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THE ECONOMICS OF INSURANCE AND CULTURAL HERITAGE IN A CHANGING WORLD[*]

Abstract

The purpose of this paper is to analyze the changes that have to be made in approaching insurance companies and museums as economic value creators in the 21st century. In doing so we shall try to point out the various economic methodologies needed to be redefined in trying to meet the new expectations both on a regulatory basis as well as on a customer basis and point out some basic similarities between the two sectors.

Key words:

Insurance, cultural heritage, museums, public good.

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in a Changing World

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1. Introduction

The inspiration for this paper is due to a project we have been working on, funded by the Scientific and

Technological Research Council of Turkey, the basic aim being to investigate risk awareness in museum management, to record risk measures taken, analyze the effectiveness of insurance and propose risk mitigation and risk management procedures. While trying to find out types of insurance coverage that were available in the market to cover risks of museums, travelling exhibitions or art in general, we became all the more aware that the issue of risk management when cultural heritage is the issue, should go beyond insurance, it should concentrate more on the minimization of risk and on developing conservation management plans rather than depending on insurance for the compensation of loss, since the loss is in this case a loss with no replacement and it is a loss to all society and to future generations. This brought us to looking at cultural heritage as a «public good» rather than a «market good», and our attention hence shifted towards the financing and preservation of public goods, part of which could be insurance. On the other hand in looking at the mission of a museum, especially as it is conceived in the modern world we grasped that it has a broad range of missions, educational, social and of course economical and metrics are being constructed for evaluating a museum in respect of the missions it fulfills. Thinking more broadly then, we looked at the insurance sector as a socioeconomic instrument rather than purely economic and that drove us towards making a comparison between these two, in terms of their roles as driving forces of the economy, their dependence on public attitudes, the ways they are evaluated by the public as well as by regulators or rating agencies, their social values and missions and their risk management priorities.

In Section 2 we give a comprehensive definition of relevant terms, in Section 3 we present an overview of insurance and cultural heritage as seen in the 21st century pointing at their new missions, and the financial and economic impact they produce. In section 4 we give the role of consumer behavior in the functioning of the two sectors, Section 5 presents current risk measurment and risk management procedures and finally in Section 6 we give potential areas for further research.

2. Basic definitions

Insurance is a risk managment technique, used to hedge against the risk of an uncertain loss by transferring

it to another party, namely the insurance company against a premium. Insurance companies take two basic risks, investment risk and underwriting risk. Well balanced investments of their assets in combination with sufficiently high premiums for the risks being underwritten generally compensate for claims of losses.

Cultural heritage refers to a set of recognized assets that reflect the historical, socioeconomic, political, scientific, artistic or educational importance of a good that has been created as a visible landmark by our ancestors (Riganty and Nijkamp 2005). We may say cultural heritage is everything that has an outstanding universal value and provides nations with a sense of identity and continuity. In its modern definition cultural heritage includes *tangible* (objects, monuments, sites) or *intangible* (songs, social practices, rituals) values as well as cultural landscapes (Jokilekto, 2005).

A *public good* is a good the consumption of which by a group of individuals does not reduce its availability for others (non-rivalry property*)*, and no one can be excluded from its use (non-excludability property). Public goods have a value beyond any purchase price, their value is related to the benefit they produce to the community as a whole. They often require large initial investment costs, a higher level of administration and are difficult to price. As such they are beyond the capacity of any individual or private corporation to finance. Public goods have «externalities», that is, value that accrues to people who benefit by other's consumption of them without paying for it themselves.

Cultural heritage may be considered to be a public good but both properties above have to be slackened. When the cultural heritage site is too crowded the non-rivalness property is violated to some degree. Similarly when there is an entrance fee the non-excludability condition may be said to be violated so cultuaral heritage is usually classified as a quasi public good. Congestion is considered to be a negative externality that reduces the benefits of the consumer. Tourism, employment and regional development may be considered production externalities while national identity, education and research are consumption externalities (Koboldt, 1995), (Frey and Meier, 2006).

Economic value of cultural heritage is defined as the amount of welfare that heritage generates for society. Total economic value is defined in terms of use and non-use values. The *use value* is the value one gets from actually visiting a certain heritage site or a monument (direct use) as well as all the recreational facilities it provides (indirect use). The *non-use* value on the other hand is the value it creates from simply the knowledge of its existence (existence value), the possibility of having the chance to visit it in some future time (option value)

and the satisfaction one has knowing that it will be a value for future generations (bequest value).

Willingness to pay is a measure of the value that the consumer attaches to the public good. It is defined as the largest amount of money that the person will be willing to pay to have the opportunity to acquire the good (Navrud and Ready, 2002).

