User Benefits of Urban Agriculture In Havana, Cuba: *An Application of the Contingent Valuation Method*

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Abstract

In Cuba, the act of growing food in the city has become a way of life. Since the beginning of the "Special Period in Time of Peace", brought about by the collapse of the Soviet Union in 1989, Cubans have engaged in many forms of urban agriculture (UA) to cope with the food crisis affecting the Island. In Havana, the popular garden movement occupies 8% of total urban land in agriculture (3.4% of total urban land) and is practiced by 18,000 gardeners who produce vegetables and fruit, and raise small livestock to increase food security and generate income. The purpose of this study was to provide estimates of the user benefits of UA, as well as qualitative and quantitative information related to this activity. The contingent valuation method (CVM) was used to elicit users' willingness to pay (WTP) for the land they use, that is currently provided at no charge by the state. The average WTP was estimated at 23.5 pesos/1000 m^2/month under current conditions and 34.4 pesos/1000 m^2/month with improvements in water and anti-theft services. These amounts represent about 11% and 14% of monthly household income, respectively. Aggregate WTP for popular gardens in the city of Havana was estimated to be 6.88 million pesos/year (344,000 $US) and 10.07 million pesos/year (503,500 $US) with the proposed improvements. The study has produced important results that give an indication of the use and non-use value of UA for gardeners of Havana. Results also suggest that CVM is a non-market valuation technique that can be successfully applied in Cuba, and can provide information to be integrated in cost-benefit analysis frameworks that assess the importance of UA.

Résumé

A Cuba, produire de la nourriture en ville est maintenant plus qu'un besoin, c'est un mode de vie. Depuis le début de la "Période spéciale en temps de paix" provoquée par la chute de l'Empire soviétique en 1989, les Cubains se sont lancés dans l'agriculture urbaine (AU) pour résoudre la crise alimentaire qui sévissait dans les villes. A La Havane, le mouvement des jardins populaires occupe maintenant 8% du territoire agricole urbain (3.4% de la superficie urbaine totale) et compte 18 000 jardiniers qui cultivent des légumes et des fruits, et élèvent de petits animaux. Cette étude avait comme objectif d'estimer les bénéfices pour les usagers de l'AU, ainsi que de fournir des données qualitatives et quantitatives sur cette activité. La méthode d'évaluation contingente (MEC) a été utilisée pour déterminer la volonté de payer (VDP) un frais d'accès à ces jardins, qui sont situés sur des terres publiques, présentement accessibles sans frais aux usagers. La VDP moyenne a été estimée à 23.5 pesos/1000 m^2/mois pour les terrains sous les conditions actuelles, et à 34.4 pesos/1000 m^2/mois pour les terrains avec des améliorations du service hydrique et avec de la protection contre le vol; ces valeurs représentent environ 11% et 14%, respectivement, du revenu mensuel des ménages . Ces estimés se traduisent à l'échelle de la ville par une VDP totale de 6.88 millions de pesos/année (344 000 $US) et de 10.07 millions de pesos/année (503 500 $US) avec les améliorations proposées. L'étude est considérée comme ayant produite des résultats importants qui donnent un aperçu de la valeur de cette activité pour les usagers. Les résultats suggèrent également que la MEC peut être appliquée avec succès à Cuba, et qu'elle peut produire de l'information pertinente pour, par exemple, des analyses avantages-coûts qui évaluent l'importance de l'agriculture urbaine.

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1. Introduction

"The cities of the 21st century are where human destiny will be played out, and where the future of the biosphere will be determined. It is unlikely that the planet will be able to accommodate an urbanised humanity that continues to draw upon resources from ever more distant hinterlands…"
(Deelstra and Girardet, 2000).

1.1. Definition and Overview

For many, the act of growing food in the city is considered marginal: a part-time, leisure activity, or a means to cope with household poverty. However, agricultural production in the urban setting, commonly called "urban agriculture" (UA), provides a vast array of economic, social and environmental benefits. Since the 1970's, its emergence and support from local governments in many countries has made it an important factor of urban food security and sustainable development. Global estimates show that approximately one-third of urban families engage in agriculture, and one-third of urban land is used for agriculture (UNDP, 1996). The Food and Agriculture Organization (FAO) of the United Nations estimates that 800 million urban residents are involved in commercial or subsistence agriculture in or around cities (FAO, 1999a). In developing countries, it is estimated that UA covers 50% or more of urban land (UNESCO, 1999).

Urban agriculture takes many forms, from the farm business to the private backyard garden. A few definitions exist of UA, but the most general states that UA is "the growing of food and non-food plant and tree crops and the raising of livestock, both within (intra-) and on the fringe of (peri-) urban areas" (Mougeot, 1994: p. 3). Definitions can vary from city to city, as some would consider UA only as the agriculture practiced within the urban setting, or intra-urban setting (Fernandez, 1999). Divergence in what is considered UA relates to the fact that some do not consider peri-

urban agriculture as UA. Farms and large gardens can be found in the peri-urban fringe of cities, but these tend to be extensive operations, without being intertwined with housing or industry.

Agriculture has always been part of the urban environment. Logically the first breath of a city relies on good land and water where agriculture can strive. It is only recently in the urban history of humanity that agriculture became divorced from cities, and the reasons are numerous and sometimes unclear (Mougeot, 1994). Most certainly, industrialization and strategies that relied on distant rural food production contributed to this separation. Philosophical aspects also contributed: Eighteenth century views in Western Europe opposed natural to artificial, natural man to urban man (Marshall, 1992: p. 223).

Nevertheless, agriculture never disappeared completely from cities. Tradition and culture have kept the household garden alive in the backyard, and ever-existing poverty in cities has pushed some families to grow food in order to cope with food insecurity. Urban agriculture emerges from a structural urban problem linked to the increase in urban population (Nugent, 1999a). Population growth in cities increases the labor force, but job markets lag urban growth, thus creating unemployment and food insecurity. The practice of UA also results from growing disparities between classes, increased food prices, elimination of food price subsidies and of the devaluation and the systematic elimination of social safety nets. This would explain why UA is present in cities that have abundant food (Bourque, 1999). Households need to revert to other means to increase income, and thus revert to agriculture. These situations explain more permanent contexts in which urban agriculture will emerge and develop, but temporary conflicts can also be the cause of UA.

These different conditions that create UA systems are found in both Northern and Southern countries alike. In its essence, UA is practiced for the same reasons, in both hemispheres, i.e. as a means to cope with food insecurity, as an income generating activity, or as a hobby. Southern countries tend to be driven by food insecurity, while Northern cities have well-developed community garden networks that create areas for residents to cultivate their hobbies. However, increasing urban poverty and dependence on food banks led many community organizations in Canada and the United States to develop intensive UA projects aimed at increasing food security and creating jobs for low income households. In Montreal, Canada, *collective* gardens were set up on peri-urban and urban land in order to provide food and autonomy to new immigrants and unemployed persons (Henn and Hunter, 1997; Chapeau, 2000)

Postwar urban development models have often been criticized for their inability in dealing with socio-economic inequalities, environmental degradation and waste (Bourne, 1991). In 1998, the world's current population of 5.9 billion was split about equally between cities and rural areas, with urban areas expected to surpass rural areas in population by the year 2005 (FAO, 1999b). Re-integrating agriculture in the urban environment has been identified as part of the solution to create the “sustainable city”: provide jobs and food to rising urban populations, and bring ecological balance through green spaces and increased biodiversity. Increasing support from governments and non-governmental organizations (NGOs) is an indication of the faith authorities have in city farming. The Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Program (UNDP), the International Development Research Center (IDRC) and many other NGOs and governments support UA through research, technical support and project funding (UNDP, 1996, Murphy, 1999). Between 1975 and 1985, governments in at least 22 countries (10

in Asia, 6 in Africa and 6 in Latin America) were supporting UA initiatives (Mougeot, 1994). Considering its experience since 1990, Cuba can also be added to that list, and while it was late in starting a UA program, its development in only 10 years is worth noting.

1.2. The Cuban Urban Food System

Since the Revolution of 1959 and until the collapse of the Soviet Union in 1991, Cuba enjoyed favorable trade agreements with the Council of Mutual Economic Assistance (CMEA), the international socialist marketplace. In the 1980s, Cuba, the most populated island in the Caribbean, ranked the highest among the Latin American countries in terms of health, nutrition, education and economic strength (Rosset and Benjamin, 1994). By 1989, they ranked 11th in the world in the Overseas Development Council's Physical Quality of Life Index, while the USA ranked 15th (Rosset, 1997).

With the fall of the Berlin wall, Cuba was plunged into a nationwide crisis. Castro designated the crisis as the *Special Period in Time of Peace*. Deere (1997) reports that at the beginning of the Special Period, from 1989 to 1992, imports dropped 63%. In 1991, domestic output decreased 25% and 14% the following year. One of the most important sectors to be affected was agriculture and food. Confronted with a 50% reduction in food imports, a 54% reduction in oil, a 60% drop in pesticides imports and a 77% drop in fertilizers from 1989 to 1992, Cuba faced significant food shortages, and thus food insecurity on the island (Rosset and Benjamin, 1994). The average daily per capita calorie consumption dropped an estimated 20%, and average daily per capita protein consumption dropped 27% (Torres, 1996). A summary of important changes is presented in table 1.1.

Table 1.1

Trade and Inputs Reductions in Cuba, 1989-1992

	1989	1992	Reduction (%)
Total imports ($US)	8.1 bn.	1.7 bn.	79
Oil (tons[1])	13.3 m.	6.1 m.	54
Fertilizer Imports (tons)	1.3 m.	300 000	77
Animal Feed (tons)	1.3 m.	475 000	63

(Source: Deere, 1997)

In this crisis situation, Cuba faced the challenge of increasing domestic food production while reducing the dependence on synthetic agricultural inputs. This gave way to important agricultural reforms by the Ministry of Agriculture (MINAGRI), including the dismantling of the state farms, their re-organization into production cooperatives in 1993, and the opening of free agricultural markets in 1994 (Deere, 1997). But most importantly, MINAGRI developed a vast program in organic and semi-organic agriculture, characterized by alternative techniques of polycropping, relay cropping, use of natural fertilizers, biopesticides and minimum tillage (Saez, 1997). Furthermore, oil shortages affected refrigeration and transportation of food from rural to urban areas. This led to a widespread popular and institutional movement of UA in Cuba (Murphy, 1999).

The Cuban experience in UA is recognized for its rapid development and ingenuity in coping with a crisis and having to work with limited inputs and resources. Before the Special Period, agriculture existed, for example in the Green Belt of Havana, but intra-urban agriculture was practically

[1] Deere (1997) does not specify the value of a "ton" used in this table.

nonexistent. In fact, gardening was perceived as a sign of poverty and underdevelopment (Altieri et al., 1999); it was also not tolerated by the authorities. At the onset of the Special Period, the state relaxed the laws regarding food growing in the city. Motivated by the fear of a worsening food shortage, Cubans spontaneously started growing food in any vacant lot they could find. This movement was adopted by the state which created, in 1994, a special unit to promote and support UA to respond to the important food needs in the cities (Chaplowe, 1996). The Urban Agriculture Department created a usufruct system that granted use rights of state land to individuals wanting to produce food. While the land remains the property of the State, the individual owns the production, which creates an incentive to produce for subsistence and commercialization.

With a population of 2 million, 20% of the island's total population, Havana was the city hardest hit by the food shortages. Keeping the focus on cultivating as much area as possible, vacant lots in Havana were transformed into production units, in addition to the green belt on the outskirts of the city. Production units vary widely in size, and organizational type. There are state-owned enterprises, cooperatives (UBPC, for Unidad Básica de Producción Cooperativa), private farms and *parcelas* (units that resemble popular gardens). Units called *autoconsumos* serve the purpose of supplying work centers and schools. Altogether, land used for agriculture totals approximately 15 000 hectares in Havana, or 21% of the urban surface (Altieri et al., 1999). According to Gonzalez (1999), agriculture covers 41% of urban land. This important disparity between the two values suggests that the former includes only non-livestock and non-dairy production, while the latter would include all production types.

One production technique worth noting is called *organopónico* and is found throughout Havana. It is mostly used where soil quality is poor. Containers with retaining walls, forming long raised beds, are filled with a high ration of compost to soil. The organopónico technique is used to grow vegetables such as lettuce, swiss chard, onion and tomato. State enterprises and cooperatives that use this type of production technique are simply called "organopónicos" although the term refers to a production technique, not an organizational structure. The organopónicos lie at the center of the urban agriculture strategy in Cuba. Their high yield potential and expanded network in all neighborhoods make fresh vegetables available to the whole urban population. Moreover, the organopónicos sell at a price institutionally set 20% under local market prices. According to Murphy (1999), organopónico production accounted for 30% of total food production (27 000 tonnes) in Havana in 1997. This is based on an estimated total production in the city including vegetables, fruits, tuber crops, flowers and milk. With respect to vegetable production exclusively, it could be safely assumed that organoponicos produce the majority of vegetables in the city. Their importance also seems to be growing, as production increased 50% in the first ten months of 1998, i.e. to 41 000 tonnes (Pagés, 1998).

