



RESEARCH REPORT

No. 2001-RR1

Existence Value: A Re-appraisal and Cross-Cultural Comparison

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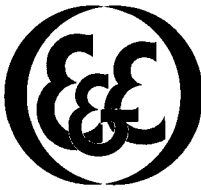
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R E S E A R C H R E P O R T

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EXISTENCE VALUE: A RE-APPRAISAL AND CROSS-CULTURAL COMPARISON

Billy Manoka

ABSTRACT

This research compared existence values held by Portland, Maine (United States) and Port Moresby (Papua New Guinea) residents for the preservation of an additional five percent of the world's tropical rain forests and identified economic and non-economic components of existence value and use values. Existence value was narrowly defined as cognitive in nature; it is the value placed on simply knowing tropical rain forests exists independent of current and future use values. Between November 1998 and February 1999, a 16 page mail-back questionnaire was sent to a random sample of residents in Portland and Port Moresby. A total of 330 and 461 questionnaires were returned from Portland, and Port Moresby, respectively for an overall response rate of 41 and 49 percent, respectively.

The results indicated that non-economic components of mean willingness to pay (WTP) accounted for at least 50 percent of the total value for both Portland and Port Moresby residents. Non-economic components of existence value (intrinsic value, good cause, moral duty etc) and use value (non-paternalistic altruism) were excluded to avoid presenting overestimated benefits. Portland and Port Moresby WTP estimates were found to be statistically different from each other. This finding invalidated the assumption that benefits could be directly transferable between countries, especially between developed and developing countries. This result was also supported by evidence of statistical differences in motives and socioeconomic variables between Portland and Port Moresby respondents. Portland residents generally had a higher value for existence (as a proportion of total mean WTP) than Port Moresby residents. Both the Portland and Port Moresby WTP estimates were lower than Kramer and Mercers' (1997) US estimates.

Results from the attitudinal models showed that Port Moresby respondents were more environment-oriented than Portland respondents were. The latter were more development oriented. Port Moresby respondents expressed the sentiment that the rich nations of the world (including the US) should bear the responsibility of preserving tropical rain forests.

1.0 INTRODUCTION

1.1 Overview

This study is an extension of Kramer and Mercer's (1997) analysis of the economic value of tropical rain forest preservation. Kramer and Mercer estimated United States (US) resident's willingness to pay (WTP) to preserve an additional five percent of the world's tropical rain forests¹. This study expanded on this work in three respects. First, the analysis was expanded to compare the WTP of Port Moresby, Papua New Guinea (PNG)² and Portland, Maine (US) residents. Not only is preserving tropical rain forests a truly global issue, it has often been framed as a developed country versus developing country issue as evidenced by the 1992 Rio Conference. Second, the extent of differences in WTP between Portland residents and Port Moresby residents was examined based on cultural orientation, motives and socioeconomic differences. Third, this study, which focused primarily on existence value, investigated the motives underlying existence value and identified the economic and non-economic components of WTP.

The study was motivated by two concerns. First, in general the concept of existence value has not been carefully defined. As a result, empirical existence value estimates often included non-economic components (intrinsic value, ethical, moral and social values) that should not be included in benefit-cost analysis and damage assessment. Second, existence values for environmental goods such as rain forest preservation are global, but little is known about the value of these resources to those living outside the US. This research compared existence values held by Portland and Port Moresby residents for the preservation of tropical rain forests and examined whether or not these were legitimate economic values for use in benefit-cost analysis and damage assessments.

1.2 Research Problem and Policy Relevance

Krutilla first defined existence value in 1967, but subsequent definitions by various economists have led to considerable confusion. For example, Bergstrom and Reiling (unpublished) asserted that "There is not a clear consensus among economists as to the economic definition of existence value." As a result, some contingent valuation (CV) studies might measure both non-

¹ Portland residents were asked to pay for rain forest preservation even though they lived thousands of miles from the locales where protection activities take place because they benefit from the role that tropical forests play in carbon cycles, climate regulation and genetic resource conservation.

² Port Moresby residents derived benefits that are both local (e.g., timber, fuelwood, medicinal plants, food, etc) and global in nature.

economic and economic components of existence value. On the other hand, important economic values may not be measured. The implications for benefit-cost analysis and damage assessment and decision-making in general are potentially immense.

The comparison of Portland and Port Moresby residents' existence values and WTP would show whether or not Portland (US) values are directly transferable to Port Moresby (PNG). Results of such comparison and other aspect of the study may provide information that could be useful in the formulation of local and global conservation policies.

1.3 Economic Existence Value Defined

Existence value as variously defined in the literature includes bequest value, cognitive value, non-paternalistic altruism, paternalistic altruism, option value, intrinsic value, ethical, moral and social values. (See for example, McConnell 1983, Randall and Stoll 1983, Brookshire, Eubanks and Sorg 1986, Madariaga and McConnell 1987, Smith 1987, Boyle and Bishop 1987, Loomis 1988, Stevens et al 1991, Bishop and Welsh 1992, Silberman, Gerlowski and Williams 1992, Kopp 1992, Larson, 1993, Freeman 1993, McConnell 1997, Kramer and Mercer 1997, and Gowdy 1997). Since some of these preferences are not measurable in terms of a Hicksian compensating or equivalent welfare measure, they are strictly non-economic, social (ethical, moral and social values) and universal (intrinsic) values and should be excluded from economic efficiency analysis. It is argued that intrinsic value and social/ethical values are non-economic values because they do not involve indifference and tradeoffs between consumption bundles or between income and consumption bundles. Theoretically there is, therefore, no Hicksian compensating or equivalent measure that reflects economic motives and well being.

In this study, economic existence value was defined as cognitive in nature; it is the value placed on simply knowing tropical rain forests exist, independent of current and future use values. Because the motive relates to the resource itself (in this case, tropical rain forests), it was assumed that the individual is expressing a trade-off between his income and tropical rain forests. Economic existence value is a nonuse or passive use value because direct and indirect on-site interactions between the individual and tropical rain forests do not occur. The interaction is non-consumptive, indirect and off-site. In fact, economic existence value is the only nonuse value. Branches II, a and b in Figure 1.1 depicts this. Economic existence value is value associated with the time devoted to environmental issues like deforestation (branch c), with merely thinking about tropical rain forests (branch d), with knowing that other individuals know that tropical rain forests exist in the present (branch e; i) and

with knowing that one's heirs will enjoy the knowledge that tropical rain forests exists in the future (branch e;ii). Values in branch e are classified as nonuse altruism because the benefits are indirect, offsite and cognitive.

Use value (branch I) now includes bequest value (branch C), use altruism (branch D) and nonuser's option value (branch E). These values are classified as use values because direct, on-site interactions between individuals and tropical rain forests occur in the present (paternalistic use altruism) and the future (bequest and passive user's option value). Both users and passive users of tropical rain forests may express these motives. For example, an individual, whether a user or a passive user, may be willing to pay to preserve more of the world's tropical rain forests because he or she values the quantity of services from tropical rain forests received by others (i.e., other users or beneficiaries of tropical rain forests). Such motive was classified as paternalistic use altruism.

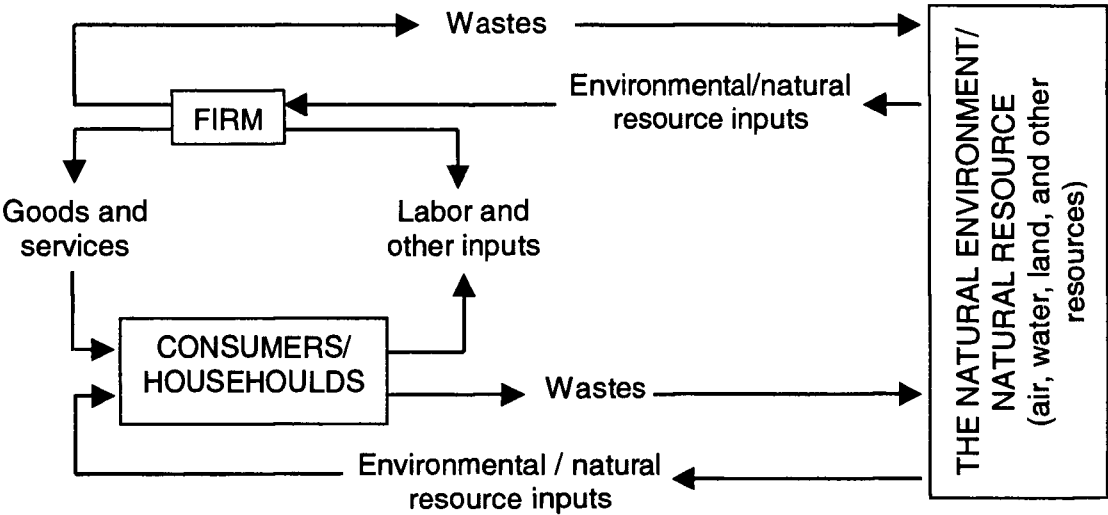


Figure 1.1. The complete economic system.

Non-paternalistic altruism is non-economic and is therefore irrelevant in benefit-cost analysis (McConnell 1997). The general public, G, has non-paternalistic altruism when G's utility also depends on B's utility. If a project costs \$1,000 and the user, B, is willing to pay only half of it (\$500), then net benefits can only be positive if the general public, G, is willing to pay more than \$500. If the beneficiaries are asked to bear the cost of the project, they will experience a fall in their utility, hence G's expenditure will fall as they get negative utility associated with the members of B. Therefore the project cannot be adopted. Thus, use value motivated by non-paternalistic altruism should not be used in benefit-cost analysis.

An individual may also express a bequest motive for future users of tropical rain forests. Moreover, a passive user of tropical rain forests may be

motivated by the desire to pay to preserve more rain forests now so that he or she may have the opportunity to use the resource some time in the future (option value).

In sum, the total economic value (TEV) of tropical rain forests is defined as:

TEV = UV (use value) + NUV (nonuse value)

UV = consumptive use + non-consumptive use + user's option value + nonuser's option value + bequest value + paternalistic altruism

NUV = Economic Existence value □ Cognitive value

1.4 Background

A tropical rain forest consists of three layers of life: the canopy, the understory and the forest floor. The canopy is the rain forests' green ceiling treetops, which can stand as high as 55-75 meters tall. The canopy houses animals of the rain forest such as monkeys, birds, tree frogs and even snakes. The understory consists of young trees, ferns and shrubs that are under the canopy, most of which do not grow to adult size because the canopy blocks out much of the sunlight. The third layer, the forest floor is almost bare, except for rotting vegetation, which nourishes the thin tropical soil. Large mammals, like jaguars and African gorillas, live here. Some of the animals mentioned above, such as the monkey, jaguar and gorilla, do not live in the tropical rain forest of Papua New Guinea (PNG). However, the PNG rain forest is home to one of the most beautiful and exotic birds in the world, the Bird of Paradise.

Tropical rain forests are located around the equator where temperatures stay at 80 degrees Fahrenheit year round. They receive 400-1,000 cm of rain each year. Tropical rain forests grow across three large regions of the world: Central and South America³ (most extensively in the Amazon), Southeast Asia and adjacent islands, and West Africa (Figure 1.2). The largest rain forests are in Brazil (South America), Zaire (West Africa) and Indonesia (Southeast Asia). Other tropical rain forests are in Hawaii (US), the islands of the Pacific (including PNG), northern Australia and the Caribbean. Closed tropical forests⁴ contain more than half of the world's species, though they cover only 7 percent of the earth's land surface. Deforestation remains a serious problem today. Over the past 30 years, the world has lost a fifth of its tropical forest cover (World Resources Institute, 1997).

³ Excluding Chile, where forests are classified as temperate.

⁴ These are blocks of forest areas that have not been disturbed by logging, agriculture, mining etc.

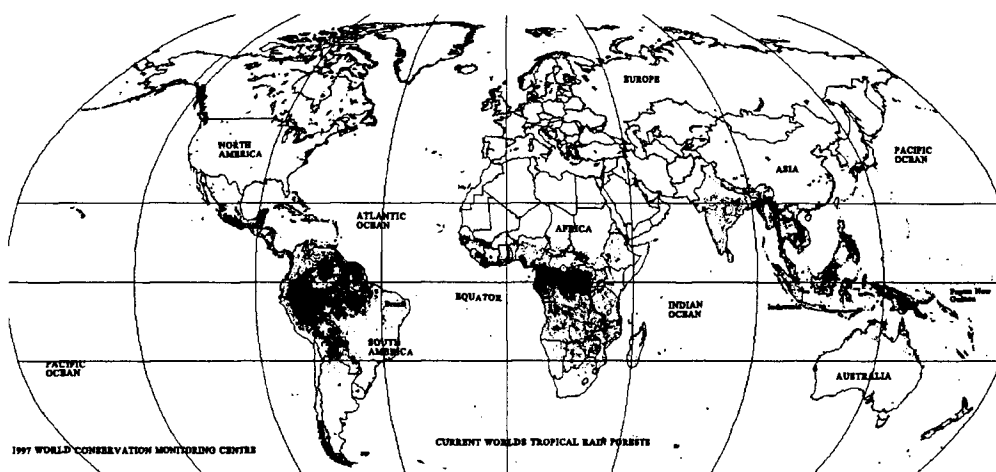


Figure 1.2 Tropical rainforest cover in the world.

Only about five percent of the world's tropical rain forests are currently being preserved. Many scientists and major conservation organizations, such as the World Wildlife Fund (WWF), estimate that at least 10 percent of all rain forests should be preserved in national parks or nature reserves. To meet this goal, another 110 million acres (an area about the size of Papua New Guinea or California) need to be preserved. New national parks or nature reserves could be created in 57 tropical countries.

PNG is one of the very few countries whose total land area is still largely covered with forests. Over 70 percent (36 million hectares) of the total land area is still forested. However, only a mere 0.02 percent (7,300 hectares) of these is protected (Figure 1.3). The pattern is the same in other tropical countries, where very little is being protected⁵. Like most tropical rain forests, PNG's rainforests have very high species diversity⁶.

⁵ World Wildlife Fund web site at <http://www.panda.org>.

⁶ The FAO classifies rain forest in the US as temperate, not tropical. Less than 4% of the US' original forests are left. Most of the original forests had been logged, developed or converted to agriculture (Rain forest Action Network (RAN), 1997; from the Internet). RAN warns that the world's tropical rain forests could face the same fate if current patterns of consumption and industrial resource extraction do not change.

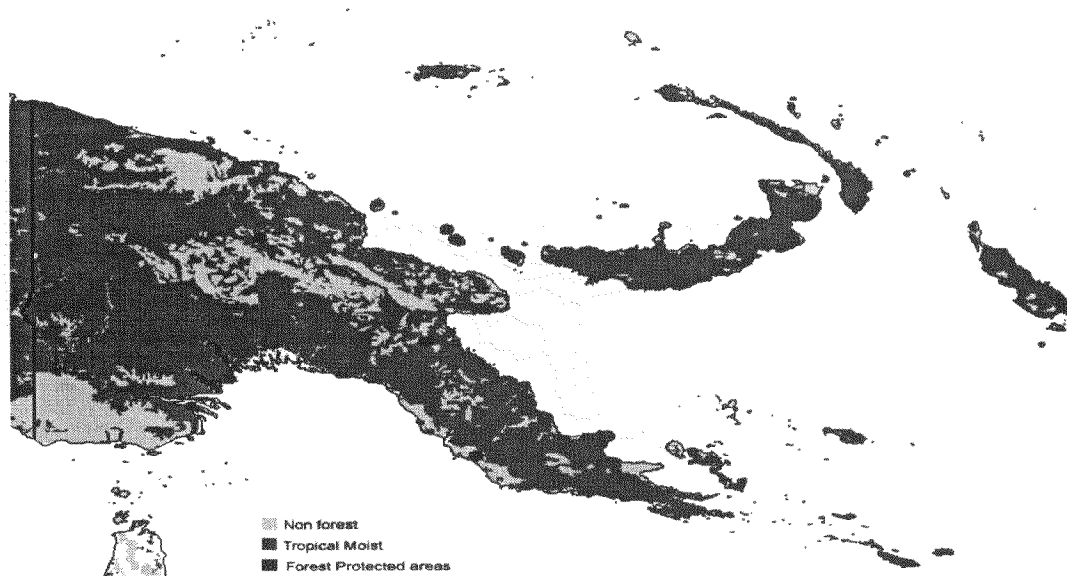


Figure 1.3. Tropical rainforest cover in Papua New Guinea.

1.5 Forestry and Conservation in Papua New Guinea

In PNG, 95 percent of the total land area is still under customary tenure. That is, land is communally owned. A group or clan (referred to as landowners) retains control over land use and transfer. The government has over the years passed various Acts to acquire customary land for development (e.g., industrial logging, mining, oil drilling, and agriculture) and conservation purposes.

The following Acts have bearing on biodiversity conservation in general: the Environmental Planning Act (1978), the Environmental Contaminants Act (1978), the Conservation Areas Act (1980, 1992), the Crocodile Trade (Protection) Act (1966), the Fauna (Protection and Control) Act (1966), the International Trade (Fauna and Flora) Act (1979), the Water Resources Act (1991) and the National Parks Act. The acquisition of customary land for conservation purposes (e.g., national park development, wildlife management areas, nature reserves) has not been successful (Eaton, 1982). In fact, the Conservation Areas Act has never been implemented.

Prior to 1991, rights to develop forest resources were acquired through the Native Timber Authority, the Timber rights purchases, and the provisions of the Private Dealings Act. In 1991, the latter two were replaced by the Forest Management Agreement (FMA) while the former remained the same but was renamed as the Timber Authority. The FMA was intended to include alternative

land uses within the defined FMA boundaries such as Wildlife Management Areas (WMA), ecotourism, and carbon offset.

The new Forestry Act of 1991 was born out of a Commission of Enquiry set up to investigate allegations of extensive malpractice, including corruption and unsustainable logging practices, in the largely foreign owned forest industry (Barnett, 1990). The aim of the reforms was to shift the industry away from a primarily exploitative log export industry to one governed by sustainable forest management principles. Among the policies proposed was the imposition of a “Logging Code of Practice” and limiting, then reducing, log exports.

However, despite these changes, the forest industry has remained to be largely a logging industry. Conservation and activities that promote sustainable resource use (e.g., ecoforestry, ecotourism, exploitation of nontimber forest products, carbon offsets and sequestration) have received little or no recognition at all from the government. This gap has been willingly filled by international (and local) non-government organizations.

Critics have labeled the above legislation as very lax in that the penalties enshrined in these Acts do not provide sufficient incentive for adherence to the laws (Hedemark and Sekhran 1996). Monitoring, compliance and enforcement have been the major problems.

