avoids stochastic seasonality that is prevalent in monthly or quarterly time series data. In the absence of stochastic seasonality, we observe volatility clusterings in the number of international tourist arrivals and their associated growth rates. Therefore, it is useful to analyse daily tourism arrivals data, much like financial data, in terms of the time series patterns, since such an analysis would provide policy makers and the industry stakeholders with accurate indicators of their short-term objectives.

In virtually all SITEs, and particularly the Maldives, tourist arrivals or growth in tourist arrivals translates directly into a financial asset. In the Maldives, every international tourist is required to pay USD 10 for every tourist bed-night spent in the Maldives. This levy is called a ‘tourism tax’ and comprises over 60% of government revenue. Hence, tourism tax revenue is a principal determinant of development expenditure. As a significant financial asset to the economy of SITEs, and particularly so in the case of the Maldives, the volatility in tourist arrivals and their growth rate is identical conceptually to the volatility in financial returns, otherwise known as financial risk.

This paper models the volatilities in the number of tourist arrivals, tourist in residence and their growth rates. The purpose of this analysis of volatility is to present a framework for managing the risks inherent in the variability of total tourist arrivals, tourist in residence and hence government revenue through the modelling and forecasting of Value-at-Risk (VaR) thresholds for the number of tourist arrivals, tourist in residence and their growth rates. This paper provides the first application of the VaR portfolio approach to manage the risk associated with tourism revenues.

The structure of the paper is as follows. In Section 2, the economy of the Maldives is described. This is followed in Section 3 by an assessment of the impact of the 2004 Boxing
Day Tsunami on tourism in the Maldives. The concept of Value-at-Risk (VaR) is analysed in Section 4, the data are discussed in Section 5, the models of volatility are presented in Section 6, the empirical results are examined in Section 7, forecasting is undertaken in Section 8, and some concluding remarks are given in Section 9.

2. Study: The Tourism Economy of the Maldives

An archipelago in the Indian Ocean, the Maldives comprises 1,190 islands, of which 200 are inhabited. It was a former British protectorate, which became independent in 1965. The Exclusive Economic Zone of the Maldives is 859,000 square kilometres, and the aggregated land area is roughly 290 square kilometres. In the 2000 census, the total population was 270,101, and is estimated to have grown at 2.4 percent per annum over the period 1990-2000.

The Maldives has shown an impressive economic growth record, with an average growth rate of 7 per cent per annum over the last two decades. This record economic performance has been achieved largely due to the growing tourism demand to the Maldives. Furthermore, economic growth has enabled Maldivians to enjoy an estimated real per capita GDP of USD 2,261 in 2003, which is considerably above average for small island developing countries, with an average per capita GDP of USD 1,500. The engine of growth in the Maldives has been the tourism industry, accounting for 37 percent of GDP, more than one-third of fiscal revenue, and two-thirds of gross foreign exchange earnings in recent years. The fisheries sector remains the largest sector in terms of employment, accounting for about one-quarter of the labour force, and is still an important source of foreign exchange earnings. Due to the high salinity content in the soil, agriculture continues to play a minor role. The government, which employs about 20 percent of the labour force, plays a dominant role in the economy, both in the production process and through its regulation of the economy.

Tourism in the Maldives has a direct impact on fiscal policy, which determines development expenditure. More than one-fifth of government revenue arises from tourism-related levies. The most important tourism-related revenues are the tourism tax, the resort lease rents, resort land rents, and royalties. Except for the tourism tax, the other sources of tourism-related revenues are based on contractual agreements with the government of the Maldives. Tourism tax is levied on every occupied bed night from all tourist establishments, such as hotels,
tourist resorts, guest houses and safari yachts. Initially, this tax was levied at USD 3 in 1981, and was then doubled to USD 6 in 1988. After 16 years with no change in the tax rate, from 1 November 2004 the tax rate was increased to USD 10. This tax is regressive as it does not take into account the profitability of the tourist establishments. Furthermore, it fails to take account of inflation, such that the tax yield has eroded over time.

Tourism tax is collected by the tourist establishments and is deposited at the Inland Revenue Department at the end of every month. This current revenue is used directly to finance the government budget on a monthly basis. Since the tax is levied directly on the tourist, any uncertainty that surrounds international tourist arrivals will affect tax receipts, and hence fiscal policy. Any adverse affect on international tourist arrivals may also result in the suspension of planned development expenditures.

The nature of tourist resorts in the Maldives is distinctive as they are built on islands that have been set aside for tourism development. Tourism development is the greatest challenge in the history of Maldives, and has led to the creation of distinctive resort islands. Domroes (1985, 1989, 1993, 1999) asserts that these islands are deserted and uninhabited, but have been converted into ‘one-island-one-hotel’ schemes. The building of physical and social infrastructure of the resort islands has had to abide by strict standards to protect the flora, fauna and the marine environment of the islands, while basic facilities for sustainability of the resort have to be maintained. The architectural design of the resort islands in the Maldives varies profoundly in their character and individuality. Only twenty percent of the land area of any given island is allowed to be developed, which is imposed to restrict the capacity of tourists on every island. All tourist accommodation must face a beach front area of five metres. In most island resorts, bungalows are built as single or double units. Recently, there has been an extensive development of water bungalows on stilts along the reefs adjacent to the beaches. All the conveniences for tourists are available on each island, and are provided by the onshore staff.

3. Impact of the 2004 Boxing Day Tsunami on Tourism in the Maldives

As the biggest ever national disaster in the history of the Maldives, the 2004 Boxing Day Tsunami caused widespread damage to the infrastructure on almost all the islands. The World
Bank, jointly with the Asian Development Bank [World Bank (2005a)], declared that the total damage of the Tsunami disaster was USD 420 million, which is 62 per cent of the annual GDP. In the short run, the Maldives will need approximately USD 304 million to recover fully from the disaster to the pre-tsunami state.

A major part of the damage was to housing and tourism infrastructure, with education and fisheries sectors also severely affected. Moreover, the World Bank damage assessment highlighted that significant losses were sustained in water supply and sanitation, power, transportation and communications. Apart from tourism, the largest damage was sustained by the housing sector, with losses close to USD 65 million. Approximately, 1,700 houses were destroyed, another 3,000 were partially damaged, 15,000 inhabitants were fully displaced, and 19 of the 202 inhabited islands were declared uninhabitable.

The World Bank also stated that the tourism industry would remain a major engine of the economy, and that the recovery of this sector would be vital for the Maldives to return to higher rates of economic growth, full employment and stable government revenue. In the Asian Development Bank report, similar reactions were highlighted by stating that it would be vitally important to bring tourists back in full force, as tourism is the most significant contribution to GDP. In fact, tourism means everything to the Maldivian economy.

In the initial macroeconomic impact assessment undertaken by the World Bank, the focus was only on 2005. The real GDP growth rate was revised downward from 7 per cent to 1 per cent, consumer prices were expected to rise by 7 per cent, the current account balance was to double to 25 per cent of GDP, and the fiscal deficit was to widen to 11 per cent of GDP, which is unsustainable, unless the government were to implement prudent fiscal measures.