Risk management is a set of operations to identify analyze and decide to accept, avoid or mitigate the uncertainty in financial decision making. It is the application of available resources so that overall risk is minimized. It is important to find the optimal level of risk reduction for long term sustainability rather than aiming at the minimization or avoidance of risk on a myopic scale.

3. Insurance and Cultural Heritage
at the Start of the 21st Century

The constant change of society, the technological developments and globalization have introduced pressing requirements on the insurance companies as well as to museums. Special services and special products are needed both as a means for better service as well as for being competitive in the market. Management is required to be carried with a holistic outlook, targeting for a sustainable long term operation. Risk management procedures are devised for the business as a whole rather than on a modular or departemental basis and new financing mechanisms have to be developed.

Insurance in our day has gone beyond its simple function of protecting a person against burglary, or a car crash as is in case of property insurance, or against early death as is the case in life insurance but has gained a social instrument status and has become an integral part of our business and social activities (Stempel, 2010).

Technological changes, global warming, increased number of catastrophes cause new risks to emerge and that is a threat. It is a threat since these new emerging risks carry high level of uncertainty, they are difficult to quantify and there is no benchmark for pricing and hence nobody wants to take a first move. Some of these risks are ageing infrastructure, food contaminants, silicosis, media risks, loss of reputation, cloning and others (Russel, 2007). Most of these will give rise to liability claims which may become quite high and may take a long time until they are settled which gives rise to the need of creating new loss reserving methodologies.

The increase in the frequency of natural disasters and particularly the correlated disasters after a single event as was seen in the last Japanese earthquake on March 2011, where we had the earthquake followed by the tsunami, the fire in oil deposit sites, radiation and power and all other related events like

the interruption of transport, the interruption of factory operations etc. implies that new ways of risk management should be assumed in the future. Insurance companies usually reinsure catastrophic claims but still they hold a buffer fund (reserve) to offset their retained portion. The reserve is usually from a contingency loading that the company puts on the premium but if such disasters are more frequent than what they have been, then the companies will have to explain to the insured why they will be paying higher premiums for otherwise low frequency events. Hence new funding methods, new capital requirements, new underwriting methods, and promotion of risk awareness would be necessary. Insurers have in recent years begun using catastrophe bonds, options, derivatives and other financial instruments to spread some of the risk of catastrophic events to the capital markets.

New products are being designed that try to provide for the changing needs of the insureds. *Micro insurance* products aim to provide some level of assurance for reletively low premiums, as a complement to social protection trying to give affordable protection to the poor against illness, old age and death and lately to the increasing extreme weather events due to global warming. With increasing longevity needs like homecare have emerged which have to be covered by modern products. Governments are trying to take measures for the well being of retirees, and are imposing rules on the way retirement benefits are being spent. Some countries like Germany and the UK are making it compulsory that an individual buy an annuity after a certain age with his accumulated retirement benefits, to protect them against unexpected longevity.

A new product that is being discussed is *Eco-Insurance* which is planned to be a potential tool for strategic management of environmentally induced risks to economic, environmental and human security. It is planned to be realized through public-private initiative and international cooperation between governments, the private sector, multilateral institutions, academia and the NGOs. The government will be expected to produce incentives such as investment tax credits for Eco-Insurance and co-financing (Lovink et.al, 2004).

Insurance business in our day is evaluated on an «economic value framework». Under this framework insurance companies determine the economic value of the capital invested in their business and the economic value of earnings to derive a risk-adjusted return on capital. This approach has led to the development of Solvency I and now of Slovency II standards which are going to come into practice for companies in Europe in January 2014. The rationale for such a legislation is to facilitate development of a single market in Europe. It is a leadway for determining minimum requirements of capital so that the risk that the insurer will be unable to meet his liabilities is minimized. The purpose is to reduce the losses suffered by policyholders in the event that a firm is unable to meet all claims fully, to provide early warning to supervisors so that they can intervene promptly if capital falls below the required level and to promote confidence in the financial stability of the insurance sector.