Deforestation is a major threat in PNG, especially from industrial logging. Between 300,000 and 330,000 hectares of natural forest are cleared each year for a variety of economic reasons. Shifting cultivation by local villagers accounts for about 200,000 hectares, industrial logging 106,000 hectares (clear felling, 6,000 hectares and selective but possibly unsustainable logging of prime timber species, 100,000 hectares), commercial agricultural operations 10,000 hectares, and the construction of economic infrastructure (including large scale mining facilities) account for about another 10,000 hectares of clearance (Filer, 1996). The World Wildlife Fund (WWF) reports a substantially lower figure (113,000 hectares per annum)⁷. As of 1991, between 720,000 and 3 million hectares of rain forests have been logged in PNG (Nadarajah, 1993).

1.6 Cross-cultural Studies

The author is unaware of any study that compares global environmental values between different countries. In fact, Kramer and Mercer (1997) suggested the need for a comparison across cultures (i.e., between countries) of global environmental benefits pertaining to tropical rain forests. While studies of

⁷ See endnote 5 for their web site.

cultural orientation towards nature across distinct cultures within the US have been published (e.g., Kluckhohn and Strodtbeck 1961), there is nothing of this nature for PNG. The proceedings of a seminar in the 1980's on 'Traditional Conservation' (Morauta et al, 1982) and a recent study by McCallum and Sekhran (1997) on a logging project in the New Ireland Province provide some information on values across cultures within PNG.

2.0 OBJECTIVES AND HYPOTHESIS

There are two primary questions that this study attempted to answer. First, what are the motives that underlie existence value? Do some of the motives not involve trade-off between income and the preservation of tropical rain forest? If so, should these values be considered as non-economic values and therefore excluded from WTP estimates. Second, do motives underlying existence value differ across cultures (i.e., Portland and Port Moresby)?

The overall aims of the research were therefore: (1) to exclude the non-economic component of use value (i.e., non-paternalistic altruism) and the non-economic components of existence value (i.e., intrinsic value and ethical, moral and social values) so that the true economic value of tropical rain forests is derived, (2) to establish whether or not existence value of a global environmental good such as tropical rain forests differs across cultures, and (3) to generate information that may have direct or indirect implications to local and global conservation policies.

Most Portland residents were expected to have existence value only while many Port Moresby residents may have both existence and use values. Use value was expected to be higher than non-economic existence value and total existence value for Port Moresby residents compared with Portland residents.

Respondents in Port Moresby may be expressing their WTP to either preserve their "own" forests, preserve forests in general or both. An additional question was asked in the Port Moresby survey so that the expressed bids could be separated into payment for "own" forests and forests located elsewhere. It was expected that Port Moresby residents would be willing to pay to preserve more of their own forests than rainforests in general. In addition, this result may have implications on the issue of cost sharing between countries, in particular between developed and developing countries. If Port Moresby residents are concerned more about their own "back yard" then the implication may be that the developed countries like the US ought to carry much of the burden of rain forest preservation if they are genuine about the role that tropical rain forests play in global environmental problems, particularly climate change.

The specific hypotheses of this study are as follows:

H1: Benefits are transferable between Port Moresby and Portland.

Since existence values were expected to differ between Portland and Port Moresby residents, it was argued that the use of benefit transfer techniques, where Portland values were applied to Port Moresby for example, might not be methodologically valid.

H2: Differences in existence value between Portland and Port Moresby residents are not significant.

If the differences were statistically significant (i.e., if H1 above does not hold) then the cultural differences could be explained by differences in motives and socioeconomic variables such as age, education and income.

H3: The order in which information is presented does not affect the way in which respondents respond.

Some background information on why the forest should be *cut* and why it should be *saved* was provided in two text boxes. One half of the sample read the cut and saves information in that order while for the other half, the order was reversed.

H4: Respondent uncertainty, when incorporated into the statistical models, does not make a difference.

This issue has only been recently investigated and these studies have produced varying results (see Ekstrand and Loomis, 1997, Alberini, Boyle and Welsh, 1997, Welsh and Bishop, 1993, Manski, 1995, Ready et al, 1995, Li and Mattsson, 1995, Champ et al, 1997, Johannesson et al, 1996, Polasky, 1996, Wang, 1997, and Poe and Welsh, 1996). Some of these studies have that the mean WTP to preserve an environmental good over the mean WTP obtained from the conventional dichotomous choice WTP question, decreased when the stated uncertainty of respondents was incorporated into the statistical model (Li and Mattsson, 1995, Champ et al, 1997, and Welsh and Bishop, 1993). Other studies on the same issue obtained the opposite result (Ready et al, 1995). Ekstrand and Loomis (1997) obtained mixed results based on a model that scaled only the uncertainty of the YES responses and a model that scaled both the YES and NO uncertainty levels. In both cases, they found that the WTP was not statistically different from the standard dichotomous choice model. Their result contradicted the suggestion by some of the authors above that the estimation and accuracy of the analysis could be improved by incorporating respondent uncertainty into the contingent valuation methodology (CVM).

In this study, the issue was addressed in the context of a sensitivity analysis because of the way the uncertainty levels were incorporated. Positive bids for those respondents that circled a value less than 10 were recoded as zero bids and one otherwise. In other words, the respondent uncertainty variable was not an independent variable. A follow-up question to the CV question asked respondents to state their level of uncertainty from a scale of 1 (uncertain) to 10 (certain) regarding their positive bid. In both the open ended and dichotomous choice double unbounded CV formats, the Tobit model was employed where the bid amount was the dependent variable. The mean WTP was expected to decrease when the uncertainty of respondents was incorporated into the statistical models.

H5: Port Moresby residents do not feel that developed countries like the US should bear the responsibility of preserving tropical rain forests (i.e., $H_0: b_{CSH} = 0$).

Port Moresby residents were expected to express the sentiment that developed countries like the US ought to carry much of the burden of rain forest preservation if it is genuine about the role that tropical rain forests play in global environmental problems, particularly climate change.

H6. Portland and Port Moresby residents do not differ in terms of attitudinal variables.

The attitudinal variables included, among others, environment orientation and development orientation. Cultural differences were expected in terms of attitudinal variables.

3.0 THEORETICAL FRAMEWORK

This section begins with a brief remark on separable utility functions and weak complementarity. A conceptual model of tropical rain forest preservation is then developed in section 3.2.

3.1 Separability and Weak Complementarity

Let a scalar F denote the quantity of tropical rain forest (a public good) which the individual values. Since F is exogenous, it is either strongly or weakly separable in preferences from all private market goods X (Freeman, 1993 and McConnell, 1983). In other words, the preferences over the X goods are independent of the F good. Let p_x be the price of X .

If preferences are strongly separable, then the utility function has an additive separable form:

$$U = U(X, F) = U(X) + U(F) \quad (3.1.1)$$

with $U_{x_i} > 0$, ($i = 1, \dots, n$ private goods), and $U_f > 0$. The marginal utility of the public good, U_f , which may be referred to as existence value at this juncture, is positive in the example but may be zero depending on the definition of existence value⁸ and assumptions about the structure of the utility framework (e.g., separability and weak complementarity). If preferences are weakly separable, then the utility function can be written in the form:

$$U = U(X, F) \quad (3.1.2)$$

where $U_{x_i} > 0$, ($i = 1, \dots, n$), and $U_f > 0$. In both cases, the marginal rates of substitution between all pairs of private goods are independent of F . Moreover, the public good does not enter the budget constraint because the individual does not pay to consume the public good. For example, tropical rain forests absorb carbon dioxide, CO_2 , from the atmosphere and thus help to prevent the "green house" effect. The general public enjoys this service at no direct cost. Therefore, a change in the level of the stock of F leads to a change in welfare but not in the consumption of X .

Given the preference structure described by equations (3.1.1) and (3.1.2), it appears that the resource, F , provides only nonuse values. The resource does not give consumptive and non-consumptive use values. Some endangered animal species that have been almost driven to extinction by habitat destruction or killing by man for reasons other than consumption fit this description. In this case, the definition of existence value (nonuse value) is a straightforward exercise since there is no on site use (McConnell, 1983).

From the expenditure minimization problem

$$e(p_x, F, U) = \min \{p_x \cdot X \mid U(X, F) = U\}$$

The indirect expenditure function is derived. Letting ΔF be the change in the quantity of the resource, the compensating surplus, denoted CS , is given by

$$CS = e(p_x, F + \Delta F, U^0) - e(p_x, F, U^0) \quad (3.1.3)$$

where U^0 is the initial level of well being. If ΔF is positive (meaning an increase), CS corresponds to WTP. If it is negative, CS corresponds to WTA.

⁸ McConnell's (1997).

Equation 3.1.3 defines existence value (nonuse value) and is also the total value of the resource since there is no use value. Existence value defined this way is often referred to as pure existence value in the literature.

However, many resources produce use values as well as nonuse values. Examples include national parks, tropical rain forests, rivers, wetlands and the other wildlife such as the bird of paradise of PNG. In terms of the illustration above, the resource, F, also provide goods and services denoted Z. the utility function can then be specified as

$$U = U(X, Z, F) = U(X) + U(V(Z, F)) \quad (3.1.4a)$$

or

$$U = U(X, Z, F) = U(X, V(Z, F)) \quad (3.1.4b)$$

where $V(\cdot)$ is the sub-utility function associated with resource, F, and p_x and p_z are the prices for X and Z respectively. Implicit in the utility framework is the assumption of weak complementarity between F and Z. A fall in the quantity of F will lead to a fall in the quantity of Z and an increase in the price of Z, p_z .

If the conceptual model is as described by equation 3.1.4, then existence value (nonuse value) can be derived appropriately by distinguishing between use values emanating from Z and nonuse values emanating from the change in the level of F. The assumptions of separable preferences and weak complementarity allow us to distinguish between use values and nonuse values.

3.2 A Conceptual Model

The task now is to be able to represent existence value and the motives underlying this value in the utility framework in a more consistent manner. Tropical rain forests provide a myriad of values associated with certain activities. Some of these values are referred to as consumptive use values associated with the consumption or extraction of forest and non-forest products and recreational hunting or fishing. Non-consumptive uses are also important. These are uses whereby the item being valued is not harvested or extracted from the forest. There are two types, direct (on-site) non-consumptive uses (photography, viewing, hiking) and indirect (off-site) uses (reading about tropical rain forest in magazines, watching TV programs on forestry). The third component of value is existence value, sometimes referred to as nonuse or passive use values as shown in Figure 1.1. Existence values are all values that are independent of current and future use by individuals and arise from a variety of motivations.

Following equation 3.1.4b, a weak separable utility function is assumed with respect to tropical rain forest use (consumptive use and non-consumptive use) and existence values (non-use value)⁹. An individual's utility depends on a sub-utility function associated with tropical rain forests and a vector of all other goods and services, x . The tropical rain forest sub-utility function is expressed as a function of consumptive use, non-consumptive use, altruism and future use values (bequest and option value) combined into one variable, h , and the stock, s , of existing tropical rain forests which captures existence value.

$$U(F(h, s), x) \quad (3.2.1)$$

where consumptive and non-consumptive uses enter h as purchased arguments while altruism, bequest and option value enter h as non-purchased arguments. Existence value enters as a non-purchased argument in s ¹⁰. The latter is a reflection that existence value does not emanate from use. The variable x represents all other goods and services. The associated prices are p_h (market prices) for use values and p_x for all other private market goods and services.

The individual selects a level of consumption of in situ purchase of some market goods and services, h , and a level of all other private market goods and services, x , to maximize utility, subject to the budget constraint and the fixed level of tropical rain forest, s .

$$\text{Max } [U(F(h, s), x) \mid y \geq p_h h + p_x x; s \text{ is preassigned}]$$

where y is income. It is assumed that $U_{Fh} > 0$, $U_{Fhh} < 0$, $U_x > 0$, $U_{xx} < 0$, and $U_{Fs} > 0$, $U_{Fss} < 0$. The first order conditions of the maximization problem implicitly define the Marshallian conditional demand functions¹¹ for the marketed goods:

$$\begin{aligned} h &= h(p_h, p_x, y, s) \\ x &= x(p_h, p_x, y, s). \end{aligned}$$

Since differences in utility are not measurable, the indirect utility function was used. Inserting the Marshallian demand functions into the direct utility function derived this. The individual's indirect utility function is expressed as:

$$V(p_h, s, p_x, y). \quad (3.2.2)$$

⁹ Kramer and Mercer (1997) specify a similar utility function.

¹⁰ Implicit in this framework is the assumption of weak complementarity between h and s .

¹¹ Known as conditional demand functions since they give demand for the x and h goods conditional upon the imposed s .

A reduction in the stock of rain forest will affect forest use values through its impact on p_h and existence values as a result of the fall in s , from s^N to s^0 . As a consequence of the assumed structure of preferences, the demand for all other goods and services is not affected. The change in consumptive and non-consumptive use values, and existence values are reflected by the impact on p_h and s , respectively. From the indirect utility function, compensating surplus (CS) is the solution to

$$V(p_h^N, s^N, p_x, y) = V(p_h^0, s^0, p_x, y + CS) \quad (3.2.3)$$

where $CS = TV_{RF}$, is the total value of the remaining stock of tropical rain forest in Kramer and Mercer's notation. p_h^N is the price vector of all consumptive and non-consumptive uses (h) in the current time period (N). s^N represents the stock of the forest that exists now; p_h^0 is the choke price where the use and non-consumptive values are driven to zero; s^0 indicates the situation where the stock of rain forest has been driven to zero. TV_{RF} is the amount of compensation required or what must be paid to the individual to make that person indifferent between preserving the current level (the left-hand side of the equation) and having it completely depleted (the right hand side).

Equation 3.2.3 is a willingness to accept welfare measure but does not pose the relevant question. Currently 5 percent of the world's tropical rain forest is being preserved. The relevant issue is preserving at least 10 percent of the forests because this is the critical level that experts estimate is sufficient to sustain the environment (Kramer and Mercer, 1997). Note that $s^0 < s^N < s^{10\%}$. The compensating surplus is then the solution to

$$V(p_h^N, s^N, p_x, y; p_h^0, s^0) \leq V(p_h^N, s^N, p_x, y - w; p_h^{10\%}, s^{10\%}) \quad (3.2.4)$$

where w (the CS) is the donation amount which includes both use value and existence value of rain forests. Note that w is not identically equivalent to TV_{RF} since the latter is a WTA measure; w is the WTP measure which can be measured empirically.

Equation 3.2.4 is based on the willingness to pay to preserve 10 percent of the world's rain forest, given that (unless payment is made) the stock will be driven to zero in the future. That is, the individual's utility now with the expectation that the stock will someday be completely depleted is less than or equal to the utility of donating \$ w (Kina w) with the expectation that 10 percent of the stock will be preserved.

The KM model is conceptually sound but is not entirely suitable for the objectives of this study, namely the isolation of existence value and its

relationship to motives in the utility framework. Therefore an extension of the model involves decomposition of w into use value and existence value and investigation of the motives that underlie existence value. Thus attention is focused on the nature of economic value and how it relates to motives. Kramer and Mercer investigated the effect of attitudinal variables on the WTP responses for rain forest protection at the estimation stage¹². However, the attitudinal variables were limited to a charitable contributions dummy variable, a rainforest visitor dummy variable and a cost-sharing dummy variable¹³. No attempt was made to examine whether or not values associated with each variable were legitimate economic values. Put another way, the WTP responses may not represent economic value.

4.0 METHODOLOGY

4.1 Model

The theoretical framework for this study was based on the KM model, but modified in light of Bergstrom and Reiling (n.d.), Stevens et al (1994), More et al (1996), McConnell (1997) and others to focus on motives. In addition, some attitudinal questions were asked to facilitate cross-cultural comparisons. Motives were implicitly assumed in the utility framework described in Chapter 3.

4.2 Survey Design and Implementation

This study followed the usual procedures carried out in CV studies. Kramer and Mercer's survey was used as a starting point but questions about motives were included. The surveys were subjected to a series of verbal protocol studies and pre-testing, from which a final survey was designed for each city (Portland, US and Port Moresby, PNG). The surveys were implemented following the modified Dillman mail back method (a postcard introduction, followed by a first questionnaire wave, reminder cards, and then a second questionnaire wave).

4.2.1 Focus group study or verbal protocol approach

Focus groups or verbal protocol analysis can be used to explore how people in Portland and Port Moresby view the various possible components of existence value. Focus groups¹⁴ and the verbal protocol technique are a good way to learn about motivation. Both types of studies facilitate the examination of

¹² This study will adopt a similar approach whereby w will be decomposed at the estimation stage.

¹³ See Kramer and Mercer (1997) for a description of these variables.

¹⁴ Focus group sizes usually range between 8 and 10 people. Blamey (1997) used focus groups in an attempt to uncover personal environmental norms and positive WTP.

the motives that give rise to individual expressions of existence value. In short, the purpose of these types of studies is to facilitate the design of surveys to be used at the pre-testing stage.

4.2.1.1 The verbal protocol technique

This study experimented with the Verbal Protocol approach. This approach had been used by psychologists and was most recently applied to CV studies by economists (Schkade and Payne, 1994, and McClelland et al, 1992). The verbal protocol approach is a “think aloud” technique where the respondent thinks out loud by literally letting his other thoughts speak for themselves on a particular CV question. There is no interaction between the respondent and the interviewer. The interviewer’s role is to intervene on occasions when the respondent stops verbalizing for a few seconds. Respondents are allowed to work at their own pace¹⁵. The advantage of this technique is that it avoids the biases that can arise if respondents are asked leading questions.

The study wanted to investigate what may be going through the respondents’ minds when responding to CV questions. This study’s primary objective was to focus on the cultural orientation/attitudinal questions relating to views about the management and use of rain forests, the WTP questions, and the questions relating to motives. According to the theory of verbal protocols, all that is required is for the respondent to report the information and intentions he or she has based on information within his or her current awareness. In other words, the study was interested in how the respondent answered the questions based on what he or she knew about tropical rain forests and the associated problems at the time of questioning. This was based on the argument that people “construct their responses at the time they are asked an elicitation question, rather than retrieve a previously formed value” (Schkade and Payne, 1994).

The verbal protocol (VP) studies were conducted simultaneously in July 1998 in Hampshire Mall, Hadley, Massachusetts (US) and at the Boroko Shopping Center, Port Moresby, PNG¹⁶. These venues were chosen because it was thought that a good cross-section of the community usually converge at these types of places to shop, socialize and recreate. At each venue, two big posters were put up to attract participants. For the Hadley venue, one poster depicted a world map showing the tropical rain forests of the world in green. Written above the map was the following phrase: “HELP INFORM DECISION

¹⁵ In the Schkade and Payne (1994) study, the interviewer would intervene after four seconds of silence. Respondents were allowed an average of 30 minutes to complete the WTP questionnaire. The sessions were recorded on audio tape. Respondents were brought to a central location.

