Risk Management of Daily Tourist
Tax Revenues for the Maldives

Michael McAleer, Riaz Shareef
and Bernardo da Veiga

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

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

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.

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

4

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, nearly100,000 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_t, which can be decomposed as:

$$Y_t = E(Y_t \mid F_{t-1}) + \varepsilon_t.$$

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

$$\varepsilon_t : \ D(\mu_t, \sigma_t)$$

where μ_t and σ_t are the unconditional mean and standard deviation of ε_t, 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_t can be calculated as:

$$VaR_t = \mu_t - \alpha\sigma_t$$

where α is the critical value from the distribution of ε_t that gives the correct confidence level. Alternatively, σ_t 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.

[Insert Figures 1-3 here]

[Insert Table 2 here]

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.

[Insert Figures 4-6 here]

[Insert Table 3 here]

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 Heteroskedastcity (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:

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

$$\varepsilon_t = h_t^{1/2}\eta_t$$

$$h_{it} = \omega_i + \sum_{l=1}^{p}(\alpha_i \varepsilon_{i,t-l}^2 + \gamma_i I(\eta_{i,t})\varepsilon_{i,t-l}^2) + \sum_{l=1}^{q}\beta_i h_{i,t-l}$$

$$I(\eta_{i,t}) = \begin{cases} 1, \varepsilon_{i,t} \leq 0 \\ 0, \varepsilon_{i,t} > 0 \end{cases}$$

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, η_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 $\alpha_1 + \frac{1}{2}\gamma_1$) 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 β_1) effect indicates the contribution of shocks to long run persistence ($\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1$) (namely, an indication of the strength of the shocks in the long run). For the GJR(1,1) model, $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1$ is a sufficient condition for the existence of the second moment, which is necessary for sensible empirical analysis. Restricting $\gamma_1 = 0$ 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 $\alpha_1 + \beta_1 < 1$.

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, η_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:

$$Y_t = \underset{(0.0541)}{0.001} + \underset{(0.0169)}{0.1561} Y_{t-1}$$

$$h_t = \underset{(0.058)}{0.592} + \underset{(0.011)}{0.121}\varepsilon_{t-1}^2 + \underset{(0.015)}{0.048}I\varepsilon_{t-1}^2 + \underset{(0.012)}{0.803}h_{t-1},$$

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 γ_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:

$$Y_t = \underset{(0.0541)}{0.001} + \underset{(0.0169)}{0.1561}Y_{t-1}$$

$$h_t = \underset{(0.058)}{0.598} + \underset{(0.009)}{0.149}\varepsilon_{t-1}^2 + \underset{(0.012)}{0.799}h_{t-1}.$$

Furthermore, as the respective estimates of the second moment conditions, $\alpha_1 + \frac{1}{2}\gamma_1 + \beta_1 < 1$ for GJR(1,1) and $\alpha_1 + \beta_1 < 1$ 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:

$$VaR_t = E(Y_t \mid F_{t-1}) - \alpha\sqrt{h_t},$$

where $E(Y_t \mid F_{t-1})$ 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

1988 International Convergence of Capital Measurement and Capital Standards. BIS: Basel, Switzerland.

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

1996 Supervisory Framework for the Use of "Backtesting" in Conjunction with the Internal Model-Based Approach to Market Risk Capital Requirements. BIS: Basel, Switzerland.

Bollerslev, T.

1986, Generalized Autoregressive Conditional Heteroscedasticity, Journal of Econometrics 31: 307-327.

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

2005 Modelling Multivariate International Tourism Demand and Volatility, Tourism Management 26: 301-479.

Domroes, M.

1985 Tourism Resources and their Development in Maldives Islands. GeoJournal 10: 119-126.

1989 Tourism in the Maldives: The Potential of its Natural Attraction and its Exploitation. Applied Geography and Development 36: 61-77.

1993 Maldivian Tourist Resorts and their Environmental Impact, in P.P. Wong (ed.), Tourism Vs Environment: The Case for Coastal Areas. Kluwer Academic Publishers: The Netherlands, 1993, pp. 69-82.

1999 Tourism in the Maldives: The Resort Concept and Tourist Related Services. Insula: International Journal of Island Affairs 8: 7-14.

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

1993 On the Relation between the Expected Value and Volatility of the Nominal Excess Return on Stocks. Journal of Finance 46: 1779-1801.

Jorion, P.

2000 Value at Risk: The New Benchmark for Managing Financial Risk. McGraw-Hill: New York.

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

2002 Recent Theoretical Results for Time Series Models with GARCH Errors. Journal of Economic Surveys 16: 245-269. Reprinted in M. McAleer and L. Oxley (eds.), Contributions to Financial Econometrics: Theoretical and Practical Issues. Blackwell: Oxford, pp. 9-33.

McAleer, M.

2005 Automated Inference and Learning in Modeling Financial Volatility. Econometric Theory 21: 232-261.

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.

2004 Modelling the Volatility in International Tourism Demand and Country Risk in Small Island Tourism Economies. Unpublished Doctoral Dissertation, University of Western Australia, Perth, Australia, pp. 440.