The 2004 Boxing Day Tsunami also caused widespread destruction and damage to countries such as Indonesia, India and Sri Lanka. Compared with the damage caused to the Maldives, the destruction which occurred in these other countries is substantially different in terms of its scale and nature. In India, widespread socioeconomic and environmental destruction was caused in the eastern coast affecting the states of Andhra Pradesh, Kerala and Tamil Nadu, and the Union Territory (UT) of Pondicherry. The Tsunami struck with 3- to 10-metre waves and penetrated as far as 3 kilometres inland, affecting 2,260 kilometres of coastline (World
Bank (2005b)). Nearly 11,000 people died in India. The tsunami also adversely affected the earning capacity of some 645,000 people whose principal economic activity is fisheries.

According to the damage assessment report published in World Bank (2005c), nearly 110,000 lives were lost in Indonesia, 700,000 people were displaced, and many children were orphaned. The total estimate of damages and losses from the catastrophe amounted to USD 4.45 billion, of which 66 per cent constituted damages, while 34 per cent constituted losses in terms of income flows to the economy. Furthermore, total damages and losses amounted to 97 per cent of Aceh’s GDP. Although Aceh’s GDP derives primarily from oil and gas, which were not affected, and most livelihoods rely primarily on fisheries and agriculture, this was still a catastrophic event.

In Sri Lanka, the human costs of the disaster were also phenomenal, with more than 31,000 people killed, nearly 100,000 homes destroyed, and 443,000 people remaining displaced. The economic cost amounted to USD 1.5 billion dollars, which is approximately 7 per cent of annual GDP (World Bank (2005d)). As in India, Indonesia and the Maldives, the tsunami affected the poorest Sri Lankans, who work in the fisheries industry, and some 200,000 people lost their employment in the tourism industry.

Compared with all the tsunami-stricken countries, the Maldives was affected entirely as a result of its geophysical nature. When the tsunami struck, the Maldives was, for a moment, wiped off the face of the earth.

4. Value-at-Risk and Tourism

Value-at-Risk (VaR) is a procedure designed to forecast the maximum expected negative return over a target horizon, given a (statistical) confidence limit, (see Jorion (2000) for a discussion). Put simply, VaR measures an extraordinary loss on an ordinary or typical day. VaR is used widely to manage the risk exposure of financial institutions and is a requirement of the Basel Capital Accord (see Basel Committee (1988, 1995, 1996)). The central idea underlying VaR is that, by forecasting the worst possible return for each day, institutions can be prepared for the worst case scenario. In the case of the banking industry, or authorized
deposit-taking institutions, more generally, such an insurance policy can help avoid bank runs, which can be devastating to the economy if they result in widespread bank failures.

In the case of SITEs such as the Maldives, where tourism revenue is a major source of income and foreign exchange reserves, it is important to understand the risks associated with this particular source of income, and to implement adequate risk management policies to ensure economic stability and sustained growth. Forecasted VaR figures can be used to estimate the level of reserves required to sustain desired long term government projects and foreign exchange reserves. Furthermore, an understanding of the variability of tourist arrivals, and hence tourism related revenue, is critical for any investor planning to invest in or lend funds to SITEs.

Formally, a VaR threshold is the lower bound of a confidence interval in terms of the mean. For example, suppose interest lies in modelling the random variable $Y_i$, which can be decomposed as:

$$Y_i = E(Y_i | F_{t-1}) + \varepsilon_i.$$  

This decomposition suggests that $Y_i$ is comprised of a predictable component, $E(Y_i | F_{t-1})$, which is the conditional mean, and a random component, $\varepsilon_i$. The variability of $Y_i$, and hence its distribution, is determined entirely by the variability of $\varepsilon_i$. If it is assumed that $\varepsilon_i$ follows a distribution such that:

$$\varepsilon_i : D(\mu_i, \sigma_i)$$

where $\mu_i$ and $\sigma_i$ are the unconditional mean and standard deviation of $\varepsilon_i$, respectively, these can be estimated using numerous parametric and/or non-parametric procedures. The procedure used in this paper is discussed in Section 6. Therefore, the VaR threshold for $Y_i$ can be calculated as:

$$VaR_i = \mu_i - \alpha \sigma_i.$$
where $\alpha$ is the critical value from the distribution of $\varepsilon_i$ that gives the correct confidence level. Alternatively, $\sigma_i$ can be replaced by alternative estimates of the variance (see Section 6 below). For further details, see McAleer et al. (2005) for a formal development, specifically the Sustainable Tourism@Risk (or ST@R) model.

5. Data Issues

The data used in this paper are total daily international tourist arrivals from 1 January 1994 to 31 December 2003, and were obtained from the Ministry of Tourism of the Maldives. As can be seen in Table 1, there were over four million tourists during this period, with Italy being the largest tourist source country. Tourists from Western Europe accounted for more than 80 per cent of tourists to the Maldives, with Russia as the biggest emerging market.

[Insert Table 1 Here]

A distinct advantage of using daily data is that it avoids stochastic seasonality that is prevalent in monthly or quarterly time series data. However, for weekly data, there is evidence of strong seasonality, where the peak tourist season corresponding to the European winter months and weaker seasonality evident in the European summer months. In the absence of stochastic seasonality, volatility clustering can be observed in the number of international tourist arrivals and their associated growth rates.

There exists a direct relationship between the daily total number of tourists in residence and the daily tourism tax revenue. Modelling the variability of daily arrivals can be problematic as institutional factors, such as predetermined weekly flight schedules, lead to excessive variability and significant day-of-the-week effects. This problem can be resolved in one of two ways. Weekly tourist arrivals could be examined, as this approach removes both the excess variability inherent in daily total arrivals and day-of-the-week effects. However, this approach is problematic as it leads to substantially fewer observations being available for estimation and forecasting. A second solution, and one that is adopted in this paper, is to calculate the daily tourists in residence. This daily total is of paramount importance to the Government of the Maldives as it has a direct effect on the tourism tax revenue received. The tourists in residence series are calculated as the seven-day rolling sum of the daily tourist
arrivals series, which assumes that tourists stay in the Maldives for seven days, on average. This is a reasonable assumption as the typical tourist stays in the Maldives for approximately 7 days, according to the Ministry of Tourism of the Maldives.

The graphs for daily tourist arrivals, weekly tourist arrivals and tourists in residence are given in Figures 1-3, respectively. All three series display high degrees of variability and seasonality, as would be expected of tourist arrivals data. As would be expected, the highest levels of tourism arrivals in the Maldives occur during the European winters, while the lowest levels occur during the European summers. The descriptive statistics for each series are given in Table 2. The daily tourist arrivals series display the greatest variability, with a mean of 1,122 arrivals per day, a maximum of 4,118 arrivals per day, and a rather low minimum of 23 arrivals per day. Furthermore, the daily arrivals series have a coefficient of variation (CoV) of 0.559, which is nearly twice the CoV of the other two series. The weekly arrivals and tourists in residence series are remarkably similar, with virtually identical CoV values of 0.3 and 0.298, respectively.

As the focus of this paper is on managing the risk associated with the variability in tourist arrivals and tourist tax revenues, the paper focuses on modelling the growth rates, namely the returns in both total tourist arrivals and total tourists in residence. The graphs for the returns in total daily tourist arrivals, total weekly tourist arrivals and total daily tourists in residence are given in Figures 4-6, respectively. The descriptive statistics for the growth rates of the three series are given in Table 3. Daily tourist arrivals display the greatest variability, with a standard deviation of 81.19, a maximum of 368.23%, and a minimum of -412.57%. Each of the series is found to be non-normally distributed, based on the Jarque-Bera Lagrange multiplier statistic for normality.
6. Volatility Models

The primary inputs required for calculating a VaR threshold are the forecasted variance, which is typically given as a conditional volatility, and the critical value of the distribution for a given level of significance. Several models are available for measuring and forecasting the conditional volatility. In this paper, the symmetric Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model of Bollerslev (1986), and the asymmetric GJR model of Glosten, Jagannathan and Runkle (1992), which discriminates between positive and negative shocks to the tourist arrivals series, will be used to forecast the required conditional volatilities.