¹⁶ The verbal protocol study in the Hadley was conducted by a research assistant while the Port Moresby portion was conducted by the researcher with the assistance of a research assistant.

MAKERS ABOUT RAIN FOREST.” The second poster read: “SURVEY RESPONDENTS NEEDED, \$10 TO YOU.” A similar approach was taken at the Port Moresby venue. The phrase above the map read: “HELP INFORM DECISION MAKERS ABOUT RAIN FOREST IN PNG AND THE WORLD.” The second poster read: “SURVEY PARTICIPANTS NEEDED, WILL PAY K10 FOR PARTICIPATING.”

Participants in each city were split into two groups. The first group were given a non-leading/ open-ended questionnaire while the second group was given a leading/dichotomous choice questionnaire (i.e., questions that came with pre-specified answers)¹⁷. Each participant was paid \$10 and K10 after participating in the Hadley and Port Moresby VPs, respectively.

Before each session began, respondents were told a set of instructions. For instance, participants were told that they were required to think aloud as they responded to each of the questions. One of the issues that arose from the leading survey was the issue of whether or not CV surveys are preference forming. This was obviously a testable hypothesis but the size of the sample did not permit a formal test at this stage. The study was only interested in developing a draft survey for pre-testing. Two rounds of VPs were conducted at each venue. The surveys were revised after each round. As a result of the second set of revisions, the pre-testing surveys were finalized.

4.2.2 A synthesis and pre-testing

The VP results from the two groups from both countries were synthesized to produce draft surveys for pre-testing. A sample of 100 respondents for each type of survey was obtained from phone directories for both Portland, Maine, U.S. and Port Moresby, PNG. Pre-testing by mail was simultaneously conducted in August 1998 in both countries. The modified Dillman method (a postcard introduction, one questionnaire wave with cover letter, postcard reminder, and a final follow-up questionnaire wave with cover letter) was followed. For Portland, 54 surveys were returned, 27 for each type of survey. This represented about a 27 percent response rate. The rather low response rate can be partly attributed to the fact that the sample was obtained from a phone book that was two years old. For Port Moresby, 38 surveys were returned, 19 for each type of survey, which represented about a 19 percent response rate. This result was not surprising considering the problems associated with conducting mail surveys in

¹⁷ Ideally when employing the verbal protocol technique, larger groups would be used. For example, in the Schkade and Payne (1994) study, 105 adult respondents were paid \$20 each for participating. Here, we used smaller groups mainly because of funding constraints. In the first round there were 8 and 9 participants in the Port Moresby and Hadley, studies respectively. The number of participants in the second round were 9 and 9, respectively.

developing countries.

The results from the pre-test in both cities were coded and tabulated on separate spread sheets. This exercise assisted in the revision of the survey questionnaire. A final survey for both cities was then developed based on this exercise. Two changes worth mentioning were questions 11 and 13, which related to motives and the CV question. From the feedback obtained from the verbal protocol studies and the pre-test, it was decided to opt for pre-specified responses instead of leaving the responses open ended. The initial (or offered) amounts were determined as follows: for the Port Moresby survey, the initial amounts started at K25 and ended at an upper limit of K500 with increments of K25. Similarly, initial amounts for the Portland survey started at \$25 and ended at an upper limit of \$225 with increments of \$25. Carson (1998) pointed out that “designing a multi-country CV study will require careful attention to the development of protocols and extensive pre-testing to ensure that the CV results obtained from different countries are as compatible as possible.” The researcher believes that this was achieved.

4.2.3 Sampling and split sample surveys

The mail surveys were conducted in Portland, Maine, U.S. and Port Moresby, PNG. In each city, two types of split sample surveys were conducted. That is, the sample was split in half. One half (500) received the dichotomous choice (DC) questionnaire and the other half (500) received the open ended (OE) survey. The difference in the DC and OE surveys related to the nature of the WTP question. In the former, an initial dollar (kina) amount was assigned at random to respondents whereas in the latter, no initial amount was assigned. This was the first type of split survey. Some background information on why the forests are *cut* and why some should be *saved* was provided in two separate text boxes. One half of the sample that received the DC survey (250) read the cut and save information in that order. The order was reversed for the other half (250). The same set up was applied to the OE survey. This was the second type of split survey.

The open ended payment question was as follows:

- * Recall that experts say we need to preserve at least 10% of all tropical rain forests in national parks and reserves. Currently, only 5% of all rain forests are preserved. Assume that the United Nations creates a special Save the Rain Forest Fund to raise enough money to preserve 110 million more acres (about the size of California (PNG)) of rain forests in national parks and nature reserves in 57 tropical countries. This would be enough to reach the goal of saving 10% of all tropical rain forests. Assume that all

of the donations to the Fund will go directly toward saving the tropical rain forests by creating and managing national parks and nature reserves. **Keeping in mind your present income and financial commitments, if you were asked to make a one-time donation to this fund, would you:** (Please circle one)


1. **Donate** (If you choose to donate, go to question 7.a)
2. **Not Donate** (If you choose not to donate, go to question 10)

The DC payment question differed from the OE CV format in the following respect: **Would you be willing and financially able to make a one time donation of \$(K)___ to this fund? Please keep in minds your present income and financial commitments.** (Please circle one)

1. Yes (If **yes**, go to question 7.a)
2. No (If **no**, go to question 7.b)

In addition, respondents were asked to state their certainty level with respect to the payment question.

* On a scale of 1 to 10, how certain are you of your answer about what you would pay? Please circle the number that best represents your answer if 1 = not certain and 10 = very certain.

1	2	3	4	5	6	7	8	9	10
Not certain								very certain	

For those who were not WTP, more probing was required to identify protest bids. The probing helped to identify whether the zero responses represented a nil value or an infinite value, and elicited reasons for the nil or infinite values¹⁸.

A random sample of 1,000 for each country was obtained from private vendors. The sample for Portland was purchased from Database America while for Port Moresby the sample was obtained free of charge from TELIKOM PNG. Due to funding constraints and logistical problems related to conducting CV surveys in a developing country like PNG (see discussion below), it was decided that samples would be drawn from two urban areas. Port Moresby was chosen because the 1980 census data showed that it contained a good mix of people from all over PNG. Port Moresby is the capital of PNG with a population of about 200,000 people. Although Portland was smaller in terms of population

¹⁸ Copies of the questionnaires are available from the author on request.

(63,000), it was chosen because it is located in a state that has large tracts of forested land.

The common denominator in both samples was literacy in English. Over 80 percent of the people in PNG lived in rural areas. They lived off the land (including tropical rain forests). Over 80 percent of them were illiterate. With PNG having more than 700 distinct languages, designing and conducting a CV survey in PNG posed an insurmountable problem. Translating surveys into local languages was not possible. Moreover, funding constraints ruled out in-person interviews. Given the constraints, a mail-back survey in PNG was only possible with a sample that was not only literate in English, but also had addresses. Therefore, a random sample was obtained only from Port Moresby residents who were literate in English and had addresses.

This raised questions about sampling bias. It was likely that the sample in Port Moresby may be skewed more towards the middle to high-income people because these are the people most expected to have personal addresses and phone numbers. In fact this was the case (see Chapters 6 and 7).

There was some concern that the target response rate of 50 to 55 percent in PNG may not be achievable within the required time frame because of logistical and other constraints. For example, unlike the US respondents, Papua New Guineans are not familiar and accustomed to surveys. There are a number of ways in which response times and rates could be improved. These involved some form of economic or similar incentive (e.g., goods, lottery system, monetary amounts, coupons, vouchers etc) being given to Port Moresby respondents. In this study, monetary amounts of K2 were given to each respondent who returned completed surveys. In the first and second questionnaire waves, K2 vouchers were enclosed which informed respondents that a K2 bill would be mailed to them should they return a completed survey. In addition, it was thought that respondents might show some interest in filling out the survey if they were asked at the end of the survey whether or not they would be interested in receiving a summary of the results of the survey. In the actual mail out, a green voucher and a blue request form for the summary of the results of the survey was enclosed. To maintain confidentiality, the respondents were asked to place the two forms in a smaller size envelope separate from the survey.

To prevent sampling bias, a similar incentive was provided for Portland participants. Also, this was necessary to ensure comparability of the Port Moresby and Portland survey results. As benefit transfer was a key issue in this study, limiting such bias was of key concern. Thus an amount of \$2 was distributed to each respondent who returned a completed survey.

The total design method proposed by sociologists Salant and Dillman (1994), referred to as the modified Dillman method (postcard introduction, one questionnaire wave with a cover letter, postcard reminder, and a final follow-up questionnaire wave with a cover letter) was followed. The mail out for the Portland survey began towards the end of October and for the Port Moresby survey, in mid November.

During the two weeks before January 27, 1999, 100 telephone follow-ups were conducted at random to non-respondents in Port Moresby. Only 23 responded. The same number of calls was conducted during March 1999 to non-respondents in Portland. Only 15 responded. A total of 461 and 330 completed surveys were received from the Port Moresby and Portland mail surveys, respectively. This represented about a 49 percent and 41 percent response rate for the Port Moresby and Portland surveys, respectively, after accounting for ineffective addresses (e.g., bad addresses, unknown persons at the address, people who have moved but left no forwarding addresses, respondents who were deceased, etc).

4.3 CV Biases

Carson (1998) discussed many of the constraints associated with contingent valuation (CV) in relation to tropical rain forests. The constraints included (1) the embedding problem (the contention that CV estimates are overly sensitive to the order in which goods are valued and the notion of one good being nested within or encompassed by another good), (2) the calibration issue; the contention that CV overestimates true economic value, (3) defining the commodity, tropical rainforests, (4) extent of the market (who will be asked to pay for rainforest preservation)¹⁹, and (5) payment and provision mechanisms (how much will it cost, how will it be paid for and how will it be provided). Kramer and Mercer adequately dealt with these problems, except for the second problem. Therefore in this study, we focused almost exclusively on the second issue by re-appraising the concept of existence value. More specifically, this study investigated the motives that underlie existence value and identified the motives that were economic and non-economic in nature.

5.0 DESCRIPTIVE DATA: CHARACTERISTICS, ATTITUDES AND MOTIVES OF SAMPLE POPULATION

This section reports summary statistics of the socioeconomic characteristics of respondent households and summaries of responses to

¹⁹ US residents were asked to pay for rainforest preservation because while they lived thousands of miles from the locales where protection activities take place, they benefit from the role that tropical forests play in carbon cycles, climate regulation and genetic resource conservation.

questions about environmental attitudes and knowledge. Comparisons are drawn between Portland and Port Moresby and the Kramer and Mercer (KM) samples. Summaries of responses to questions about motives in relation to the willingness to pay questions are also presented.

Port Moresby and Portland respondents exhibited characteristics that were quite different in many respects (Table 5.1). Even though Portland and KM respondents exhibited some differences, these differences were not dramatic (age and household size were the only two that were very similar). The differences are not surprising since the KM sample was drawn from the US population. In fact, respondents from the KM survey exhibited characteristics (i.e., median income, median number of school years completed, median age, and average household size) that were quite similar to the 1990 US population census.

Table 5.1. Socioeconomic characteristics of sample

Variable	Range	Median
Income: Port Moresby (PNG)	<\$2,250 - 45,000 or more	\$ 7,875
Portland (US)	<\$9,999 - 120,000 or more	\$37,500
KM (US)	\$7,500 - 127,500	\$31,500
Education: Port Moresby	0 - 21+ years	13 years
Portland	3 - 21+ years	16 years
KM	8 - 24 years	13.6 years
Age (head of household)		
Port Moresby	18 - 63 years	38 years
Portland	18 - 96 years	46.6 years
KM	18 - 95 years	47.9 years
Household size:		<u>Mean</u>
Port Moresby	1 - 31	6.80
Portland	1 - 7	2.43
KM	1 - 9	2.51
Variable		Percentage
<u>Sex</u>		
Port Moresby: Male		75%
Female		25%
Portland : Male		60%
Female		40%
KM : Male		67%
Female		33%
<u>Conservation Organization Membership</u>		
Port Moresby		3%
Portland		31%
KM		25%

Table 5.1. Continued.

	Number of Respondents		Response rate
Port Moresby	461		49%
Portland	330		41%
KM	542		56%
<u>Race</u>			Percentage
<u>Area where respondent lived most of his/her childhood.</u>			
Port Moresby:	Rural village		61%
	Rural plantation/farm		2%
	Small outstation		6%
	Urban (town or city)		17%
	Suburb		10%
	Other		4%
Portland:	Rural (non farm)		9%
	Rural (farm)		8%
	Small town		32%
	Urban (large town, city)		29%
	Suburban		19%
	Other		3%
		Port Moresby	Portland
Contributed to charity	y	71%	85%
	n	29%	15%
Want to receive summary of result.	y	88%	51%
	n	12%	49%
Want to receive K2 or \$2.	y	65%	43%
	n	35%	57%
Time taken to complete survey.		Mean 50.29 minutes Median 30 minutes	Mean 25.01 minutes Median 20 minutes

The median cash income for Portland respondents was \$37,500, higher than the KM median of \$31,500. For Port Moresby, it was \$7,875 (K17, 500), considered middle income in PNG. The median number of school years completed by participants from Portland and Port Moresby was 16 (KM, 13.6) and 13 years, respectively. The median age for Port Moresby respondents was 38 years, much younger than respondents from Portland, 46.6 years (KM, 47.9 years). Average household size was 2.43 (KM, 2.51) and 6.8 persons for

Portland and Port Moresby, respectively. As expected, households are usually larger in developing countries than in developed countries. There were overwhelmingly more male respondents in both samples {Portland, 60% (KM, 67%) and Port Moresby, 75%}, which indicated the fact that phone and address listings are typically in the name of male heads of households. The proportion of female participants (40%) in Portland was higher than in Port Moresby. About a third (31%) of Portland respondents (KM, 25%) had membership in conservation organizations compared to a mere 3% for Port Moresby participants.

Respondents in Portland were Caucasian (95%) while in Port Moresby, they were mostly native/indigenous (92%) then. The majority (63%) of participants in Port Moresby lived most of their childhood in rural areas as opposed to 17% in Portland. Eighty-five percent of those surveyed in Portland contributed to charity the previous year (71%, Port Moresby). A large proportion of Port Moresby respondents (88%) wanted to receive a summary of the results (Portland 51%). This level of interest may be reflective of the close association between Papua New Guineans and their forest. A higher proportion of Port Moresby respondents (65%) wanted to receive K2 as opposed to 43% of Portland respondents who wanted to receive \$2 for returning a completed survey. It could be assumed that the marginal utility of a smaller amount of money such as K2 might be higher for Port Moresby respondents than the marginal utility of \$2 for Portland respondents. Port Moresby respondents took longer (median time 30 minutes) to complete the survey than Portland respondents (median time 20 minutes) did. This may be due to the fact that English is a second language to Port Moresby participants.

With respect to responses to questions about visits to and knowledge of tropical rain forest, the results from the Portland sample were quite similar to the results from the KM study (Table 5.2). A higher proportion of the respondents had some knowledge of tropical rain forest (95%), (KM, 91%) and the causes of deforestation (86%) (KM, 81%) despite the fact that very few of them had previously visited (15%) (KM, 11%) or plan to visit (12%) (KM, 8%) a tropical rain forest. The latter result indicates that Portland respondents may have a higher non-use (existence) value (see also discussion of results in table 5.8). Sixty-one percent of the respondents think that the US should ban the import of products made from wood from tropical rain forests.

Table 5.2. Responses to questions on visits to and knowledge of tropical rain forests

	Yes	No
Previously visited a tropical rain forest		
Portland	15%	85%
KM	11%	89%
Plan to visit a tropical rain forest		
Portland	12%	55%*
KM	8%	61%*
Any knowledge of tropical rain forests		
Portland	95%	5%
KM	91%	9%
Knowledge of causes of deforestation		
Portland	86%	14%
KM	81%	19%
Should the US ban the imports of products made from tropical rain forests (Portland only)	61%	12%**

* 31 and 33% of the Portland and KM samples, respectively, were uncertain.

** 27% were not sure.

Table 5.3 shows results of Port Moresby respondents answers to questions about visits to, benefits from, ownership of forested land, dependence on, and perceptions on media coverage of rain forest in PNG. Over two-thirds (77%) of the respondents visited PNG's rain forest the previous year for various reasons; the median and mean number of visits was 2 and 4.2, respectively. Thirteen percent of the respondents worked or otherwise received some form of monetary benefits from the rain forest. While 62% own forested land in their areas, a mere 12% of them received monetary benefits from logging or other types of economic activity. This result suggests that much of the rain forest in PNG is largely undisturbed. In fact, over 70% of the land in PNG are still forested. The livelihood of the people in the respondents' areas depended to a larger extent (median = 80%) on rain forests. Over half (57%) of the respondents believed there was very little media coverage of rain forest issues (causes of deforestation) in PNG over the last 12 months. Logging was the most publicized issue (52%), followed by the effects of mining (12%), natural disasters (11%), and forest policy (8%). Logging and forest policy have been and continue to be hot issues since the Barnett Forest Enquiry in 1982. The effects of mining on the environment received overwhelming publicity as a result of the Bougainville Copper Mine unrest in 1989 and the Ok Tedi Environmental Law suit in 1995. Sporadic landowner unrest's had occurred in other mineral projects elsewhere in the country.

Table 5.3. Responses to questions on visits to, benefits from, ownership of forested land, dependence on and perceptions on media coverage of rain forest in PNG.

		Range	Median	Mean
Number of times visited forest last year		1 - 100	2	4.2
			Yes	No
Visited forest last year			77%	23%
Work or otherwise receive monetary benefits from rain forest			13%	87%
Owner of forested land (landowner)			62%	38%
Landowner: receive monetary benefits from logging or other				
Types of economic activity			12%	88%
			Range	Median
To what extent does the livelihood of the people in your area depend on rain forests?			0 - 100%	80%
	None at all	Very little	Moderate	A lot
Media coverage of rain forest issues in PNG	5%	57%	27%	10%
Most publicized issue				Percentage
Logging				52%
Effects of mining				12%
Natural disasters				11%
Forestry policy				8%
Land use issues				6%
Forest fires				4%
Other				7%

Table 5.4 shows respondents' opinions on tropical rain forest management, which revealed a similar pattern of agreement on the issues between the respondents from both countries.

Table 5.4. Opinions on tropical rain forest management (percentage)*.