Shareef, R. and M. McAleer

2005 Modelling the Uncertainty in International Tourist Arrivals to the Maldives. Under revision for Tourism Management.

World Bank

2005a Tsunami: Impact and Recovery. Joint Needs Assessment World Bank-Asian Development Bank-UN System.
http://siteresources.worldbank.org/INTMALDIVES/Resources/mv-na-full-02-14-05.pdf

2005b Counting the Cost: Rebuilding Lives and Property in India after the Tsunami.
http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EXTTSUNAMI/0,,con

tentMDK:20326347~menuPK:621586~pagePK:64168445~piPK:64168309~theSitePK:
621037,00.html

2005c Indonesia: Preliminary Damage and Loss Assessment, The 26 December 2004 Natural
Disaster.
http://siteresources.worldbank.org/INTINDONESIA/Resources/Publication/280016-
1106130305439/damage_assessment.pdf

2005d Counting the Cost: A first look at what it will take to rebuild lives
http://www.worldbank.lk/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/SRI
LANKAEXTN/0,,contentMDK:20342271~pagePK:141137~piPK:141127~theSitePK:2
33047,00.html.

Figure 1: Daily Tourist Arrivals
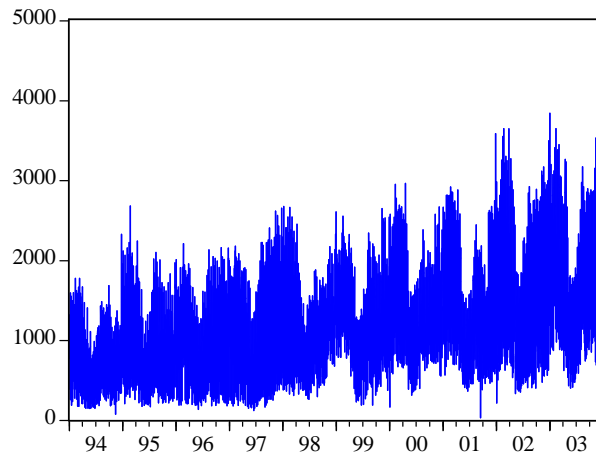
Figure 2: Weekly Tourist Arrivals
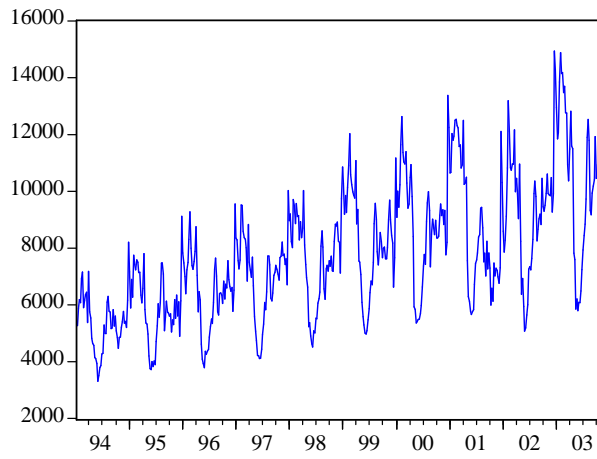
Figure 3: Daily Tourist in Residence

20
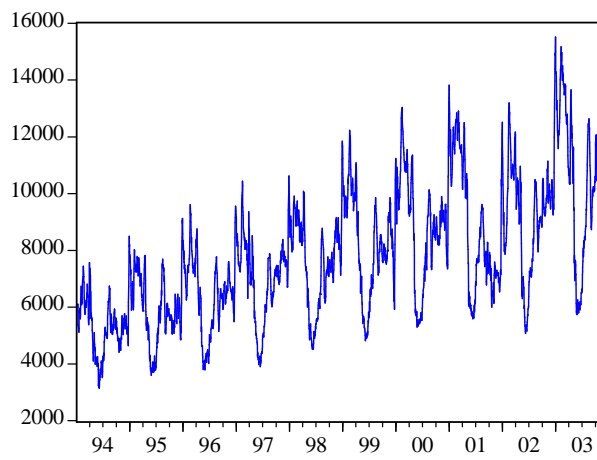
Figure 4: Growth Rates in Daily Tourist Arrivals
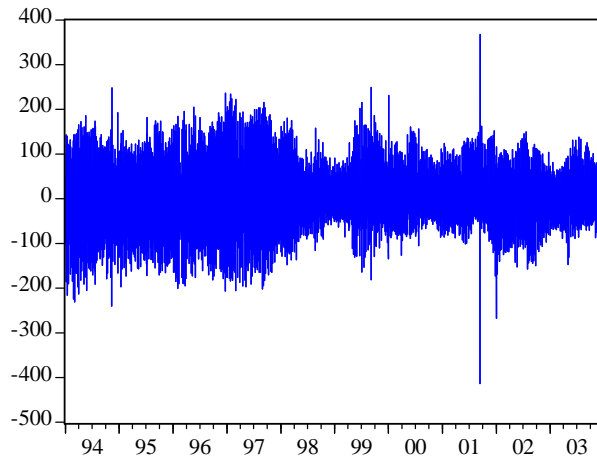
Figure 5: Growth Rates in Weekly Tourist Arrivals
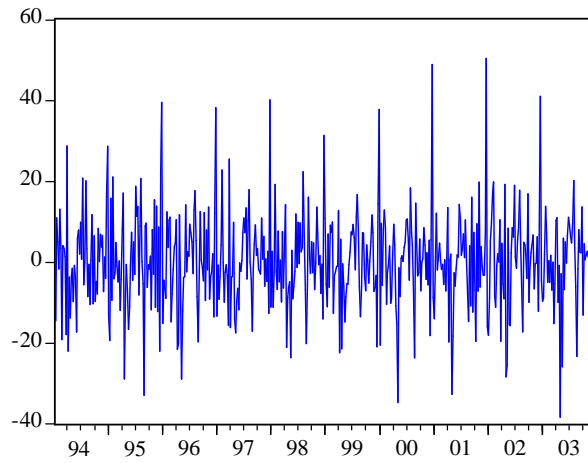
Figure 6: Growth Rates in Daily Tourist in Residence