The garden movement in Havana has also been an important aspect in the struggle for food security. The *parcelas* (popular gardens) are lots granted through a state usufruct system, i.e. leased without charge to individuals seeking self-subsistence for their households. However, with the creation of agricultural markets, some gardeners also engage in sales to the local population, either formally at the market or informally from their garden site. The gardens produce a vast array of fruits, vegetables and tuber crops, with some animal raising and medicinal plants to cope with shortages in medicine which also affect the Island. Most common crops include banana, plantain,

cassava, onion, tomato, pepper and papaya[2]. Popular gardens occupy 2 438 hectares of the land in Havana, which represents 8% of agriculture land in Havana, or 3.4% of total urban land. Roughly 18 000 individuals are involved and produced 24 983 tonnes of food in 1999 (Gonzalez, 1999).

Although the explanations given by different sources of the types and extent of UA in Cuba do not always coincide, they all reflect the importance of the movement. Together, the intra and peri-urban agriculture units of Havana produced 160 000 tonnes of food in 1997; some neighborhoods produce more than 30% of their food needs (Murphy, 1999).

What had started as a crisis response in 1990 to offset the impacts of the eastern bloc collapse has resulted in a world-renowned alternative system of food production. The data previously cited indicate that UA has made an important contribution to alleviating food insecurity in Havana; furthermore, widely recognized benefits also include job creation, income enhancement, community solidarity, environmental beautification and ecological waste management (Moskow, 1999; Murphy, 1999; Gonzalez, 1999; Altieri et al., 1999; Warwick 1999; Cruz et al., 1999). Important environmental and health benefits are also derived from the low-input organic production techniques that greatly reduce air, water and soil contamination from synthetic pesticides and fertilizers. In other words, the UA system in Havana seems to respond to all of the goals that should be included in sustainable urban food systems (UNDP, 1996).

[2] See Appendix I for a complete list of crops grown in Havana.

However, now that the economy and the food situation have improved, there are concerns that Cuba will revert back to a chemically intensive agriculture and increased foreign food imports to serve urban centers, thus reducing support for UA (Perez, 1998, Chaplowe, 1996). In 1999, the US announced a new policy that allowed sales of food and agricultural supplies to non-governmental entities in Cuba (Emling, 1999). Further easing of the US embargo would probably be an important challenge to UA. Moreover, there is still a debate on UA's efficiency and its importance in a non-crisis situation, as some urban planners view it as a response to an emergency (UNDP, 1997).

Urban agriculture faces many other challenges. Agriculture is seen by planners as a rural activity and goes against the image of a modern city; some health issues are raised related to animal husbandry; and urban land is vulnerable to growing real estate values. Even if the benefits of UA are obvious in Cuba, using land for agriculture in Havana figures as a *temporary activity* in the city's management plan. UA is threatened by other types of development (Cruz, 1999), such as hotels and dollar shops to supply the growing population of tourists and wealthy Cubans. While it is hard to argue that Cuba has had enough economic growth, there is debate on how development should take place and at what cost. If UA reports a vast array of benefits, its displacement will induce costs to some parts of society, namely the users of land for agriculture. But at what cost?

On a global scale, advocates are claiming there are vast benefits to UA. However, most cities and national governments have not created policy initiatives to promote it. Even in Cuba, where national, regional and local governments participate and contribute to the UA movement, it is not clear how the activity fits into the long-term plans of the country. Economics can contribute to the

debate by *quantifying* the vast array of impacts (e.g. food output, income generation) of UA. Already well recognized in the world, the Cuban UA experience in Havana could serve as a pertinent case study to conduct such an analysis.

1.3. Benefit Analysis and Urban Agriculture

As for other natural resources, urban land in Cuba is a scarce resource in demand for various uses. Agriculture is in competition with other types of urban development that also benefit society. The competition for land creates the need to evaluate which projects should be favored and which should not, using for example a cost-benefit analysis (CBA) framework. Ideally land would be allocated to the use that yields the highest difference between benefits and costs. This is what is called a cost-efficient choice (Pearce, 1993).

The basic concept of cost-efficiency has been widely criticized in recent years, because only a limited number of parameters, reflecting strict economic impacts, such as job creation or production costs, were integrated in the equations. Other impacts such as environmental degradation or population displacement were not considered. This gave way to the development of *environmental* CBA, i.e. a framework that includes not only economic impacts, but also social and environmental impacts (Hanley and Spash, 1993). The major challenge in integrating all these impacts is that some are not monetizable or quantifiable, which makes it difficult to compare them. For example, what are the benefits of preserving a wilderness area rather than using the trees for lumber? It can be assumed that the benefits of wilderness are not only economic, but

social and environmental as well. These benefits can be classified as market and non-market benefits, and produce use and non-use *value* for individuals in society.

Together these two types of value form the "total economic value" (TEV) (Tietenberg, 2000). If TEV can be measured, it gives a much broader picture of the whole array of values of the environmental resource[3].

Economic value is not an objective measure of the value of a good, but rather the subjective value that an individual places on it (Wistowski, 1995), depending on the utility provided by the good. If it has value - or utility -, the individual will be willing to give up other goods to acquire that specific good, if the good has more value than the ones already held. When a good has a price, it can simply be put that the value of the good is estimated at that price; if it is purchased, it is considered that the good has at least that value for the individual, and that the money spent on it is better spent for that good rather than for others. If all goods had a clearly defined economic value, it would be easier to make policy decisions, just by weighing the values against each other. But when goods do not have a price, such as environmental resources that are not traded in markets, the task gets more complicated. Deriving economic values for these types of goods is made possible by methods such as contingent valuation (CVM).

[3] This is not to say that the whole value of the good is given by TEV, just its economic value as a good that can provide utility for individuals. Environmental goods such as wilderness also have an *intrinsic* value, the value associated to the fact of existing for itself (See Bateman and Langford, 1997).

The TEV of a good can be subdivided in two parts, *use and non-use* value. Urban agriculture as a good can provide direct use value to the producer that uses the land to grow food; it also provides indirect use value to the producer that uses the good to simply engage in a leisure activity; it can also provide option value to the producer that values the land as a potential good to be used in the future.

Urban agriculture also has non-use value for users and non-users of the good. Urban agriculture provides existence value, or the value that an individual puts on the fact that UA simply exists; it also provides bequest value to the individual that puts value on the fact that UA will exist for future generations; and provides altruistic value to the individual that values the fact that others can enjoy, or derive utility from the good.

Urban agriculture plays different roles and provides different types of benefits. Therefore it can be assumed that utility increases with additional units of UA. While in North America it is mostly considered a hobby (leisure benefits), in Latin America, Asia and Africa, it is often a necessity and a way of life (food security and income benefits). The benefits of UA are social, economic and environmental; the importance of each type of benefit in the benefit bundle depends on each individual, user or non-user, of the good.

The fact that at least some individuals derive utility from urban agriculture makes it a policy issue, in the sense that reducing or increasing its quantity or its price will have welfare impacts on some parts of society. Economic valuation can assist in making policy decisions by putting a price on

land used for UA. Some might simply suggest to set up a market for land and let individuals express their value through the market. However, such a mechanism would only reflect certain types of value and ignore others. Knowing what society is *willing to pay* for preserving land for UA is an indication of its benefits, of its economic value. The willingness to pay (WTP) amount reflects what society is ready to trade-off in terms of money (or other goods) to keep land in UA.

1.4. Research Objectives

Because the policy issue behind UA is relatively new, no standard method of quantitative analysis has yet been established, but there is a strong need for it in order to measure the benefits and the costs of UA (Nugent, 1999b). In Cuba, and especially in Havana where UA is intensively practiced, the growing importance of the movement makes it a current policy issue. This would explain why economic valuation of the Havana UA system is needed (Cruz, 1999; Fernandez, 1999; Perez, 1999; Gonzalez, 2000).

The main objective of this study is to contribute to the analysis of UA by measuring its economic value, using Havana as a case study. The contingent valuation method (CVM) is believed to be an interesting method to assess the combined market and non-market benefits of UA in Havana. Contingent valuation is a direct method to extract WTP values from individuals. It is a survey-based instrument that creates a hypothetical market for the good and asks respondents for their WTP (Mitchell and Carson, 1989). Interestingly, this study is the first CVM experiment for Cuba, and is also the first CVM study to be applied to UA.

This study also aims at contributing to the literature related to the application of CVM in southern countries. Few studies have applied CVM in the South, and most of them have suffered from bias and badly developed surveys (Shultz, 1997). However, there is evidence that CVM can be properly executed in the South, and can bear valid results (Whittington, 1998). Finally, this study will assess the usefulness of CVM in Cuba, as well as assess its usefulness in measuring benefits of UA systems.

The specific objectives of the study are the following:

- Collect quantitative and qualitative data on UA in Havana;
- Estimate users' willingness to pay for UA land among individual producers granted a unit of land in usufruct in Havana;
- Provide some information on the benefits of UA for users, and what determines WTP;
- Estimate the aggregate economic value of UA for users in Havana.

2. Literature Review

2.1. Economics of Urban Agriculture

2.1.1. Urban Agriculture Land as a Quasi-Private Good

The use of non-market valuation techniques such as CVM is useful when the good does not have a price that reflects its value. When goods have a determined price, they are considered *private* goods and are "bought and sold in organized markets where those participating have identifiable individual property rights to the goods" (Mitchell and Carson, 1989: p. 55). Their value is revealed by their price.

The contingent valuation method has been used to value quasi-private and public goods. Quasi-private goods are similar to private goods, with the exception that they are not freely traded in the market. Public goods on the other hand differ widely from private goods: they have no explicitly identifiable individual property rights because consumers cannot be excluded from enjoying them; public goods can also be considered non-rival goods (Mitchell and Carson, 1989). The three different types of goods are presented in Table 2.1.

Table 2.1

Classes and Characteristics of Goods

Class of good	Characteristics	Examples
Pure private	Individual property rights Ability to exclude potential consumers Traded freely in competitive markets	Agricultural products Televisions Insurance
Quasi-private	Individual property rights Ability to exclude potential consumers Not freely traded in competitive markets	Public libraries Camping permits Beaches
Pure public	Collective property rights Cannot exclude potential consumers Not traded in any organized markets	Air visibility Scenic view National defense

(Source: Mitchell and Carson, 1989)

In this study, the good is public (state-owned) urban land used for agriculture; it does not have a price and is not traded in markets. However, unlike a pure public good, users need to be granted use rights to consume it and one unit of land has one or more users, thus excluding all other individuals; it has rival and exclusive properties. Land used for urban agriculture in Havana can therefore be considered a *quasi-private* good. As it is discussed later in this chapter, CVM compares favorably to other non-market valuation techniques when valuing this type of good (Carson et al., 1996).

2.1.2. Urban Agriculture and Household Welfare

Generally, when a UA activity resembles medium to large-scale rural production, it is considered part of the agriculture sector. When UA is marginal or conducted on a small scale, it is not documented and does not appear in production data. For these reasons, there has been little economic analysis of UA. There is growing literature on urban agriculture, but most if not all

studies focus only on qualitative aspects of the activity. However, there is evidence that UA is a relatively important economic activity in many countries, which is also true for small-scale production units such as gardens and small farms. According to a compilation by the Urban Agriculture Network (UNDP, 1996), in Dar es Salaam, urban agriculture was the second largest employer in 1988. In the United States, more than one third of the dollar value of the agricultural product is produced within urban metropolitan areas (Heimlich, 1989). Densely populated Hong Kong produces nearly 50% of its own vegetables and most of its own poultry (Rauber, 1997). In Havana, UA activities increased employment by 6% (Gonzalez, 1999). When the non-market benefits of UA are considered in addition to market benefits, there is much to be recognized and assessed.

Perhaps the most comprehensive economic analysis of UA comes from Nugent (1999a and 1999b), who contributed two papers to the topic. Nugent (1999b) presents a cost-benefit theoretical framework introducing the need to include *nonmonetizable* and *nonquantifiable* values and impacts of UA, which, along with quantifiable values and impacts, decrease or increase society's welfare.

Nugent (1999a) takes this discussion at the microeconomic level to understand the welfare impacts of changes in UA for households. At the household level, urban agriculture land is included in a utility maximizing framework, and is defined as a (consumable) good. Urban agriculture land (UA) is assumed to provide utility to the user, thus

$\delta U/\delta UA > 0$

and a change in the provision of UA has welfare impacts.

The decision to engage in UA can lead to changes in how households allocate time and expenditures. It can be assumed that households try to maximize utility subject to a budget constraint that includes household resources, household returns from employment, and prices (of inputs, food and other consumables):

Max U(q, UA)

s.t pq=y

where q are all other goods consumed by the household. It is expected that households will allocate their time to the activities that yield the most utility. Therefore, a household would produce its own food if it considers it less costly to do so than to buy food.