The GJR($p,q$) model is given as:

\[
Y_t = E(Y_t \mid F_{t-1}) + \varepsilon_t
\]

\[
\varepsilon_t = h_t^{1/2} \eta_t
\]

\[
h_t = \omega + \sum_{i=1}^{p} (\alpha_i \varepsilon_{t-i}^2 + \gamma_i I(\eta_{t-i}) \varepsilon_{t-i}^2) + \sum_{i=1}^{q} \beta_i h_{t-i}
\]

\[
I(\eta_{t-i}) = \begin{cases} 
1, & \varepsilon_{t-i} \leq 0 \\
0, & \varepsilon_{t-i} > 0 
\end{cases}
\]

where $F_t$ is the information set available to time $t$, and $\eta_t : iid(0,1)$. The four equations in the model state the following: (i) the growth in tourist arrivals depends on its own past values; (ii) the shock to tourist arrivals has a predictable conditional variance component, $h_t$, and an unpredictable component, $\eta_t$; (iii) the conditional variance depends on its own past values and the recent shocks to the growth in the tourist arrivals series; and (iv) the conditional variance is affected differently by positive and negative shocks to the growth in tourist arrivals.

In this paper, $Y_t = E(Y_t \mid F_{t-1}) + \varepsilon_t$ is modelled as a simple AR(1) process. For the case $p = q = 1$, $\omega > 0$, $\alpha_1 \geq 0$, $\alpha_1 + \gamma_1 \geq 0$, $\beta_1 \geq 0$ are sufficient conditions to ensure a strictly
positive conditional variance, $h_t > 0$. The ARCH (or $\alpha_i + \frac{1}{2}\gamma_i$) effect captures the short run persistence of shocks (namely, an indication of the strength of the shocks in the short run), and the GARCH (or $\beta_i$) effect indicates the contribution of shocks to long run persistence ($\alpha_i + \frac{1}{2}\gamma_i + \beta_i$) (namely, an indication of the strength of the shocks in the long run). For the GJR(1,1) model, $\alpha_i + \frac{1}{2}\gamma_i + \beta_i < 1$ is a sufficient condition for the existence of the second moment, which is necessary for sensible empirical analysis. Restricting $\gamma_i = 0$ in the GJR(1,1) model leads to the GARCH(1,1) model of Bollerslev (1986). For the GARCH(1,1) model, the second moment condition is given by $\alpha_i + \beta_i < 1$.

In the GJR and GARCH models, the parameters are typically estimated using the maximum likelihood estimation (MLE) method. In the absence of normality of the standardized residuals, $\eta_t$, the parameters are estimated by the Quasi-Maximum Likelihood Estimation (QMLE) method (for further details see, for example, Li, Ling and McAleer (2002) and McAleer (2005)). The second moment conditions are also sufficient for the consistency and asymptotic normality of the QMLE of the respective models.

7. **Empirical Results**

The variable of interest for the Maldivian Government is the number of tourists in residence at any given day as this figure is directly related to tourism revenue. In this section, the tourists in residence series are used to estimate the GARCH(1,1) and GJR(1,1) models described in Section 6. All estimation was conducted using the EViews 5 econometric software package, though similar results were obtained using the RATS package. The models are estimated using QMLE for the case $p=q=1$.

The estimated GJR(1,1) equation for the tourists in residence series for the full sample is given as follows:

$$Y_t = 0.001 + 0.1561Y_{t-1}$$

$$(0.0541) (0.0169)$$
where the figures in parentheses are standard errors. All the parameters are estimated to be positive and significant, which indicates that the model provides an adequate fit to the data. As $\gamma_1$ is estimated to be positive and significant, it appears that volatility is affected asymmetrically by positive and negative shocks, with previous negative shocks having a greater impact on volatility than previous positive shocks of a similar magnitude.

The estimated GARCH(1,1) equation for the tourists in residence series for the full sample is given as follows:

$$h_t = 0.592 + 0.121 e_{t-1}^2 + 0.048 I_t e_{t-1}^2 + 0.803 h_{t-1},$$

$$\text{(0.058)} \quad (0.011) \quad (0.015) \quad (0.012),$$

Furthermore, as the respective estimates of the second moment conditions, $\alpha_i + \frac{1}{2} \gamma_i + \beta_i < 1$ for GJR(1,1) and $\alpha_i + \beta_i < 1$ for GARCH(1,1), are satisfied, the QMLE are consistent and asymptotically normal. This means that the estimates are statistically adequate and sensible for purposes of interpretation.

8. Forecasting

A rolling window is used to forecast the 1-day ahead conditional variances and VaR thresholds for the tourists in residence, with the sample ranging from 7 January 1994 to 31 December 2003. In order to strike a balance between efficiency in estimation and a viable number of rolling regressions, the rolling window size is set at 1,000, which leads to a forecasting period from 3 May 1997 to 31 December 2003. Using the notation developed in the previous sections, the VaR threshold forecast for the growth rate of tourists in residence at any given time $t$ is given by:
\[ \text{VaR}_t = E(Y_t | F_{t-1}) - \alpha \sqrt{h_t}, \]

where \( E(Y_t | F_{t-1}) \) is the forecasted expected growth rate of total tourists in residence, and \( h_t \) is the forecasted conditional variance of the growth rate in total tourist arrivals.

Figures 7 and 8 give the forecasted variances for both models. As can be seen from the figures, the forecasts are quite similar, with a correlation coefficient of 0.98. The forecasted VaR thresholds are given in Figures 9 and 10, respectively. As discussed in Section 2, the forecasted VaR threshold represents the maximum expected negative growth rate that could be expected given a specific confidence level. As is standard in the finance literature, where many of these techniques were developed, this paper uses a 1% level to calculate the VaR. In other words, growth rates smaller than the forecasted VaR should only be observed in 1% of all forecasts, which is referred to as the correct “conditional coverage”. The results show that, in using the GJR (GARCH) model, we observe 32 (30) instances where the actual daily growth rate is smaller than the forecasted VaR threshold. Based on a Likelihood Ratio test, both models display the correct conditional coverage. In addition, Figures 11 and 12 give the second moment conditions for each rolling window of both models. As the condition is satisfied for every rolling window, this provides greater confidence in the statistical adequacy of the two estimated models. Finally, both models lead to the same average VaR at -6.59%, which means that, on average, the lowest possible daily growth rate in tourists in residence, and hence in tourist tax revenues, is -6.59%, given a 99% level of significance.