21
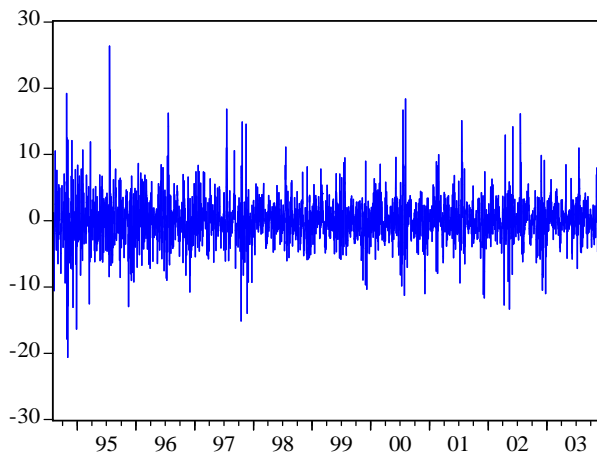
Figure 7: GJR Variance Forecasts for Tourists in Residence
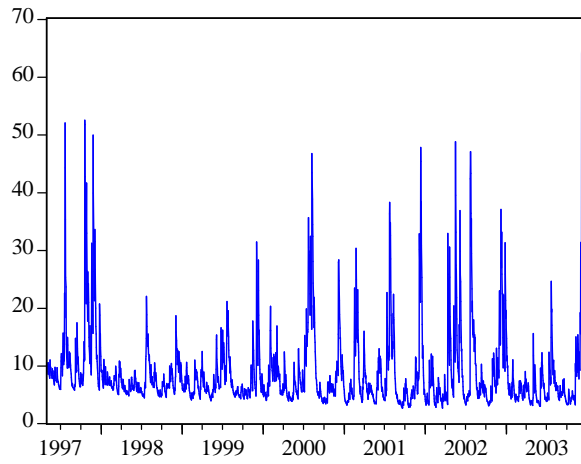
Figure 8: GARCH Variance Forecasts for Tourist in Residence
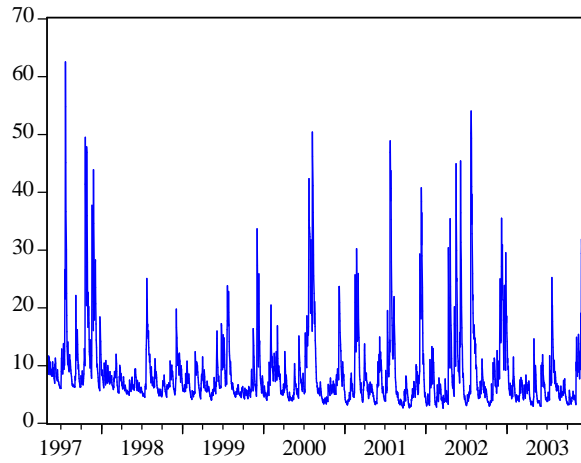
Figure 9: Growth Rates for Tourist in Residence and GJR VaR Thresholds

Growth Rate ——— GJR VaR

22
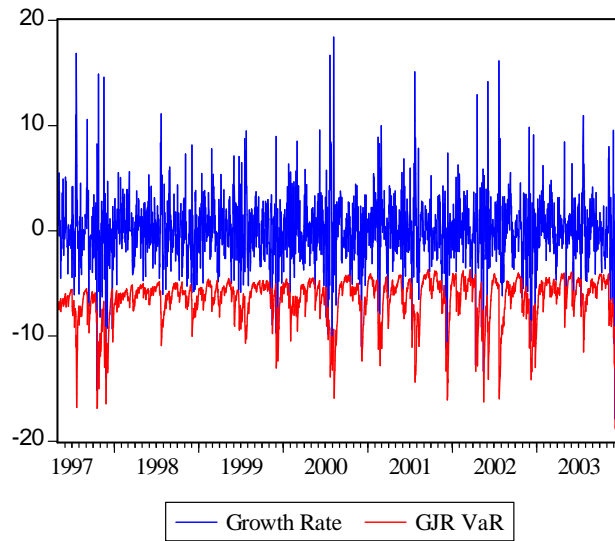
Figure 10: Growth Rates for Tourist in Residence and GARCH VaR Thresholds
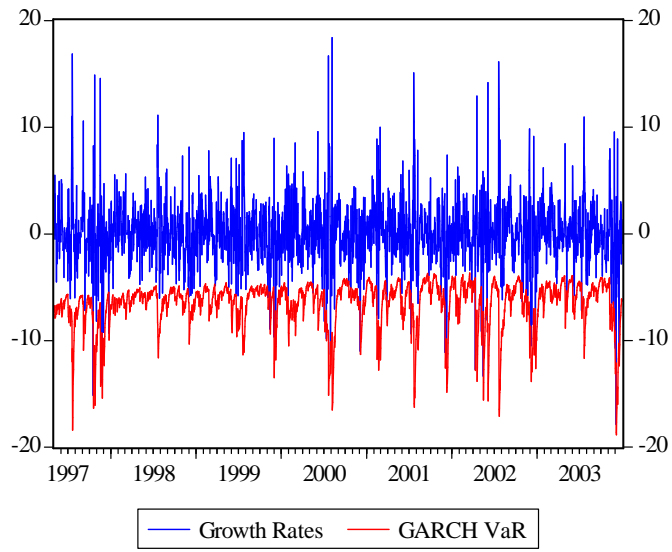
Figure 11: Rolling Second Moment Condition for GJR
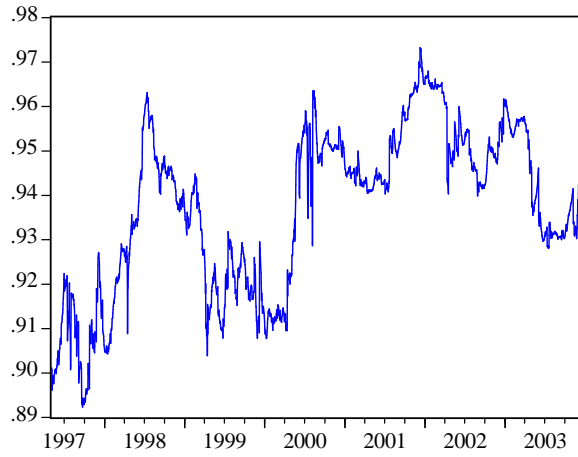
Figure 12: Rolling Second Moment Condition for GARCH