Nugent (1999a) however states that the decision to engage in UA activities does not have a predictable relationship to income, wages, prices or other employment opportunities. Factors such as social and cultural background, risk perception, and family power relationships come into play. In other words, UA provides non-market benefits that have economic value to the household, thus influencing the decision to engage in it or not. This explains Seeth et al.'s (1998) conclusion that social and cultural factors are more important than the opportunity cost of employment (for garden plots in Russia). Urban agriculture also contributes to the diversification of a city's environment, providing open space, air pollution reduction and recreational areas.

Market and non-market benefits derived from UA thus contribute to the welfare of the user, but also to non-users, as introduced earlier. The next section provides a discussion of use and non-use-value.

2.1.3. Use and Non-Use Values of Urban Agriculture

Typically individuals value non-market goods for their use value and their non-use value. As stated earlier in the introduction, these two types of value make up the total economic value (TEV) of a good.

Mitchell and Carson (1989: p. 62) define the use class of benefits as "all the current direct and indirect ways in which an agent expects to make physical use of a public good". This class of benefits consists of direct, indirect and option use value.

In the case of UA, direct use benefits may arise from the productive use of the land, making possible the cultivation of fruits, vegetables and animal breeding. The indirect use benefits of UA arise from the non-productive use of the land, such as when users consider their UA activity a hobby, or use their garden for relaxation or the maintenance of good health. Another indirect benefit that accrues specifically from UA is the sense of food security and independence of growing one's own food for one's household. Although related to direct use benefits, this benefit refers to a state of mind rather than the physical quantity of food one can produce on their land.

Finally, option use value of UA may also be part of the benefit bundle of a user, if they value the possibility of using the land in the future.

The non-use class of benefits described in Mitchell and Carson (1989) consists of all benefits that are not derived from personal use. *Passive use* values (Arrow et al., 1993) relate to the utility an individual can get from the simple fact that a non-market good exists. This general class of non-use value is broken down into three parts, namely existence value, bequest value and altruistic value (Lazo et al., 1997). Existence value of UA is simply the value an individual, user or non-user, places on the fact that UA exists independent of who and how many persons actually derive utility from the good. Altruistic value on the other hand is the value that is placed on knowing that other individuals have access and use land for UA. Finally, bequest value is the value that is placed on knowing that the UA will be available and will provide utility for future generations.

Table 2.2 provides a summary of use and non-use value of UA.

Table 2.2

Total Economic Value of UA

Benefit Class	Value Category	… In Urban Agriculture
Use		
	Direct Use value	Crops
	Indirect Use value	Recreation benefits, health benefits
	Option Use value	Future use of land
Non-Use		
	Existence value	Knowing UA is part of city landscape
	Altruistic value	Knowing others gain utility from UA
	Bequest value	Knowing that future generations will have access to UA

(Source: Mitchell and Carson, 1989)

2.2. Theoretical Measures of Welfare

This section considers the theoretical measures of consumer welfare that are the foundations of cost-benefit analysis. This is a basic review of consumer welfare economics, based mainly on van Kooten (1993), Bishop and Woodward (1995), and Mitchell and Carson (1989).

Three theoretical measures of welfare are usually used in economics. These are consumer surplus (CS), compensating variation (CV) and equivalent variation (EV).

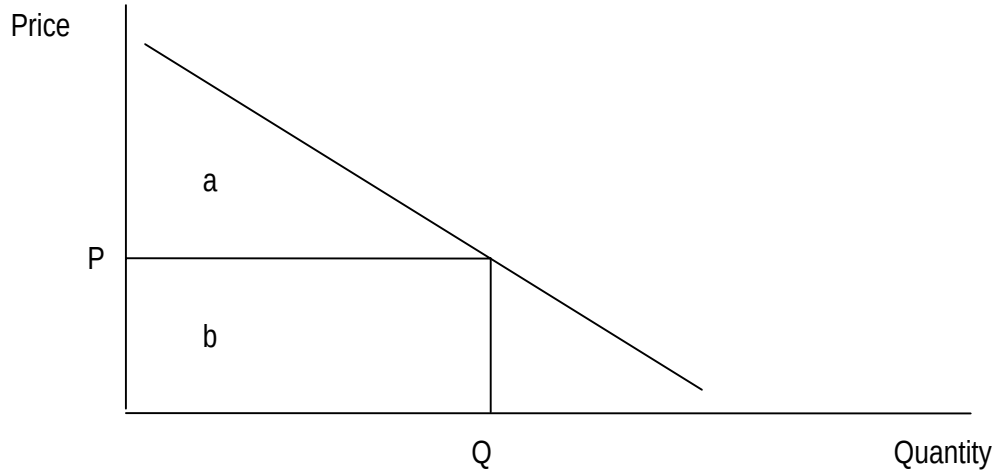
2.2.1. Marshallian and Hicksian Compensated Demand

The notion of consumer surplus was first introduced by French engineer Dupuit in late 19th century, and later elaborated by Alfred Marshall (van Kooten, 1993). Consumer surplus measures the welfare that consumers gain when they purchase a good (or a service). Basically, it is the difference between the marginal willingness to pay (WTP) for a good and its market price. The marginal willingness to pay curve is the individual's demand curve for the good, commonly called the Marshallian or Ordinary demand curve. This curve is shown in figure 1. The ordinary demand curve shows the quantities of the good demanded relative to the price of that good. As consumers typically want to consume more when price falls, the curve is downward sloping. At price P, consumers want to consume Q quantity of the good, and thus pays P * Q for the good, but the *value* that the consumer places on the good is the total area under the demand curve, a + b. Zone a is referred to as consumer surplus, one of the welfare measures used to assess the welfare that an individual gains from consuming goods. Price fluctuations of the good will affect consumer

welfare: if the price goes up, the surplus area under the curve decreases, but if the price goes down, consumer surplus increases.

Figure 1

Ordinary Demand Curve and Consumer Surplus



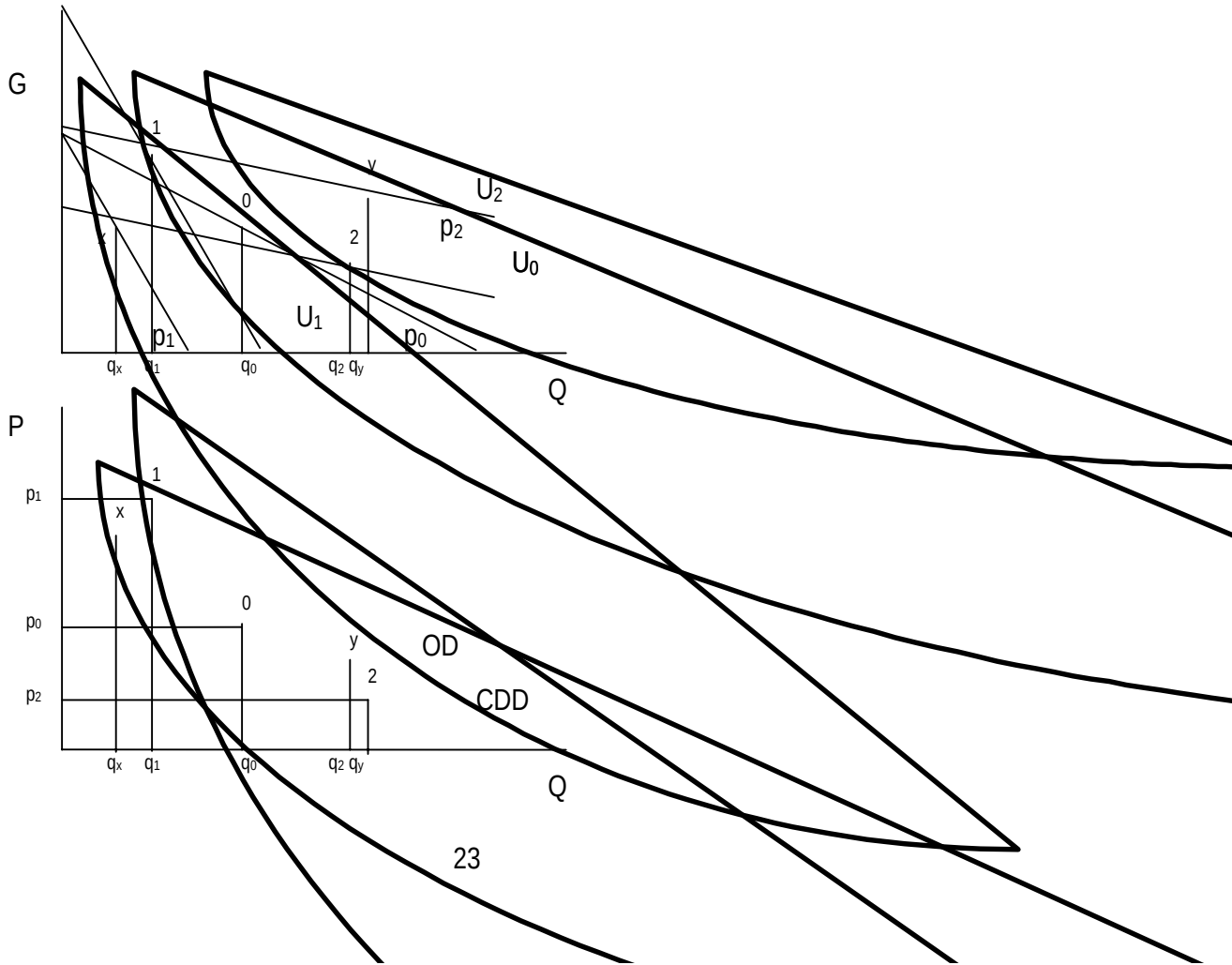
The purpose of consumer surplus is to measure in monetary terms the impact of a policy change that would affect the provision or the price of a good. However, as van Kooten (1993) states, CS is not accurate when there are changes in income. When there is a change in income related to price changes, the best measure of welfare is simply the difference between income levels. In other words, when prices change and have an impact on income, the best measure of welfare is the amount of income necessary to compensate the individual so he remains on the same utility curve. Compensating variation (CV) and equivalent variation (EV) are the two direct theoretical measures that enable this measurement.

Hicksian Compensated Demand Curves

Before proceeding to CV and EV, it is important to distinguish between Hicksian (compensated) demand curves and Marshallian (ordinary) demand curves. Figure 2 illustrates the derivation of these two types of curves. It is assumed that the individual maximizes utility subject to a budget constraint, and that income is allocated to two goods, Q and G. Q is one good, and G is a set that includes all other goods available to the individual. The price of G is set at p_G=1, so price changes is this example will only be price changes in Q. In the top part of the figure, the individual maximizes utility subject to a budget constraint. At first, with price p_0 for the good Q, the individual maximizes utility at point 0 on U_0. The slope of the budget line is given by the negative of the price ratio, $-p_0$ (actually, $-p_0/P_G = -p_0/1=-p_0$).

Figure 2

Derivation of Hicksian and Marshallian Demand Curves



(Source: van Kooten, 1993)

To derive the Marshallian ordinary demand curve for Q, the budget amount is held constant and p is allowed to change. At the higher price p_1, the slope of the budget line gets steeper, and the individual adjusts levels of G and Q to achieve a new equilibrium at the lower utility level U_1, at point X. The individual thus consumes less of Q, say q_x. At the lower price p_2, the individual can purchase more of good Q relative to his or her fixed income level, and thus adjusts level to reach U_2 at a new equilibrium point Y. The individual now consumes q_y. These two new equilibrium points and the initial equilibrium point 0 construct the ordinary demand curve (OD) in the lower portion of figure 2.

To derive the Hicksian compensated demand function for Q, utility is now held constant while prices are allowed to change. This is where the compensation notion comes into play. In order to keep the individual on a constant utility level, income must counterbalance the effect of the price changes on the individual's utility. Thus if price p of Q goes up, the individual must be compensated to stay on the original level of utility, while if p goes down, some income must be taken away.

This can be seen in figure 2. The individual is once again maximizing utility subject to a budget constraint and facing p_0; s/he stands at point 0. If price p goes up, the budget line is steeper but income compensation shifts the new budget line to the right until U_0 is reached again, but with new

quantities of Q and G. Because Q is now more expensive, the individual maximizes utility by substituting Q for G, and thus consumes more of G and consumes q_1; however the same utility level U_0 is maintained because compensation was given to do so. If price p goes down, the opposite situation occurs. The budget line shifts rightward and income has to be taken away in order to leave the individual at U_0. This cheaper price of Q makes the individual adjust the composition of his bundle to consume q_2 and less of G. These two equilibrium points on U_0 and the initial 0 point construct the Hicksian compensated demand curve (CD) in the bottom part of figure 2.