9. Conclusion

In the Maldives, tourist arrivals and the growth in tourist arrivals translate directly into a financial asset for the Government, as each international tourist is required to pay USD 10 for every tourist bed-night spent in the Maldives. This levy is called a ‘tourism tax’ and enters directly into government revenue, so that tourism tax revenue is a principal determinant of development expenditure. As a significant financial asset to the economy of SITEs, and particularly so in the case of the Maldives, the volatility in tourist arrivals and in their growth rates are conceptually equivalent to the volatility in financial returns, which is more commonly known as financial risk.
Daily international arrivals to the Maldives and their associated growth rates were analysed for the period 1994-2003. This seems to be the first analysis of daily tourism arrivals and growth rates data in the tourism research literature. The primary purpose for analysing volatility was to model and forecast the Value-at-Risk (VaR) thresholds for the number of tourist arrivals and their growth rates. This would also seem to be the first paper in the tourism research literature to have applied the VaR portfolio approach to manage the risks associated with tourism revenues.

The empirical results based on two widely-used conditional volatility models showed that volatility was affected asymmetrically by positive and negative shocks, with previous negative shocks to the growth in tourist arrivals having a greater impact on volatility than previous positive shocks of a similar magnitude. The forecasted VaR threshold represented the maximum expected negative growth rate that could be expected given a specific confidence level. Both conditional volatility models led to the same average VaR at -6.59%, which meant that, on average, the lowest possible growth rate in tourists in residence, and hence in tourist tax revenues, was -6.59%. This should be useful information for both private and public tourist providers in the Maldives.
References

Basel Committee on Banking Supervision
1995 An Internal Model-Based Approach to Market Risk Capital Requirements. BIS: Basel, Switzerland.

Bollerslev, T.

Chan, F., C. Lim and M. McAleer

Domroes, M.

Glosten, L.R., R. Jagannathan, and D.E. Runkle
Jorion, P.

Li, W.K., S. Ling and M. McAleer

McAleer, M.

McAleer, M., R. Shareef and B. da Veiga
2005 ST@R: A Model of Sustainable Tourism@Risk. Unpublished paper, School of Economics and Commerce, University of Western Australia.

Shareef, R.

Shareef, R. and M. McAleer
2005 Modelling the Uncertainty in International Tourist Arrivals to the Maldives. Under revision for Tourism Management.

World Bank
2005b Counting the Cost: Rebuilding Lives and Property in India after the Tsunami.
http://web.worldbank.org/WSITE/EXTERNAL/COUNTRIES/EXTTSUNAMI/0,con
2005c Indonesia: Preliminary Damage and Loss Assessment, The 26 December 2004 Natural Disaster.

2005d Counting the Cost: A first look at what it will take to rebuild lives
Figure 4: Growth Rates in Daily Tourist Arrivals

Figure 5: Growth Rates in Weekly Tourist Arrivals

Figure 6: Growth Rates in Daily Tourist in Residence
Figure 10: Growth Rates for Tourist in Residence and GARCH VaR Thresholds

Figure 11: Rolling Second Moment Condition for GJR

Figure 12: Rolling Second Moment Condition for GARCH
Table 1. Composition of Tourist Arrivals, 1994-2003

<table>
<thead>
<tr>
<th>Source Country</th>
<th>Head Count</th>
<th>% Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Italy</td>
<td>852,389</td>
<td>20.78</td>
</tr>
<tr>
<td>2. Germany</td>
<td>730,453</td>
<td>17.81</td>
</tr>
<tr>
<td>3. UK</td>
<td>603,501</td>
<td>14.72</td>
</tr>
<tr>
<td>4. Japan</td>
<td>381,374</td>
<td>9.30</td>
</tr>
<tr>
<td>5. France</td>
<td>238,638</td>
<td>5.82</td>
</tr>
<tr>
<td>6. Switzerland</td>
<td>237,245</td>
<td>5.79</td>
</tr>
<tr>
<td>7. Austria</td>
<td>118,324</td>
<td>2.89</td>
</tr>
<tr>
<td>8. The Netherlands</td>
<td>60,011</td>
<td>1.46</td>
</tr>
<tr>
<td>Total International Tourist Arrivals</td>
<td>4,101,028</td>
<td>100</td>
</tr>
</tbody>
</table>
## Table 2: Descriptive Statistics

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Daily Arrivals</th>
<th>Weekly Arrivals</th>
<th>Tourists in Residence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1,122</td>
<td>7,833</td>
<td>7,699</td>
</tr>
<tr>
<td>Median</td>
<td>1,007</td>
<td>7,510</td>
<td>7,430</td>
</tr>
<tr>
<td>Maximum</td>
<td>4,118</td>
<td>14,942</td>
<td>15,517</td>
</tr>
<tr>
<td>Minimum</td>
<td>23</td>
<td>3,316</td>
<td>3,145</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>627</td>
<td>2,351</td>
<td>2,293</td>
</tr>
<tr>
<td>Skewness</td>
<td>1.087</td>
<td>0.535</td>
<td>0.593</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>4.436</td>
<td>2.784</td>
<td>2.981</td>
</tr>
<tr>
<td>CoV</td>
<td>0.559</td>
<td>0.300</td>
<td>0.298</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>1033</td>
<td>25.808</td>
<td>201.597</td>
</tr>
<tr>
<td>Statistics</td>
<td>Daily Arrivals</td>
<td>Weekly Arrivals</td>
<td>Tourists in Residence</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Mean</td>
<td>0.010</td>
<td>0.163</td>
<td>5.24e-12</td>
</tr>
<tr>
<td>Median</td>
<td>-7.66</td>
<td>-0.027</td>
<td>-0.039</td>
</tr>
<tr>
<td>Maximum</td>
<td>368.23</td>
<td>50.37</td>
<td>26.34</td>
</tr>
<tr>
<td>Minimum</td>
<td>-412.57</td>
<td>-38.45</td>
<td>-20.64</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>81.19</td>
<td>11.66</td>
<td>3.21</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.143</td>
<td>0.344</td>
<td>0.283</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>3.01</td>
<td>4.95</td>
<td>8.76</td>
</tr>
<tr>
<td>CoV</td>
<td>8,119</td>
<td>71.53</td>
<td>6.12e11</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>12.44</td>
<td>92.61</td>
<td>4,799.9</td>
</tr>
</tbody>
</table>
NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:
http://www.feem.it/Feem/Pub/Publications/WPapers/default.html
http://www.repec.org