23
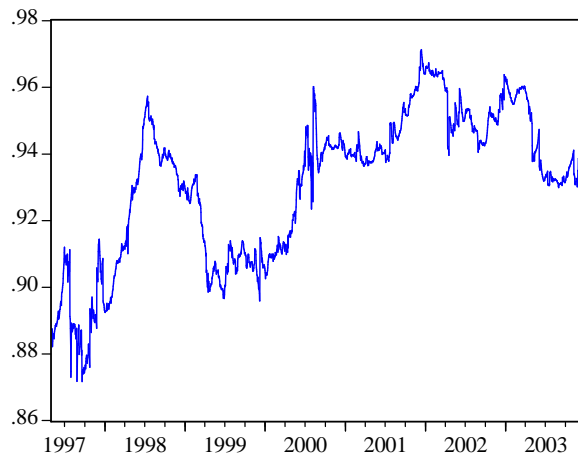
Table 1. Composition of Tourist Arrivals, 1994-2003

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

Table 2: Descriptive Statistics

Statistics	Daily Arrivals	Weekly Arrivals	Tourists in Residence
Mean	1,122	7,833	7,699
Median	1,007	7,510	7,430
Maximum	4,118	14,942	15,517
Minimum	23	3,316	3,145
Std. Dev.	627	2,351	2,293
Skewness	1.087	0.535	0.593
Kurtosis	4.436	2.784	2.981
CoV	0.559	0.300	0.298
Jarque-Bera	1033	25.808	201.597

Table 3: Descriptive Statistics for Growth Rates

Statistics	Daily Arrivals	Weekly Arrivals	Tourists in Residence
Mean	0.010	0.163	5.24e-12
Median	-7.66	-0.027	-0.039
Maximum	368.23	50.37	26.34
Minimum	-412.57	-38.45	-20.64
Std. Dev.	81.19	11.66	3.21
Skewness	0.143	0.344	0.283
Kurtosis	3.01	4.95	8.76
CoV	8,119	71.53	6.12e11
Jarque-Bera	12.44	92.61	4,799.9

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	*Masahisa FUJITA 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
ETA	5.2004	*Romano PIRAS:* Growth, Congestion of Public Goods, and Second-Best Optimal Policy
CCMP	6.2004	*Herman R.J. VOLLEBERGH:* Lessons from the Polder: Is Dutch CO2-Taxation Optimal
PRA	7.2004	*Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN* (lxv): Merger Mechanisms
PRA	8.2004	*Wolfgang AUSSENEGG, 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	10.2004	*Florian ENGLMAIER, Pablo GUILLEN, Loreto LLORENTE, Sander ONDERSTAL and Rupert SAUSGRUBER* (lxv): The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions
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. JANSSEN* (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
PRA	16.2004	*Marta STRYSZOWSKA* (lxv): Late and Multiple Bidding in Competing Second Price Internet Auctions
CCMP	17.2004	*Slim Ben YOUSSEF:* R&D in Cleaner Technology and International Trade
NRM	18.2004	*Angelo ANTOCI, Simone BORGHESI and Paolo RUSSU* (lxvi): Biodiversity and Economic Growth: Stabilization Versus Preservation of the Ecological Dynamics
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	20.2004	*Guido CANDELA and Roberto CELLINI* (lxvii): Investment in Tourism Market: A Dynamic Model of Differentiated Oligopoly
NRM	21.2004	*Jacqueline M. HAMILTON* (lxvii): Climate and the Destination Choice of German Tourists
NRM	22.2004	*Javier Rey-MAQUIEIRA PALMER, Javier LOZANO IBÁÑEZ and Carlos Mario GÓMEZ GÓMEZ* (lxvii): Land, Environmental Externalities and Tourism Development
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, Mondher SAHLI and Pasquale M. SGRO* (lxvii):Tourism, Trade and Domestic Welfare
NRM	25.2004	*Riaz SHAREEF* (lxvii): Country Risk Ratings of Small Island Tourism Economies
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
CSRM	28.2004	*Nicoletta FERRO:* Cross-Country Ethical Dilemmas in Business: A Descriptive Framework
NRM	29.2004	*Marian WEBER* (lxvi): Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada's Boreal Mixedwood Forest
NRM	30.2004	*Trond BJORNDAL, Phoebe KOUNDOURI and Sean PASCOE* (lxvi): Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting
CCMP	31.2004	*Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part I: Sectoral Analysis of Climate Impacts in Italy
CCMP	32.2004	*Marzio GALEOTTI, Alessandra GORIA ,Paolo MOMBRINI and Evi SPANTIDAKI:* Weather Impacts on Natural, Social and Economic Systems (WISE) Part II: Individual Perception of Climate Extremes in Italy
CTN	33.2004	*Wilson PEREZ:* Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution
KTHC	34.2004	*Gianmarco I.P. OTTAVIANO and Giovanni PERI* (lxviii): The Economic Value of Cultural Diversity: Evidence from US Cities
KTHC	35.2004	*Linda CHAIB* (lxviii): Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison

KTHC	36.2004	*Franca ECKERT COEN and Claudio ROSSI* (lxviii): <u>Foreigners, Immigrants, Host Cities: The Policies of Multi-Ethnicity in Rome. Reading Governance in a Local Context</u>
KTHC	37.2004	*Kristine CRANE* (lxviii): <u>Governing Migration: Immigrant Groups' Strategies in Three Italian Cities – Rome, Naples and Bari</u>
KTHC	38.2004	*Kiflemariam HAMDE* (lxviii): <u>Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm</u>
ETA	39.2004	*Alberto CAVALIERE:* <u>Price Competition with Information Disparities in a Vertically Differentiated Duopoly</u>
PRA	40.2004	*Andrea BIGANO and Stef PROOST:* <u>The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?</u>
CCMP	41.2004	*Micheal FINUS* (lxix): <u>International Cooperation to Resolve International Pollution Problems</u>
KTHC	42.2004	*Francesco CRESPI:* <u>Notes on the Determinants of Innovation: A Multi-Perspective Analysis</u>
CTN	43.2004	*Sergio CURRARINI and Marco MARINI:* <u>Coalition Formation in Games without Synergies</u>
CTN	44.2004	*Marc ESCRIHUELA-VILLAR:* <u>Cartel Sustainability and Cartel Stability</u>
NRM	45.2004	*Sebastian BERVOETS and Nicolas GRAVEL* (lxvi): <u>Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach</u>
NRM	46.2004	*Signe ANTHON and Bo JELLESMARK THORSEN* (lxvi): <u>Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits</u>
NRM	47.2004	*John MBURU* (lxvi)*:* <u>Wildlife Conservation and Management in Kenya: Towards a Co-management Approach</u>
NRM	48.2004	*Ekin BIROL, Ágnes GYOVAI and Melinda SMALE* (lxvi)*:* <u>Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transition al Economy</u>
CCMP	49.2004	*Gernot KLEPPER and Sonja PETERSON:* <u>The EU Emissions Trading Scheme. Allowance Prices, Trade Flows, Competitiveness Effects</u>
GG	50.2004	*Scott BARRETT and Michael HOEL:* <u>Optimal Disease Eradication</u>
CTN	51.2004	*Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG:* <u>Simple Priorities and Core Stability in Hedonic Games</u>
SIEV	52.2004	*Francesco RICCI*: <u>Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory</u>
SIEV	53.2004	*Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON:* <u>Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?</u>
NRM	54.2004	*Ingo BRÄUER and Rainer MARGGRAF* (lxvi): <u>Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams</u>
NRM	55.2004	*Timo GOESCHL and Tun LIN* (lxvi): <u>Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices</u>
NRM	56.2004	*Tom DEDEURWAERDERE* (lxvi): <u>Bioprospection: From the Economics of Contracts to Reflexive Governance</u>
CCMP	57.2004	*Katrin REHDANZ and David MADDISON:* <u>The Amenity Value of Climate to German Households</u>
CCMP	58.2004	*Koen SMEKENS and Bob VAN DER ZWAAN:* <u>Environmental Externalities of Geological Carbon Sequestration Effects on Energy Scenarios</u>
NRM	59.2004	*Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA* (lxvii): <u>Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management</u>
NRM	60.2004	*Timo GOESCHL and Danilo CAMARGO IGLIORI* (lxvi):<u>Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon</u>
CCMP	61.2004	*Barbara BUCHNER and Carlo CARRARO*: <u>Economic and Environmental Effectiveness of a Technology-based Climate Protocol</u>
NRM	62.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: <u>Resource-Abundance and Economic Growth in the U.S.</u>
NRM	63.2004	*Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ* (lxvi): <u>Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis</u>
NRM	64.2004	*E.C.M. RUIJGROK and E.E.M. NILLESEN* (lxvi): <u>The Socio-Economic Value of Natural Riverbanks in the Netherlands</u>
NRM	65.2004	*E.C.M. RUIJGROK* (lxvi): <u>Reducing Acidification: The Benefits of Increased Nature Quality. Investigating the Possibilities of the Contingent Valuation Method</u>
ETA	66.2004	*Giannis VARDAS and Anastasios XEPAPADEAS*: <u>Uncertainty Aversion, Robust Control and Asset Holdings</u>
GG	67.2004	*Anastasios XEPAPADEAS and Constadina PASSA*: <u>Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach</u>
GG	68.2004	*Michael FINUS*: <u>Modesty Pays: Sometimes</u>!
NRM	69.2004	*Trond BJØRNDAL and Ana BRASÃO*: <u>The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications</u>
CTN	70.2004	*Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZDAÏT*: <u>On Coalition Formation with Heterogeneous Agents</u>
IEM	71.2004	*Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA*: <u>Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants</u>
IEM	72.2004	*Alessandro LANZA, Matteo MANERA and Michael MCALEER*: <u>Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns</u>
SIEV	73.2004	*Margarita GENIUS and Elisabetta STRAZZERA*: <u>The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests</u>