2.2.2. Compensating and Equivalent Variations

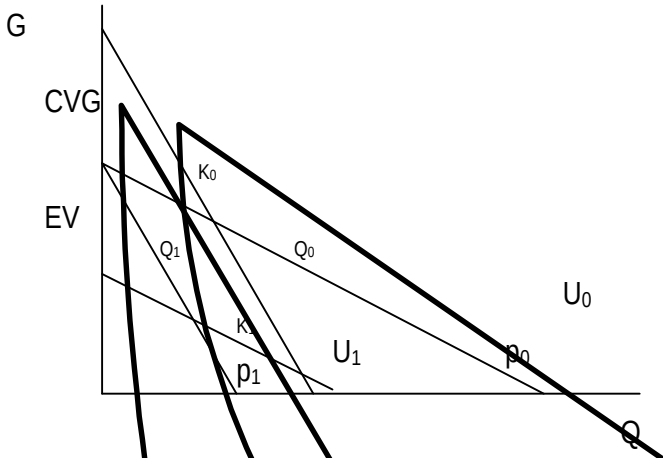
Van Kooten (1993) states that CV and EV are more accurate measures of welfare than CS because they keep utility constant. This property allows the accurate assessment of the impact of policy changes on consumer welfare, by calculating the income necessary to compensate (or take from) the individual in order to maintain a certain utility level.

Compensating Variation and EV measures from the Hicksian compensated demand curve are straightforward. Figure 3 illustrates a similar graph to the upper portion of figure 2, with goods Q and G. Suppose the price of Q increases from p_0 to p_1. The compensating variation of the price increase - measured in terms of G - is the amount of G necessary to compensate the individual for the higher price of Q, so the initial level of utility can be maintained. It is a *willingness to accept* amount to avoid the decrease in Q. This is depicted in figure 3 by the difference in G between the two budget lines: the initial line with p_0 and the new one parallel to the budget line with p_1 but

tangent to U_0. On the other hand, for a price decrease of Q, or a quantity increase in Q, compensating variation is interpreted by Mitchell and Carson (1989) as the consumer's WTP in order to gain the new level of the good and still maintain his/her initial level of utility.

Figure 3

Compensating Variation and Equivalent Variation for a Price Increase



(Source: van Kooten, 1993)

The EV of a price increase of Q is the amount of money that would have to be taken away from the individual (amounts of G) to provide a utility level U_1 at the original set of prices. The focus here is on the new utility level. Figure 3 shows that the price increase of p_0 to p_1 places the individual on a lower utility curve U_1, but with a different set of prices, at point Q_1. Equivalent variation is the difference in G between the two budget lines: the initial line with p_0 and the new one, parallel to the initial line but tangent to the new utility level U_1. Mitchell and Carson (1989) simply explain EV in the case of a price increase (or a quantity decrease) as the amount of income necessary that an individual in willing to pay to avoid the decrease. In the case of a price decrease or a quantity increase, EV is the minimum amount of compensation the consumer is

willing to accept in order to do without the quantity increase and still enjoy the level of utility which would have resulted of the quantity if the good in question had been increased.

Although this theoretical framework is developed using goods that have a price and are traded in markets, it is also usable within the context of valuating non-market goods. Assuming that utility is increasing in the non-market good, and thus of value to consumers, these goods also fit in the framework. The use of equivalent and compensating variation is particularly interesting when one wants to assess the welfare impacts of a policy regarding non-market goods, such as environmental quality or social programs.

For all types of goods, however, the Hicksian compensated demand curve cannot be observed because it is a function of, among other things, utility levels, and these levels cannot be observed on the basis of market data. In order to get values for CV and EV, direct and indirect methods are used, and thus bypass the necessity of deriving utility functions.

The Contingent Valuation Method (CVM) approach allows for a direct measurement of CV and EV. This is done by asking respondents their willingness to pay for a decrease in the price or an increase in the provision of a good, or their willingness to accept (in compensation) for an increase in the price or a decrease in the provision of a good.

2.2.3. Illustration Using Differences Between Expenditure Functions

Mitchell and Carson (1989) and Shyamsundar and Kramer (1996) use expenditure functions to illustrate what happens when there is a change in the provision of a non-market good. This is particularly interesting because it shows what change in income, coupled with the change in the non-market good, leaves the respondent's utility level unchanged. Individual users of UA are used here as an example.

Suppose an individual has an expenditure function of the form:

$$e(p, UA, U) = Y \quad (1)$$

where p is a vector of prices, UA is the provision of the non-market good (urban agriculture land), U is the level of utility and Y is the minimum income necessary to maintain utility level U given prices p and provision of the non-market good UA.

Let p represent a vector of prices (that will remain unchanged), UA_0, U_0, and Y_0 represent initial levels of the arguments and UA_1, UA_2, U_1, U_2, Y_1 and Y_2 some subsequent levels.

At the initial level of UA access, each user's expenditure function is expressed as:

$$e(p, UA_0, U_0) = Y_0 \quad (2)$$

where U_0 is the maximum obtainable utility level given prices p and UA access at UA_0. Thus Y_0 represents the minimum income amount necessary to attain the "with UA" utility level.

In the first WTP scenario, WTP1, individuals are confronted with a hypothetical loss of access to UA (provision of UA goes from access to UA (UA_0) to no access to UA (UA_1). This new level UA_1 decreases utility (from U_0 to U_1). The new expenditure function of the user is:

$$e(p, UA_1, U_1) = Y_1 \quad (3)$$

where Y_1 denotes the minimum income necessary to maintain U_1. Assuming that access to UA, UA_0, is preferred to no access, UA_1, equivalence surplus (ES)[4] can be expressed as

$$ES = e(p, UA_0, U_1) - e(p, UA_1, U_1) = Y_0 - Y_1 \quad (4)$$

Because UA_0 is preferred to UA_1, less income will be necessary to maintain U_1 in the presence of UA_0 than in the presence of UA_1. Thus equation (4) yields a negative number, and represents the maximum amount the individual would be willing to pay while maintaining level U_1 of utility.

In the second WTP scenario, WTP2, individuals are asked what amount they would be WTP for the proposed improvements in UA, while maintaining their initial level of utility with no improvements. The expenditure function with no improvements is of the form

$$e(p, UA_0, U_0) = Y_0 \quad (5)$$

and gives the minimum amount of income necessary to maintain U_0. The new proposed level of UA, say UA_2 creates a new expenditure function

$$e(p, UA_2, U_0) = Y_2 \quad (6)$$

which is expected to give a lower minimum amount of income than in (5), assuming that UA_2 is preferred to UA_0. Willingness to pay for the improvement in UA in this case is a compensating surplus measure (CS) and can be expressed as the difference between (5) and (6):

$$CS = e(p, UA_0, U_0) - e(p, UA_2, U_0) \quad (7)$$

2.3. The Contingent Valuation Method

2.3.1. History and Description

The contingent valuation method (CVM) is a widely recognized approach to non-market valuation. Mitchell and Carson (1989: p. 2) define it as a method that "uses survey questions to elicit people's preferences for public goods by finding out what they would be willing to pay for specified

[4] Equivalence surplus is analogous to EV, but is more appropriate when there is a fixed change in the provision of a good, and not variations. This also applies later for CV that is expressed as compensating surplus (CS).

improvements in them". This method circumvents the absence of markets for non-market goods by creating hypothetical markets for them, and asking respondents what they would do in specific hypothetical situations where they would need to value their preferences for the good.

Contingent valuation is considered a direct method as it extracts from the respondents their willingness to pay or their willingness to accept amounts, which are direct expressions of Hicksian welfare measures described in the previous section.

A basic CVM study includes three main components:

1. A detailed description of the good being valued and the hypothetical circumstance under which it is made available to the respondent. Because CVM relies on hypothetical markets, this part is considered very important to yield reliable and valid WTP values. Respondents need to have a clear idea of the good to be valued, of the market created, the payment vehicle to which their "money would go", the structure under which the good is to be provided.
2. Questions eliciting WTP values. In this section, respondents are asked to state their maximum WTP (or WTA) for the good, following an elicitation procedure that facilitates the valuation process.
3. Questions about respondents' characteristics, their preferences relevant to the good to be valued and their use of the good. The data collected in this section complements the WTP data in order to explain variations of WTP amounts across respondents. For example, household income and education influence maximum WTP amounts.

The contingent valuation method has come a long way since Ciriacy-Wantrup (1947) first advocated the use of "direct interview method" to measure values associated with natural resources. He was the first economist to suggest valuation of non-market environmental resources by asking people directly about their values:

"Individuals of a sample or of a social group as a whole may be asked how much money their are willing to pay for successive quantities of a collective good" (Ciriacy-Wantrup, 1952: 241-242).

The controversies and criticism surrounding the idea of non-market valuation and hypothetical situations, along with the need for more efficient policy making, created a sort of forum for discussion on the issue. Researchers undertook many studies to assess its reliability and validity, and conducted empirical work using CVM. In fact, CVM is the most widely used approach to value public goods (Mitchell and Carson, 1995). A bibliography compiled by these authors contains over 1600 citations, and the production of CVM literature was increasing every year from 1972 to 1992. According to Carson (1999), there are now more than 2000 papers and studies dealing with CVM, and the method has been used for more than 35 years, in more than 50 countries. CVM has received considerable acceptance in the United States and in other countries as a tool for measuring values to be used in benefit-cost analysis (Bishop et al., 1995).

In developing countries, CVM has not been used as extensively as in developed countries. A compilation conducted in Latin America and the Caribbean (Shultz, 1997) identified 12 CVM studies that focused mainly on the value of drinking water supply and protected areas. Only three of these have been published as journal articles or as book chapters, suggesting that

methodologically rigorous studies are lacking in these countries. Shultz (1997) also points out that many of these studies suffered from inadequate scenario design and sampling that introduced important biases in the results. The author concludes that more training in environmental economics and further research are needed to improve the quality of CVM studies in Latin American and Caribbean countries.

Despite these poor results, economists and policy analysts do not discard the use of CVM in developing countries, but rather assume that it is fairly easy to use and can elicit accurate values for non-market goods (Whittington, 1998). In fact, the hypothetical scenarios presented in developing countries often seem very realistic, and the respondents take the survey very seriously. This is due to the fact that the studies often estimate use value of public facilities and services, which are easily understood and subject to taxes or fees. Well developed scenarios and methodologically sound approaches to analyzing the data can increase the accuracy of CVM in developing countries.

2.3.2. Assessment of CVM

A wide range of non-market goods has been valued with CVM. The first elaborate study was conducted by Davis (1963, 1964) who used questionnaires to estimate the benefit of outdoor recreation in the Maine Backwoods area. Since then, many studies have attempted to value public goods, such as wilderness preservation (Walsh et al., 1984), water quality (Sutherland and Walsh, 1985; Desvousges et al., 1987), beaches (Silberman et al., 1992), agricultural land (Halstead, 1984), damages from oil spills (Carson et al., 1992) and curbside recycling (Aadland

and Caplan, 1999). Although less numerous, CVM has also been applied in developing countries, to value household water services (Boadu, 1992, Whittington et al., 1990), tropical forest protection (Shyamsundar and Kramer, 1996); and in countries in economic transition, to value surface water quality (Mourato, 1998).

The previous enumeration shows studies that have attempted to value both use and non-use value, with the underlying objective of contributing to decision making regarding non-market goods. While environmental CBA frameworks have integrated use value, such as direct consumptive and non-consumptive use found in recreational services, the concept of adding option use value or non-use value is rather new and subject to criticism. In fact, much of the debate on the validity of CVM focuses on the issue of integrating non-use value in non-market valuation.

This is mainly due to the fact that some social scientists such as Diamond and Hausman (1993) are skeptical that individuals can actually assess their preferences and put a monetary value on a non-market good that they do not use. This would be because many aspects of non-market goods may not well be understood and not well known by non-users, which makes it difficult to assess preferences: "Contingent valuation surveys focus specifically on questions with which people have little or no experience because they generally do not use the resource" (Diamond and Hausman, 1993: p. 30).

However, this is not always the case. Environmental concerns have driven many individuals to understand, and even defend issues that involve "non-use" goods, such as endangered species or

ecologically sensitive areas, although they will most probably never use these amenities for their own consumption. Moreover, individuals do place monetary value on these non-use goods. Contributing to non-profit organizations is an example of such valuation. Mitchell and Carson (1989) and Arrow et al. (1993) would also argue that assessing non-use value, namely through CVM, is well rooted in welfare economics, and can be measured through carefully designed surveys.

These economists and many others support the idea that measuring non-use (or "passive") use value becomes imperative when pure public goods are involved, such as levels of air quality or remote wilderness areas, because without it these have little or no economic value. If passive use cannot be accounted for, this would mean for example, that environmental damage to non-used areas should not be a concern in cost-benefit analysis, as these non-used non-market goods would have no value in the economic sense. Moreover, Carson (1999: p.6) adds that

"failure to consider passive use value is clearly inconsistent with economic theory if the objective is to maximize public welfare in any well-defined sense as pure public goods would clearly be under supplied".