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http://ec.europa.eu/internal_market/insurance/solvency/index_en.htm. Besides defining regulations for quantitative requirements, it also sets out requirements for governance and focuses on disclosure and transparency. For a discussion of the the Solvency II standards in terms of the «economic value» creation outlook another good reference is a report produced by PriceWaterhouse (2008) and may be found at http://www.pwc.com/us/en/insurance/economic-measurement-insurance-liabilities.jhtml

Museums in our day, to be considered successful, have to state clearly their roles and missions and they have to produce internationally standardized data, and the digitization of their operations is becoming compulsory. NUMERIC, is a European Commission project aiming at the digitization of cultural heritage in Europe while EGMUS (European Statistics Group www.egmus.eu) is collecting standardized and comparable statistics for museums in Europe. Museums can take different organisational forms. Mainly, they can be private for-profit organisations, private non-profit organisations and public organisations run in a non-profitable way. The role of a museum can be modelled in two different ways: the first approach is maximising utility of a museum in a benevolent way, while the second approach is more institutional and emphisizes the importance of intitutional settings like the dependence on public support (Frey and Meier 2006). While in the 20th century the focus was on presentation and display, the focus now has shifted on audience engagement and experiences, museums now are expected to act in highly collaborative partnerships and have learning outcomes as a proxy for success. The educational mission of the museums has started to become all the more important and sharing the cultural heritage in their custody has increased collection mobility. Studies show that the number of museum visitors (as an indicator of public interest) depends on having an active exhibitions programme. Temporary exhibitions also encourage the public to revisit the permanent collection which is a benefit. This mobility on the other hand has brought the need for protection mechanisms during transfer. State indemnity schemes are a partial solution to the mobility problem. The Institute of Museums and Library Services(IMLS) 2010 report says the following (http://www.imls.gov/assets/1/AssetManager/DiscussionGuide.pdf) :

«If [a museum] fails to provide a social benefit, it wastes society's resources. To produce a social outcome–to provide a positive benefit to its targeted audiences–must be such an organization's first responsibility. Museums must not merely do things right, they must do the right things».

Maxwell (2004), from The Getty Leadership Institute points out that half a century ago, art museums were largely measured in terms of the size and importance of their collection but in our day there is no longer an agreed upon method of measuring achievement. He defines a set of metrics and points out that the metrics must have three attributes, they should be directly connected with the core values amd mission of art musuem, should be reliable indicators of long term organisational and financial health and should be easily verified and reported. His set of metrics, are quality of experience, fulfillment of educational mendate, institutional reputation, management priorities and achievements, cali-

ber and diversity of staff , standard of governance, scope and quality of collection, contributions to scholarship, contributions to art conservation, quality of exhibitions, facilities' contribution to core mission. He defines at least 10 operations under each heading that have to be evaluated by attendees and lead towards the final evaluation but does not mention any scale or evaluation benchmark. The main question to ask of course is whether social benefit or economic benefit should be a proxy or in what way can we define a balancing definition. Weil, S. (2005) forms a matrix such that the «mission versus market» priorities are evaluated.

3.1. Insurance companies and museums as financial stimulators

In the introduction of the annual report of CEA(European insurance and reinsurance federation), it is stated that European insurers have generated a premium income of over 1100bn Euros, employed 1 million people and invested more tha 7500bn Euros in the economy (2010 figures). Moreover it is seen that European insurers withstood the economic crisis well showing a 3.5% increase in gross premiums.

Ryphama (2005) points out that cultural heritage creates jobs and household income, heritage tourism, property value and small business incubation. In Norway, historic rehabilitation creates 16.5% more jobs than new construction and every direct job in the cultural heritage sector creates 26.7 indirect jobs, compared to the auto industry where the factor is only 6.3 to 1.

Greffe (2009) has carried out a study for measuring the economic impact of the Louvre on the French economy. The author applies three different approaches in evaluating the financial impact and finds out that the Louvre's impact on the French economy varies from €936 million to €1.157 billion, depending on the option selected, the net number of jobs created varies from 10,292 under the most adverse scenario to 21,225 under the most favorable scenario and an average net tax gain of €39 million may be conceived.

In Greece the new Acropolis museum has created an increase of % 203,4 in the number of visitors and an increase in income of % 230 while the increase without the Acropolis museum was just % 38. The values are given by the Greek state statistics authority for January 2010 in comparison with January 2009. The total number of visitors for the period January-December 2010 was 1.3 million.

In Turkey the Aghia Sophia museum had a total of 3 million visitors in 2010 while in restoration. To see the effect of restoration statistics of January 2010 were compared with January 2011 when the retoration was over and an increase of 18.7% was seen which is attributed to the completion of the restoration (Earnst Young, Istanbul Cultural Center 2010 Impact report)

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Picasso in The Metropolitan Museum of Art, on view from April 27 through August 15, 2010, drew 703,256 visitors. Doug + Mike Starn on the Roof: Big Bambú, shown from April 27 through October 31, 2010, attracted 631,064. The survey found that 72% of the Met's summer visitors traveled from outside the five boroughs of New York. The median length of stay in the City was five nights and the average spending per person was on average $ 1050. The Metropolitan museum does not charge any fee so the museum does not directly benefit however it adds on value to the economic development of the city. Both institutions besides creating higher financial impact than the production sector they in addition have and a social function which adds even more value to their existence.