IEM	116.2004	*Valeria COSTANTINI and Francesco GRACCEVA*: Social Costs of Energy Disruptions
IEM	117.2004	*Christian EGENHOFER, Kyriakos GIALOGLOU, Giacomo LUCIANI, Maroeska BOOTS, Martin SCHEEPERS, Valeria COSTANTINI, Francesco GRACCEVA, Anil MARKANDYA and Giorgio VICINI*: Market-Based Options for Security of Energy Supply
IEM	118.2004	*David FISK*: Transport Energy Security. The Unseen Risk?
IEM	119.2004	*Giacomo LUCIANI*: Security of Supply for Natural Gas Markets. What is it and What is it not?
IEM	120.2004	*L.J. de VRIES and R.A. HAKVOORT*: The Question of Generation Adequacy in Liberalised Electricity Markets
KTHC	121.2004	*Alberto PETRUCCI*: Asset Accumulation, Fertility Choice and Nondegenerate Dynamics in a Small Open Economy
NRM	122.2004	*Carlo GIUPPONI, Jaroslaw MYSIAK and Anita FASSIO*: An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application
NRM	123.2004	*Margaretha BREIL, Anita FASSIO, Carlo GIUPPONI and Paolo ROSATO*: Evaluation of Urban Improvement on the Islands of the Venice Lagoon: A Spatially-Distributed Hedonic-Hierarchical Approach
ETA	124.2004	*Paul MENSINK*: Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited
NRM	125.2004	*Mauro FABIANO, Gabriella CAMARSA, Rosanna DURSI, Roberta IVALDI, Valentina MARIN and Francesca PALMISANI*: Integrated Environmental Study for Beach Management:A Methodological Approach
PRA	126.2004	*Irena GROSFELD and Iraj HASHI*: The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic
CCMP	127.2004	*Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL*: A General Equilibrium Analysis of Climate Change Impacts on Tourism
CCMP	128.2004	*Reyer GERLAGH*: A Climate-Change Policy Induced Shift from Innovations in Energy Production to Energy Savings
NRM	129.2004	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources, Innovation, and Growth
PRA	130.2004	*Bernardo BORTOLOTTI and Mara FACCIO*: Reluctant Privatization
SIEV	131.2004	*Riccardo SCARPA and Mara THIENE*: Destination Choice Models for Rock Climbing in the Northeast Alps: A Latent-Class Approach Based on Intensity of Participation
SIEV	132.2004	*Riccardo SCARPA Kenneth G. WILLIS and Melinda ACUTT*: Comparing Individual-Specific Benefit Estimates for Public Goods: Finite Versus Continuous Mixing in Logit Models
IEM	133.2004	*Santiago J. RUBIO*: On Capturing Oil Rents with a National Excise Tax Revisited
ETA	134.2004	*Ascensión ANDINA DÍAZ*: Political Competition when Media Create Candidates' Charisma
SIEV	135.2004	*Anna ALBERINI*: Robustness of VSL Values from Contingent Valuation Surveys
CCMP	136.2004	*Gernot KLEPPER and Sonja PETERSON*: Marginal Abatement Cost Curves in General Equilibrium: The Influence of World Energy Prices
ETA	137.2004	*Herbert DAWID, Christophe DEISSENBERG and Pavel ŠEVČIK*: Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game
CCMP	138.2004	*ZhongXiang ZHANG*: The World Bank's Prototype Carbon Fund and China
CCMP	139.2004	*Reyer GERLAGH and Marjan W. HOFKES*: Time Profile of Climate Change Stabilization Policy
NRM	140.2004	*Chiara D'ALPAOS and Michele MORETTO*: The Value of Flexibility in the Italian Water Service Sector: A Real Option Analysis
PRA	141.2004	*Patrick BAJARI, Stephanie HOUGHTON and Steven TADELIS* (lxxi): Bidding for Incompete Contracts
PRA	142.2004	*Susan ATHEY, Jonathan LEVIN and Enrique SEIRA* (lxxi): Comparing Open and Sealed Bid Auctions: Theory and Evidence from Timber Auctions
PRA	143.2004	*David GOLDREICH* (lxxi): Behavioral Biases of Dealers in U.S. Treasury Auctions
PRA	144.2004	*Roberto BURGUET* (lxxi): Optimal Procurement Auction for a Buyer with Downward Sloping Demand: More Simple Economics
PRA	145.2004	*Ali HORTACSU and Samita SAREEN* (lxxi): Order Flow and the Formation of Dealer Bids: An Analysis of Information and Strategic Behavior in the Government of Canada Securities Auctions
PRA	146.2004	*Victor GINSBURGH, Patrick LEGROS and Nicolas SAHUGUET* (lxxi): How to Win Twice at an Auction. On the Incidence of Commissions in Auction Markets
PRA	147.2004	*Claudio MEZZETTI, Aleksandar PEKEČ and Ilia TSETLIN* (lxxi): Sequential vs. Single-Round Uniform-Price Auctions
PRA	148.2004	*John ASKER and Estelle CANTILLON* (lxxi): Equilibrium of Scoring Auctions
PRA	149.2004	*Philip A. HAILE, Han HONG and Matthew SHUM* (lxxi): Nonparametric Tests for Common Values in First-Price Sealed-Bid Auctions
PRA	150.2004	*François DEGEORGE, François DERRIEN and Kent L. WOMACK* (lxxi): Quid Pro Quo in IPOs: Why Bookbuilding is Dominating Auctions
CCMP	151.2004	*Barbara BUCHNER and Silvia DALL'OLIO*: Russia: The Long Road to Ratification. Internal Institution and Pressure Groups in the Kyoto Protocol's Adoption Process
CCMP	152.2004	*Carlo CARRARO and Marzio GALEOTTI*: Does Endogenous Technical Change Make a Difference in Climate Policy Analysis? A Robustness Exercise with the FEEM-RICE Model
PRA	153.2004	*Alejandro M. MANELLI and Daniel R. VINCENT* (lxxi): Multidimensional Mechanism Design: Revenue Maximization and the Multiple-Good Monopoly
ETA	154.2004	*Nicola ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS*: Is there any Scope for Corporatism in Stabilization Policies?
CTN	155.2004	*Johan EYCKMANS and Michael FINUS*: An Almost Ideal Sharing Scheme for Coalition Games with Externalities
CCMP	156.2004	*Cesare DOSI and Michele MORETTO*: Environmental Innovation, War of Attrition and Investment Grants