A widely stated example of the importance of non-use value lies in the Exxon Valdez oil spill on the shores of Alaska in 1989. While use damages were obvious from the accident, the public's reaction to the event demonstrated that there was also important non-use damage that affected non-users, outside the affected area. The National Oceanic and Atmospheric Administration (NOAA), the U.S. federal agency responsible for issuing damage assessment regulations for oil

spills, created a Panel do review and assess CVM as a method to measure passive use values. The panel, led by Nobel laureates in economics Kenneth Arrow and Robert Solow, concluded that

"… Passive use loss - interim or permanent - is a meaningful component of the total damage resulting from environmental accidents […] Thus the Panel concludes that CV studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment - including lost passive-use values" (Arrow et al., 1993: p.4610).

On the other hand, the idea of putting a monetary value on a non-market good that is actually used personally by the individual seems more realistic. In their study of WTP for a curbside recycling program, Aadland and Caplan (1999: p.782) argue that

"there may be a spectrum of goods for which CV surveys more closely measure preferences, in particular curbside recycling, which resemble private goods that respondents have some prior experience paying for."

This doesn't mean however that CVM surveys eliciting use value can be designed loosely. There is still the important fact that the situations are hypothetical and prone to inaccurate responses. The Panel's favorable conclusions in Arrow et al. (1993) were drawn with the condition of "good quality CV surveys". The next section describes the elements of survey design, including sampling, hypothetical market, and elicitation methods used commonly in CVM. Biases related to these components of CVM are explained and discussed throughout the section.

2.3.3. Survey Design

This section focuses on the elements necessary to construct a reliable survey in CV. It describes issues related to sampling issues, scenario design, elicitation methods, testing and scenario administration.

2.3.3.1. Population and Sampling

The first step in designing a CV study is to define the population that is affected by the change in the provision of the non-market good. This task is relatively simple when the study aims at eliciting use values; the population of users of a non-market good can be identified through geographical location, user associations or by simply "intercepting" them while using the good in question. In his study of user benefits of wilderness parks, Wistowsky (1995) distributed surveys to campers entering or leaving the three targeted wilderness parks, and asked them to complete the survey and return it by mail. CV studies eliciting user value are expected to yield high response rates, as the respondents feel directly concerned and are willing to collaborate.

Defining the population for a CV study eliciting non-use value is more complex: in theory, non-users can have existence, altruistic or bequest value for a good from anywhere. Non-users can also consider becoming users in the future, thus having option use value for the good. It is reasonable to think that WTP of non-users will decrease with distance separating them from the good. This is to say there would exist a certain distance at which all respondents would not be

willing to pay anything. In their study of non-use value for wetlands in Great Britain, Bateman and Langford (1997) used *distance-decay* analysis and a number of concentric zones centered upon the wetlands, to demonstrate that there was a direct inverse relationship between distance and non-user WTP for the preservation of the wetlands.

Once the population is defined, a sample of the target population needs to be randomly determined, from which data will be retrieved and used to determine characteristics and preferences of the total population. Mitchell and Carson (1989) state that there are two ways in which the reliability of CV sample statistics can be enhanced: by sufficiently large sample size; and through the use of robust statistical techniques that lower or eliminate the undue influence of outliers. Inaccurate sample design can lead to biases, such as sampling frame bias, which occurs when the sampling frame does not give every member of the population chosen a known and positive probability of being included in the sample. Another important bias is sample selection bias, that occurs when the respondents of the survey have a specific set of values for the good, that does not necessarily coincide with the population's set (Mitchell and Carson, 1989). Mail CVM studies are particularly vulnerable to this bias, as respondents that fill out the questionnaires are often sensitive to the issue and thus represent a sub-set of the population only.

2.3.3.2. Scenario Design

Mitchell and Carson (1995) state two goals of the scenario design. First, define the characteristics of the good to be valued and second, ensure that respondents find the scenario plausible.

Defining the good implies a carefully worded description along with clear levels of change in the provision of the good. Especially when the respondents are not familiar with the good, visual aids can increase the understanding of the good's characteristics. An example of this is a study by Desvouges et al. (1983), which used a ladder graded 0 to 10, representing different levels of water quality. Respondents could refer to precise water quality levels on the scale ("okay for boating only", "game fish can live in it", "safe for swimming" and "safe to drink"). Failure to define the good adequately can lead to amenity misspecification bias, where the respondent perceives a good that is different than the intended good (Mitchell and Carson, 1989).

To come up with realistic values, respondents need to be informed on the mechanism through which payment would take place, or the payment vehicle. According to Anderson and Bishop (1986), the payment vehicle needs to follow two basic guidelines: realism and neutrality. Respondents need to find that the payment mechanism makes common sense, and must not influence the respondent's value for the good. Many different types of payment vehicle are allowed. The payment vehicle can take the form of a tax, a monthly fee, a contribution to a non-profit organization, an increase in permit price, etc. While a realistic payment vehicle can easily be found among the vast array of possibilities, some may provoke emotional reactions, thus compromising the true underlying value for the good. The use of taxes is a good example. Anderson and Bishop (1986: p.120) are concerned that "people will use the CV question to express general dissatisfaction with tax rates rather than to express a value for the resource". When the payment vehicle is non neutral, or non realistic, it can generate payment vehicle bias and affect true WTP.

2.3.3.3. Elicitation Methods

The elicitation method of a CV survey is the mechanism used to help respondents state their WTP amounts. The choice of an elicitation method has concerned CV researchers for years. It would be safe to say that an important part of the CV literature deals with this issue; this is mainly due to the fact that the different elicitation methods do not always yield similar WTP amounts. General discussions can be found in several publications, namely Mitchell and Carson (1989), Schulze et al. (1996), Skade and Payne (1993), Anderson and Bishop (1986) and Boyle and Bishop (1988). The following is an overview of five different elicitation methods commonly used in CVM. They are the bidding game, open-ended, payment card, dichotomous choice and contingent ranking approaches.

1. The Bidding Game Method

The bidding game method (BG), or iterative bidding method, is the oldest elicitation method. In fact, as is shown in Burness et al. (1983), "contingent valuation" and "iterative bidding technique" were analogous expressions. Until the 1980s, it was also the most commonly used approach.

Using BG to elicit WTP amounts consists of the interviewer stating a starting bid from which the bidding can commence. The interviewer then revises the bid upwards or downwards depending on the respondent's answer to the starting bid. The increases or decreases continue until a final "yes" is stated by the respondent. The final bid is considered the maximum WTP amount.

The argument in favor of this technique is that the bidding process helps the respondent in reaching the maximum WTP value for the good under valuation. Also, Boadu (1992) and

Whittington et al. (1990) found that the technique was appropriate, as it reflected the way business was conducted in local markets.

The bidding game's weakness is that the starting bids can have an influence on final bids. This *starting point bias* was observed by Boyle et al. (1985), and reported in Cummings et al. (1986). Other empirical CV studies, such as Brookshire (1980), Whittington et al. (1990) and Desvouges et al. (1987) tested and found inconclusive evidence of starting point bias. Results of a recent study by Casini and Romano (1998) showed no difference between estimated values of WTP using BG and values using the dichotomous choice approach.

It could be argued that starting bid influence would be stronger when the respondent is not familiar with the good, and thus the starting bid is taken as an indication of the value of the good. Therefore, CV that aims at eliciting non-use value should not use BG. However, the previously stated papers suggest that there can be starting point bias when assessing use-values as well; this was the case in Boyle et al. (1985). The evidence presented here suggests that caution must be used when eliciting WTP values with the bidding game technique.

2. The Open Ended Question Method

The open ended question method (OE) is set as an alternative to the bidding game that can mitigate against possible starting point bias. Once the good and the payment vehicle has been described, respondents are asked to give a WTP amount, without the help of any bidding process or other type of stimulus. Despite its simplicity and potential for zero influence on the bids, Anderson and Bishop (1986) suggested that open ended formats do not provide sufficient stimuli

or enough information to encourage respondents to thoroughly consider their value for the good. Considering the fact that individuals are not accustomed to valuating non-market goods, it is hard to tell if the amount they state is really their maximum WTP.

Open-ended formats are also prone to error from strategic answers (also called *strategic bias*). Strategic bias occurs when respondents understate or overstate their bid in order to influence policy decisions related to the provision of the good. Cummings et al. (1986) stated that when the hypothetical market seems highly plausible, respondents understate their bid as a reaction to possible price increases; this is termed the "free-riding" effect. On the other hand, when the respondent does not believe that the payment will occur in reality, the amount may be overstated in order to insure that the proposed policy or project is undertaken. One common strategic response is called "protest zero" and consists of answering "zero" to any amount as a means to protest against the idea of putting a price on the good that is being valued. This is mostly observed in studies on the value of pure public goods. Respondents can consider it inadequate or even unethical to put a price on such goods. While it is plausible to think situations will arise, especially in an open-ended format where any amount is possible, Wistowski (1995) concludes from empirical evidence that strategic bias is not a concern and does not represent a major problem in the application of CVM.

Recent studies comparing continuous (OE) to discrete elicitation methods, such as dichotomous choice (DC) showed significant differences between WTP values. In Ready et al. (1996), DC generated consistently larger estimates of WTP that OE responses; in Kealy and Turner (1993), DC responses were 1.4 to 2.5 times larger than OE values; a compilation of 11 comparative

studies by Brown et al. (1996) found that in all cases, DC results exceeded OE results, with the ratio varying from 1.12 to 4.78. Schulze et al. (1996) also found similar results, with the interesting fact that higher ratios were found in non-use value studies.

While the OE format leaves the respondent "on his own" to answer the WTP questions, a carefully worded and precise description of the good can be sufficient to elicit preferences. Schulze et al. (1996) are also more comfortable with the more conservative amounts generated by OE, and thus advise the use of it for contingent valuation surveys.

3. The Payment Card Method

Mitchell and Carson (1981) developed the payment card method to elicit values for water quality improvements. This method offers more information to the respondent than the OE approach, without providing starting bids that can influence individual preferences. A payment card lists a series of values from which respondents choose an amount that best represents their maximum WTP. Some cards simply put values in a specified range while others add "anchors" representing amounts that individuals already spend on other public goods, such as national defense or education.

The payment card approach has not been used much in CV. Some researchers such as Arrow et al.(1993), Boyle and Bishop (1988) and Mitchell and Carson (1981) were concerned with the potential for anchor-point bias (analogous to starting point bias in BG), range bias and centering bias. Anchor point bias occurs when respondents' bids are influenced by the anchors on the card; range bias refers to the influence of the list of amounts on the card; and centering bias is found

when respondents have a tendency to simply choose the value amount in the middle of the card's list of amounts. However, Mitchell and Carson (1981), Boyle and Bishop (1988) and Rowe et al. (1996) all tested for these biases and did not detect any affect of anchor amounts, range amounts or center amounts. This suggests that the PC method may yield unbiased results for CV surveys.

4. The Dichotomous Choice Methods

The dichotomous choice method (DC) was developed by Bishop and Heberlein (1979). The method uses a large number of predetermined prices and asks each respondent a yes/no answer to one of the amounts. In recent years, more sophisticated forms of DC have been employed to increase efficiency. Shyamsundar and Kramer (1996) used a "double-bounded" DC format, using a follow-up question to the initial question. If respondents said "yes" to the first bid, a second higher bid was presented and another (final) yes/no answer was solicited. When a "no" response to the first bid was given, a second lower bid was given. Welsh and Poe (1998) constructed a "multiple bounded" DC format, which allowed respondents to vote on a wide range of bids. For each bid, respondents needed to state their level of payment certainty, which consisted of five levels: "definitely yes", "probably yes", "not sure", "probably no" and "definitely no".

Formerly called the "take-it-or-leave-it" approach in Mitchell and Carson (1989), this method has the advantage of simplifying the task of respondents and presents them with a situation that resembles everyday economic decisions. Basically the respondent is expected to say "yes" if their WTP is equal to or higher than that the bid, and "no" otherwise. For these reasons Arrow et al. (1993) concluded that the DC format was the preferred method to elicit non-market value.

While the recommendation of the NOAA Panel is commendable, DC has also its share of setbacks. The most common bias that affects DC is called "yea-saying" and refers to the influence of the proposed bid, making respondents systematically answer "yes". This bias is similar to starting point bias in BG explained earlier. This bias leads to overstatement of WTP, as pointed out by Blamey et al.(1999) and Boyle et al. (1998). Yea-saying would be responsible for consistently larger estimates of WTP values elicited with DC compared to OE (refer to sub-section on OE). Mitchell and Carson (1989) also mention that the discrete nature of the responses creates the need for many more observations to achieve the same level of statistical precision. Moreover, DC CV studies require more sophisticated statistical procedures to analyze the data.

5. Other Elicitation Approaches

New developments in CV research include a family of elicitation procedures that present to respondents different combinations of non-market good provision levels and WTP values from which to choose from. Contingent ranking, contingent rating and paired-comparison methods form this group of methods. The contingent ranking method, for example, was used in a study reported by Anderson and Bishop (1986) that aimed at eliciting preferences for visibility levels in national parks. Respondents were given eight cards depicting various fees, various levels of visibility and various other recreational characteristics (like congestion in the parks). Respondents ranked the alternatives from most-preferred to least-preferred. Most empirical applications of these methods took place in the 1990s. Researchers such as (Delavan, 2000) advocate the use of contingent ranking when policy makers want information on the implications of different levels of non-market good provisions.