NOTE DI LAVORO PUBLISHED IN 2004

IEM 1.2004 Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB: Empirical Analysis of National Income and So2 Emissions in Selected European Countries
ETA 2.2004 Masahika FUTITA and Shlomo WEBER: Strategic Immigration Policies and Welfare in Heterogeneous Countries
PRA 3.2004 Adolfo DI CARLUCCIO, Giovanni FERRI, Cecilia FRALE and Ottavio RICCHI: Do Privatizations Boost Household Shareholding? Evidence from Italy
ETA 4.2004 Victor GINSBURGH and Shlomo WEBER: Languages Disenfranchisement in the European Union
PRA 7.2004 Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN (lxv): Merger Mechanisms
PRA 8.2004 Wolfgang AUGSENEGG, Pegaret PICHLER and Alex STOMPER (lxv): IPO Pricing with Bookbuilding, and a When-Issued Market
PRA 9.2004 Pegaret PICHLER and Alex STOMPER (lxv): Primary Market Design: Direct Mechanisms and Markets
PRA 11.2004 Bjarne BRENDSTRUP and Harry J. PAARSCH (lxv): Nonparametric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders
PRA 12.2004 Ohad KADAN (lxv): Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values
PRA 13.2004 Maarten C.W. JANSEN (lxv): Auctions as Coordination Devices
PRA 14.2004 Gadi FIBICH, Arieh GAVIOUS and Aner SELA (lxv): All-Pay Auctions with Weakly Risk-Averse Buyers
PRA 15.2004 Orly SADE, Charles SCHNITZLEIN and Jaime F. ZENDER (lxv): Competition and Cooperation in Divisible Good Auctions: An Experimental Examination
CCMP 16.2004 Marta STRYSZOWSKA (lxv): Late and Multiple Bidding in Competing Second Price Internet Auctions
PRA 17.2004 Slim Ben YOUSSEF (lxvi): The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions
SIEV 19.2004 Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA: Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice
NRM 21.2004 Jacqueline M. HAMILTON (lxvii): Climate and the Destination Choice of German Tourists
NRM 23.2004 Pius ODUNGA and Henk FOLMER (lxvii): Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya
NRM 24.2004 Jean-Jacques NOWAK, Monther SAHLI and Pasquale M. SGRO (lxvii): Tourism, Trade and Domestic Welfare
NRM 26.2004 Juan Luis EUGENIO-MARTÍN, Noelia MARTÍN MORALES and Riccardo SCARPA (lxvii): Tourism and Economic Growth in Latin American Countries: A Panel Data Approach
NRM 27.2004 Raúl Hernández MARTÍN (lxvii): Impact of Tourism Consumption on GDP. The Role of Imports
NRM 29.2004 Marian WEBER (lxviii): Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada’s Boreal Mixedwood Forest
NRM 30.2004 Trond BJØRNDAL, Phoebe KOUNDOURI and Sean PASCOE (lxviii): Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting
CTN 33.2004 Wilson PEREZ: Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution
KTHC 36.2004  Franca ECKERT COEN and Claudio ROSSI: An Application to the Recreational Value of Forests – A Note from the Experience of Eritrean Immigrants in Stockholm

KTHC 37.2004  Kristine CRANE: Possibilities of the Contingent Valuation Method: Does the Degree of Competition Matter?


ETA 39.2004  Alberto CAVALIERE: Price Competition with Information Disparities in a Vertically Differenntiated Duopoly

PRA 40.2004  Andrea BIGANO and Stef PROOST: The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?

CCMP 41.2004  Michael FINUS: International Cooperation to Resolve International Pollution Problems

KTHC 42.2004  Francesco CRESPI: Notes on the Determinants of Innovation: A Multi-Perspective Analysis

CTN 43.2004  Sergio CURRARINI and Marco MARINI: Coalition Formation in Games without Synergies

CTN 44.2004  Marc ESCRIBUÉLA-VILLAR: Cartel Sustainability and Cartel Stability

NRM 45.2004  Sebastian BERVOETS and Nicolas GRAVEL: Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach

NRM 46.2004  Signe ANTHON and Bo JELLESMARK THORSEN: Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits


NRM 48.2004  Ekin BIROL, Ágnes GYOVAI and Melinda SMALE: Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transition al Economy

CCMP 49.2004  Gernot KLEPPER and Sonja PETERSON: The EU Emissions Trading Scheme: Allowance Prices, Trade Flows, Competitiveness Effects

GG 50.2004  Scott BARRETT and Michael HOEL: Optimal Disease Eradication

CTN 51.2004  Dinko Dimitrov, Peter BORM, Ruud HENDRIKX and Shao CHIN SUNG: Simple Priorities and Core Stability in Hedonic Games

SIEV 52.2004  Francesco RICCI: Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory


NRM 54.2004  Ingo BRÄUER and Rainer MARGGRAF: Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams

NRM 55.2004  Tom DEDEURWAERDERE: Bioprospection: From the Economics of Contracts to Reflexive Governance

CCMP 57.2004  Katrin REHDANZ and David MADDISON: The Amenity Value of Climate to German Households


NRM 59.2004  Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA: Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management

NRM 60.2004  Timo GOESCHL and Danilo CAMARGO IGLIORI: Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon

CCMP 61.2004  Barbara BUCHNER and Carlo CARRARO: Economic and Environmental Effectiveness of a Technology-based Climate Protocol


NRM 63.2004  Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ: Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis

RNM 64.2004  E.C.M. RUIJGROK and E.E.M. NILLESEN: The Socio-Economic Value of Natural Riverbanks in the Netherlands


EZA 66.2004  Gianmits VARDAS and Anastasios XEPAPADEAS: Uncertainty Aversion, Robust Control and Asset Holdings

GG 67.2004  Anastasios XEPAPADEAS and Constadin PASSA: Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach

GG 68.2004  Michael FINUS: Modesty Pays: Sometimes!

NRM 69.2004  Trond BJØRNDAL and Ana BRASÃO: The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications

CTN 70.2004  Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZAÏT: On Coalition Formation with Heterogeneous Agents

IEM 71.2004  Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA: Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants

Rob DELLINK and Ekko van IERLAND: Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment
Rosella LEVAGGI and Michele MORETTO: Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach
Francis BLOCH and Armando GOMES: Contracting with Externalities and Outside Options.
Rabah AMIR, Efrosyni DIAMANTOU and Liciu XUE: Merger Performance under Uncertain Efficiency Gains.
Francis BLOCH and Matthew O. JACKSON: The Formation of Networks with Transfers among Players.
Daniel DIERMEIER, Hilia ERASLAN and Antonio MERLO: Bicameralism and Government Formation.
Sanjeev GOTAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ: Economics: An Emerging Small World?
Edward CARTWRIGHT: Learning to Play Approximate Nash Equilibria in Games with Many Players.
Elisiossos PAPPYRIS and Reyer GERLAGH: Natural Resources, Investment and Long-Term Income.
A. MARKANDYA, S. PEDROSOD and D. STREIMIKIENE: Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?
Rolf GOLOMBEK and Michael HOEL: Climate Agreements and Technology Policy.
Sergei IZMALKOV: Multi-Unit Open Ascending Price Efficient Auction.
Gianmarco I.P. OTTAVIANO and Giovanni PERI: Cities and Cultures.
Massimo DEL GAITTO: Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities, Centralisation versus devolution.
Pierre-André JOUVEY, Philippe MICHEL and Gilles ROTILLON: Equilibrium with a Market of Permits.
Bob van der ZWAAN and Reyer GERLAGH: Climate Uncertainty and the Necessity to Transform Global Energy Supply.
Gustavo BERGANTÍNOS and Juan J. VIDAL-PUGA: Defining Rules in Cost Spanning Tree Problems Through the Canonical Form.
Siddhartha BANDYOPADHYAY and Mandar OAK: Party Formation and Coalitional Bargaining in a Model of Proportional Representation.
Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA: The Impact of Surplus Sharing on the Stability of International Climate Agreements.
Chiara M. TRAVISI and Peter NIJKAMP: Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents.
Valentina BOSETTI and David TOMBERLIN: Real Options Analysis of Fishing Fleet Dynamics: A Test.
Alessandra GORIA e Gretel GAMBARELLI: Economic Evaluation of Climate Change Impacts and Adaptability in Italy.
Kira BÖRNER: The Political Economy of Privatization: Why Do Governments Want Reforms?
Angela GRANZOTTO, Fabio PRANOVI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo DIERMEIER, Hülya ERASLAN and Antonio MERLO: The Formation of Networks with Transfers among Players.
Valeria COSTANTINI and Francesco GRACCEVA: Oil Security, Short- and Long-Term Policies.
<table>
<thead>
<tr>
<th>Page Dimensions: 595.0x842.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IEM 116.2004</strong></td>
</tr>
<tr>
<td><strong>IEM 117.2004</strong></td>
</tr>
<tr>
<td><strong>IEM 119.2004</strong></td>
</tr>
<tr>
<td><strong>IEM 120.2004</strong></td>
</tr>
<tr>
<td><strong>KTHC 121.2004</strong></td>
</tr>
<tr>
<td><strong>NRM 122.2004</strong></td>
</tr>
<tr>
<td><strong>ETA 124.2004</strong></td>
</tr>
<tr>
<td><strong>NRM 125.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 126.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 127.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 128.2004</strong></td>
</tr>
<tr>
<td><strong>NRM 129.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 130.2004</strong></td>
</tr>
<tr>
<td><strong>IEM 133.2004</strong></td>
</tr>
<tr>
<td><strong>ETA 134.2004</strong></td>
</tr>
<tr>
<td><strong>SIEV 135.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 136.2004</strong></td>
</tr>
<tr>
<td><strong>ETA 137.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 138.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 139.2004</strong></td>
</tr>
<tr>
<td><strong>NRM 140.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 141.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 142.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 143.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 144.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 147.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 148.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 149.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 150.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 151.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 152.2004</strong></td>
</tr>
<tr>
<td><strong>PRA 153.2004</strong></td>
</tr>
<tr>
<td><strong>CTN 155.2004</strong></td>
</tr>
<tr>
<td><strong>CCMP 156.2004</strong></td>
</tr>
</tbody>
</table>
NOTE DI LAVORO PUBLISHED IN 2005