CCMP	157.2004	*Valentina BOSETTI, Marzio GALEOTTI and Alessandro LANZA*: How Consistent are Alternative Short-Term Climate Policies with Long-Term Goals?
ETA	158.2004	*Y. Hossein FARZIN and Ken-Ichi AKAO*: Non-pecuniary Value of Employment and Individual Labor Supply
ETA	159.2004	*William BROCK and Anastasios XEPAPADEAS*: Spatial Analysis: Development of Descriptive and Normative Methods with Applications to Economic-Ecological Modelling
KTHC	160.2004	*Alberto PETRUCCI*: On the Incidence of a Tax on PureRent with Infinite Horizons
IEM	161.2004	*Xavier LABANDEIRA, José M. LABEAGA and Miguel RODRÍGUEZ*: Microsimulating the Effects of Household Energy Price Changes in Spain

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	*Qiang WU 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	6.2005	*Valentina BOSETTI, Carlo CARRARO and Marzio GALEOTTI*: The Dynamics of Carbon and Energy Intensity in a Model of Endogenous Technical Change
IEM	7.2005	*David CALEF and Robert GOBLE*: The Allure of Technology: How France and California Promoted Electric Vehicles to Reduce Urban Air Pollution
ETA	8.2005	*Lorenzo PELLEGRINI and Reyer GERLAGH*: An Empirical Contribution to the Debate on Corruption Democracy and Environmental Policy
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
KTHC	12.2005	*Carla MASSIDDA*: Estimating the New Keynesian Phillips Curve for Italian Manufacturing Sectors
KTHC	13.2005	*Michele MORETTO and Gianpaolo ROSSINI*: Start-up Entry Strategies: Employer vs. Nonemployer firms
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 PIGLIARU*: 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
IEM	22.2005	*Fausto CAVALLARO*: An Integrated Multi-Criteria System to Assess Sustainable Energy Options: An Application of the Promethee Method
CTN	23.2005	*Michael FINUS, Pierre v. MOUCHE and Bianca RUNDSHAGEN*: Uniqueness of Coalitional Equilibria
IEM	24.2005	*Wietze LISE*: Decomposition of CO2 Emissions over 1980–2003 in Turkey
CTN	25.2005	*Somdeb LAHIRI*: The Core of Directed Network Problems with Quotas
SIEV	26.2005	*Susanne MENZEL and Riccardo SCARPA*: Protection Motivation Theory and Contingent Valuation: Perceived Realism, Threat and WTP Estimates for Biodiversity Protection
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-VALIÑAS*: 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