	SA	A	N	D	SD	NO	N A
a) The earth is like a spaceship with only limited room and resources.	45.0	34.0	6.0	9.0	2.0	4.0	1.0
	37.0	51.0	4.0	4.0	1.0	1.0	2.0
b) The earth can support a much larger population than exists today.	8.0	27.0	12.0	32.0	18.0	4.0	1.0
	2.0	16.0	14.0	44.0	21.0	1.0	3.0
c) Humans must live in harmony with nature to survive.	67.7	28.4	2.6	0.7	0.0	0.4	0.2
	52.0	43.0	2.0	1.0	0.0	1.0	1.0

Table 5.4. Continued.

d) As much tropical rain forest as possible should be preserved no matter what the cost.	64.8	27.7	4.2	2.4	0.2	0.2	0.4
	26.0	42.0	16.0	11.0	2.0	2.0	1.0
e) I have a moral duty to help protect tropical rain forests.	50.0	41.0	6.0	1.0	0.0	1.0	1.0
	14.0	46.0	29.0	5.0	1.0	3.0	2.0
f) Rain forests should be preserved simply because they exist, regardless of any benefit or harm to humans.	31.0	37.0	9.0	16.0	4.0	2.0	1.0
	13.0	35.0	19.0	26.0	3.0	1.0	2.0
g) The main reason for preserving rain forests is to benefit future generations.	55.6	33.8	4.4	4.4	0.2	1.1	0.4
	18.0	52.0	16.0	9.0	1.0	2.0	2.0
h) Tropical rain forests should not be completely protected.	3.7	17.8	10.1	32.7	34.7	0.7	0.2
	3.0	19.0	19.0	40.0	16.0	2.0	1.0
i) If rain forest destruction continues on its present course, we will soon experience a major ecological catastrophe.	57.4	36.0	2.9	1.5	0.4	1.1	0.7
	21.0	44.0	20.0	7.0	2.0	5.0	2.0
j) The measures that have been taken to protect tropical rain forests are not necessary and will cause too much economic suffering.	3.0	12.0	12.0	46.0	22.0	4.0	1.0
	1.0	2.0	10.0	52.0	28.0	5.0	2.0
k) People in tropical countries (including my area in PNG) prefer development to conservation.	14.0	37.0	18.0	19.0	8.0	3.0	1.0
	4.0	33.0	19.0	20.0	5.0	18.0	2.0

* Unshaded areas = Port Moresby; shaded areas = Portland.

SA = strongly agree, A = agree, N = neutral, D = disagree, SD = strongly disagree,

NO = no opinion, and NA = no answer.

Respondents from both samples were asked the reasons why people in tropical countries cut rain forest and why tropical rain forests should be saved (Table 5.5). The two common answers were the prevention of plant and animal species extinction (30.4% Port Moresby, 33% Portland) and the prevention of the greenhouse effect (global warming) (28.9% Port Moresby, 32.2% Portland).

Table 5.5. Reasons for protecting and for cutting tropical rain forests (percentage).

					A	MA
a) Forests should be cut to provide fuelwood in tropical countries for household cooking and heating.	26.0	30.0	40.0	3.0	1.0	2.9
	23.0	26.0	44.0	4.0	3.0	1.7
b) Forests should be preserved to prevent plant and animal species extinction.	96.5	2.4	0.7	0.2	0.2	30.4
	91.0	6.0	1.0	1.0	2.0	33.0
c) Forests should be cut to provide money to pay off foreign debts.	4.0	17.0	76.0	3.0	1.0	0.4
	3.0	8.0	87.0	1.0	1.0	1.1
d) Forests should be preserved to provide tourism and recreation opportunities.	87.0	9.0	2.0	1.0	1.0	10.0
	47.0	28.0	19.0	4.0	2.0	1.7
e) Forests should be cut to provide for economic development in tropical countries.	18.0	34.0	43.0	5.0	1.0	3.6
	10.0	27.0	59.0	2.0	2.0	1.7
f) Forests should be preserved to save plants and animals that could be used for medicine.	89.0	7.0	1.3	2.2	0.4	11.5
	88.0	8.0	2.0	1.0	1.0	17.5
g) Forests should be cut to provide more land for food production.	18.0	45.0	33.0	2.0	1.0	2.2
	9.0	26.0	58.0	3.0	3.0	0.0
h) Forests should be preserved to help to prevent the greenhouse effect (global warming).	89.0	6.4	1.8	2.6	0.2	28.9
	83.0	9.0	5.0	2.0	2.0	32.2
i) Other	20.7	0.4	0.4	0.0	78.5	3.5
	5.0	0.0	0.0	0.3	94.7	2.3
j) Did not answer.						6.7
						8.6

A = agree, N = neutral, D = disagree, NO = no opinion, NA = no answer, and MA = most agreed with.

A split sample survey in relation to the contingent valuation (CV) question was conducted. One half of the sample in each country received the

dichotomous choice (DC) CV survey while the other half received the open ended (OE) survey. The results are shown in Table 5.6. The median of positive responses to the DC CV question was \$22.50 (K50) and \$50 for Port Moresby and Portland respondents, respectively. Bids ranged from K0 – 1,000 and \$0 – 500, respectively. In the OE case, the median of the positive responses was \$5.24 (K11.65) for Port Moresby participants and \$50 for respondents in Portland. Bids ranged from K0 – 500 and \$0 – 3,000, respectively. Note that in the DC survey, Port Moresby respondents were willing to pay a higher proportion (0.29%) of their income (based on median) than Portland respondents (0.13%). But the opposite was true in the OE survey (Port Moresby 0.07% and Portland 0.13%).

Table 5.6. Responses to contingent valuation and certainty questions.

	Port Moresby			Portland		
	Range	Median of positive responses		Range	Median of positive responses	
BID: Dichotomous choice (DC)	K0 - 1000	K50 \$22.50		\$0 - 500	\$50	
Open ended (OE)	K0 - 500	K11.65 \$5.24		\$0 - 3000	\$50	
	YES	NO	NA	YES	NO	NA
Total WTP: DC	69%	29%	2%	44%	56%	0%
OE	75%	23%	2%	56%	43%	1%
	10 certain	1-9 uncertain	NA	10 certain	1-9 uncertain	NA
Certainty	44%	53%	3%	30%	66%	4%
	Port Moresby					
		Both		PNG Only	ROTW only	NA
WTP to preserve		60%		33%	2%	5%
Proportion PNG	Range	0.02 - 90%				
	Median	50%				

NA = no answer, ROTW = rest of the tropical world.

In both cases, a higher proportion of Port Moresby respondents were WTP to preserve tropical rain forests (DC-68%, OE-75%) (Portland, DC-44%, OE-56%). More (66%) respondents in Portland were uncertain about their positive response to the payment question than their counterparts in Port Moresby (53%). Port Moresby respondents were asked an additional question on

the distribution of their positive response. An overwhelming number of them (60%) were WTP to preserve rain forests both throughout the world and in PNG. The percent for the preservation of PNG’s forests ranged from 0.02 - 90% with a median of 50%.

Responses to questions on reasons for not donating are presented in Table 5.7. Protest bids were proportionally higher for respondents in Port Moresby (32%) compared with 13% in Portland. Twenty-four percent of those surveyed in Port Moresby believed that since the rich nations of the world (including the US) get all the rain forest benefits, they should pay. In Portland only 9% believed this.

Table 5.7. Responses to questions on reasons for not paying

	Port Moresby	Portland
Reason for not paying	%*	%*
1. I don't care about tropical rain forests.	0	1
2. I do not approve of giving money to the UN.	8	11
3. The tropical (rich) nations of the world (including the US) get all the rain forest benefits, so they should pay. PNG (US) citizens should not have to pay to preserve tropical rain forests.	24	9
4. I cannot afford to pay anything to preserve tropical rain forests.	35	56
5. I object to this type of question (reason(s) specified). [Protest bid]	32	13
6. Other (reason(s) specified) [Protest bid]	17	25
No answer	6	4

* The total of each response was divided by the total number of zero bids.

Port Moresby respondents had a higher use value but a lower existence value than Portland respondents (Table 5.8). The use value (35%, Portland 4%) bequest motive (28%, Portland 26%) were overwhelmingly chosen as the most important reasons for payment by Port Moresby respondents. Only 4% of the respondents chose the cognitive motive (economic existence value) as the most important reason compared with 9% in Portland. Similarly, 7% of the Port Moresby respondents chose the intrinsic value motive (non-economic existence value) as opposed to 20% in Portland.

Table 5.8. Percentage of factors affecting or motives underlying respondents' WTP

	Most important reason	
	Port Moresby	Portland
<i>Factors motivating payment</i>		
1. Consumptive and non-consumptive Use value	35*	4
2. Bequest value (future use value)	28	26
3. Cognitive value (economic existence value)	4	9
4. Non-paternalistic altruism (non-economic use value)	7	11
5. Paternalistic altruism (use value)	4	6
6. Option value (future use value)	1	1
7. Intrinsic value (non-economic existence value)	7	19
8. Good cause (social value, non-economic)	3	2
9. Moral duty (moral value, non-economic)	6	6
10. Other considerations	2	10
Did not answer	2	6
<i>Factors considered in deciding how much to pay</i>		
1. Contribute my fair share (social/moral value)	30	10
2. If I do not support this cause, who will?	3	1
3. Depends on household income and other financial circumstances.	17	28
4. Whether or not preservation of tropical rain forest will actually work.	7	7
5. Concerned about environmental quality in general.	22	24
6. I am uncertain about my future financial situation.	3	9
7. I have a duty to take care of the earth.	16	11
8. Other	2	3
Did not Answer	4	6

* 32% of the respondents were WTP because they directly used or consumed goods and services provided by tropical rain forests.

As to the factors in deciding how much to pay, the fair share motive (30%) was the main choice if Port Moresby respondents while for the Portland respondents, it was "household income and other financial circumstances". Environmental quality also figured significantly in both samples (Port Moresby 22% and Portland 24%).

6.0 ECONOMETRIC MODELS AND ESTIMATION RESULTS

6.1 Econometric Models

Several econometric models were developed: (1) to estimate the welfare

changes or the total value and the economic existence value from an increase in the level of tropical rain forest preservation for each country, (2) to estimate some attitudinal models, and (3) to test some of the hypothesis described in Chapter 2 above.

Each respondent's true WTP, w_i , for rain forest preservation is influenced by a vector of explanatory variables Z_i (such as socioeconomic variables, views about forest use and management issues, motives etc) so that:

$$w_i = Z_i' \beta + e_i \quad (6.1)$$

where β is a vector of behavioral parameters and e_i is an independently and normally distributed error term with mean zero and standard deviation σ . Because of the nature of the data, the Maximum Likelihood Estimation (MLE) technique was employed to fit probit, logit or tobit regression models. A probit or logit model was estimated using MLE if the dependent variable is a 0 or 1 variable. A tobit model was fitted using MLE where the dependent variable (in this case the bid amount) contains data that had a large group of zero values apart from positive values. If OLS (ordinary least squares) was employed, the resulting parameter estimates may be biased and the mean WTP estimates may be meaningless. Frequently, valuations of environmental goods had been found to be skewed, thus a lognormal distribution may sometimes be assumed. Thus equation 6.1 becomes:

$$\log w_i = Z_i' \beta + e_i. \quad (6.2)$$

In this study, only the log likelihood models were used.

Respondents were confronted with two different contingent valuation formats, the open-ended (OE) and dichotomous choice (DC) CV questions. Each half of the sample in each country received each type of CV. In the OE case, no initial amount was offered. Respondents were asked the following question: "Keeping in mind your present income and financial commitments, if you were asked to make a one time donation to this fund, would you: 1. Donate / 2. Not Donate". Because of the nature of the CV format, it is believed that the respondents' stated bid was their true WTP. By comparison, for example, in the case of the payment card format, a respondent's true WTP was likely to be within an interval between the value he/she selected and the adjoining value.

In the DC double unbounded format, the respondent was confronted with an offered amount but then in the next two follow-up questions, was asked to specify his/her bid. Thus, it is argued that the specified bid amount was the respondent's true WTP and therefore the DC double unbounded CV format can

be treated like the OE CV survey. The initial amounts varied across individuals, ranging from \$25 to \$225 in increments of \$25 for US respondents (K25 to K500 in increments of K25 for PNG). The Maximum Likelihood Estimation (MLE) technique was used to fit tobit models for the existence value equations (equations 6.3 and 6.4, where the bid amount is the dependent variable), the response uncertainty models (equations 6.6 and 6.7) and the behavioral models (equation 6.5).

The tobit model was employed for the DC CV models because of the way the CV question was asked. Respondents were offered an initial amount but were not offered dollar or kina amounts in the two follow up questions. Instead, they were asked to specify the amounts that they were WTP. In other words, the DC CV question was unbounded and therefore the DC models can be estimated just like the OE models. Different types of data can be generated by different types of CV formats and as such separate econometric models are estimated for each CV format.

6.1.1 Motive models: economic existence value

The task is to isolate WTP for economic existence value. Following Stevens et al (1994), this can be achieved by partitioning WTP into its various components according to the function:

$$WTP_{oe} = f(UV, B, PA, NPA, OV, CG, IV, GC, MD, FS, EQ, X) \quad (6.3)$$

$$WTP_{dc} = f(UV, B, PA, NPA, OV, CG, IV, GC, MD, FS, EQ, X) \quad (6.4)$$

where the dependent variable for both equations is the bid amount (WTP_{oe} for the open ended CV survey and WTP_{dc} for dichotomous choice CV survey), UV is use value, B is bequest value, PA is paternalistic altruism, NPA is non-paternalistic altruism, OV is option value, GC is good cause, MD represents moral duty, IV is intrinsic value, CG represents cognitive value, FS is fair share, EQ is environmental quality in general and X is a vector of socioeconomic characteristics such as education, income, and age. According to Stevens et al, “this representation is similar to a hedonic approach whereby the ‘commodity’ (*contribution to the preservation of an increased quantity of tropical rain forest*) consists of several attributes.” Except for the variable X, all the other variables are dummy variables.

The dummy variables are described as follows:

UV = 1 if consumptive and non-consumptive use value was considered an important reason for paying and zero otherwise.

B = 1 if bequest value...
 CG = 1 if cognitive value...
 NPA = 1 if non-paternalistic altruism...
 PA = 1 if paternalistic altruism...
 OV = 1 if option value...
 IV = 1 if intrinsic value...
 GC = 1 if good cause...
 MD = 1 if moral duty...
 FS = 1 if fair share was considered the most important reason in deciding how much to pay and zero otherwise; and
 EQ = 1 if environmental quality was considered the most important reason in deciding how much to pay and zero otherwise.

Cognitive value represents economic existence value. Setting the means of the dummy variables UV, B, PA, NPA, OV, GC, MD, IV, FS and EQ equal to zero isolates economic existence value. The resulting amount “can be interpreted as payment for the resource itself.” (Stevens et al, 1994). All other variables enter the calculation of WTP for the resource itself.

Equations 6.3 and 6.4 were estimated using two separate samples, Port Moresby (PNG) and Portland (Maine, US).

To investigate the response uncertainty issue, the YES responses associated with certainty levels 1 to 9 were recorded as NO (= 0) responses. Again separate models were estimated for the OE and DC models.

Another perspective would be to calculate the proportion of responses to each of the responses related to the motive questions (Stevens et al, 1994). This way, some idea of the magnitude of the components of the average WTP can be deduced. The classification would be as follows:

- Group 1: Use Value;
- Group 2: Other use value I; economic component (Bequest, Paternalistic Altruism, Option Value);
- Group 3: Other use value II; non-economic component (Non-paternalistic Altruism);
- Group 4: Nonuse Value I; Economic Existence Value (Cognitive Value);
- Group 5: Nonuse Value II: Non-economic existence value I; (Intrinsic Value);
- Group 6: Nonuse Value III: Non-economic existence value II; (Ethical/Moral/Social Values- e.g., good cause, moral duty and fair share).

From either of these procedures, the average economic existence value was expected be smaller than has been traditionally estimated or thus average WTP (or the average total value of the resource) will be lower than has been traditionally estimated.

These models can also be used to test for cultural differences. That is, comparisons can be made on the basis of the statistical significance and signs of the motive and socioeconomic variables between the Port Moresby and Portland samples.

6.1.2 Attitudinal and cultural models

In this section, behavioral/attitudinal models were estimated for the OE and DC CV surveys. For example, how do opinion on rain forest management issues, views on the use of tropical rain forests (why save or cut) cost sharing, income, etc affect a respondents' WTP for the preservation of tropical rain forests? The model to be estimated was:

$$\text{WTP} = f(\text{RFV}, \text{COI}, \text{COH}, \text{RTIDH}, \text{RTIDE}, \text{CSH}, \text{NAFFORD}, \text{NATMAG}, \text{CCS}, \text{FMS}, \text{RU}, \text{LOGINC}) \quad (6.5)$$

where:

LOGINC is logincome (in Kina (PNG) and US\$);

COI is the environmental orientation 1 variable. This is the variable related to respondents' opinion on rain forest management (6 = strongly agree 1 = no opinion);

COH is the development orientation 1 variable. This is the variable related to respondents' opinion on rain forest management (6 = strongly agree 1 = no opinion);

CCS is charitable contributions dummy (1 = contributed to charities in 1997);

RFV is the rain forest visitor dummy (1 = visited or plans to visit rain forests, for US residents; 1 = visited PNG rain forest last year for PNG residents);

RTIDH is the environmental orientation 2 variable. This is the variable related to respondents' opinion on why rain forests are cut and why rain forests should be saved (4 = agree 1 = no opinion);

RTIDE is the development orientation 2 variable. This is the variable related to respondents' opinion on why rain forests are cut and why rain forests should be saved (4 = agree 1 = no opinion);

CSH is a cost-sharing dummy (1 = PNG residents [US residents] believing industrialized countries [tropical countries] should help

pay for tropical rain forest preservation);
 NAFFORD is the affordability dummy (1 = if respondent cannot afford to donate);
 NATMAG is the dummy for subscribing to nature magazines (1 = if subscribed to nature magazines);
 RU is the rural / urban dummy variable (1= if respondent lived most of his/her childhood in a rural area);
 FMS is family size; and
 IE is an information effect dummy (1 = if the respondent received the SAVE the rain forest information before the CUT information).

6.1.3 Factor analysis

Factor analysis was employed to identify clusters or groups that entailed a similar or common trait (Kass and Tinsley 1979). The procedure was applied to questions related to respondents' opinion on tropical rain forest management issues. The responses in this group were represented by the variables COA through COK. The other question was related to respondents' views on reasons for protecting and for cutting tropical rain forests and the responses were denoted by the variables RTIDA through RTIDH.