CCMP 1.2005 Stéphane HALLEGATTE: Accounting for Extreme Events in the Economic Assessment of Climate Change
CCMP 2.2005 Qi Wang and Paulo Augusto Nunes: Application of Technological Control Measures on Vehicle Pollution: A Cost-Benefit Analysis in China
CCMP 3.2005 Andrea BIGANO, Jacqueline M. HAMILTON, Maren LAU, Richard S.J. TOL and Yuan ZHOU: A Global Database of Domestic and International Tourist Numbers at National and Subnational Level
CCMP 4.2005 Andrea BIGANO, Jacqueline M. HAMILTON and Richard S.J. TOL: The Impact of Climate on Holiday Destination Choice
ETA 5.2005 Hubert KEMPF: Is Inequality Harmful for the Environment in a Growing Economy?
CCMP 9.2005 Angelo ANTOCI: Environmental Resources Depletion and Interplay between Negative and Positive Externalities in a Growth Model
CTN 10.2005 Frédéric DEROIAN: Cost-Reducing Alliances and Local Spillovers
NRM 11.2005 Francesco SINDICO: The GMO Dispute before the WTO: Legal Implications for the Trade and Environment Debate
PRCG 14.2005 Clara GRAZIANO and Annalisa LUPORINI: Ownership Concentration, Monitoring and Optimal Board Structure
CSRM 15.2005 Parashar KULKARNI: Use of Ecolabels in Promoting Exports from Developing Countries to Developed Countries: Lessons from the Indian LeatherFootwear Industry
KTHC 16.2005 Adriana DI LIBERTO, Roberto MURA and Francesco PIGLIA: How to Measure the Unobservable: A Panel Technique for the Analysis of TFP Convergence
KTHC 17.2005 Alireza NAGHAVI: Asymmetric Labor Markets, Southern Wages, and the Location of Firms
KTHC 18.2005 Alireza NAGHAVI: Strategic Intellectual Property Rights Policy and North-South Technology Transfer
KTHC 19.2005 Mombert HOPPE: Technology Transfer Through Trade
PRCG 20.2005 Roberto ROSON: Platform Competition with Endogenous Multihoming
CCMP 21.2005 Barbara BUCHNER and Carlo CARRARO: Regional and Sub-Global Climate Blocs, A Game Theoretic Perspective on Bottom-up Climate Regimes
CTN 23.2005 Michael FINUS, Pierre v. MOUCHE and Bianca RUNDSHAGEN: Uniqueness of Coalitional Equilibria
CTN 25.2005 Sonobe LAHIRI: The Core of Directed Network Problems with Quotas
NRM 27.2005 Massimiliano MAZZANTI and Anna MONTINI: The Determinants of Residential Water Demand Empirical Evidence for a Panel of Italian Municipalities
CCMP 28.2005 Laurent GILOTTE and Michel de LARA: Precautionary Effect and Variations of the Value of Information
NRM 29.2005 Paul SARFO-MENSAH: Exportation of Timber in Ghana: The Menace of Illegal Logging Operations
CCMP 30.2005 Andrea BIGANO, Alessandra GORIA, Jacqueline HAMILTON and Richard S.J. TOL: The Effect of Climate Change and Extreme Weather Events on Tourism
NRM 31.2005 Maria Angeles GARCIA-VALINAS: Decentralization and Environment: An Application to Water Policies
NRM 32.2005 Chiara D’ALPAOS, Cesare DOSI and Michele MORETTO: Concession Length and Investment Timing Flexibility
CCMP 33.2005 Joseph HUBER: Key Environmental Innovations
CTN 34.2005 Antoni CALVÓ-ARMENGOL and Rahmi İLKILIÇ (lxxii): Pairwise-Stability and Nash Equilibria in Network Formation
CTN 35.2005 Francesco FERI (lxxii): Network Formation with Endogenous Decay
CTN 36.2005 Frank H. PAGE, Jr. and Myrna H. WOODERS (lxxii): Strategic Basins of Attraction, the Farsighted Core, and Network Formation Games
Alessandra CASELLA and Nobuyuki HANAKI (lxxii): Information Channels in Labor Markets. On the Resilience of Referral Hiring
Matthew O. JACKSON and Alison WATTS (lxxii): Social Games: Matching and the Play of Finitely Repeated Games
Anna BOGOMOLNAIA, Michel LE BRETON, Alexei SAVVATEEV and Shlomo WEBER (lxxii): The Egalitarian Sharing in Provision of Public Projects
Francesco FERI, Stochastic Stability in Network with Decay
Aart de ZEEUW (lxxii): Dynamic Effects on the Stability of International Environmental Agreements
C. Martijn van der HEIDE, Jeroen C.J.M. van den BERGH, Ekkos C. v. IERLAND and Paulo A.L.D. NUNES: Measuring the Economic Value of Two Habitat Defragmentation Policy Scenarios for the Veluwe, The Netherlands
Carlo VIEIRA and Ana Paula SERRA: Abnormal Returns in Privatization Public Offerings: The Case of Portuguese Firms
Anna ALBERINI, Valentina ZANATTA and Paolo ROSATO: Combining Actual and Contingent Behavior to Estimate the Value of Sports Fishing in the Lagoon of Venice
Michael FINUS and Bianca RUNDSHAGEN: Participation in International Environmental Agreements: The Role of Timing and Regulation
Carlo CARRARO, Johan EYCKMANS and Michael FINUS: Optimal Transfers and Participation Decisions in Networks
Ana MAULEON, José SEMPERE-MONERRIS and Vincent J. VANNETELBOSCH (lxxii): A Characterization of Stochastically Stable Among Unionized Firms
Carlo CARRARO, Johan EYCKMANS and Michael FINUS: Are EU Environmental Policies Too Demanding for New Members States?
Matteo MANERA: Modeling Factor Demands with SEM and VAR: An Empirical Comparison
Oliver TERCIUEUX and Vincent VANNETELBOSCH (lxxii): A Characterization of Stochastically Stable Networks
Ana MAULEON, José SEMPERE-MONERRIS and Vincent J. VANNETELBOSCH (lxxii): R&D Networks
Carlo CARRARO: From the Theory of the Firm to FDI and Internalisation: A Survey
Alessandra del BOCA, Marzio GALEOTTI, Charles P. HIMMELBERG and Paola ROTA: Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal
Margaretha BREIL, Greetel GAMBARELLI and Paulo A.L.D. NUNES: Economic Valuation of On Site Material Damages of High Water on Economic Activities based in the City of Venice: Results from a Dose-Response-Expert-Based Valuation Approach
Alessandra del BOCA, Marzio GALEOTTI, Charles P. HIMMELBERG and Paola ROTA: Investment and Time to Plan: A Comparison of Structures vs. Equipment in a Panel of Italian Firms
Gernot KLEPPER and Sonja PETERSON: Emissions Trading, CDM, JI, and More – The Climate Strategy of the EU
Maia DAVID and Bernard SINCLAIR-DESIGN: Environmental Regulation and the Eco-Industry
Alain-Désiré NIMUBONA and Bernard SINCLAIR-DESIGN: The Pigouvian Tax Rule in the Presence of an Eco-Industry
Margaretha BREIL, Greetel GAMBARELLI and Paulo A.L.D. NUNES: Environmental Innovations: Institutional Impacts on Co-operations for Sustainable Development
Dimitra VOYAKI and Anastasios XEPAPADEAS (lxxii): Criteria for Assessing Sustainable Development: Theoretical Issues and Empirical Evidence for the Case of Greece
Andreas LÖSCHEL and Dirk T.G. RÜBBELKE: Impure Public Goods and Technological Interdependencies
Arisen T. de BLAEIJ, Paulo A.L.D. NUNES and Jeroen C.J.M. van den BERGH: Modeling ‘No-choice’ Responses in Attribute Based Valuation Surveys
Carlo CARRARO, Carmen MARCHIORI and Alessandra SGOBBI: Applications of Negotiation Theory to Water Issues
Carlo CARRARO, Carmen MARCHIORI and Alessandra SGOBBI: Advances in Negotiation Theory: Bargaining, Coalitions and Fairness
Sandra WALLMAN (lxxiv): Network Capital and Social Trust: Pre-Conditions for ‘Good’ Diversity?
Asimina CHRISTOFOROU (lxxiv): On the Determinants of Social Capital in Greece Compared to Countries of the European Union
Eric M. USLANER (lxxiv): Varieties of Trust
Grazia L. BOSETTI and Gianni LOCATELLI: A Data Envelopment Analysis Approach to the Assessment of Natural Parks’ Economic Efficiency and Sustainability. The Case of Italian National Parks
Margherita GRASSO and Matteo MANERA: Asymmetric Error Correction Models for the Oil-Gasoline Price Relationship