3.2. Economic Value of Insurance and Cultural Heritage

Considering the role of insurance in economic development we see that insurance contributes to economic growth as well as to the well-being of the poor so it has a social value as well. One of the arguments is that the availability of insurance enables risk averse managers to undertake higher risk and higher return activities than they would do in the absence of insurance. This in its turn promotes higher productivity and growth. On the other hand when we look at life insurance for example, we see that companies have long term liabilities and are obliged to keep reserves which may reach huge values and these would be invested in the financial market. This makes insurers serve as institutional investors providing capital to infrastructure and other long term investments. Moreover insurance can be thought as complementary to banking especially in facilitating credit transactions (Schmalensee, 2006)

Cultural heritage is a historical social asset that cannot be substituted in case of loss or damage and as such differs from normal economic goods. There is essentially no market for such goods since they cannot be replaced or reproduced, but these goods produce value. In Section 2 economic value of cultural heritage was said to be comprised of use and non-use value and that cultural heritage could be treated as a public good. Mazzanti (2003) points out that economic benefits should be disentangled in microeconomic and macroeconomic benefits. Quoting the author:

«*Microeconomic approach accrues to individuals as users of cultural heritage, macroeconomic value arises at a systemic level, involving society(the region, the country of reference as a whole). Such benefits may be measured either in monetary terms(flows of monetary units arising out of a stock of cultural capital) or non-monetary (i. e. occupation generated by cultural activites)*».

The consumer's point of view in attaching value, may be considered to be a welfare economics approach, in which we define value in terms of the amount the individual is willing to pay for a change in the level of the commodity. In

terms of cultural heritage we may be asking the individuals whether they would be willing to pay, and if so what amount would they be willing to pay for example for the preservation of some site, or for the addition of new educational services in a museum, the increase of publications etc.

If the proxy in evaluating economic value is revenue production then it means that it should be preserved as long as possible to create ongoing revenue. However here once more we are faced with a controversy. The more the cultural heritage site is exposed to visitors for the sole purpose of creating revenue, the faster it starts to lose value due to overuse. Examples of this is the possible detorioration (and hence loss of value) of several cultural heritage objects in a museum due to the air pollution that too many visitors give rise to, or to too much exposition to light and heat due to long hours of operation.

4. The Role of Consumer Behavior

The success of both sectors depends highly on the ability of management to understand and correctly evaluate consumer preferences and human behavior.

People who buy insurance, are those who value the «ease of mind» that insurance provides much more than those that prefer to self-insure. They prefer to pay a premium to transfer a possible loss to an insurer rather than living with the uncertainty. The amount of premium that they would pay depends highly on their degree of risk aversion and the way they evaluate the risk they represent. Risk prone individuals would mostly buy no insurance. The insurer who declares a price (premium) for a certain product, is never sure whether his risk estimate for the insured individual is correct. He applies *underwriting* to achieve a certain level of screening and attain homogeneous portfolios, but the process is costly. One of the risks that the insurer is faced in case risk classification is not sufficient, is *adverse selection*. High risk insureds (unhealthy people for example) finding the premium low in terms of the evaluation of their own risk, will buy more insurance than they would otherwise do, and this will destroy the equilibrium that the insurer hopes to have. Another issue that individual behavior effects is that of *moral hazard*. Full insurance provides too much of a protection and after buying insurance people do not pay the care that they would without insurance. This attitude makes them more risky then they originally appeared to be and the product they have bought then becomes underpriced which in the long run may put the company's solvency at risk. The third point to be mentioned under insurance operations is *fraud* which is the attempt of the insured to claim a payment without having experienced a loss in reality. One of the lines where fraudulent claims are frequently encountered is health insurance where both the insured and the health care provisor have a benefit (to the disadvantage of the insurer of course), and nowadays the great threat is auto producing. Fraudelent claims give rise to billions of yearly losses to the companies but no effective solution has yet been produced.

Similarly cultural heritage management will have to know how much value the individuals would attach to cultural heritage. Survey studies have to be carried out to determine the willingness to pay but these are costly. It is known that there are intrinsic motivations, extrinsic motivations and reputational motivations that drive the people to give money for goods that they might not even have a chance to see. However the willingness to pay declaration depends on many factors. It depends highly on the level that the people understand the survey questions at stake, have enough information, and declare their true preferences. It is also a function of people's financial and educational backgrounds. Parallel to adverse selection in insurance we have here the *free rider* problem. Being a public good, people might give false signalling as to their preferences so that they benefit as a free riders. If too many consumers decide to free-ride, private costs exceed private benefits and the incentive to provide the good or service through the market disappears. Details on the surveys and their applications are given in Appendix II.