2.3.3.4. Scenario Testing and Administration

Researchers often point out the importance of a well designed survey is key to achieve accuracy and validity in CV. Mitchell and Carson (1995) propose a five step testing procedure: 1) discussion with policy and technical experts on the good under valuation; 2) focus groups to enlarge the discussion on the valuation process and receive comments on the initial versions of the survey; 3) In-depth interviews to test an initial draft; 4) a small pre-test of 10 to 50 interviews and 5) a pilot test to refine questions, evaluate explanatory variables and determine monetary thresholds when a method using bids has been chosen for eliciting WTP.

With respect to survey administration, Arrow et al. (1993) and Mitchell and Carson (1995) advocate the use of personal (face-to-face) interviews, rather than mail surveys and phone interviews. The mail survey is considered third choice as it is plagued with many problems. It typically employs lists, such as telephone directories, which covers only a small part of the population; returned surveys come from interested respondents on the issue, which is a form of sampling bias. There is also a problem with the fact that there is no control on the process of filling out the survey, such as controlling the order in which questions are answered. Mail surveys have the advantage however of being less costly than the two other interviewing techniques.

Arrow et al. (1993) do not discard telephone interviews, as they can be interesting in terms of costs and central supervision. However, face-to-face interviews have the advantage of being able to

maintain respondent motivation and allow the use of graphic supplements. Coverage and response rates are also higher than with phone interviews.

Phone and personal interviews are however vulnerable to interviewer bias. This type of bias occurs when respondents give WTP amounts that differ from their true WTP in order to please the specific interviewer or gain status in their eyes (Mitchell and Carson, 1989). Careful training of interviewers must be undertaken to homogenize the interview process among interviewers and to suggest "neutral" behavior from the interviewers.

2.3.4. Analysis and Treatment of Continuous Data from Contingent Valuation Studies

One of the main advantages of using an eliciting method that yields continuous values of WTP, such as the bidding game, is that data analysis can be done using linear regression models[5]. These models enable the estimation of bid curves, which explain the relationship between WTP and explanatory variables.

The classical linear regression model presented in Mukherjee et al.(1998) assumes that the population regression Y is a linear function of a vector of explanatory variables X:

[5] Some consider the bidding game a discrete method because yes/no responses are given to different bids. This is mostly true however when bids are far apart from each other, and/or when the bidding game is limited in the number of bids, which resembles a dichotomous choice with follow-ups. In these cases a qualitative choice model is necessary to analyze the data, such as the ordered logit model (see Whittington et al., 1990).

$$Y = \alpha + \beta X + \varepsilon_x$$

where α is a constant, β is a vector of coefficients on X and ε is the error term. The classical linear regression model is based on the following assumptions:

1. the error terms have 0 mean: $E(\varepsilon_x)=0$;
2. they have a constant variance: $V(\varepsilon_x)=\sigma^2$;
3. they have 0 covariances (no autocorrelation): $E(\varepsilon_i, \varepsilon_j) = 0$, for all $i \neq j$
4. X is non-stochastic, implying that $E(X_i \varepsilon_i) = 0$

In the classical *normal* linear regression model a fifth assumption is made:

5. the error term follows a normal distribution: $\varepsilon_i \sim N(0, \sigma^2)$

The analogous sample regression can be written as

$$Y_i = a + bX_i + e_i$$

where i = 1, … n (where n is the sample size); a is the estimator of α; b is the estimator of β; e is the residual, or the estimator of ε_x. Coefficients a and b are least squares estimators obtained by minimizing the sum of squared residuals with respect to a and b.

It should be added that to be able to make valid inferences about the population based on the sample, it is assumed that the sample is obtained through independent random sampling of Y for a given set of X values. This assumption and the previously stated ones make least square estimators interesting in terms of statistical inference.

Moreover, the Gauss-Markov theorem states that least square estimators, subject to these assumptions (excluding the normality assumption), are termed best linear unbiased estimators (BLUE) of a and b, i.e.:

$E(a) = \alpha$ and $E(b) = \beta$

and V(a) and V(b) have minimum variances among all unbiased estimators of a and b.

Mukherjee et al. (1998) further explain that with the normality assumption added, least squares estimators are also the maximum likelihood estimators.

This is to say that under classical normal linear regression assumptions, errors are normally, independently, and identically distributed (normal i.i.d.), and *ordinary* least squares (OLS) regressions can be performed. The derived least squares estimators from OLS are the most efficient to make inferences about the population from the sample. However, when errors are not normal, i.e. not normal i.i.d., their efficiency is greatly reduced (Hamilton, 1998). For example, OLS degrades quickly in the presence of heavy-tailed error distributions, which is associated with the presence of outliers.

Regression Diagnostics

Diagnostics are helpful to look for potential problems that could affect the accuracy of the regression results. Autocorrelation, multicollinearity and heteroskedasticity are among the common problems that can be encountered in data sets. This section presents these three situations along with tests and corrections for them.

Autocorrelation refers to the correlation between sequential values of a variable and is often present in time series or spatial series (Hamilton, 1998). Auto-correlated errors lead to inefficient coefficient estimates, biased standard errors estimates and invalid t and F tests. First-order correlation occurs between successive errors. Hamilton (1998) suggests the Durbin-Watson test to identify first-order correlation. In the presence of autocorrelation, a Cochrane-Orcutt regression (Hamilton, 1998) can be performed instead of the basic linear regression, which incorporates a relation between successive errors in order to correct for the problem.

A second important problem related to variable correlations in the data set refers to *multicollinearity*. This problem exists when there is strong correlation (say at least 0.60) between two explanatory variables. According to Hamilton (1998), multicollinearity can lead to troubles such as:

- substantially higher standard errors, with correspondingly lower t statistics
- unexpected changes in coefficient magnitudes or signs
- nonsignificant coefficients despite a high adj. R^2

Dropping one of the correlated variables can correct for multicollinearity, but extreme caution must be exercised in this approach. Adding more information, through more data, or theoretical restrictions is a preferred approach.

One of the assumptions of the regression model is that the variation of the dependent variable around the regression surface - the error variance - is everywhere the same (Fox, 1991). This is a condition called homoskedasticity. Its opposite, *heteroskedasticity*, is a widely observed and discussed problem in regression analysis of cross-sectional data. The reason is that the variation of the dependent variable(s) rarely remains the same when their level increases or decreases (Mukherjee et al., 1998). Mukherjee et al. (1998) also explain that heteroskedasticity is often linked to skewed distributions of the variables under study. This is particularly true in CVM studies: the dependent variable, commonly WTP, is often positively skewed as more respondents tend top give low WTP amounts while few are high WTP amounts. This study will use the Cook-Weisberg (1982) test for heteroskedasticity as suggested by Hamilton (1998).

Heteroskedasticity is a violation of the assumptions about the error term, which has adverse implications for least square estimators. One of the important impacts of this condition is that the standard formulae for the standard errors will not be valid, since they are based on the assumption of homoskedasticity. Consequently, it is not possible to perform accurate t-tests and F-tests (Mukherjee et al., 1998). Power transformations including log transformations of skewed variables can correct for this problem.

When heteroskedasticity persists, BLUE estimates from OLS may be obtained from a *weighted* least squares (WLS) regression model. This procedure is possible when the specific error variance of an observation can be obtained by multiplying a constant variance by the corresponding weight of that observation (Mukherjee et al., 1998). In other words, WLS performs an OLS that will not be influenced as much by outliers.

2.3.5. Validity Assessment

Mitchell and Carson (1989), Bishop and Woodward (1995) and Bishop et al. (1998) identify three types of validity that CVM studies should be subject to: content validity, construct validity (both convergent and theoretical) and criterion validity.

Within the scope of this study, the information available will only permit the evaluation of *content validity* and *theoretical construct validity*. The former refers to how appropriate were the design and the execution of the study. Bishop et al. (1998) suggest four steps to assess the content of a CV study. First, the study design must be compared to the economic theory underlying WTP. In other words, the design is valid if the information provided during the interview would permit theoretical respondents to reveal their WTP. Second, the extent to which the study communicates effectively to the relevant population must be evaluated. Third, the adequacy of various facets of the study execution (elicitation method, payment vehicle) must be assessed. And fourth, whether the econometrics used to estimate mean and aggregate WTP values were adequate.

Theoretical construct validity will also be assessed in this study. This involves examining the relationship between the dependent variable (WTP) and other variables that are theoretically supposed to explain variations in the dependent variable (Bishop and Woodward, 1995). The signs and the magnitudes on the coefficients of certain variables in the bid equation are particularly revealing for theoretical construct validity. Income for example, is often believed to be positively correlated with WTP. The goodness-of-fit of a model can be expressed through adj. R^2 values, as this statistic measures the degree to which the independent variables explain the variations in the dependent variable (Mukherjee et al., 1998). An adj. R^2 of at least 0.10 is needed usually to say that a CVM study is valid (Mitchell and Carson, 1989). An adj. R^2 of 10% is acceptable and often observed in studies with cross sectional data (Buzby et al., 1995).

Convergent construct validity refers to how the results from the CVM compare with the results from other non-market valuation techniques. Criterion validity refers to how the results of the method under evaluation compares to results from a "criterion which is unequivocally closer to the theoretical construct that the measure whose validity is being assessed" (Mitchell and Carson, 1989: p. 192). In the case of CVM, *simulated markets* provide one way to do so. Simulated markets involve creating real-life situations where participants actually pay for the good or receive compensation for giving it up. In their assessment of convergent validity for quasi-public goods, Carson et al. (1996) found that CVM estimates of WTP compared favorably with results from revealed preferences techniques[6]. Because the good valued in this study is also a quasi-public

[6] Revealed preferences techniques include the travel cost model (TCM) and the hedonic pricing method (HPM). In the former, the value of the good is derived from the amount of expenses the consumer is ready to spend in travel to reach the good and be able to consume it. In the latter,

good (or quasi-private good), some confidence can be gained from this analysis of convergent construct validity.

2.3.6. Concluding Comments with Respect to CVM

This section presented an overview of CVM with respect to its theoretical and empirical aspects in valuing non-market goods. While CVM still presents some complications with respect to its validity and reliability, many researchers maintain their enthusiasm and continue to use it in many policy issues and in many countries. The reasons are quite simple. When it comes to valuing goods that do not have a market price, CVM offers a straightforward, direct and adaptable technique to elicit preferences. The hypothetical market opens the way to unlimited valuation questions that can be tailor made to shed light on specific policy issues. It is also the only method that can elicit non-use values, an important part of the total economic value of a public good.

On the other hand, in its strength also lies its most important weakness: its very own nature of being based on hypothetical situations. A hypothetical decision will not always correspond to a decision in a real situation, and this is at the center of the debate on contingent valuation. However, this debate has been constructive. Validity and reliability testing is inherent to many studies and has identified some of the "do's and don'ts" of administering CVM surveys.

According to the literature reviewed in the previous sections, it is quite clear that CVM is an accepted and accurate method to elicit non-market values, if theoretically sound and

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value for the non-market good is derived from the impact its provision has on prices of market

methodologically rigorous design, implementation and analysis are undertaken. If it respects these requirements, CVM results can be valid and reliable, in the sense that they follow individual economic behavior and they compare favorably with the results of other methods or actual markets. In many studies, especially when eliciting use value, this is the case. This is not to say that CVM is necessarily inappropriate as a means to elicit non-use value. It rather suggests that in this case results tend to be less valid and hard to compare because no other method can assess non-use value.

The previous section also presented the different formats available to the researcher, especially with respect to administration techniques (mail, phone, personal interview) and elicitation methods. Each of these are vulnerable to a set of different complications and biases, and it is hard to identify *ex ante*, based on literature, which interview technique and which elicitation format will be best for a study. The best strategy seems to start with a good understanding of the advantages and drawbacks of each, a good understanding of the issue and the policy context, and a precise definition of the good to be valued.

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goods (See Turner et al., 1994).

3. Methodology

This chapter pertains to the various elements that went into the CVM survey and analysis. Specifications are presented related to the survey design, testing and administration. The last sub-section gives the specifications of the linear regression model used to analyze the data.

3.1. Survey design

3.1.1. The Good

The non-market good being valued is land in *usufruct* used in Havana for urban agriculture. As mentioned previously, this type of land is not traded in markets and therefore does not have a price. Two "levels" of quality of the good were valued: a first level represented by the actual conditions under which the land is being used, and a subsequent level represented by an improvement in water and anti-theft services.