Umberto CHERUBINI and Matteo MANERA: Hunting the Living Dead A “Peso Problem” in Corporate Liabilities Data

Hans-Peter WEIKARD: Cartel Stability under an Optimal Sharing Rule

Joëlle NOAILLS, Jeroen C.J.M. van den BERGH and Cees A. WITTHAGEN (lxvii): Local and Global Interactions in an Evolutionary Resource Game

Joëlle NOAILLS, Cees A. WITTHAGEN and Jeroen C.J.M. van den BERGH (lxvii): Spatial Evolution of Social Norms in a Common-Pool Resource Game

Massimiliano MAZZANTI and Roberto ZOBOLI: Economic Instruments and Induced Innovation: The Case of End-of-Life Vehicles European Policies

Anna LASUT: Creative Thinking and Modelling for the Decision Support in Water Management

Valentina BOSETTI and Barbara BUCHNER: Using Data Envelopment Analysis to Assess the Relative Efficiency of Different Climate Policy Portfolios

Ignazio MUSU: Intellectual Property Rights and Biotechnology: How to Improve the Present Patent System

Giulio CAIPELLI, Susanna MANCI NELLI and Massimiliano MAZZANTI: Social Capital, R&D and Industrial Districts

Rosella LEVAGGI, Michele MORETTO and Vincenzo REBBA: Quality and Investment Decisions in Hospital Care when Physicians are Devoted Workers

Valentina BOSETTI and Laurent GILOTTE: Carbon Capture and Sequestration: How Much Does this Uncertain Option Affect Near-Term Policy Choices?

Nicolella FERRO: Value Through Diversity: Microfinance and Islamic Finance and Global Banking

A. MARKANDYA and S. PEDROSO: How Substitutable is Natural Capital?

Anil MARKANDYA, Valeria COSTANTINI, Francesco GRACCEVA and Giorgio VICINI: Security of Energy Supply: Comparing Scenarios From a European Perspective

Vincent M. OTTO, Andreas LÖSCHEL and Rob DELLINK: Energy Biased Technical Change: A CGE Analysis

Caputo CARAVEO: Abuse of Competitive Fringe


Anna ALBERINI and Alberto LONGO: Coordination in Networks Formation: Experimental Evidence on Learning and Salience

Michele MORETTO and Sergio VERGALLI: Migration Dynamics

Anil MARKANDYA, Valeria COSTANTINI, Francesco GRACCEVA and Giorgio VICINI: Security of Energy Supply: Comparing Scenarios From a European Perspective

Rob DELLINK, Michael FINUS and Niels OLIEMAN: Quality and Investment Decisions in Hospital Care when Physicians are Devoted Workers


Rob DELLINK, Michael FINUS and Niels OLIEMAN: Coalition Formation under Uncertainty: The Stability of the Adjusted and Unadjusted Environmental Kuznets Curve

Francesco BOSELLO and Jian ZHANG: Assessing Climate Change Impacts: Agriculture

Alessandro COLOGNI and Matteo MANERA: Oil Prices, Inflation and Interest Rates in a Structural Cointegrated VAR Model for the G-7 Countries

Chiara M. TRAVISI and Jean-Christophe PEREAU and Tarik TAZDAÏT: Bargaining with Non-Monolithic Players


Valeria COSTANTINI, Riccardo CRESCENZI, Fabrizio De FILIPPIS, and Luca SALVATI: Bargaining in the Agricultural Negotiations of the Doha Round: Similarity of Interests or Strategic Choices?

An Empirical Assessment

Gigliola FREY and Matteo MANERA: Econometric Models of Asymmetric Price Transmission

Alessandro COLOGNI and Matteo MANERA: Oil Prices, Inflation and Interest Rates in a Structural Cointegrated VAR Model for the G-7 Countries

Chiara M. TRAVISI and Roberto CAMAGNI: Sustainability of Urban Sprawl: Environmental-Economic Indicators for the Analysis of Mobility Impact in Italy

Joëlle NOAILLS, Erik LICHTENBERG, Dominic MANCINI, and Gregmar I. GALINATO: Was It Something I Ate? Implementation of the FDA Seafood HACCP Program

Anna ALBERINI and Aline CHIABAI: Urban Environmental Health and Sensitive Populations: How Much are the Italians Willing to Pay to Reduce Their Risks?