Using the factor analysis (with varimax rotation) procedure in SAS 6.12, two clusters were identified²⁰ for the COi and the RTIDi variables, one describing an 'environmental' orientation and the other representing a 'development' orientation. The groups were labeled 1 for the former and 2 for the latter (Tables 6.6 and 6.7). Mean scale scores were then used to select the representative or proxy variables COi and RTIDi from each cluster. The criteria for selecting a representative variable within each cluster were as follows. For clusters with an odd number of variables, the variable with the median mean value was selected as a representative variable for that particular cluster. For clusters with an even number of variables, the selection was made between the two middle variables. The variable whose mean was closer to the mean of the cluster was chosen. Even though variables were selected from two samples, the sources turned out to be less complicated. The following variables were selected:

COI = (If rain forest destruction continues on its present course, we will soon experience a major ecological catastrophe.),
 COH = (Tropical rain forests should not be completely protected.),
 RTIDH = (Forests should be preserved to help to prevent the greenhouse effect (global warming)),

²⁰ SAS automatically determines the number of factors and the variables that fall under each factor. Eigenvalues and a "scree" plot (i.e., the break in the plotted line of eigenvalues) are also provided. Eigenvalues and "scree" plots are used to determine the number of factors (see Kaiser 1960 and Cattell and Jaspers.1967).

RTIDE = (Forests should be cut to provide for economic development in tropical countries, see Tables 6.6 and 6.7).

COI and COH were the environmental orientation¹ and development orientation¹ variables, respectively.

RTIDH and RTIDE were the environmental orientation² and development orientation² variables, respectively. Factor analysis was used to get at a simplified model structure and moreover, the procedure also takes care of any multicollinearity that might crop up among the variables.

6.1.4 Protest zero bids

Protest zero bids were excluded from the analysis because zero bids associated with protests do not necessarily indicate a zero value for the resource being valued (Stevens et al. 1994). Respondents may in fact be in favor of the cause but may be objecting to some aspect of the survey (e.g., the format of the CV question asking for personal contributions) or just ambivalent. They may view such an exercise as immoral and unethical. In other words, respondents may be showing conflicting feelings about saving tropical rain forest, feelings that may be acting in opposite ways and as such, protest zero bids should be identified and excluded from the analysis.

The number of protest zero bids excluded from the original data (shown in parenthesis) was as follows, denoting Port Moresby as POM and Portland as POR: POM DC 25 (from 219), POM OE 18 (from 240), POR DC 24 (from 154) and POR OE 20 (from 173). Note that the original data were the final data that excluded observations with missing values.

6.2 Estimation Results and Discussion

This section discusses the results shown in Tables 6.8 to 6.17. The models were fitted using SAS version 6.12.

6.2.1 The information effect hypothesis

There were four subsamples for each country, two within the open-ended (OE) and dichotomous choice (DC) CV surveys. One-half of the sample within the OE and DC surveys received information related to reasons for saving tropical rain forests before the information related to reasons for cutting rain forests. Thus, the subsamples were labeled as either 'POM Save' or 'POR Save'. When the order of the information was reversed for the other half of the sample, the subsamples were similarly labeled as either 'POM Cut' or 'POR Cut'. The

surveys were designed this way to test whether or not the order in which information was received affected respondents' WTP.

Two approaches were taken to test this hypothesis. First, a pooling test was carried out to see if the 'save' and 'cut' subsamples within each CV survey could be pooled (The null hypothesis was that the betas between the two subsamples are equal). Second, an information effect (IE) dummy variable was included in the pooled models to ascertain the statistical significance of information order. The null hypothesis being $b_{IE} = 0$. That is, the order in which information is received does not affect respondents WTP.

For each of the CV surveys, the subsamples were run separately and then as pooled data. Loglikelihood ratio (LR) values were then obtained from these regressions and plugged into the following formula:

$$\lambda = -2[\text{LR}_{\text{restricted}} - (\text{LR}_{\text{unrestrictedsave}} + \text{LR}_{\text{unrestrictedcut}})]$$

where λ is the LR test value which is chi-square distributed, $\text{LR}_{\text{restricted}}$ is the LR value for the pooled model, $\text{LR}_{\text{unrestrictedsave}}$ and $\text{LR}_{\text{unrestrictedcut}}$ are the LR values for the 'save' and 'cut' sub-samples, respectively.

The pooling test results for the motive models showed that only the Portland DC data could be pooled (Table 6.13). For Port Moresby, both the sub-samples within the OE and DC surveys could not be pooled. For Portland, only the sub-samples within the OE survey could not be pooled. For the sub-samples that could not be pooled, it was concluded that the order in which information was received might have affected the respondents' responses. However, there may be other reasons since in a pooling test, the hypothesis formally stated is that the estimated coefficients between the sub-samples are equal. Thus student t-tests of the variables (already in the model) between the sub-samples were conducted to identify which variables were and were not statistically different between the sub-samples. It was found that generally most of the motive and socioeconomic variables were statistically different between the sub-samples.

In the second approach, an information effect ($IE = 1$ if respondent received the 'save' information before the 'cut' information) dummy variable was included in the pooled models. The results showed that this variable was not statistically significant for the POM OE, POM DC and POR OE pooled models (Table 6.14). The variable was significant for the POR DC pooled model. Thus the study failed to reject the null hypothesis for the POM OE, POM DC and POR OE pooled models but not for the POR DC pooled model. This result indicates that the POM OE, POM DC and POR OE models should be estimated

as pooled models while the POR DC model should be estimated as two separate models. This outcome contradicted the pooling test results.

This contradiction could be attributed to the nature of the models. The motive models did not include attitudinal variables. The motive variables were basically related to the CV (payment) question itself. Thus, it was decided to go by the pooling test results.

The two approaches were repeated in the behavioral/attitudinal models and the results from both approaches were consistent with each other. The pooling test results showed that the Portland OE and DC models should be estimated as pooled models while the Port Moresby OE and DC models should be estimated separately (Table 6.18). The IE dummy variable was significant for the POM models but not for the POR models (Table 6.19). Thus for the behavioral models, Portland respondents were not affected by the order in which information was presented.

6.2.2 Willingness to pay and existence value: a comparison

Prior to estimation, it was expected that, as a proportion of total mean willingness to pay (WTP): (1) existence value (as traditionally defined) would be smaller for Port Moresby residents and larger for Portland residents, and (2) direct use value would be larger for Port Moresby residents and smaller for Portland residents. The hypothesis was based on the fact that Port Moresby residents were asked to value a resource that was located in their country whereas Portland residents were asked to value a resource located elsewhere in the tropics. As shown in Table 6.10, for the OE cut sub-samples, existence value accounted for 45% of total mean WTP for Port Moresby respondents compared with 43% for Portland respondents. Apart from this result, existence value (economic existence value + non-economic existence value) as a proportion of WTP was generally lower for Port Moresby (POM) respondents than Portland (POR) respondents: POM OE save 33%, POR OE save 44%; POM OE cut 45%, POR OE cut 43%; POM DC save 37%, POM DC cut 32%, POR DC pooled 53%. The results also show that direct use value as a proportion of WTP was higher for POM residents than POR residents: POM OE save 32%, POR OE save 10%; POM OE cut 15%, POR OE cut 6%; POM DC save 22%, POM DC cut 23% and POR DC pooled 8%.

As mentioned above, economic existence value was estimated by setting the mean values of the dummy variables UV, B, OV, PA, NPA, IV, GC, MD, FS and EQ equal to zero. For most of the subsamples (for both countries), economic existence value accounted for less than 17% of total WTP (POM OE save 2%, POR OE save 10%; POM OE cut 11%, POR OE cut 4%; POM DC save 4%,

POM DC cut 3% and POR DC pooled 17%) whereas non-economic existence value accounted for over 29% of total WTP (POM OE save 31%, POR OE save 44%; POM OE cut 34%, POR OE cut 39%; POM DC save 33%, POM DC cut 29% and POR DC pooled 36%). These results were expected.

In dollar terms, existence value (EV) (and economic existence value, EEV) and WTP (and economic WTP, EWTP) differed between Port Moresby and Portland residents. The comparisons are as follows:

Open Ended (MLE Tobit estimation)

POM saves \$10.54 (WTP), \$3.40 (EV) and \$6.41 (EWTP), \$0.24 (EEV);
 POR save \$7.70 (WTP), \$4.15 (EV) and \$3.61 (EWTP), \$0.79 (EEV);
 POM cut \$9.12 (WTP), \$4.19 (EV) and \$4.69 (EWTP), \$0.96 (EEV);
 POR cut \$7.34 (WTP), \$3.19 (EV) and \$3.56 (EWTP), \$0.30 (EEV);

Payment card Kramer and Mercer (MLE estimation)

\$31 (WTP)

Dichotomous Choice double unbounded (MLE Tobit estimation)
 POM save \$16.12 (WTP), \$5.99 (EV) and \$8.98 (EWTP), \$0.69 (EEV);
 POM cut \$6.61 (WTP), \$2.14 (EV) and \$4.01 (EWTP), \$0.19 (EEV);
 POR pooled \$3.31 (WTP), \$1.75 (EV) and \$1.81 (EWTP), \$0.56 (EEV);

Dichotomous Choice double bounded Kramer and Mercer (MLE Logit estimation)

\$21 (WTP)

A comparison of the difference between WTP and EWTP, on the one hand, and EV and EEV on the other, showed that the differences between the estimates within the sub-samples were more pronounced for the latter than the former (Table 6.1). However, in the case of the former, the divergence was still significant for all the sub-samples. Thus this result supports an earlier finding that ethical, moral and social values tend to drive a wedge between *willingness to pay* and *economic (true) willingness to pay*, on the one hand, and *existence value* and *economic existence value*, on the other. And if the divergence between the estimates is quite profound, as was the case here, failure to account for such values may lead to overestimation.

Table 6.1. Difference between WTP and economic WTP, and existence value and economic existence value

	Difference between WTP and EWTP	Difference between EV and EEV
<i>Open Ended</i>		
POM* save	39%	93%
POR* save	53%	81%
POM cut	49%	77%
POR cut	51%	91%
<i>Dichotomous Choice</i>		
POM save	44%	88%
POM cut	39%	91%
POR pooled	45%	68%

*POM = Port Moresby; POR = Portland.

Another perspective would be to calculate the proportion of responses to the motive questions so that some idea of the magnitude of the components of the average WTP could be deduced. Table 6.2 below outlines the proportion of responses to the contingent valuation question in terms of the classification described in section 6.2.1. It describes a similar pattern discussed above. That is, generally use value accounted for a higher proportion of total WTP for Port Moresby respondents than for Portland respondents. Existence value as traditionally defined (i.e., economic existence value + intrinsic value + ethical, social or moral values) was much higher for Portland respondents than Port Moresby respondents. Generally, the proportion of direct use value was larger than existence value for Port Moresby respondents but the latter was larger than the former for Portland respondents. Similarly, WTP decomposed in this manner also showed that economic existence value accounted for a much smaller proportion of total WTP.

Table 6.2. Proportion of motive responses to total WTP

Group	Open Ended				Dichotomous Choice		
	Save		Cut		Save	Cut	Pooled
	PO M	POR	PO M	POR	PO M	PO M	POR
I. Use value	44%	9%	35%	2%	31%	32%	4%
II. Other use value	31%	25%	32%	46%	33%	36%	36%
III. Non-economic use value	4%	13%	9%	12%	11%	7%	12%
IV. Economic existence value	1%	14%	8%	8%	5%	1%	7%
V. Intrinsic value	5%	21%	7%	21%	6%	14%	17%
VI. Ethical, social, moral values	12%	9%	8%	6%	9%	7%	9%
Other factors	2%	9%	0%	6%	4%	3%	14%

6.2.3 Equality of means test

Bootstrapping was employed to obtain standard errors for the mean WTP estimates in order to conduct the equality of means test. A SAS bootstrapping program was written to automate the procedure. Repeated samples of 60% of the original sample from each model were taken 1,000 times. Mean WTP estimates were then obtained from each sample drawn. Standard errors were obtained from 1,000 of these estimates from each model. These standard errors were used to conduct the tests discussed below.

6.2.2.1 Portland versus Port Moresby estimates

Generally, the Port Moresby OE and DC WTP estimates were higher than the Portland estimates. The comparison is as follows: POM OE (save \$10.54, cut \$9.12) > POR OE (save \$7.70, cut \$7.34); POM DC (save \$16.12, cut \$6.61) > POR DC (pooled \$3.31). However, these differences were not large, which raise the following question: are the two WTP estimates (Portland versus Port Moresby) statistically different? It was hypothesized that benefits were directly transferable between Portland and Port Moresby. The null hypothesis being $H_0: \mu \text{ (Port Moresby)} = \mu \text{ (Portland)}$. In other words, Port Moresby (PNG) and Portland (US) WTP estimates would not be statistically different.

The equality of means test results between both cities showed that Port Moresby and Portland estimates were statistically different at the 5% level (Table 6.3). The tests were conducted between the Port Moresby OE save and Portland OE save; Port Moresby OE cut and Portland OE cut; Port Moresby DC save and Portland DC pooled; and the Port Moresby DC cut and Portland DC pooled models. This finding invalidates the assumption that benefits could be directly transferable between countries, especially between developed and developing countries. The differences may also be explained by differences in motives and socioeconomic variables between Port Moresby and Portland residents as discussed in section 6.2.4.

Table 6.3. Equality of means test Port Moresby versus Portland willingness to pay (WTP) estimates

	Open Ended			
	Save		Cut	
	Port Moresby	Portland	Port Moresby	Portland
Mean WTP	\$10.54	\$7.70	\$9.12	\$7.34
Standard errors*	(2.49)	(0.60)	(2.78)	(0.48)
Sample size	113	75	109	78

Table 6.3. Continued.

Degrees of freedom (df)	131	117		
t _{0.025} (df), 2 tailed	±1.96	±1.96		
t(computed)	11.626	6.550		
Reject Ho: μ _{pom} = μ _{por} **	YES	YES		
	Dichotomous Choice Double Unbounded			
	Port Moresby	Portland	Port Moresby	Portland
	Save	pooled	cut	pooled
Mean WTP	\$16.12	\$3.31	\$6.61	\$3.31
Standard errors*	(4.64)	(0.14)	(0.98)	(0.14)
Sample size	94	130	90	130
Degrees of freedom (df)	93	92		
t _{0.025} (df), 2 tailed	±1.96	±1.96		
t(computed)	26.758	31.722		
Reject Ho: μ _{pom} = μ _{por} **	YES	YES		

* Standard errors were obtained via bootstrapping.

** μ_{pom} = Port Moresby mean wtp; μ_{por} = Portland mean wtp.

A word of caution though about this conclusion. Most benefit transfer methods do not, in fact, advocate directly transferring values between countries. It is usually argued that some adjustments are necessary for differences in income, purchasing power parity, and/or demographic variables. For this study, adjustments may not be possible particularly since WTP seemed to be linked to income in Portland but not in Port Moresby.

6.2.2.2 Open ended versus dichotomous choice estimates

In general, the Portland OE WTP estimates (save \$7.70, cut \$7.34) were greater than the DC pooled WTP estimate (\$3.31). However, for Port Moresby, the DC save estimate (\$16.12) was the highest followed by the OE estimates (save \$10.54, cut \$9.12) and the DC cut estimate (\$6.61). Again these differences are not large. Similar equality of means test results as in section 6.2.2.2 were obtained between the open ended and dichotomous choice double unbounded payment formats (Table 6.4). The OE and DC estimates were found to be statistically different.

Table 6.4. Equality of means test: open ended versus dichotomous choice willingness to pay (WTP) estimates.

	Port Moresby			
	Save		Cut	
	Open Ended	Dichotomous Choice	Open Ended	Dichotomous Choice
Mean WTP	\$10.54	\$16.12	\$9.12	\$6.61
Standard errors*	(2.49)	(4.64)	(2.78)	(0.98)
Sample size	113	94	109	90
Degrees of freedom (df)	136		139	
t _{0.025} (df), 2 tailed	±1.96		±1.96	
t(computed)	-10.472		8.788	
Reject Ho: $\mu_{oe} = \mu_{dc}$ **	YES		YES	
	Portland			
	Save	Pooled	Cut	Pooled
Mean WTP	\$7.70	\$3.31	\$7.34	\$3.31
Standard errors*	(0.60)	(0.14)	(0.48)	(0.14)
Sample size	75	130	78	130
Degrees of freedom (df)	79		85	
t _{0.025} (df), 2 tailed	±1.96		±1.96	
t(computed)	62.392		72.327	
Reject Ho: $\mu_{oe} = \mu_{dc}$ **	YES		YES	

* Standard errors were obtained via bootstrapping.

** μ_{oe} = Open Ended mean wtp; μ_{dc} = Dichotomous Choice mean wtp.

6.2.2.3 Save versus cut estimates

For both cities, the 'save' estimates were generally greater than the 'cut' estimates. The comparison is as follows: POR OE save (\$7.70) > cut (7.34); POM DC save (\$16.12), OE save (\$10.54) > POM OE cut (\$9.12), DC cut (\$6.61). That is, the average respondent who received the 'save' information first was willing to pay more than the average respondent that received the 'cut' information first was. But the differences were not large. Again as in the two previous cases, the 'save' and 'cut' estimates for each city were found to be statistically different (Table 6.5).

Table 6.5. Equality of means test: save versus cut willingness to pay (WTP) estimates

	Port Moresby			
	Open Ended		Dichotomous Choice	
	Save	Cut	Save	Cut
Mean WTP	\$10.54	\$16.12	\$9.12	\$6.61
Standard errors*	(2.49)	(4.64)	(2.78)	(0.98)
Sample size	113	94	109	90
Degrees of freedom (df)	136		139	
t _{0.025} (df), 2 tailed	±1.96		±1.96	
t(computed)	-10.472		8.788	
Reject Ho: $\mu_{save} = \mu_{cut}$ **	YES		YES	
	Portland: Open Ended			
	Save		Cut	
Mean WTP	\$7.70		\$7.34	
Standard errors*	(0.60)		(0.48)	
Sample size	75		78	
Degrees of freedom (df)	142			
t _{0.025} (df), 2 tailed	±1.96			
t(computed)	4.088			
Reject Ho: $\mu_{save} = \mu_{cut}$ **	YES			

* Standard errors were obtained via bootstrapping.