3.1.2. Population and Sampling Strategy

The target population for this survey was the group of individual users of these units of land, commonly called *parceleros*[7] in Cuba. The typical gardener is granted free and individual use rights of units of land belonging to the state. The individual makes a request to the local authorities and is given a piece of land that may range from a few hundred square meters to a few

[7] Parcelero can be loosely translated by "gardener", but the term in Cuba represents only the gardeners that use land in usufruct, as opposed to private garden holders. Consequently, the term

hectares, based on availability of land and production objectives. Each gardener receives a card mentioning name, location and size of unit. Because sizes of land and production objectives could vary widely from user to user, it was decided that the sample would only consider users of one hectare or less. This was done to eliminate users that had entrepreneurial projects such as cooperatives and to avoid large differences in the type of good being valued, i.e. land for intensive operations is a different type of good than land used for small-scale gardening. It should be noted however that there are very few *usufruct* units over one hectare in Havana, and thus excluding them should not make the sample non-representative of Havana's gardens. Variations in unit size and production were also expected within the chosen population, which justified the need for supplementary data. The following sub-section gives an overview of these data.

With respect to population sampling, there were limitations to properly construct a random sample of all users of UA in Havana. Any research project in Cuba involving surveys must go through state authorities that revise the material and decide on its acceptance. Because of the time constraint for this study, it was not possible to go through the formal process. Therefore, this research was conducted in two areas for which the host organization of the author, the *Fundación Antonio Nuñez Jimenez de la Naturaleza y el Hombre*, had previously received authorization to conduct survey work. These two areas were the districts of *Camilo Cienfuegos* (Municipality of East Havana) and *Pogoloti-Finlay* (Municipality of Marianao). Although not chosen at random, these two areas are still interesting because they present two different contexts in which UA takes place. It would be reasonable to say that they represent well the UA movement in Havana.

"garden" instead of "unit of land" can be loosely used here to translate *parcela.* "Gardener" and "garden" will be used here to represent a *parcelero* and his *parcela.*

Camilo Cienfuegos would fit the description of a small suburb, with low population density and relatively higher income levels. Pogoli-Finlay is an area closer to the center of the city with high population density and lower incomes. There are approximately 500 gardeners in these two areas, which represent roughly 3% of the total gardener population in Havana.

Respondents were identified through the local UA delegates that hold a list of all usufruct landholders. There were no possibilities of contacting the gardeners apart from direct contact at their house or garden. When they were found, they were asked to participate in the study. As Moskow (1999), also pointed out, the logistical challenge of simply arranging the interviews precluded the attempt to randomize the sample. In other words, the "random" element of the sample came from the fact that willing gardeners encountered on a given day were interviewed.

Interviews were conducted in the months of December 1999, February, March and April 2000.

3.1.3. Survey Technique

Cultural background and limited infrastructure did not permit the use of telephone or mail surveys. People are not accustomed to filling out surveys, although the population is one of the most literate in the world (CIA, 2000). Phone services are poor and available in only a minority of households. This was also the first application of CVM in Cuba, and thus the use of face-to-face interviews was strongly advocated to monitor the process and enable helpful conservation with the respondents.

Three interviewers administered surveys, with the author doing the majority (77%). The two other interviewers were state urban agriculture delegates assigned to the two areas under study. Training was provided by the author and consisted of three steps: 1) an overview of the questions with possible answers and problems; 2) a simulated interview; and 3) attendance and participation to an interview given by the author. Frequent follow-ups took place to answer questions and revise completed surveys. Both interviewers were university graduates with fieldwork experience.

Interviewer bias

An identical test as for starting point bias was conducted in order to identify and evaluate the importance of interviewer bias. There was also a test for "foreign interviewer" bias, which tested for differences between bids stated to interviewer 1 (foreign, author) and bids stated to combined interviewers 2 and 3 (local UA delegates).

3.2. Survey Questions

The survey included a total of 35 questions divided in four sections: three sections (30 questions) on UA general data and respondent data, and one contingent valuation section of 5 questions. It took approximately 30 minutes to complete the interview. The complete survey translated from Spanish is found in appendix I.

3.2.1. Supplementary Data Collection

The first section was called “General Data of the Garden” and aimed partly at getting comfortable with the respondent by asking short questions on the unit, the nature of the activity and the respondent’s opinion of UA. The following data were collected: location of the unit, date of creation, land tenancy (to verify if land was in usufruct), production techniques used, size of unit, diversity and quantity of production based on last year production, type of activity (only activity, second job or hobby), number of hours worked per week, hours worked by others in the same unit, a question on how long they would like to keep the unit, and a series of questions eliciting their opinion on UA in general in Cuba.

The following section was entitled “Economic Data on the Garden”. This section was used to elicit information on the benefits of the unit and on problems facing the garden. Question 2.1 asked about the purpose of production, i.e. if the production was used for family consumption, donations and/or sales, and proportions for each category. Question 2.2 asked the number of persons and the number of families that benefited from the garden. Question 2.3 referred to production value, based on section one’s question on last year’s harvest. This question asked for the production value in Cuban pesos[8], if the user would sell the whole production at actual market prices. Question 2.4 asked for household food needs covered by the garden (in %), and for household food savings per month (in Cuban pesos). Question 2.5 presented a list of potential benefits from UA and asked the respondent to rank each one on a scale of 1 to 5, 1 being “not important” and 5 being “very important”. In the second part the respondent chose from the previous list the two

[8] Cuban pesos are also annotated “MN” (for *moneda nacional*). The exchange rate was at 20 MN for one US dollar in April 2000.

most important benefits that s/he received from the garden. In question 2.6, respondents rated on a scale of 1 to 5 the levels of quality and performance of the two last harvests. In question 2.7, respondents were asked to point out the two main problems affecting the garden. Finally, in question 2.8 respondents were asked to describe the inputs they used in the garden and say if they would consider using chemical inputs[9].

The fourth section concluded the interview with general questions on age, gender, number of dependents, total monthly household income, completed education level and participation in a horticultural club.

3.2.2. Willingness to Pay Questions

The third section pertained to the elicitation of WTP amounts for the land used in UA. In this CVM study, two WTP questions were asked concerning the provision and quality of UA land. Using the bidding game technique, the survey asked individual users of UA:

1. Their maximum WTP for the piece of land under use in its actual conditions (WTP1);
2. Their maximum WTP for the piece of land under use with guaranteed water supply and theft protection (WTP2)[10].

[9] As law prohibits the use of chemical pesticides in the city, this question aimed at evaluating the degree of voluntary interest in producing organically.
[10] These two problems were mentioned the most in the survey pre-test. More detail is given on the choice of these two problems in section 3.3.3.

Follow-up questions were added after each WTP question to identify "protest bids". The payment vehicle was a monthly fee to be paid to the state; no specification was given on where the money would go, to keep the scenario simple so not to confuse the respondent (Fernandez, 1999).

Question 3.1 asked for the respondent's WTP for the unit of land based on the actual conditions that they produced under:

"Presently you are not paying for the unit of land you are cultivating. You have ___ m^2 of land and your production value is ___ pesos (per year or per month). Suppose that the state would charge a monthly fee (for each 1000 m^2) to all users, and that you would have to pay this amount to maintain access to your unit of land, or loose access to it. Note that the actual conditions of your garden are maintained.

If the state charged a monthly fee of ___ pesos / month / 1000 m^2 (USE STARTING BIDS 10, 20 OR 40), would you pay it or would you abandon the unit of land?" [11]

Bidding Process

The bidding game started with 10, 20 or 40 pesos/month/1000 m^2. Each interviewer needed to follow a predetermined pattern to use the starting bids. For example, interviewer 3 was set to do 30 interviews; she needed to start the bidding process of the 10 first ones at 20 pesos, the 10 following ones at 10 pesos and the 10 last ones at 40 pesos/month/1000 m^2. Careful attention

was given to the fact that *each* 1000 m^2 would be charged these amounts, and respondents who did not understand were helped by the interviewer. For example, the interviewer might indicate how many lots of 1000 m^2 were included in their whole garden. When the question remained unclear, the respondent was asked to value the whole piece of land. Bids were incremented by 10 pesos at a time until the respondent said "no", or decreased by 10 pesos at a time until the respondent said "yes". In the first "increasing" case, the last "yes" response was assumed to be their maximum WTP amount, and in the second "decreasing" case, the first yes was their maximum WTP amount.

In question 3.3, WTP was elicited for the unit of land with specific improvements:

"Now suppose that the problem of lack of water and the problem of theft would be resolved for the gardeners in the community, in the sense that these problems would not affect the production of your garden anymore. In this case,

If the state charged a monthly fee of ___ pesos / month / 1000 m^2, would you pay it or would you abandon the unit of land?"

The starting bids for question 3.3 were directly related to the stated maximum WTP amount in 3.1. That amount was incremented by 20 pesos with 10 pesos decrements or increments. However,

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[11] This is a direct translation from the original wording in Spanish. The reader may have noticed the simple wording that differs from more elaborate CV WTP questions. Fernandez (1999) suggested simplicity as a means to reduce possible confusion.

when the respondent said “zero”, “don’t know” or “refuse” to answer question 3.1, the starting bid for 3.3 was the same starting bid as for 3.1.

Questions 3.2 and 3.4 asked clarifications when the respondent responded “zero”, “don’t know” or “refuse”, to the WTP questions. This was to identify protest bids and possible problems related to the survey design.

3.2.3. Elements from Pretesting

As mentioned in section 3.2.2, the bidding game technique was used to help respondents reach their maximum WTP amounts. The decision to use a bidding game was based on the fact that during the pretest, some respondents had difficulty answering an open-ended format question, which had been suggested by Fernandez (1999). Respondents did not seem to want to answer, often stating that “the state would decide on the amount to be paid”. This is consistent with the mentality in a country with a centrally planned economy such as Cuba. Prompting the respondent by specifically asking “what was their personal opinion of a fair amount to be paid” was also unsuccessful. On the other hand, respondents reacted to suggested random amounts by the author, which justified the use of a bidding game.

Starting bids were selected based on the mean WTP calculated from the pretest data, given either through the open-ended format (when successful) or the bidding game format. Mean WTP in the pretest was 17pesos/month/1000 m^2. Three starting bids were set around that value, i.e. 20 pesos, 10 pesos and 40 pesos/month, and for the purpose of making the good uniform,

respondents were required to evaluate the bid on a per 1000 m^2 basis. As suggested by Thomassin (2000), small samples should not have more than three starting points: the lower starting point must be set so that most respondents would be WTP the amount; the middle starting point must be set at what would be the expected mean WTP amount; the upper starting point must be set so that most respondents would not be WTP the amount. The author acknowledges that the bid selection process was approximate at best, but research and field conditions did not permit a rigorous selection of bids.

The specific improvements of question 3.3 were also based on the pretest results. Water and theft were the two most cited problems in question 2.7. This second WTP question was considered important because of the limiting effect these two problems seem to have on the respondents' enjoyment of their gardens. This is consistent with results from many studies evaluating concerns in UA (Murphy, 1999, UNDP, 1996, Gonzalez, 1999, Nugent, 1999a, Bourque, 1999). Water and theft problems sometimes claimed an important part of their output, and some respondents in the pretest spontaneously stated higher WTP amounts if one or both of these problems were resolved. The information collected with question 3.3 could also support decision making regarding more infrastructure investments for UA in Havana, coming for example from NGOs such as Care International.

3.3. Specifications of the Regression Model

This section presents the variables hypothesized to have an impact on WTP and thus act as predictors of WTP amounts stated by respondents.

3.3.1. Transformation of the Data

In order to make the data usable for analysis, a few modifications to some of the raw data were required.

For production values in pesos, when the respondent could only respond in terms of a range, the center of the range was used. Production values in pesos per month were transformed into a value per year. However, when appropriate, some annual amounts were left blank, as some stated production values per month were only for particular months, and were not representative of annual production. Productivity data were transformed so that these would be expressed in pesos/year/m^2. This was necessary to enable comparisons between different sized lots.

WTP values, when not given for each 1000 m^2, were calculated on a per 1000 m^2 value based on the size of land, for all lots greater than 1000 m^2. WTP values given for all lots 1000 m^2 and less were kept as is. For the purpose of this study, an assumption is made that WTP is not influenced by the size of land under or equal to 1000 m^2. In other words, marginal value of land is zero for all lots <= to 1000 m^2, but positive when the land gets to sizes larger than 1000 m^2.

There was no distinction made between small unregistered vendors who did not have sales permits and permanent larger producers who sold in designated areas. It should be noted though that most respondents engaged in sales resembled the former type.

3.3.2. Explanatory Variables

Income and Dependents in the Household

In general, the most important explanatory variable of WTP is expected to be household income. Contingent valuation asks respondents for amounts of money (or goods) they are willing to pay or accept in compensation, and thus it is believed that income levels have a significant impact on WTP. This is mostly true however when the value of the non-market good represents an important part of the total income of the respondent. Because the share of the value of the goods to be valued is often larger in developing countries (Whittington et al, 1990), it would be safe to assume that this factor should affect WTP of gardeners in a country like Cuba. However, only 66% of the respondents gave a household income level, which made it difficult to include in the regression analysis. An alternative would be to include the number of persons that economically depend on the respondent, a variable that gives an indication of the importance of the economic status, as suggested by Fernandez (1999). As the production from the gardens is an input into the household's consumption function, it is expected that WTP will increase with the number of dependents.