Michele BERNASCONI and Matteo GALIZZI: Coordination in Networks Formation: Experimental Evidence on Learning and Salience

Michele MORETTO and Sergio VERGALLI: Migration Dynamics

Antonio MUSOLESI and Mario NOSVELLI: Water Consumption and Long-Run Urban Development: The Case of Milan

Benno TORGLER and Maria A. GARCIA-VALIÑAS: The Determinants of Individuals' Attitudes Towards Preventing Environmental Damage

Alberto LONGO and Anna ALBERINI: What are the Effects of Contamination Risks on Commercial and Industrial Properties? Evidence from Baltimore, Maryland

Anna ALBERINI and Alberto LONGO: The Value of Cultural Heritage Sites in Armenia: Evidence from a Travel Cost Method Study

Mikel GONZALEZ and Rob DELLINK: Impact of Climate Policy on the Basque Economy

Gilles LAFFORGUE and Walid OUESLATI: Optimal Soil Management and Environmental Policy
Martin D. SMITH and Larry B. CROWDER (lxxvi): Valuing Ecosystem Services with Fishery Rents: A Lumped-Parameter Approach to Hypoxia in the Neuse River Estuary

NRM 115.2005

Dan HOLLAND and Kurt SCHNIEER (lxxvi): Protecting Marine Biodiversity: A Comparison of Individual Habitat Quotas (IHQs) and Marine Protected Areas

PRCG 117.2005

John NELLIS: The Evolution of Enterprise Reform in Africa: From State-owned Enterprises to Private Participation in Infrastructure — and Back?

PRCG 118.2005

Bernardo BORTOLOTTI: Italy’s Privatization Process and Its Implications for China

SIEV 119.2005

Anna ALBERINI, Marcella VERONESI and Joseph C. COOPER: Detecting Starting Point Bias in Dichotomous-Choice Contingent Valuation Surveys

CTN 120.2005

Federico ECHENIQUE and Mehmet B. YENMEZ: A Solution to Matching with Preferences over Colleagues

KTHC 121.2005

Valeria GATTAI and Corrado MOLTENI: Dissipation of Knowledge and the Boundaries of the Multinational Enterprise

KTHC 122.2005

Valeria GATTAI: Firm’s Intangible Assets and Multinational Activity: Joint-Venture Versus FDI

CCMP 121.2005

Socrates KYPREOS: A MERGE Model with Endogenous Technological Change and the Cost of Carbon Stabilization

CCMP 124.2005

Fuminori SANO, Keigo AKimoto, Takashi HOMMA and Toshimasa TOMODA: Analysis of Technological Portfolios for CO2 stabilizations and Effects of Technological Changes

CCMP 125.2005

Fredrik HEDENUS, Christian AZAR and Kristian LINDGREN: Induced Technological Change in a Limited Foresight Optimization Model

CCMP 126.2005

Reyer GERLAGH: The Value of ITC under Climate Stabilization

PRCG 127.2005

John NELLIS: Privatization in Africa: What has happened? What is to be done?

PRCG 128.2005

Raphael SOUBEYRAN: Contest with Attack and Defence: Does Negative Campaigning Increase or Decrease Voters’ Turnout?

PRCG 129.2005

Pascal GAUTIER and Raphael SOUBEYRAN: Political Cycles: The Opposition Advantage

ETA 130.2005

Giovanni DI BARTOLOMEO, Nicola ACOCELLA and Andrew HUGHES HALLETT: Dynamic Controllability with Overlapping Targets: A Generalization of the Tinbergen-Nash Theory of Economic Policy

SIEV 131.2005

Elissaios PAPYRAKIS and Reyer GERLAGH: Institutional Explanations of Economic Development: the Role of Precious Metals

ETA 132.2005

Giovanni DI BARTOLOMEO and Nicola ACOCELLA: Tinbergen and Theil Meet Nash: Controllability in Policy Games

IEM 133.2005

Adriana M. IGNACIUK and Rob B. DELLINK: Multi-Product Crops for Agricultural and Energy Production – an AGE Analysis for Poland

IEM 134.2005

Raffaele MINIACI, Carlo SCARPA and Paola VALBONESI: Restructuring Italian Utility Markets: Household Distributional Effects

SIEV 135.2005

Valentina ZANATTA, Paolo ROSATO, Anna ALBERINI and Dimitrios REPPAS: The Impact of Speed Limits on Recreational Boating in the Lagoon of Venice

NRM 136.2005

Chi-CHUR CHAO, Bharat R. HAZARI, Jean-Pierre LAFFARGUE, Pasquale M. SGRO, and Eden S. H. YU (lxxviii): Tourism, Jobs, Capital Accumulation and the Economy: A Dynamic Analysis

NRM 137.2005

Michael MCALEER, Riaz SHAREEF and Bernardo da VEIGA (lxxviii): Risk Management of Daily Tourist Tax Revenues for the Maldives
### 2004 SERIES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Editor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCMP</td>
<td>Climate Change Modelling and Policy</td>
<td>Marzio Galeotti</td>
</tr>
<tr>
<td>GG</td>
<td>Global Governance</td>
<td>Carlo Carraro</td>
</tr>
<tr>
<td>SIEV</td>
<td>Sustainability Indicators and Environmental Valuation</td>
<td>Anna Alberini</td>
</tr>
<tr>
<td>NRM</td>
<td>Natural Resources Management</td>
<td>Carlo Giupponi</td>
</tr>
<tr>
<td>KTHC</td>
<td>Knowledge, Technology, Human Capital</td>
<td>Gianmarco Ottaviano</td>
</tr>
<tr>
<td>IEM</td>
<td>International Energy Markets</td>
<td>Anil Markandya</td>
</tr>
<tr>
<td>CSRM</td>
<td>Corporate Social Responsibility and Sustainable Management</td>
<td>Sabina Ratti</td>
</tr>
<tr>
<td>PRA</td>
<td>Privatisation, Regulation, Antitrust</td>
<td>Bernardo Bortolotti</td>
</tr>
<tr>
<td>ETA</td>
<td>Economic Theory and Applications</td>
<td>Carlo Carraro</td>
</tr>
<tr>
<td>CTN</td>
<td>Coalition Theory Network</td>
<td></td>
</tr>
</tbody>
</table>

### 2005 SERIES

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Editor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCMP</td>
<td>Climate Change Modelling and Policy</td>
<td>Marzio Galeotti</td>
</tr>
<tr>
<td>SIEV</td>
<td>Sustainability Indicators and Environmental Valuation</td>
<td>Anna Alberini</td>
</tr>
<tr>
<td>NRM</td>
<td>Natural Resources Management</td>
<td>Carlo Giupponi</td>
</tr>
<tr>
<td>KTHC</td>
<td>Knowledge, Technology, Human Capital</td>
<td>Gianmarco Ottaviano</td>
</tr>
<tr>
<td>IEM</td>
<td>International Energy Markets</td>
<td>Anil Markandya</td>
</tr>
<tr>
<td>CSRM</td>
<td>Corporate Social Responsibility and Sustainable Management</td>
<td>Sabina Ratti</td>
</tr>
<tr>
<td>PRCG</td>
<td>Privatisation Regulation Corporate Governance</td>
<td>Bernardo Bortolotti</td>
</tr>
<tr>
<td>ETA</td>
<td>Economic Theory and Applications</td>
<td>Carlo Carraro</td>
</tr>
<tr>
<td>CTN</td>
<td>Coalition Theory Network</td>
<td></td>
</tr>
</tbody>
</table>