** μ_{save} = Open Ended save mean wtp; μ_{cut} = Open Ended cut mean wtp.

6.2.4 Cultural comparison by motives, age, education and income

The differences in benefits, as shown in section 6.2.3, could be explained by differences in motives and socioeconomic variables. Table 6.8 shows that respondents from the Port Moresby OE save model, motivated by use value (UV), bequest value (B), option value (OV), paternalistic altruism (PA), non-paternalistic altruism (NPA), cognitive value (CG), intrinsic value (IV), good cause (GC) and moral duty (MD), were willing to pay more to preserve tropical rain forest. Payment for one's fair share (FS) and concern for environmental quality (EQ) in general were not statistically significant. Note that the FS and EQ variables were related to the decision about *how much* to pay whereas the other factors above were the '*why*' reasons that respondents may consider in deciding whether to pay some amount. Age, education and income level were not statistically significant. By comparison, for the Portland OE model, respondents motivated by UV, B, NPA, CG, IV, MD were willing to pay more but would pay less if they were motivated by the option value. PA, GC, FS and EQ were not statistically significant. As expected, payment increased with

income but older respondents were willing to pay less. Education was not statistically significant.

Thus for the OE save models, the motivating factors that were different between Portland and Port Moresby residents were option value, paternalistic altruism and good cause. Port Moresby residents were willing to pay more if motivated by the option value whereas Portland residents were willing to pay less. Paternalistic altruism and good causes were motivating factors for Port Moresby residents but not for Portland residents. Age and income were the determining factors for Portland residents but not for Port Moresby residents.

Respondents from the Port Moresby OE cut model were willing to pay more if motivated by UV, B, PA, NPA, CG, IV, MD, FS and EQ but would pay less if motivated by the option value. GC was not statistically significant, unlike the socioeconomic variables. For the Portland OE cut model, respondents motivated by UV, B, OV, PA, NPA, CG, IV, GC and MD were willing to pay more. Again as expected, payment increased with income but decreased with age. Option value, good cause, fair share and environmental quality were the motivating factors that were different between the two countries. While Portland residents were willing to pay more if motivated by the option value, Port Moresby residents were willing to pay less. Good cause was a significant factor for Portland residents but not for Port Moresby residents. On the other hand, fair share and environmental quality were motivating factors for Port Moresby respondents but not for Portland respondents. Again, as in the save models, age and income were significant variables for Portland residents but not for Port Moresby residents.

Table 6.6. Factor loadings resulting from principal components factor analysis with items related to respondents' opinions on tropical rain forest management

	Factor Loading		Mean Scale Score ^a		
	POM*	POR*	POM ^b	POR ^c	Combined
<i>Environmental Orientation 1</i>			5.29	4.81	5.09
As much tropical rain forest as possible should be preserved no matter what the cost.	0.70	0.70	5.54	4.76	5.21
I have a moral duty to help protect tropical rain forests.	0.65	0.59	5.36	4.61	5.05
Humans must live in harmony to survive.	0.57	0.57	5.62	5.46	5.56
The main reason for preserving rain forests is to benefit future generations.	0.52	0.46	5.45	4.63	5.11
If rain forest destruction continues on its present course, we will soon experience a major ecological catastrophe (COI).	0.51	0.61	5.38	4.73	5.11

Table 6.6. Continued.

Rain forests should be preserved simply because they exist, regardless of any benefit or harm to humans.	0.48	0.49	4.69	4.26	4.51
The earth is like a spaceship with only limited room and resources.	0.27	0.65	5.01	5.20	5.09
<i>Development Orientation 1</i>			3.55	3.27	3.43
The measures that have been taken to protect tropical rain forests are not necessary and will cause too much economic suffering.	0.41	0.52	3.16	2.77	3.00
People in tropical countries prefer development to conservation.	0.40	0.26	4.20	3.58	3.94
The earth can support a much larger population than exists today.	0.29	0.36	3.21	3.46	3.31
Tropical rain forests should not be completely protected (COH).	0.27	0.48	3.63	3.28	3.49

^a Strongly agree =6, Agree =5, Neutral =4, Disagree =3, Strongly Disagree =2, and No opinion =1.

^b N = 461

^c N = 330

* POM = Port Moresby, POR = Portland

Table 6.7. Factor loadings resulting from principal components factor analysis with items related to respondents' opinions on the reasons for saving and cutting tropical rain forests

	Factor Loading		Mean Scale Score ^a		
	POM *	POR *	PNG ^b	US ^c	Combined
<i>Environmental Orientation 2</i>			3.86	3.67	3.78
Forests should be preserved to save plants and animals that could be used for medicine.	0.59	0.50	3.83	3.84	3.83
Forests should be preserved to prevent plant and animal species extinction.	0.57	0.61	3.95	3.92	3.94
Forests should be preserved to help to prevent the greenhouse effect (global warming) (RTIDH).	0.55	0.48	3.82	3.73	3.78
Forests should be preserved to prevent plant and animal species extinction.	0.37	0.25	3.84	3.21	3.58

Table 6.7. Continued.

<i>Development Orientation 2</i>			2.63	2.43	2.55
Forests should be cut to provide for economic development in tropical countries (RTIDE).	0.57	0.65	2.67	2.46	2.58
Forests should be cut to provide more land for food production.	0.53	0.71	2.82	2.44	2.66
Forests should be cut to provided fuelwood in tropical countries for household cooking and heating.	0.44	0.54	2.80	2.69	2.76
Forests should be cut to provide money to pay off foreign debts.	0.40	0.55	2.23	2.13	2.19

^a Agree = 4 , Neutral = 3, Disagree = 2, and No opinion = 1; ^b N = 461; ^c N = 330.

* POM = Port Moresby, POR = Portland.

Comparison of the DC models was made between the pooled Portland model and the Port Moresby save and cut models (Table 6.9). For the three models, respondents were willing to pay more if motivated by UV, B, OV, NPA, CG, IV and MD. Respondents from the Port Moresby save model were willing to pay less if motivated by paternalistic altruism; on the other hand, respondents from the Port Moresby cut model and the Portland pooled model were willing to pay more if motivated by the same factor. Good cause was a significant factor for Port Moresby residents but not for Portland residents. On the other hand, fair share and environmental quality were motivating factors for Portland respondents but not for Port Moresby respondents. As expected, payment increased with education for Portland residents. Education though was not significant for Port Moresby respondents.

One of the questions posed in Chapter 2 was whether or not economic existence value existed. As Tables 6.8 and 6.9 show, economic existence value does exist. In all the models, the cognitive motive was statistically significant. The respondents were willing to pay more if they were motivated by the cognitive motive.

Table 6.8. Decomposition of willingness to pay (open ended)

	Estimated Coefficient ^a			
	Save		Cut	
Variable	Port Moresby	Portland	Port Moresby	Portland
Constant	-3.05(2.19)*	-8.26(2.28)*	-0.90(0.50)	-11.18(2.60)*
Use Value (UV)	3.98(11.53)*	3.96(3.03)*	2.20(5.80)*	5.39(2.91)*
Bequest Value (B)	3.80(9.64)*	2.84(3.38)*	2.22(5.58)*	5.24(7.74)*
Option Value (OV)	3.94(3.65)*	- 15.44(3.03)*	- 10.09(5.68)*	6.30(3.11)*
Paternalistic Altruism (PA)	3.70(5.27)*	1.28(0.97)	2.19(3.39)*	4.95(5.41)*
Non-paternalistic Altruism (NPA)	4.66(7.11)*	2.14(2.06)*	2.34(3.90)*	4.57(5.12)*
Cognitive Value (CG)	3.81(3.45)*	2.74(2.20)*	1.93(3.29)*	3.27(3.22)*
Intrinsic Value (IV)	4.06(7.27)*	2.47(3.13)*	2.43(3.7)*	4.54(6.15)*
Good Cause (GC)	3.94(5.61)*	2.06(0.93)	-0.95(1.04)	4.18(2.32)*
Moral Duty (MD)	4.21(9.06)*	3.28(2.20)*	1.97(2.86)*	5.00(3.81)*
Fair Share (FS)	0.19(0.79)	0.10(0.08)	1.15(3.0)*	0.54(0.75)
Environmental Quality (EQ)	-0.24(0.57)	-0.81(0.81)	1.19(3.14)*	0.96(1.61)
Age	0.01(0.95)	-0.04(2.54)*	0.01(0.44)	-0.03(2.22)*
Education (ED)	0.02(0.72)	-0.02(0.27)	0.01(0.25)	0.14(1.60)
Log Income	0.558(1.519)	2.57(2.94)*	0.33(0.77)	2.08(2.30)*
σ	1.04(13.15)*	2.11(8.62)*	1.45(12.42)*	1.63(9.30)*
Number of observations	113	75	109	78
Range of Bid amounts	K0 - K500	\$0 - \$3000	K0 - K488	\$0 - \$1500
Number of protest zero bids excluded	10	7	8	13

Note: absolute value of t-statistic in parentheses.

^a Dependent variable is the log of bid amount specified by the respondents.

* Significant at 5% level.

** Significant at 10% level.

6.2.5 Comparison with previous study: Kramer and Mercer

In general, WTP estimates of this study were far lower than the Kramer and Mercer (KM) estimates. For the open ended payment survey, the Portland estimates varied from \$7.34 (cut) to \$7.70 (save) per household, while for the KM payment card survey, the estimate was \$31 per household. Likewise, the Port Moresby estimates (POM saves \$10.54 and cut \$9.12) were lower than the KM estimate. Similarly, the Portland DC pooled and the Port Moresby cut WTP estimates of \$3.31 and \$6.61, respectively, were considerably lower than KM's DC double bounded estimate of \$21 per household. The Port Moresby DC save estimate of \$16.12 was closer. However, comparison between the studies may be weakened by the fact that: (1) the statistical models were not identical, (2) the extent of the market was different, and (3) the payment formats were different. On the second point, KM's study was based on a countrywide sample while this study was based on samples drawn from Portland, Maine (US) and Port Moresby (PNG) only.

Table 6.9. Decomposition of willingness to pay (dichotomous choice double unbounded)

Variable	Estimated Coefficient ^a		
	Save	Cut	Pooled
	Port Moresby	Port Moresby	Portland
Constant	-1.17(0.87)	-1.01(0.74)	-8.93(1.96)*
Use Value (UV)	3.96(9.30)*	4.03(11.03)*	3.90(2.90)*
Bequest Value (B)	3.92(9.36)*	4.04(11.00)*	4.66(7.17)*
Option Value (OV)	2.28(2.90)*	3.82(3.43)*	4.27(2.58)*
Paternalistic Altruism (PA)	-22.17(7.99)*	4.06(5.14)*	2.53(2.33)*
Non-paternalistic Altruism (NPA)	3.81(6.66)*	3.79(7.19)*	3.76(4.10)*
Cognitive Value (CG)	3.65(3.89)*	4.88(4.56)*	4.18(3.73)*
Intrinsic Value (IV)	4.33(5.58)*	4.56(10.16)*	3.43(4.56)*
Good Cause (GC)	3.23(2.41)*	4.71(6.85)*	2.83(1.62)
Moral Duty (MD)	3.83(5.32)*	3.71(4.70)*	4.71(3.84)*
Fair Share (FS)	0.12(0.37)	0.32(1.01)	3.22(2.69)*
Environmental Quality (EQ)	0.04(0.11)	0.16(0.49)	1.82(2.94)*
Age	- 0.04(3.08)*	-0.01(0.84)	-0.01(0.45)
Education (ED)	0.08(1.56)	0.04(1.12)	0.35(3.27)*
Log Income	0.57(1.44)	0.22(0.60)	0.63(0.70)
σ	1.21(11.93)*	1.02(11.23)*	2.22(10.24)*
Number of observations	94	90	130
Range of Bid amounts	K0 - K1000	K0 - K500	\$0 - \$500
Number of protest zero bids excluded	9	16	24

Note: absolute value of t-statistic in parentheses.

^aDependent variable is the log of bid amount specified by the respondents.

* Significant at 5% level.

** Significant at 10% level.

A comparison of total WTP for all households in the US between this study and the KM study showed a huge difference. Assuming 91 million households, total WTP was estimated as follows:

US OE saves \$364 million;
US OE cut \$161.07 million;
KM payment card \$2.821 billion;
US DC double unbounded pooled \$114.66 million; and
KM DC double bounded \$1.911 billion.

6.2.6 Economic willingness to pay

For valuation purposes, the appropriate value to use would be the mean economic WTP (EWTP) since this value represents the true economic value of the resource as previously argued. The mean EWTP per household was estimated by setting the mean values of the dummy variable NPA, and the ethical and social variables (IV, GC, MD, FS and EQ) equal to zero. Table 6.8 shows that for Port Moresby respondents, average WTP per household ranged from K16.53 (\$6.61) to K40.30 (\$16.12) and average economic WTP ranged from K10.02 (\$4.01) to K22.45 (\$8.98). For Portland respondents, average WTP ranged from \$3.31 to \$7.70 and average economic WTP ranged from \$1.81 to \$3.61.

Table 6.15 shows the total economic WTP for city (Port Moresby and Portland) households and for all households (PNG and US). Total EWTP ranged from \$200,400 (K501,000) to \$449,000 (K1,122,500) for Port Moresby households and \$38,010 to \$75,810 for Portland households. Assuming that the estimates can be generalized to the general population, total EWTP ranged from \$4.5m (K11.3m) to \$10.09m (K25.2m) and from \$164.7m to \$328.5m for PNG and US households, respectively.

6.2.7 Cost sharing

The cost sharing dummy variable (CSH) was significant and negative for the Port Moresby OE cut and DC save models. That is, Port Moresby respondents who believed that the developed nations of the world should bear the cost of preservation were not willing to pay anything. This variable was not significant for the Portland respondents (Tables 6.16 and 6.17).

6.2.8 Respondent uncertainty

A follow-up question to the CV question asked respondents to state their level of uncertainty from a scale of 1 (uncertain) to 10 (certain) regarding their positive bid answer. Positive bids were recoded as zero bids for those who circled any value less than 10. As expected, since the number of positive bids fell by more than half for nearly all the subsamples, the average WTP fell by over 90 percent from the original estimates (Table 6.10). Therefore, in this study, when the uncertainty of respondents was incorporated into the statistical models, average WTP decreased, substantially.

Table 6.10. Composition of willingness to pay

	Open Ended				Dichotomous Choice		
	Save		Cut		Save	Cut	Pooled
	POM*	POR*	POM	POR	POM	POM	POR
Total willingness to pay	\$10.54 K26.35	\$7.70	\$9.12 K22.79	\$7.34	\$16.12 K40.30	\$6.61 K16.53	\$3.31
Composition of total willingness to pay							
Use value ^a	32%	10%	15%	6%	22%	23%	8%
Other use value ^b	26%	27%	26%	39%	29%	35%	30%
Non-economic use value ^c	6%	9%	9%	9%	9%	7%	9%
Economic existence value ^d	2%	10%	11%	4%	4%	3%	17%
Non-economic existence value ^e	31%	44%	34%	39%	33%	29%	36%
Other factors	3%		5%	3%	3%	3%	
Total WTP	100%	100%	100%	100%	100%	100%	100%
Economic WTP ^f	60% \$6.41 K16.03	47% \$3.61	52% \$4.69 K11.72	49% \$3.56	55% \$8.98 K22.45	61% \$4.01 K10.02	55% \$1.81

^a Includes consumptive and non-consumptive use value.

^b Includes bequest value, option value and paternalistic altruism.

^c Includes non-paternalistic altruism.

^d Includes cognitive value.

^e Includes intrinsic value, good cause, moral duty and fair share.

^f Economic WTP = use value + other use value + economic existence value

Exchange rate: K1.00 = US\$0.40.

* POM = Port Moresby, POR = Portland.

6.2.9 Payment for backyard versus the rest of the world

An additional question was asked in the Port Moresby survey to find out whether or not respondents were paying to preserve tropical rain forest

throughout the world (response 1), or preserve rain forest in PNG only (response 2) or both (response 3). Those who circled response 3 were asked to state the proportion of their donation that would go towards the preservation of PNG's forest. Two separate regressions were run for the 'PNG only' model and the 'Rest of the Tropical World' model. The results (Table 6.11) indicate that Port Moresby respondents preferred, on average, that over 70% of their contribution go towards the preservation of PNG's rain forest. This result was expected. Port Moresby respondents were more concerned about their 'own' backyard than preserving tropical rain forests in general. From this result, it can be construed that if the rest of the world, especially the developed countries including Portland, are genuine about their concerns for the global benefits provided by tropical rain forests, then they need to bear the bulk of the burden for preserving rain forests in the tropics. This result could also support the case for the establishment of a local "Conservation Trust Fund".

Table 6.11. Comparison of WTP between original models and respondent (un)certainty models.

	Open Ended				Dichotomous Choice		
	Save		Cut		Save	Cut	Pooled
	POM*	POR*	POM	POR	POM	POM	POR
<u>Original Model</u>							
Total willingness to pay	\$10.54 K26.35	\$7.70	\$9.12 K22.79	\$7.34	\$16.12 K40.30	\$6.61 K16.53	\$3.31
% positive bids	83%	55%	80%	54%	76%	66%	42%
<u>Certainty Model</u>							
Total willingness to pay	\$0.64 K1.59	\$0.25	\$0.69 K1.73	\$0.19	\$0.87 K2.17	\$0.10 K0.25	\$0.12
% positive bids	44%	20%	40%	19%	38%	26%	15%

Exchange rate: K1.00 = US\$0.40

* POM = Port Moresby, POR = Portland

Table 6.12. Payment for 'backyard' vs. rest of the tropical world.

Open Ended	Willingness to Pay	% total
<i>Save</i>		
Total	K26.35	
Rest of the tropical world	K 4.79	18.2%
PNG only	K18.17	69.0%
<i>Cut</i>		
Total	K22.79	
Rest of the tropical world	K 3.64	16.0%
PNG only	K17.78	78.0%
Dichotomous Choice double unbounded		

Table 6.12. Continued.