A new research area known as *benefit transfer* analysis is developing looking at how much information can be transferred from a study that has been completed at some site to another site where a certain policy decision is going to be given. Such studies have been carried out for environmental probems but not yet for cultural heritage so it is an open area of study (Riganti and Nijkamp, 2005). It is important however to understand the effect that population and demographic characteristics might have on the analysis so that decisions are not irrelevant. These studies are closely linked to *meta analysis* which is an integration of findings derived from different statistical analyses. In terms of cultural studies the value to be transferred would be the willingness to pay variable.

The above discussion implies that both institutions have to create incentives for correct action. Those incentives would be for participating in the preservation and betterment of the cultural sector on one hand and creating deterrence schemes for minimizing fraud and adverse selection in the insurance sector.

5. Risk Measurement and Risk Management

Insurance companies have been trending towards a higher risk profile. The risks they carry include insurance risk, credit risk, operational risk, market risk as well as liquidty risk, reputational risk, strategic risk, legal risk and business risk. Risk management of the companies has shifted towards an enterprise risk management approach where all the risks are considered together. This gives rise to the need of defining new risk measures that consider the interrelations between the various risks. The new regulatory agenda known as Solvency II defines capital allocation standards between these various risks as well as rules for minimum capital. Insurance companies are obliged to have *internal models* to assess their own risks, besides the risk capital defined by the Solvency II standards. In our day models have moved from deterministic to stochastic, dynamic decision making is required, rather than calculating discounted prof-

its companies are expected to produce realistic balance sheets, they have to test extreme scenarios and they have to find new hedging procedures for their risk (Kabbaj and Zeilstra, 2003).

When we look at the insurance business we have cash inflows and cash outflows. The insurance company has some initial capital, collects premiums and pays claims. One of the basic risks comes through wrong pricing.

For example when pricing a life insurance product the insurer makes some assumption about mortality, lapse rates and surrenders, has an interest assumption for discounting future liabilities and has estimates for expenses. If enough screening of the insureds was not done, the company could have accepted substandard risks and this will give rise to a mortality loss, could have estimated a higher interest than that which was realized in the market and could have underestimated expenses. Considering that life insurance is a long term commitement if all three go wrong than the company is sure to go bankrupt at one point. The risk becomes even more severe when products carry guarantees. The companies then have to hedge their liabilities in the capital markets but then again there are usually no instruments of so long a period and hence the company has to function in an incomplete market.

When we come to non-life insurance things are even more complicated. There it is not only the frequency of claims but it is also the severity of claims that carry uncertainty. There is huge amount of data but usually it is dirty so data mining techniques have to be used. The parameters effecting the premiums in a non-life insurance calculation are larger in number so GLM models are used to determine the most effective attributes. Moreover the company when deciding on its capital it has to consider to have reserves for claims that have accrued but not been settled. Regulators are now imposing methodologies to be used for the calculation of claim reserves.

Risk measurement for insurance companies involves the assessment as well as the distribution of capital (Cummins, 2000). Under the new regulatory regime two types of capital are defined which companies are expected to carry.

Risk Bearing Capital is defined as the financial statement assets minus financial statement liabilities. The criticism against this is that it is not a dynamic view of an ongoing active company.

Risk Adjusted Capital is defined as the sum of *depletion capital* and *risk tolerance capital*. Depletion capital is defined as the expected capital reduction from an adverse year (1% shortfall) while risk tolerance capital is defined as the capital required to continue business after an adverse year.

New risk measures are being constructed for this very purpose. The mathematical modelling of these risk measures is given in Appendix I.

One other risk of insurance companies is growth. Management generally sees it as a benfit to increase the size of the portfolio. But increasing the size gives rise to the need for more capital which is generally overlooked.

This reminds us of the loss of value of cultural heritage due to over use which is in a way implies an increase in the portfolio of visitors.

Cultural heritage management has to deal with a diversity of risks. These range from those posed by natural hazards such as floods and earthquakes, those attributable to remote human activities such as pollution and fire, and those due to wear and tear. The objects in a museum are effected by many and diversified risks. Depending on the type of the heritage good, the level at which each one of the risks effects it differs. The risks that lead to wear and tear are usually relative humidity, temperature, light levels, pests and polluntants. Regular follow up procedures have to be set at an optimal way (Walker, 2009).