CTN	37.2005	*Alessandra CASELLA and Nobuyuki HANAKI* (lxxii): Information Channels in Labor Markets. On the Resilience of Referral Hiring
CTN	38.2005	*Matthew O. JACKSON and Alison WATTS* (lxxii): Social Games: Matching and the Play of Finitely Repeated Games
CTN	39.2005	*Anna BOGOMOLNAIA, Michel LE BRETON, Alexei SAVVATEEV and Shlomo WEBER* (lxxii): The Egalitarian Sharing Rule in Provision of Public Projects
CTN	40.2005	*Francesco FERI*: Stochastic Stability in Network with Decay
CTN	41.2005	*Aart de ZEEUW* (lxxii): Dynamic Effects on the Stability of International Environmental Agreements
NRM	42.2005	*C. Martijn van der HEIDE, Jeroen C.J.M. van den BERGH, Ekko C. van IERLAND and Paulo A.L.D. NUNES*: Measuring the Economic Value of Two Habitat Defragmentation Policy Scenarios for the Veluwe, The Netherlands
PRCG	43.2005	*Carla VIEIRA and Ana Paula SERRA*: Abnormal Returns in Privatization Public Offerings: The Case of Portuguese Firms
SIEV	44.2005	*Anna ALBERINI, Valentina ZANATTA and Paolo ROSATO*: Combining Actual and Contingent Behavior to Estimate the Value of Sports Fishing in the Lagoon of Venice
CTN	45.2005	*Michael FINUS and Bianca RUNDSHAGEN:* Participation in International Environmental Agreements: The Role of Timing and Regulation
CCMP	46.2005	*Lorenzo PELLEGRINI and Reyer GERLAGH*: Are EU Environmental Policies Too Demanding for New Members States?
IEM	47.2005	*Matteo MANERA*: Modeling Factor Demands with SEM and VAR: An Empirical Comparison
CTN	48.2005	*Olivier TERCIEUX and Vincent VANNETELBOSCH* (lxx): A Characterization of Stochastically Stable Networks
CTN	49.2005	*Ana MAULEON, José SEMPERE-MONERRIS and Vincent J. VANNETELBOSCH* (lxxii): R&D Networks Among Unionized Firms
CTN	50.2005	*Carlo CARRARO, Johan EYCKMANS and Michael FINUS*: Optimal Transfers and Participation Decisions in International Environmental Agreements
KTHC	51.2005	*Valeria GATTAI*: From the Theory of the Firm to FDI and Internalisation:A Survey
CCMP	52.2005	*Alireza NAGHAVI*: Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal
SIEV	53.2005	*Margaretha BREIL, Gretel 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
ETA	54.2005	*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
CCMP	55.2005	*Gernot KLEPPER and Sonja PETERSON*: Emissions Trading, CDM, JI, and More – The Climate Strategy of the EU
ETA	56.2005	*Maia DAVID and Bernard SINCLAIR-DESGAGNÉ*: Environmental Regulation and the Eco-Industry
ETA	57.2005	*Alain-Désiré NIMUBONA and Bernard SINCLAIR-DESGAGNÉ*: The Pigouvian Tax Rule in the Presence of an Eco-Industry
NRM	58.2005	*Helmut KARL, Antje MÖLLER, Ximena MATUS, Edgar GRANDE and Robert KAISER*: Environmental Innovations: Institutional Impacts on Co-operations for Sustainable Development
SIEV	59.2005	*Dimitra VOUVAKI and Anastasios XEPAPADEAS* (lxxiii): Criteria for Assessing Sustainable Development: Theoretical Issues and Empirical Evidence for the Case of Greece
CCMP	60.2005	*Andreas LÖSCHEL and Dirk T.G. RÜBBELKE*: Impure Public Goods and Technological Interdependencies
PRCG	61.2005	*Christoph A. SCHALTEGGER and Benno TORGLER*: Trust and Fiscal Performance: A Panel Analysis with Swiss Data
ETA	62.2005	*Irene VALSECCHI*: A Role for Instructions
NRM	63.2005	*Valentina 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
SIEV	64.2005	*Arianne 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
CTN	65.2005	*Carlo CARRARO, Carmen MARCHIORI and Alessandra SGOBBI*: Applications of Negotiation Theory to Water Issues
CTN	66.2005	*Carlo CARRARO, Carmen MARCHIORI and Alessandra SGOBBI*: Advances in Negotiation Theory: Bargaining, Coalitions and Fairness
KTHC	67.2005	*Sandra WALLMAN* (lxxiv**)**: Network Capital and Social Trust: Pre-Conditions for 'Good' Diversity?
KTHC	68.2005	*Asimina CHRISTOFOROU* (lxxiv): On the Determinants of Social Capital in Greece Compared to Countries of the European Union
KTHC	69.2005	*Eric M. USLANER* (lxxiv): Varieties of Trust
KTHC	70.2005	*Thomas P. LYON* (lxxiv): Making Capitalism Work: Social Capital and Economic Growth in Italy, 1970-1995
KTHC	71.2005	*Graziella BERTOCCHI and Chiara STROZZI* (lxxv): Citizenship Laws and International Migration in Historical Perspective
KTHC	72.2005	*Elsbeth van HYLCKAMA VLIEG* (lxx): Accommodating Differences
KTHC	73.2005	*Renato SANSA and Ercole SORI* (lxxv): Governance of Diversity Between Social Dynamics and Conflicts in Multicultural Cities. A Selected Survey on Historical Bibliography
IEM	74.2005	*Alberto LONGO and Anil MARKANDYA*: Identification of Options and Policy Instruments for the Internalisation of External Costs of Electricity Generation. Dissemination of External Costs of Electricity Supply Making Electricity External Costs Known to Policy-Makers MAXIMA

NRM	115.2005	*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	116.2005	*Dan HOLLAND and Kurt SCHNIER (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	123.2005	*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	*Raphaël 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

(lxv) This paper was presented at the EuroConference on "Auctions and Market Design: Theory, Evidence and Applications" organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003

(lxvi) This paper has been presented at the 4th BioEcon Workshop on "Economic Analysis of Policies for Biodiversity Conservation" organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL) , Venice, August 28-29, 2003

(lxvii) This paper has been presented at the international conference on "Tourism and Sustainable Economic Development – Macro and Micro Economic Issues" jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003

(lxviii) This paper was presented at the ENGIME Workshop on "Governance and Policies in Multicultural Cities", Rome, June 5-6, 2003

(lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference "The Future of Climate Policy", Cagliari, Italy, 27-28 March 2003

(lxx) This paper was presented at the 9th Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004

(lxxi) This paper was presented at the EuroConference on "Auctions and Market Design: Theory, Evidence and Applications", organised by Fondazione Eni Enrico Mattei and Consip and sponsored by the EU, Rome, September 23-25, 2004

(lxxii) This paper was presented at the 10th Coalition Theory Network Workshop held in Paris, France on 28-29 January 2005 and organised by EUREQua.

(lxxiii) This paper was presented at the 2nd Workshop on "Inclusive Wealth and Accounting Prices" held in Trieste, Italy on 13-15 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics

(lxxiv) This paper was presented at the ENGIME Workshop on "Trust and social capital in multicultural cities" Athens, January 19-20, 2004

(lxxv) This paper was presented at the ENGIME Workshop on "Diversity as a source of growth" Rome November 18-19, 2004

(lxxvi) This paper was presented at the 3rd Workshop on Spatial-Dynamic Models of Economics and Ecosystems held in Trieste on 11-13 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics

(lxxvii) This paper was presented at the Workshop on Infectious Diseases: Ecological and Economic Approaches held in Trieste on 13-15 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics.

(lxxviii) 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.