<i>Save</i>		
Total	K40.30	
Rest of the tropical world	K 5.68	14.1%
PNG only	K23.74	58.9%
<i>Cut</i>		
Total	K16.53	
Rest of the tropical world	K 1.53	9.3%
PNG only	K11.47	69.4%

Table 6.13. Likelihood ratio (LR) test for pooling data (motive models) ^a

Open Ended									
Port Moresby					Portland				
		LR					LR		
Pooled		-376.87			Pooled		-251.94		
Subsample 1: Save		-151.57			Subsample 1: Save		-115.47		
Subsample 2: Cut		-176.02			Subsample 2: Cut		-106.02		
Lamda		98.56			Lamda		60.89		
Critical signif)	Chi2	(5%	16 df	26.30	Critical signif)	Chi2	(5%	16 df	26.30
Since Chi2 calculated > critical Chi2, we reject Ho that the betas are equal between the subsamples, i.e., the data cannot be pooled.					Since Chi2 calculated > critical Chi2, we reject Ho that the betas are equal between the subsamples, i.e., the data cannot be pooled.				
Dichotomous Choice Double Unbounded									
Port Moresby					Portland				
		LR					LR		
Pooled		-320.50			Pooled		-173.01		
Subsample 1: Save		-138.91			Subsample 1: Save		-86.32		
Subsample 2: Cut		-113.12			Subsample 2: Cut		-77.33		
Lamda		136.95			Lamda		18.72		
Critical signif)	Chi2	(5%	16 df	26.30	Critical signif)	Chi2	(5%	16 df	26.30
Since Chi2 calculated > critical Chi2, we reject Ho that the betas are equal between the subsamples, i.e., the data cannot be pooled.					Since Chi2 calculated < critical Chi2, we fail to reject Ho that the betas are equal between the subsamples, i.e., the data can be pooled.				

^a This table corresponds to Tables 6.8 and 6.9.

$\text{lamda} = -2 * [\text{LRpooled} - (\text{LRsave} + \text{LRcut})]$.

Table 6.14. Information effect hypothesis test (motive models)

Pooled Data	Estimated Coefficient ^a			
	Open Ended		Dichotomous Choice	
Variable	Port Moresby	Portland	Port Moresby	Portland
Constant	-1.97(1.49)	-12.60(3.89)*	-1.88(1.39)	-10.13(2.21)*
Use Value (UV)	2.11(8.06)*	1.69(1.59)	2.21(6.90)*	3.77(2.85)*
Bequest Value (B)	1.81(6.20)*	2.48(4.80)*	2.17(6.74)*	4.65(7.26)*
Option Value (OV)	-4.43(4.33)*	-0.89(0.43)	0.77(0.89)	4.37(2.69)*
Paternalistic Altruism (PA)	1.65(3.14)*	1.55(1.86)**	-2.20(2.15)*	2.82(2.60)*
Non-paternalistic Altruism (NPA)	1.61(3.42)*	1.13(1.56)	1.55(3.18)*	3.95(4.32)*
Cognitive Value (CG)	1.69(3.03)*	0.37(0.47)	-0.43(0.50)	3.97(3.60)*
Intrinsic Value (IV)	1.98(4.10)*	2.03(3.56)*	1.98(4.14)*	3.59(4.79)*
Good Cause (GC)	0.49(0.75)	-0.91(0.60)	0.04(0.05)	2.78(1.62)
Moral Duty (MD)	2.16(4.83)*	1.20(1.13)	0.75(1.12)	4.59(3.81)*
Fair Share (FS)	0.96(3.72)*	1.43(1.98)*	0.95(3.05)*	3.48(2.92)*
Environmental Quality (EQ)	0.96(3.09)*	1.32(2.26)*	0.77(2.34)*	1.64(2.66)*
Information Effect (IE)	0.31(1.38)	0.76(1.64)	0.29(1.10)	0.88(1.80)**
Age	0.003(0.20)	-0.04(2.93)*	-0.04(2.65)*	-0.006(0.37)
Education (ED)	0.01(0.34)	0.08(1.15)	0.07(1.67)	0.35(3.34)*
Log Income	0.68(2.09)*	3.00(4.29)*	0.93(2.53)*	0.76(0.81)
σ	1.53(17.93)*	2.31(12.46)*	1.65(16.18)*	2.18(10.25)*
Number of observations	222	153	184	130
Range of Bid amounts	K0 - K500	\$0 - \$3000	K0 - K1000	\$0 - \$500

Note: absolute value of t-statistic in parentheses.

^a Dependent variable is the log of the bid amount specified.

* Significant at 5% level.

** Significant at 10% level.

Table 6.15. Economic willingness to pay estimates for tropical rain forest preservation

Survey Type	Mean EWTP/ Household	Total EWTP city Households	Total EWTP all Households ^a
Open Ended			
<i>Save</i> Port Moresby	K16.03	K801,500 \$320,600	K18,017,720 \$7,207,088
Portland	\$3.61	\$75,810	\$328,510,000
<i>Cut</i> Port Moresby	K11.72	K586,000 \$234,400	K13,173,280 \$5,269,312
<i>Portland</i>	\$3.56	\$74,760	\$323,960,000

Table 6.15. Continued.

Dichotomous Choice Double-Unbounded			
Port Moresby: Save	K22.45	K1,122,500 \$449,000	K25,233,800 \$10,093,520
Port Moresby: Cut	K10.02	K501,000 \$200,400	K11,262,480 \$4,504,992
Portland: Pooled	\$1.81	\$38,010	\$164,710,000

Assumed household population:

Port Moresby 50,000; PNG 1,124,000 (PNG National Statistical Office 1990).

Portland 21,000; US 91,000,000 (US Bureau of Census 1992).

Exchange rate PGK1 = \$0.40.

^a All households in PNG and the US.

6.2.10 Attitudinal/behavioral models: a comparison

Tables 6.16 and 6.17 show the results of the OE and DC models. The cost sharing dummy and the affordability dummy variables were significant and negative for respondents from the Port Moresby OE cut and DC save samples. That is, Port Moresby respondents who believed that the developed nations of the world should bear the cost of preservation were not willing to pay anything. In addition, those who could not afford to pay anything were also not willing to pay at all. These variables through were not significant for Portland respondents and the other two Port Moresby sub-samples.

The environmental orientation 1 variable (COI) was significant only for the Portland DC pooled model. It was not significant for the rest of the sub-samples. The coefficient was negative suggesting that respondents were willing to pay less, which was not expected. This particular variable was related to the respondents' opinions on tropical rain forest management, namely: "If rain forest destruction continues on its present course, we will soon experience a major ecological catastrophe." The development orientation 1 variable (COH) was significant only for the Port Moresby DC cut model and the Portland DC pooled model. But the coefficient was positive, which was contrary to expectation. However, the sign of the coefficient may not be surprising because of the way the response statement was phrased, that is: "Tropical rain forests should not be completely protected."

The environmental orientation 2 variable (RTIDH) and the development orientation 2 variable (RTIDE) were related to the respondents' opinions on the reasons for protecting and for cutting tropical rain forests. The former was significant only for the Port Moresby DC cut and OE cut models. As expected, the coefficient was positive, suggesting that the respondents who believed that "Forests should be preserved to help to prevent the greenhouse effect (global

warming)” were willing to pay more. The latter (RTIDE: “Forests should be cut to provide for economic development in tropical countries”) was significant only in the Port Moresby DC cut and OE cut, and the Portland OE and DC pooled models. In all the cases, respondents were willing to pay less, which was expected.

Only respondents from the Portland OE pooled model were willing to pay more if they had visited tropical rain forest in the past or planned to visit in the future. This variable was not significant for the rest of the subsamples. Respondents from the Portland DC pooled and Port Moresby OE save models who made charitable contributions in 1997 were willing to pay more. As expected, payment decreased for respondents with a larger family size. This variable was significant for the Port Moresby DC save model only.

As expected, payment increased with income for respondents from the Port Moresby DC save and OE save, and the Portland OE pooled models.

Table 6.16. Tobit estimations of responses to attitudinal/cultural questions (open ended)

Variable	Estimated Coefficient ^a		
	Port Moresby		Portland
	Save	Cut	Pooled
Constant	-0.57(0.32)	2.15(2.52)*	-0.20(0.07)
Rain Forest Visitor Dummy (RFV)	0.09(0.30)	-0.12(0.82)	-0.81(1.96)*
Environmental Orientation 1 (COI)	0.11(0.74)	0.01(0.14)	0.03(0.26)
Development Orientation 1 (COH)	0.16(1.68)	0.04(0.77)	-0.002(0.01)
Environmental Orientation 2 (RTIDH)	-0.01(0.06)	0.30(2.42)*	-0.10(0.35)
Development Orientation 2 (RTIDE)	-0.16(1.01)	0.16(2.01)*	-0.48(1.96)*
Cost Sharing Dummy (CSH)	-11.25(0.0004)	-5.61(7.49)*	-15.50(0.0004)
Affordability Dummy (NAFFORD)	-11.54(0.0007)	-5.52(7.41)*	-15.54(0.001)
Nature Magazine (NATMAG)	0.34(0.41)	0.003(0.009)	-0.44(1.11)
Charitable Contribution (CCS)	0.48(1.94)*	0.08(0.60)	0.23(0.54)
Family Size (FMS)	0.01(0.27)	-0.02(1.05)	0.22(1.61)
Rural Urban Dummy (RU)	0.06(0.20)	0.09(0.68)	-0.35(0.85)
Log Income	0.78(2.29)*	0.09(0.53)	1.15(2.02)*
σ	1.12(13.37)*	0.57(26.90)*	1.62(13.13)*
Number of observations	113	109	153
Range of Bid amounts	K0 - K500	K0 - K488	\$0 - \$3000

Note: absolute value of t-statistic in parentheses.

^a Dependent variable is the log of the amount specified.

* Significant at 5% level.

** Significant at 10% level.

Table 6.17. Tobit estimations of responses to attitudinal/cultural questions
(dichotomous choice double unbounded)

Variable	Estimated Coefficient ^a		
	Save	Cut	Pooled
	Port Moresby	Port Moresby	Portland
Constant	3.39(3.27)*	-0.17(0.10)	-1.23(0.27)
Rain Forest Visitor Dummy (RFV)	-0.05(0.27)	0.06(0.19)	0.62(1.05)
Environmental Orientation 1 (COI)	-0.06(0.50)	0.13(0.83)	0.78(3.16)*
Development Orientation 1 (COH)	0.03(0.45)	0.29(2.65)*	0.82(3.41)*
Environmental Orientation 2 (RTIDH)	-0.14(0.67)	0.60(2.60)*	-0.60(1.61)
Development Orientation 2 (RTIDE)	-0.02(0.22)	-0.31(2.01)*	-0.63(1.83)**
Cost Sharing Dummy (CSH)	-5.99(4.75)*	-11.72(0.0005)	-16.35 (0.0003)
Affordability Dummy (NAFFORD)	-5.93(9.32)*	-11.70(0.0008)	-17.64(0.0007)
Nature Magazine (NATMAG)	0.31(0.80)	0.20(0.30)	-0.08(0.16)
Charitable Contribution (CCS)	0.22(1.16)	0.30(1.03)	1.55(2.75)*
Family Size (FMS)	-0.04(2.39)*	-0.01(0.23)	0.27(1.37)
Rural Urban Dummy (RU)	0.06(0.41)	0.32(1.09)	0.02(0.04)
Log Income	0.52(3.06)*	0.23(0.65)	0.004(0.004)
σ	0.65(26.18)*	1.10(11.52)*	1.90(10.68)*
Number of observations	94	90	130
Range of Bid amounts	K0 – K1000	K0 - K500	\$0 - \$500

Note: absolute value of t-statistic in parentheses.

^aDependent variable is the log of the amount specified.

* Significant at 5% level.

** Significant at 10% level.

Table 6.18. Likelihood ratio (LR) test for pooling data (attitudinal models) ^a

Open Ended									
Port Moresby					Portland				
				LR					LR
Pooled				-264.51	Pooled				-195.68
Subsample 1: Save				-154.51	Subsample 1: Save				-82.90
Subsample 2: Cut				-96.79	Subsample 2: Cut				-104.14
Lamda				26.41	Lamda				17.28
Critical signif)	Chi2	(5%	14 df	23.69	Critical signif)	Chi2	(5%	14 df	23.69

Table 6.18. Continued.

Since Chi2 calculated > critical Chi2, Ho (the betas are equal between the subsamples, i.e., the data cannot be pooled) was rejected.					Since Chi2 calculated < critical Chi2, Ho (the betas are equal between the subsamples, i.e., the data can be pooled) was not rejected.				
Dichotomous Choice Double Unbounded									
Port Moresby					Portland				
			LR					LR	
Pooled			-217.86		Pooled			-151.45	
Subsample 1: Save			-89.24		Subsample 1: Save			-73.87	
Subsample 2: Cut			-114.18		Subsample 2: Cut			-66.58	
Lamda			28.88		lamda			21.99	
Critical	Chi2	(5%	14	23.69	Critical	Chi2 (5%	14	23.69	
signif)			df		signif)		df		
Since Chi2 calculated > critical Chi2, Ho (the betas are equal between the subsamples, i.e., the data cannot be pooled) was rejected.					Since Chi2 calculated < critical Chi2, Ho (the betas are equal between the subsamples, i.e., the data can be pooled) was not rejected.				

^a This table corresponds to Tables 6.16 and 6.17.

lamda = -2 * [LRpooled - (LRsave + LRcut)]

Table 6.19. Information effect hypothesis test (attitudinal models)

Pooled Data	Estimated Coefficient ^a			
	Open Ended		Dichotomous Choice	
Variable	Port Moresby	Portland	Port Moresby	Portland
Constant	0.91(0.86)	-1.51(0.50)	0.87(0.85)	-2.62(0.56)
Rain Forest Visitor Dummy (RFV)	-0.03(0.15)	-0.82(1.99)*	0.06(0.33)	0.50(0.86)
Environmental Orientation 1 (COI)	0.08(0.96)	-0.006(0.04)	0.05(0.45)	0.83(3.37)*
Development Orientation 1 (COH)	0.11(1.89)**	0.003(0.02)	0.18(2.71)*	0.82(3.44)*
Environmental Orientation 2 (RTIDH)	0.05(0.35)	-0.05(0.17)	0.29(1.81)**	-0.53(1.41)
Development Orientation 2 (RTIDE)	-0.00003 (0.0003)	-0.47(1.94)**	-0.17(1.80)**	-0.61(1.80)**
Information Effect Dummy (IE)	-0.30(2.08)*	0.50(1.38)	0.30(1.76)**	0.76(1.57)
Cost Sharing Dummy (CSH)	-11.11(0.0009)	-15.38(0.0004)	-10.93(0.0007)	-15.74(0.0003)

Table 6.19. Continued.

Affordability Dummy (NAFFORD)	-10.48(0.0009)	-15.48(0.001)	-11.25(0.001)	-17.47(0.0007)
Nature Magazine (NATMAG)	0.14(0.31)	-0.42(1.05)	0.26(0.62)	0.01(0.02)
Charitable Contribution (CCS)	0.23(1.50)	0.19(0.44)	0.37(2.03)*	1.30(2.24)*
Family Size (FMS)	-0.01(0.36)	0.25(1.84)**	-0.04(1.83)**	0.19(0.93)
Rural Urban Dummy (RU)	-0.01(0.06)	-0.47(1.13)	0.18(1.08)	-0.08(0.14)
Log Income	0.53(2.63)*	1.36(2.33)*	0.42(2.19)*	0.19(0.19)
σ	0.96(18.72)*	1.60(13.13)*	0.97(16.92)*	1.87(10.69)*
Number of observations	222	153	184	130
Range of Bid amounts	K0 - K500	\$0 - \$3000	K0 - K1000	\$0 - \$500

Note: absolute value of t-statistic in parentheses.

^a Dependent variable is the log of the amount specified.

* Significant at 5% level.

** Significant at 10% level.

7.0 SUMMARY AND POLICY IMPLICATIONS

7.1 Summary of Major Findings

7.1.1 Information effect hypothesis

The information effect hypothesis test was conducted for the motive models and the attitudinal models. Two approaches were taken to test this hypothesis, a pooling test and an information effect (IE) dummy variable test (the null hypothesis being $b_{IE} = 0$) (see sections 6.1.1 and 6.1.2, respectively). That is, the order in which information is received does not affect respondents' WTP.

The test results for the motive models were inconsistent. The pooling test results showed that only the Portland DC data could be pooled (Table 6.13). The dummy variable test showed that the Port Moresby OE, DC and Portland OE models should be estimated as pooled models while the Portland DC model should be estimated as two separate models. This outcome contradicted the pooling test results. This contradiction could be attributed to the nature of the models. The motive models did not include attitudinal variables related to the 'save' and 'cut' information. The motive variables were basically related to the CV (payment) question itself. Thus, it was decided to go by the pooling of test results.

For the attitudinal models, the results from both approaches were consistent. The pooling test and the dummy variable test results showed that the Portland OE and DC models should be estimated as pooled models while the Port Moresby OE and DC models should be estimated separately (Tables 6.18 and 6.19). Thus for the behavioral models, Portland respondents were not affected by the order in which information was presented compared with Port Moresby respondents.

7.1.2 Composition of WTP

The WTP estimates were perceived as payment for existence in general. The results for both surveys showed that at least 50% of the mean WTP was accounted for by the non-economic components. Moreover, as a proportion of total mean willingness to pay (WTP): (1) existence value (as traditionally defined) was smaller for Port Moresby residents and larger for Portland residents, and (2) use value was larger for Port Moresby residents and smaller for Portland residents (Table 7.1). This was expected since Port Moresby residents were asked to value a resource that was located in their country whereas Portland residents were asked to value a resource located elsewhere in the tropics.

Table 7.1. Composition of WTP (reproduced from Table 6.10)

	Open Ended				Dichotomous Choice		
	Save		cut		save	cut	pooled
	POM*	POR*	POM	POR	POM	POM	POR
Total willingness to pay	\$10.54 K26.35	\$7.70	\$9.12 K22.79	\$7.34	\$16.12 K40.30	\$6.61 K16.53	\$3.31
Total use value ^a	58%	37%	41%	45%	51%	58%	38%
Economic existence value ^b	2%	10%	11%	4%	4%	3%	17%
Non-economic value ^c	37%	53%	43%	48%	42%	36%	45%
Other factors	3%		5%	3%	3%	3%	
Total WTP	100%	100%	100%	100%	100%	100%	100%
Economic WTP ^d	60% \$6.41 K16.03	47% \$3.61	52% \$4.69 K11.72	49% \$3.56	55% \$8.98 K22.45	61% \$4.01 K10.02	55% \$1.81

^a Includes consumptive and non-consumptive use value, bequest value, option value and paternalistic altruism.

^b Includes cognitive value.

^c Includes non-paternalistic altruism, intrinsic value, good cause, moral duty and fair share.

^d Economic WTP = Total use value + economic existence value.

Exchange rate: K1.00 = US\$0.40.

* POM = Port Moresby, POR = Portland.

7.1.3 Benefits transfer

The equality of means test results showed that Portland and Port Moresby benefit estimates were statistically different (Table 6.3). This result invalidated the assumption that benefits could be directly transferable between localities, especially between developed and developing countries. A word of caution though about the conclusion above. Most benefit transfer methods do not, in fact, advocate directly transferring values between countries. They usually argue that some adjustments are necessary for differences in income, purchasing power parity, and/or demographic variables. For this study, no adjustments may be possible since WTP seemed to be linked to income in Portland but not in Port Moresby.