One of the decisions that museum management has to give is the level of preservation they want to exercise. Torre and Mason (1999) in a report of the Getty Conservation Institute, discuss the different views that may be attached to benefit of conservation. They say «*preservation is not an end but the means towards an end- described in terms of cultural confidence, cultural diversity or a strong sense of place*». They point out that new approaches and methodologies have to be defined so as to evaluate cultural heritage preservation in terms of sustainability and cultural capital.

The risk managers of the museum have to give an important decision: to what level is it desired to minimize risk, is there an optimal and cost efficient risk mitigation level. Waller, R. (1995, 2002) develops a multilevel model for risk assessment and assigns values to the magnitude of the risk. The scientific methods he uses is of no interest to this particular study, what is important however is the new approach he introduces to collection management that involves also the optimality of decisions in terms of economic values. He expresses his aim as follows:

«*We do not strive to eliminate risk. Instead we manage risk to a level such that the normative choice is to make no further investments in risk reduction. The aim is to forecast risk rather than stopping at the level of measuring damage to property*».

6. Challenges for the future

This study has shown several directions for further research. Insurance company operations are well defined, methodologies have been created to serve the functioning of companies, but still there is need for defining new operational and risk assessment mechanisms. Looking at cultural heritage modelling on the other hand, we see that methodologies that have been used to our day, like the survey methods for determining willingness to pay, have been largely borrowed from environmental studies. Johnson and Thomas (1998) give quite an extensive list for potential research concerning the economic modelling of museums, stressing the need for the development of theoretical models, the need for new definitions of growth, the possible effect of digitization of museum

objects and the creation of virtual musuems, the evaluation of altruistic behavior and the role of the state in funding museum operations.

One major difference that seperates the insurance business from the cultural heritage business is that there are nearly no studies that define some kind of optimisation for the functioning of cultural heritage institutions. One such study is by Koboldt (1995), where he proposes a solution for optimizing the use of cultural heritage under 3 different targets. The first one is maximizing welfare, the second is profit maximization through increasing the supply, optimization under a zero profit constraint and supply with a fixed cost subsidy. He defines a decision process on the price to charge and the resulting demand.

Another direction is the need for defining new funding mechanisms. Both the insurance as well as the cultural heritage sectors have to devise hybrid funding systems whereby both the government as well as the institution has to participate. These might be thought as complementary systems like the social insurance and private insurance combination or health care systems. Similarly if governments devise a successful incentive program for funding cultural heritage through financial assistance, free expert advice, legal instruments or tax incentives the results will help in the development of community identity. Sable and Kling (2001), introduce the idea of a double public good whereby social welfare is modeled as depending on both public and private benefits and it highlights the need for dual-level policy making in order to avoid unbalanced heritage conservation.

It is a common practice for a museum not to insure the permanent exhibition. Insurance for museums if any is no more than a homewoners insurance or fine arts insurance for protection against standard perils. It is only when the heritage goods are on loan that insurance becomes an issue. There are state indemnity schemes for reducing the financial burden of the organiser because he does not have to buy insurance. They are also an assurance for the lender because he knows that he will have compensation from the state in case anything happens to the property. However the government does not always guarantee 100% compensation for damage, theft or loss of value. Whenever there are exclusions a shared liability system may provide the solution. A shared liability systems is an agreement between the two museums(lender and borrower). The issue of insurance however is still an open question. The question of «how much insurance», «how much protection» is still a subject that is under discussion.

Shantayanan, D. and Jack, W. (2007) discuss social protection policies by considering the tradeoff between risk reduction and insurance and Holzmann, R., and Jorgensen, S. (2000), propose a new definition for social protection grounded in social management. These studies and the ideas of Eco-Insurance introduced in Section 3 may lead to new ideas in risk management of cultural heritage.

Another line of research is meta analysis which is further linked to benefit transfer analysis. Noonan (2003) has carried out a meta analytic study of the literature on contingent valuation methods. There are not many studies of benefit

transfer applied for cultural heritage and it is still an open field. The work by Tuan et.al. (2009) and Riganti and Nijkamp (2005) may serve as references. The benefit transfer studies may be further developed by analyzing the credibility and experience rating methodologies that are applied in insurance rating (Klugman, 1992).

On a more technical level new statistical methods, new distributions for the willingness to pay modelling may be developed. The extensive experience of actuaries on distribution modelling may serve as a reference point. Random Utility theory has been tried in a few studies and may be developed further. Regret theory may take the place of utility theory in modelling consumer behavior. There are a few studies for defining insurance decisions and it may be applicable in the modelling of the willingness to pay for cultural heritage as well. Fuzzy modelling may be carried out in defining the risk levels and in developing preservation plans.

7. Appendix I

An insuarance company undertakes the risk of the insured against a premium. It has an initial capital, collects premiums and pays claims. The larger the insurance company the larger the capital that it must have at hand although usually there is not a one-to one correspondance. When the risk it has undertaken is too much to withold it transfers part of it to the reinsurer. So insurance is a means of risk sharing between the insured and the insurance company as well as between the insurer and the reinsurer.

It is assumed that risk averse people who buy insurance are willing to pay a premium that is larger than the expected value of losses. This implies that the person attaches a value to his wealth that is different than its monetary value. The premium P^+ that the person would be willing to pay satisfies

$$E[u(w - X)] = u(w - P^+) \tag{1}$$

where u(.) is his utility of wealth, w is his initial wealth and X is the random risk he is expected to face. Similarly the insurer has to charge a premium that is higher than the expected losses, to account for contingencies, and hence he defines a minimum premium P^- for which he will be willing to sell the product. Both parties acquire a higher utility and the policy becomes feasible if the premium satisfies

$$P^- \leq P \leq P^+ \tag{2}$$

The utility function of a risk averse individual would be increasing in wealth and concave down implying that they prefer a fixed loss to a random loss of the same expected value. Expected Utility was brought into the economics of

insurance by Borch (1961). Borch's sheds light to how risk can be optimally shared between economic agents, and how should the the insurance industry best be organised so that social security and social welfare is increased. He models reinsurance arrangements as a bargaining game and he uses Pareto optimality to characterize the preferred solution. He shows that under a fair premium it is to the interest of the parties to buy full insurance. A basic reference for his work is Borch(1974).

The *mean variance* analysis of Markowitz's portfolio theory does not adequately describe insurance risks, since most insurance risks are highly skewed and have long thick tails.

Another approach is Yaari's dual theory of choice. While expected utility assigns a value to a prospect by taking a transformed expectation that is linear in probabilities but not linear in wealth, that is

$$E[U(W)] = \sum_{i=1}^{n} p_i u(w_i) \qquad (3)$$

Yaari's dual theory does exactly the reverse, in other words, distorts the probabilities but ends up in a formulation that is linear in wealth. Using Yaari's duality theory Wang has derived risk adjusted premiums, that is premiums that contain inherent risk loading (Wang 1995). He introduces a proportional hazards transform(PH) for the probability distrortion defined as a map

$$\Pi_\rho : S_X(t) \mapsto S_Y(t)$$

$$S_Y(t) = [S_X(t)]^{1/\rho} \qquad (4)$$

with $S_X(t) = \Pr\{X > t\}$ and $\rho > 0$, an exogeneous index that determines the extent of distortion (can be thought as the risk aversion parameter in EU).

He defines the certainty equivalent premium as the PH mean which is given as

$$\pi_\rho(X) = \int_0^\infty [S_X(t)]^{1/\rho} \, dt \qquad \rho \geq 1 \qquad (5)$$

There are other premium principles and details on this subject may be found in Premium Principles http://media.wiley.com/product_data/excerpt/63/04708467/0470846763-6.pd but are beyond the scope of this paper.

What we have presented so far is a means for pricing an insurance product. The premium is a risk measure. Another major decision that an insurance company has to give is what capital it should have at hand so that it remains solvent. Below we provide a generalization of risk measures to cover premium principles, technical provisions and solvency capital requirements.

7.1 Risk Measures

A risk measure may be defined as a mapping from the set of quantifiable risks to the real line

$$X \mapsto \rho(X) \tag{6}$$

Risk measures include ordinary values like the mean, the standard deviation, the variance as well as measures like probability of ruin, value at risk, tail value at risk, distorted riks measures and others.

There are several properties that risk measures are expected to satisfy so that results are coherent. We herewith give the properties as defined by Artzner et al (1998). Coherent risk measures have to satisfy the following four axioms:

1. Positive homogeneity, namely $\rho(\lambda X) = \lambda \rho(X)$

2. Translation invariance, namely $\rho(X + k) = \rho(X) + k$

3. Monotonicity, namely for $X \geq Y$, we have $\rho(X) \geq \rho(Y)$ $\quad$ (7)

4. Subadditivity, namely $\rho(X + Y) \leq \rho(X) + \rho(Y)$

The Var(or quantile) measure is equivalent to to the probability of maximum loss. Although it is a standard measure for banking when insurance business is concerned it has several drawbacks. The major drawback is that it does not satisfy the subadditivity condition. The property implies that diversification reduces risk and Var does not satisfy this. Another drawback of Var is that it does not give some sense of how bad is your deficiency. These two issues introduce TVar (or CTE; conditional tail expectation) as a better risk measure although not the best, for insurance. This measure gives a sense of «how bad is bad», it is actually the mean size of losses exceeding Var and is defined for a confidence level α as,

$$TVaR_\alpha(X) = \frac{1}{1-\alpha} \int_\alpha^1 VaR_q(X)dq \tag{8}$$

for the discrete case, and

$$CTE_\alpha(X) = E\big[X \big| X > VaR_\alpha(X)\big] \tag{9}$$

Extended discussions on risk measures and their implications for insurance may be found in (Kaye, P, 2005)

Another problem that insurance modelling faces is the need for defining measures for a collection of risks. For example interest rate risk and credit risk are not additive as a result of the unknown correlation between the two (Boyle 1995).The problem that the insurer is faced is that of defining a combined risk

that includes operational, market and credit risk together. However the problem is that we are faced with the problem of defining a risk measure for (X_1, X_2, X_3) for which we know nothing about the joint distribution, but we have information about the marginal. That drove researchers to introduce a new notion, known as commotonicity. Commonotonic risks satisfy a series of conditions as given in Dhaene, J. et al (2002, 2004, 2011).

As far as insurance is concerned the introduction of commonotonic risks has given the actuary a tool to find an approximation for the distribution of dependent risks as well as approximations for the risk measure of the sum of dependent risks.

8. Appendix II

8.1 Economic Models of Cultural Heritage

There are two classes of survey methods that lead to the attainment of an economic value for a cultural heritage good. The first class is known as **revealed preference** methods and includes the *travel cost method* and the *hedonic price approach* and the second class is the **stated preference** methods and includes the contingent valuation method, the *conjoint* and *choice* models. Both of these aim at determining the willingness to pay anda re survey based methodologies.

The *travel cost* method attempts to deduce value from observed behavior and assumes that the total travel cost to a cultural site is a measure to the economic value attached to the site by the visitor. The *hedonic price* models examine the contribution of different attributes to price for housing, wage levels including environmental quality.

Contingent valuation is carried out by asking consumers directly on their willingness to pay for cultural heritage. It is a single attribute survey method. The questions that are asked may be open ended, closed ended (referandum type) or two stage double dichotomous. There are several problems with this method that derives from the way the questions are posed. Throsby (2003), questions whether the contingent valuation methods are efficient in capturing all aspects of the economic value of cultural goods, He points out that the CVM presuposses that the decision makers behave rationally in trying to maximize their utility under known constraints. It also assumes that consumer have well defined preferences for public goods and that this demand can be measured by the amount of other goods they are prepared to give up. One problem that we are faced when carrying on a CVM study for cultural goods is that people may not have enough information about the cultural heritage good they are asked to define a price they are willing to pay. Other problems with this method is with the single ended

questions where they are directly asked to declare a price. Usually people do not have enough insight to give an answer and extreme values may come out, moreover protest zeros have to be cleared.

The outcome is a value for the willingness to pay, it may be the mean value or the median of the answers and confidence intervals may be devised. To be able to attach an economic value to the results of the survey a utility function is defined. Solutions are derived by using probit or logit methods depending on the model. Details on creating intervals for the point estimators as well as on defining statistical efficiency measures an extensive study is by (Hanneman and Kanninen, 1999). Some studies that have used the Contingent valuation method in cultural heritage problems. Literature on this may be found in Bedate et al (2006), Fonesca and Rebelo (2010), Navrud and Ready (2002), Throsby, 2006.

Conjoint and choice models are multi-attribute models and are basically derivatives of contingent valuation models. Those that participate in the suvey give their preferences for a set of attributes. Moreover some studies now have started to do a segmentation analysis over the socioeconomic attributes like age, educational level, and location of the participators and try to extract information of the willingness to pay in terms of these attributes.

Massiani and Rosato, (2008), Montenegro et al. (2010), Mazzanti et al. (2006), Santagata and Signorello (2000). Ruijgrok (2006), for a case study in Netherlands evaluates housing comfort value, recreation value and bequest value by using the hedonic price method and contingent valuation method. He compares costs and potential income and deduces that economic benefits of conserving cultural heritage surpass its cost. He carries his analysis assuming income and costs from the three values are independent. It might be of interest to look whether any correlations exist and look at the cost/benefit results under such an assumption.

Impact analyses are carried out to determine the driving effect that the activities of a cultural institution will have on the economy. The yearly monetary flows are evaluated without any consideration given to the cultural or educational effects.

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