7.1.4 OE vs DC estimates and save vs cut estimates

Within each city, the DC and OE estimates and 'save' and 'cut' estimates were found to be statistically different (Tables 6.4 and 6.5).

7.1.5 Comparison with Kramer and Mercer

In general, WTP estimates of this study were far lower than the Kramer and Mercer (KM) estimates. For the open ended payment survey, the Portland estimates varied from \$7.34 (cut) to \$7.70 (save) per household, while for the KM payment card survey, the estimate was \$31 per household. Likewise, the Port Moresby estimates (POM save \$10.54 and cut \$9.12) were lower than the KM estimate. Similarly, the Portland DC pooled and the Port Moresby cut WTP estimates of \$3.31, and \$6.61, respectively, were considerably lower than KM's DC estimate of \$21 per household. The Port Moresby DC save estimate of \$16.12 was closer. However, comparison between the studies may be weakened by the fact that: (1) the statistical models were not identical, (2) the extent of the market was different, and (3) the payment formats were different. On the second point, KM's study was based on a countrywide sample while this study was based on samples drawn from Portland, Maine (US) and Port Moresby (PNG) only.

7.1.6 Major Port Moresby / Portland differences in terms of motives, attitudes and socioeconomic variables

For the OE save models, the motivating factors that were different between Portland and Port Moresby residents were option value, paternalistic altruism and good cause. Port Moresby residents were willing to pay more if motivated by the option value whereas Portland residents were willing to pay less. Paternalistic altruism and good cause were motivating factors for Port Moresby residents but not for Portland residents. Age and income were the determining factors for Portland residents but not for Port Moresby residents

(Table 6.8).

For the OE cut models, option value, good cause, fair share and environmental quality were the motivating factors that were different between the two countries. While Portland residents were willing to pay more if motivated by the option value, Port Moresby residents were willing to pay less. Good cause was a significant factor for Portland residents but not for Port Moresby residents. On the other hand, fair share and environmental quality were motivating factors for Port Moresby respondents but not for Portland respondents. Again, as in the save models, age and income were significant variables for Portland residents but not for Port Moresby residents.

Comparison of the DC models was made between the pooled Portland model and the Port Moresby save and cut models (Table 6.9). The following differences between the sub-samples were observed. Respondents from the Port Moresby save model were willing to pay less if motivated by paternalistic altruism; on the other hand, respondents from the Port Moresby DC cut model and the Portland DC pooled model were willing to pay more if motivated by the same factor. Good cause was a significant factor for Port Moresby residents but not for Portland residents. On the other hand, fair share and environmental quality were motivating factors for Portland respondents but not for Port Moresby respondents. As expected, payment increased with education for Portland residents. Education though was not significant for Port Moresby respondents.

One of the research questions posed in Chapter 2 was whether or not economic existence value existed. As Tables 6.8 and 6.9 show, economic existence value does exist. In all the models, the cognitive motive was statistically significant. The respondents were willing to pay more if they were motivated by the cognitive motive.

The following differences were observed from the attitudinal models (Tables 6.16 and 6.17). The cost sharing dummy and the affordability dummy variables were significant and negative for respondents from the Port Moresby OE cut and DC save samples. That is, Port Moresby respondents who believed that the developed nations of the world should bear the cost of preservation were not willing to pay anything. In addition, those who could not afford to pay anything were also not willing to pay at all. These variables though were not significant for Portland respondents and the other two Port Moresby sub-samples.

The environmental orientation 1 variable (COI) was significant only for the Portland DC pooled model. It was not significant for the rest of the sub-

samples. The coefficient was negative, suggesting that respondents were willing to pay less, which was not expected. This particular variable was related to the respondents' opinions on tropical rain forest management, namely: "If rain forest destruction continues on its present course, we will soon experience a major ecological catastrophe." The development orientation 1 variable (COH) was significant only for the Port Moresby DC cut model and the Portland DC pooled model. But the coefficient was positive, which was contrary to expectation. However, the sign of the coefficient may not be surprising because of the way the response statement was phrased, that is: "Tropical rain forests should not be completely protected."

The environmental orientation 2 variable (RTIDH) and the development orientation 2 variable (RTIDE) were related to respondents' opinions on the reasons for protecting and for cutting tropical rain forests. The former was significant only for the Port Moresby DC cut and OE cut models. As expected, the coefficient was positive suggesting that the respondents who believed that "Forests should be preserved to help to prevent the greenhouse effect (global warming)" were willing to pay more. The latter (RTIDE: "Forests should be cut to provide for economic development in tropical countries") was significant only in the Port Moresby DC cut and OE cut models, and the Portland OE and DC pooled models. In all the cases, respondents were willing to pay less, which was expected.

Only respondents from the Portland OE pooled model were willing to pay more if they had visited tropical rain forest in the past or planned to visit in the future. This variable was not significant for the rest of the subsamples. Respondents from the Portland DC pooled and Port Moresby OE save models who made charitable contributions in 1997 were willing to pay more. As expected, payment decreased for respondents with a larger family size. This variable was significant for the Port Moresby DC save model only.

As expected, payment increased with income for respondents from the Port Moresby DC save and OE save models, and the Portland OE pooled models.

7.1.7 Payment for Backyard versus Rest of the World.

Are shown in Table 6.12, Port Moresby respondents preferred, on average, that over 70% of their contribution go towards the preservation of PNG's rain forest. This result was expected. Port Moresby respondents were more concerned about their 'own' backyard than preserving tropical rain forest in general. This result has implications on the issue of cost sharing. If the developed countries, including the US, are genuine about their concerns for the

global benefits provided by tropical rain forests, then they should bear much of the burden for preserving rain forests in the tropics. This result could also provide support for the establishment of a local “Conservation Trust Fund”.

7.1.8 Certainty issue

When the uncertainty of respondents was incorporated into the statistical models, the average WTP decreased substantially (Table 6.11).

7.2 Policy Implications

The research attempted to measure the true economic value of tropical rain forests preservation in providing benefits that are global in nature. The divergence between mean WTP and mean economic WTP was found to be large for both cities. Non-economic components accounted for at least 50% of the total value (Table 7.1). Therefore, failure to exclude the non-economic components of existence value and use value may lead to inaccurate benefit estimates (in the case of gain in welfare as a result of increased rain forest preservation) and overestimated damage claims (in the case of loss in welfare as a result of say pollution). The suggested procedure ensured that certain values were not doubly counted. It was argued that the narrow definition of WTP and existence value avoided double counting while the potential for double counting was imminent in most alternative definitions. For example, an individual's WTA or WTP for the preservation of 5% of the world's tropical rain forest will likely include both use and nonuse values via the impact on prices for consumptive and non-consumptive uses, and the level of rain forest stock, respectively (Chapter 3, section 3.2). Alternative definitions of existence value in the literature include cognitive value, paternalistic and non-paternalistic altruism, option value and intrinsic value. Nonuse values then include existence and bequest values according to definitions in the literature. In this study, existence value was defined as consisting only of the cognitive motive. Total use values was defined as including consumptive and non-consumptive use value, bequest value, option value and paternalistic altruism (Chapter 1, section 1.3, Figure 1.1). If the definition adopted in this study is used values in branches a (bequest), d (paternalistic altruism) and e (option value) are use values from society's viewpoint. It was argued that values in branches a, d and e may have been accounted for in branch I. Therefore, use values may be counted twice, first, in branch I and second, in branch II.

One of the important policy implications was related to the issue of cost sharing between the developed and developing countries. It was found that at least half of the Port Moresby respondents were concerned more about their own “back yard” than preserving rain forests in general. These respondents expressed

the sentiment that the rich nations of the world (including the US) should bear the responsibility of preserving tropical rain forests if they were genuine about the role that tropical rain forests play in global environmental problems. This conclusion was further supported by the result that Portland residents generally had a higher value for existence (as a proportion of WTP) than Port Moresby residents, which may suggest that Portland residents should pay more to preserve tropical forests did.

As mentioned above, at least half of the Port Moresby respondents were more concerned about their “own back yard” than preserving rain forests in general. These respondents also would prefer that at least 70% or more of their payment go towards the preservation of PNG’s rain forest. This result provides an argument for the establishment of a Conservation Trust Fund (CTF) for PNG’s rain forests. It also provides support for the desirability of reinstating the reforestation levy in the current revenue system. Thus at the local level, such a fund may also be funded from a reforestation levy. At the global level, funding could come from organizations such as the World Bank, the Global Environmental Facility (GEF)²¹ or from developed countries like the US.

A recent revenue study for the forestry sector recommended the imposition of an environmental levy at K10 / m³ on all logs harvested²². It also suggested that such a levy could be channeled into a CTF to enable conservation activities (Hunt, 1999).

The fund could be used to reforest logged over areas, to preserve natural forests and to create alternative income earning opportunities (e.g., ecoforestry, ecotourism, carbon offsets etc) to landowners that forgo the development of their land. The fund could also be used to monitor large-scale logging and other development projects that impact on the forests. The results also provide support for the creation of plantation forests (by reclaiming grassland) as an alternative to exploiting natural forests.

The results of this study also invalidate the validity of the assumption that benefits are somehow directly transferable between different countries, especially between developed and developing countries. Since existence values differed between Portland and Port Moresby residents, it was argued that the use of benefit transfer techniques, where for example Portland values were applied to Port Moresby, might not be methodologically valid. However, this result may

²¹ In October 1998, GEF provided a US\$15 million biodiversity grant to the Conservation Trust Fund in PNG. This was an initiative of The Nature Conservancy (TNC). TNC has an office in PNG. The fund was intended to support landowner driven small- and medium-scale conservation projects that entail alternative income-earning opportunities other than large scale logging. The CTF is expected to be operational in the year 2000.

²² Hunt’s (1999) argument was that logging companies should be made to internalize the environmental (social) cost that they cause.

misrepresent what benefit transfer is intended to do. Most benefit transfer methods do not, in fact, advocate directly transferring values between countries. They usually argue that some adjustments are necessary for income, purchasing power parity, and/or demographic variables.

Also the study provides benefit estimates that may be useful in benefit transfer applications in PNG. Non-market valuation studies are generally costly to conduct. The study also provides benefit estimates that may be used in national income accounting or the notion of “Green Accounting”.

7.3 Other Policy Implications

In light of the general support for the preservation of tropical rain forests that has been shown by respondents from both cities, a brief discussion of the following policies is advanced here. PNG may consider some aspects of these for policy development.

Landowners should be educated about land use options that will lead to sustainable forestry management. These included such land use options as ecoforestry, ecotourism, carbon offsets, scientific research etc that result in biodiversity conservation and at the same time provide income to landowners. Since landowners in PNG generally have a very high discount rate, such educational awareness is very important and this is where the role of NGOs becomes very vital. For example, the Forest Management Agreements system was intended as a legal mechanism to assure forest management, thus having a multiple focus beyond the acquisition of timber rights alone. One of the aims of FMA's was to create landowner awareness on the implications of logging, and ensure their participation in the enterprise. The absence of landowner participation in forest management decisions is evidence of the lack of its provision in the new Forestry Act.

There are other ways in which tropical rain forests in PNG and elsewhere can be preserved. For example, American energy utility companies that persistently add to atmospheric carbon could offer direct payments or grants to PNG in exchange for PNG's willingness not to clear forests. This scheme is known as the “carbon-swap” or “carbon offset” scheme²³. Because the scheme provides grants, not loans, PNG could benefit by participating in this scheme.

A similar scheme, known as “debt for nature” swaps, may appear attractive to PNG since it is indebted. The scheme involves swapping “nature”

²³ Panayotou and Rosenfeld (1994) reported that despite the novelty of the concept, agreements between American utility companies and conservation projects in Guatemala, Malaysia and Paraguay have resulted in grants of as much as \$2 million to these countries.

(not necessarily just land, but also development rights, conservation restrictions, etc) of highly indebted developing countries in exchange for cancellation or reduction of the debts to the World Bank²⁴. If wild nature (access prohibitions, development restrictions, conservation easements, etc.) is to be “traded” in exchange for debt forgiveness or for any other purpose, it will be important to know the total value (use and nonuse) of the land in question. Only then will the economic rationalization of rain forests allocation be truly actualized. However, debt swaps will be less likely now that much of the debt is being forgiven for the poorest countries in the world as a result of the Cologne meeting (July 1999). The trend seems to be towards more straight-out debt forgiveness.

There is yet another interesting policy proposed by the World Commission on Forests and Sustainable Development (WCFSD) (news item from RAN’s web site, 3/27/98). The Commission was proposing a new global system to measure the economic value of unexploited forests through the formulation of a mechanism being described as “forest capital”. The Commission suggests that countries be rewarded for not exploiting forests. Such countries would then qualify for “forest capital credits” granted by international financial agencies. The “forest capital credits” would be calculated as a product of the opportunity cost of not exploiting these resources on a sustainable basis. This study fits the above policy perfectly, in the sense that it provides a measure of the economic value of PNG’s unexploited forests.

Another policy scheme worth considering is the direct financing from international financial institutions like the World Bank for forest conservation. Recent news reports (United Press International, 4/29/98, and Reuters, 4/29/98) shared Brazil’s decision to set aside a large tract of rain forests, about the size of England. The deal was brokered by the WWF and the World Bank as part of a goal of setting aside 10 percent of the world’s rain forests. Both organizations were also reported to be working in Indonesia on a similar deal. The Brazilian government will receive at least USD35 million in World Bank aid to protect the massive virgin forest.

However, the forest preserves will only work if they have the backing of local people. There will obviously be a lot of pressure put on to stopping this movement by the cattle and lumber companies, etc. So, local support is very important.

Another policy issue worth considering is the greenhouse gas-trading project developed under the guidelines of the global climate change agreement

²⁴ This scheme has come under a lot of criticism, and may not even be implemented in its present form. But more politically and culturally acceptable modifications of this idea will probably be developed and tried out in the future.

reached in December 1997 in Kyoto, Japan. The agreement is known as the Kyoto protocol. PNG is a signatory to the Kyoto protocol but has yet to implement the program. The protocol involves the selling of emissions credits by developing countries to companies in industrialized countries that produce heat-trapping carbon gases by burning fossil fuels – thereby making the rain forest's ability to absorb carbon gases a quantifiable asset. One of the companies operating under the Kyoto agreement's procedures, is a Swiss company called Societe Generale de Surveillance Holding S. A. (SGS). Reuters quotes SGS chairman as saying "Creating a market for carbon offsets provides developing countries additional financial resources from their tropical forests – money that can be earned without cutting down their trees."

Costa Rica was the first country to implement the Kyoto protocol. It launched a program to save more than 1.25 million acres of rain forest by selling carbon credits to companies in industrialized countries. The carbon credits are called Certified Tradable offsets, with each corresponding to one ton of carbon to be absorbed by its trees. This study shows positive use and existence value for rain forest benefits and therefore justifies PNG participation.

In May 1998, the Department of Foreign Affairs and DEC to the NEC for its consideration jointly submitted a policy submission entitled "Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change". The purpose of the submission was for the NEC to endorse the Kyoto Protocol on climate change, note its contents, and solicit NEC's direction for the DEC to formulate appropriate national legislation, policies and programs to implement PNG's commitments under the convention and the Kyoto protocol.

7.4 Summary

The two central theses of this research were first, that the existence value of a resource included both economic and non-economic components. Existence value was decomposed into its economic and non-economic components. Furthermore, non-paternalistic altruism was excluded from use values. Thus the total economic value of rain forests preservation was reported by including only the economic components of use values and existence value. Second, existence value of global benefits emanating from tropical rain forests was hypothesized to differ across cultures in some respects.

As expected, the non-economic component of existence value was generally found to be relatively large (at least 50 percent of total WTP) and thus justified the objectives of this study. In addition, as expected, we found that use value was higher than existence value for Port Moresby residents compared with Portland residents. This was not surprising as most Port Moresby dwellers stated

that they had visited their villages (or homes in rural areas) more than once in 1997.

We also found differences in existence value between Port Moresby and Portland based on differences in orientations towards tropical rain forests management and motives underlying existence value. Differences in existence values were also attributed to differences in income, education and other variables (refer to section 7.1 above).

In short, the research provided some insight into the application of contingent valuation to resources providing benefits that are global in nature in a two-city setting. It presented a procedure for how economic existence value and economic use values could be obtained. The procedure also ensured that double counting of certain values was avoided. More importantly, the research showed that the Portland and Port Moresby WTP estimates were statistically different thus invalidated the assumption that benefits were somehow directly transferable between countries. This finding was supported by evidence of cultural differences in existence value held by Portland and Port Moresby residents in terms of motives, attitudes and socioeconomic variables.

7.5 Limitations and Suggestions for Future Research

Problems such as high illiteracy, many languages, large subsistence sector etc, have limited the application of contingent valuation to developing countries. Most residents of tropical countries live in rural areas; they have no access to telephones and have no formal addresses. These problems were also characteristic of PNG. As such, it was decided that in order to avoid logistical problems, a sample would be drawn from Port Moresby, PNG. This city was selected because census data showed that it contained a good mix of people from all over Papua New Guinea. For comparison, a city was also selected from the US. Portland, Maine was selected because it still had large tracts of forested land. Thus, the results of this study may not be generalized to the population because the samples were drawn from selected localities, Port Moresby in PNG and Portland, Maine (US). Therefore, this research may be treated as a pilot study that warrants further work.

A most encouraging result though was that a mail-back survey worked in Port Moresby. Thus the next step would be to do a countrywide mail back survey and see if it would work. In this case, two surveys would be mailed one in English and the other in Pidgin (broken English). The latter is widely spoken in PNG. In PNG's case, addresses of schools, churches, small government outposts and some development projects in rural areas could be used to reach the rural population.

It was found that most respondents who expressed protest zero bids and some who stated that they were uncertain about their positive bid were objecting to the format of the CV question (i.e., asking for voluntary contributions). This may have contributed to the less than 50 and 40% response rates obtained from the Port Moresby and Portland surveys, respectively. Thus, it is suggested that a 'yes'/'no' voting format may be more appropriate.

What had this study achieved suggests that a multi-country CV study for tropical rain forests maybe feasible. This is important because: (1) the question arises as to whether benefits from developed countries could be applied to developing countries; (2) it would be useful to know people's attitude towards development, conservation and sustainable development, and (3) government's attention could be attracted if an economic value could be attached to the use of forests for purposes such as subsistence production, non-timber forest products, eco-tourism, ecoforestry, carbon offsets, global benefits such as carbon cycling, climate regulation, other direct and indirect use values and existence values, particularly in developing countries.

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