Education

Education levels are also important in CVM surveys, as respondents need to understand the context and the hypothetical scenarios. Not understanding the exercise can result in non-responses or over or underestimates of amounts. The latter is because non-market goods are difficult to value, and respondents may prefer to not give high values. Cuba has a high rate of

basic education and literacy compared to other countries in the world, which made all the respondents comfortable with the hypothetical situations. However, field observation suggested that respondents with higher education levels could answer more easily and understood the exercise. Moreover, it is possible that more educated gardeners may have a better understanding of agricultural techniques and have a higher level of success in their gardening experience. Education levels can therefore be a factor that can influence WTP amounts.

Education is also often correlated with income in Latin America (Psacharopoulos, 1995), and field observations indicate this is also the case in Cuba. In Cuba all salaries are provided by the state and strict salary categories are respected. Apart from participation in illegal activities, it is not possible for individuals with low education levels to receive high wages, as would some self-made businessman in Canada, for example. Education levels can therefore compensate for the lack of data regarding individual income levels.

Other Variables

From the variables related to urban agricultural practice, many could have an impact on WTP. The ones most suspected to have an impact are those related to the intensity of the activity. Four variables were included in the model: size of land holding in square meters, annual production value in pesos per m^2, quality levels of the last two harvests, and a sales dummy. The quality level refers to question 2.6 and was an expression of the perceived quality of the crops, on a scale of 1 to 5. The sales dummy took the value "1" when the respondent engaged in informal or formal sales of their produce. Apart from land size holding, these variables are expected to be positively correlated to WTP. Land size holding is expected to negatively affect WTP, based on the

assumption of decreased marginal utility for land. Hence, a gardener with a few thousand square meters will value each 1000 m^2 less that the gardener that only has one piece of 1000 m^2.

Another interesting variable to include in the model is the intensity of the activity as perceived by the respondent. Respondents were asked if they considered their activity in the garden to be their only activity, a second job or a hobby. The information provided by this variable can tell us if the non-market values of the UA activity are important to the different types of producers, i.e. the ones that make a living out of it, and also the ones that use the land to practice their hobby. In other words, it could provide information on the *direct* use value and the *indirect* use value for the respondent. To make this inference however, a closer look at the stated benefits of UA by the respondents (question 2.5) is necessary to see if the most important ones are related to indirect use value or not. Three dummy variables were generated, one for each activity type.

Finally, a dummy for the area where the unit of land is located is created to test for differences between WTP in the two areas of study, Camilo Cienfuegos and Pogoli-Finlay. This predictor is assumed to be significant as land and socioeconomic factors vary between these two areas.

The above variables will be used to construct a bid curve for WTP "without improvements" from question 3.1, also referred in the following sections as "WTP1".

Specifications to the WTP "With Improvements" Model

A different model was needed to explain WTP amounts for an "improved" garden (WTP2). It was suspected in this case that actual garden variables integrated in the WTP1 model would not be adequate, as WTP2 asked respondents for the amount they would pay for an improved piece of land in UA. Therefore, the explanatory variables related to production value, harvest quality and selling activity were dropped from the model; however, area in square meters of land was not dropped as no changes in the size of land were included in the "improvement" CV scenario. The dummies on activity types were kept to test if considering the activity a job or a hobby influences WTP. One garden variable, related to the two most important problems in the garden, was added. It was assumed that WTP2 would be positively correlated with the two stated problems if they include either water or theft. In order to limit the number of variables in the model, a single dummy variable "PROB" was generated, taking the value 1 if at least one of the two main problems cited was either water or theft, and 0 if not. Finally, demographic variables were included, under the same theoretical assumptions as for model 1. A summary of explanatory variables is provided in table 3.1.

Table 3.1

Summary of Explanatory Variables Used in the Regression Models

Variable	Description
WTP1	WTP in pesos/month/1000m2 of land in the present conditions
WTP2	WTP in pesos/month/1000m2 of land with resolved problems of water and theft
INC	Total monthly household income in pesos
DEPEND	Number of persons that economically depend on the respondent
ED1-ED4	Completed education level dummies (primary, secondary, pre-university and university)
AREA	Size of land in square meters
PY1	Monetary production value pesos per year per m2 (based on last year of production)
Q1-Q5	Quality level dummies for all five levels in the scale, 5 being the highest level
ACT1-ACT3	Activity type dummies: act1 (=1 if "only activity), act2 (=1 if "second job"), act3 (=1 if "hobby")
SALES	Sales dummy, taking the value 1 if sold part of production, and 0 if not
PROB	Most important problems affecting the garden; dummy variable taking the value 1 if two most important problems stated included water and/or theft, and 0 if not
REG	District where the land was located, taking the value "1" for Camilo Cienfuegos, and "O" if not (implying the second area of study, Pogoloti-Finlay)
INT1-INT3	Interviewer dummies (3)
LINT	Local interviewer dummy, =1 if Cuban interviewer and 0 if not
SP1	Starting points for the initial bidding leading to WTP1 (pesos)
SP2	Starting points for the bidding leading to WTP2 (pesos)

Thus we have a proposed regression model for WTP1 (question 3.1):

Model 1:

WTP1= f (AREA, INC, DEPEND, ED1-ED4, PY1, ACT1-ACT3, Q1-Q5, SALES)

and for WTP2 (question 3.3):

Model 2:

WTP2= *f* (AREA, INC, DEPEND, ED1-ED4, ACT1-ACT3, **PROB**)

The STATA (5.0) statistical package was used to analyze the data and the regression models used in this study.

3.3.3. Model Specifications for Bias Testing

The variables SP1 and SP2 will be added to models 1 and 2 respectively to test for starting point bias. This is different than the approach suggested by Boyle et al. (1985) that used a simple regression model of WTP on starting bids. In the case of this study, it is considered preferable to keep the explanatory variables in the model, in order to account for them. This model will need to be tested for multicollinearity in case the coefficient on the starting point variables show insignificant.

Thayer (1981) used a model that examined the occurrence of starting point bias caused by boredom of the respondent. This may occur when the starting bid was too far from the respondent's true WTP value, which causes the respondent to cut the game short in order to save time. From the fieldwork in this study, it was observed that the respondents were not pressed by time, took the time to answer and comment on the hypothetical situations, and were fully

cooperative throughout the survey. Since boredom bias was not considered significant in this study, using Thayer's (1981) test for starting point bias was not appropriate.

The variable REG will be added to test for differences between the 2 regions. Finally, a test for interviewer bias will be done by adding dummies INT1, INT2, INT3 and LINT, the latter being a dummy to test for local and foreign interviewer bias.

4. Results and Discussion

This section pertains to the results obtained from the contingent valuation survey as well as the analysis of the results from the WTP questions. As mentioned earlier in the introduction, two of the research objectives were to collect information on quantitative and qualitative data of urban producers of Havana, as well as elicit their WTP for two different levels of provision of UA. This section presents the results, a discussion of the results and comments on the validity of the study.

4.1. Sample Results

Participation of gardeners in the study was exceptional, both in terms of collaboration and understanding of the exercise. No one refused to participate, but some surveys were unusable because of missing data, or because the respondent did not fit the sample criteria. According to the researcher's interpretation of the results, there were no protest bids and WTP values appeared reasonable[12]. In general, the respondents took the survey seriously and answered as accurately as they could. A few respondents preferred not to answer when they were not sure, especially when related to WTP or production questions. Table 4.1 presents the sample information.

A total of 137 interviews were done, with 127 of these respecting the sample criteria and were usable in the sense that they served to collect qualitative and quantitative data on the sample. Of

[12] However, a few did not answer the WTP questions, not because they were protesting, but because they found it unlikely that usufruct land would ever be paid for in "their country", referring to the system as a symbol of the Revolution.

the 127, three did not give a WTP amount for the land "in the actual conditions" (WTP1), and 14 did not give a WTP amount for the land "with improvements" (WTP2). Respondents who did not answer to WTP1 said they were unable to estimate a value at this time. The reader should note that the higher number of non-responses for WTP2 was due to the fact that the question was added later to the questionnaire, and thus the first respondents were not asked that question. Hence, 124 surveys were usable to analyze WTP1 and 113 to analyze WTP2.

Of the 127 usable surveys, 54 were administered in Pogoli-Finlay and 73 in Camilo Cienfuegos. The author administered 54 and 23 interviews in Camilo Cienfuegos and Pogoloti-Finlay, respectively. The UA delegate of Camilo Cienfuegos (interviewer 2) administered 20 surveys in her area, and the UA delegate of Pogoloti-Finlay (interviewer 3) administered 30 surveys in her neighborhood.

Table 4.1

Sample Statistics

	Camilo Cienfuegos	Pogoloti-Finlay	**Total**
Usable interviews	74	53	**127**
Usable interviews for CV (WTP1)	72	52	**124**
Usable interviews for CV (WTP2)	51	62	**113**

4.2. Qualitative and Quantitative Survey Statistics

The 30 complementary questions to the CVM questions collected data related to household characteristics and UA. The purpose of these questions was two-fold: contribute to general and economic data collection on UA in Cuba, as suggested by Fernandez (2000) and Gonzalez (2000); and serve as explanatory variables in Models 1 and 2. Tables 4.2 to 4.7 present the descriptive data from this study.

Consistent with other studies (Cruz and Fernandez, 1999; Gonzalez, 1999; Moskow, 1999; Murphy, 1999), most urban gardeners were retired men that had a plot to contribute to household food security (figure 4.2). Indeed, only 8% of respondents were women, but as Moskow (1999) pointed out, this may be due to men's agricultural background, and women's household responsibilities during the Special Period, which kept them from engaging in food production. On average, the respondents had at least a high school level education (level 2). Typically in Cuba people live in an extended family setting with some shared income between the members, but the economically dependent members seem to be well divided. Each UA household supported approximately four dependents, and had a total monthly income of 400 pesos (20 $US). There is however a difference in mean income between the two areas, suggesting that Camilo Cienfuegos gardeners are slightly wealthier (table 4.2).

Table 4.2

General Respondent Characteristics by Region

	Camilo Cienfuegos	Pogoloti-Finlay	**Total**
Age (years)	61	56	**59**
Gender (% male)	91	94	**92**
Dependents	4.6	4.0	**4.4**
Income (pesos/month)	460	362	**403**
Education (levels 1-4)	2.4	2.2	**2.36**

Units of land are larger in Camilo Cienfuegos and production value per square meter is lower, an expected result given the fact there should be decreasing marginal production value (table 4.3). Camilo Cienfuegos is not as densely populated as Pogoloti-Finlay, giving the possibilities to gardeners to cultivate larger plots. It should be noted that land sizes in table 4.3 are actual cultivated areas, and not the areas formally allocated by the state. In Pogoloti-Finlay for example, individuals are not formally registered for more than 800 m^2, but when it is possible, some cultivate more land, which is tolerated by the authorities. This can also be seen in Camilo Cienfuegos where the maximum land size allocated to one person is 2 500 m^2, but average land size is 2 850 m^2. The higher production value found in Pogoloti-Finlay may also come from the fact that gardeners work more hours in that area, and that the UA activity is considered more of a job than a hobby. There are also more individuals per unit in Pogoloti-Finlay, and 58% engage in sales in that area, compared to 27% in Camilo Cienfuegos. Overall, 57% already had agricultural experience before, which did not necessarily imply small-scale gardening experience (table 4.4). Many respondents only had experience in sugarcane and coffee plantations. Most respondents (81%) , especially in Pogoloti-Finlay (94%), wanted to continue their UA activity for “as long as possible”. Responses in this category included “until my health permits it”, “for unlimited time”, and

"until they (the state) need the land for something else". Only a few respondents planned on pursuing their activity for "a few more years" or "until the Special Period is over". Most respondents (82%) also agreed that even if the Special Period would end, agriculture should remain in the city, while 7% disagreed and 8% partially agreed. The quality of the last two harvests has an average of 3 on a scale of 1 to 5, considered a "normal" quality. Finally, in this part of the survey, respondents were asked their opinion on the use of synthetic pesticides. In the cities, synthetic pesticide use is illegal. To the question "if the use of synthetic pesticides was not prohibited in the city, would you consider using them?", 61% responded with the negative.

Table 4.3

Quantitative Garden Statistics[13]

	Camilo Cienfuegos	Pogoloti-Finlay	**Total**
Size (m^2)	2850	1325	**2213**
	(2403)[14]	(1553)	**(2216)**
Production value	1.77	5.21	**3.26**
(pesos/year/m^2)	(2.50)	(4.12)	**(3.71)**
Hours of work/week	21.8	35.2	**27.5**
	(15.6)	(17.0)	**(17.5)**
Number of workers	1.52	2.62	**1.98**
	(0.63)	(1.18)	**(1.05)**

[13] All values are averages

Table 4.4

Qualitative Garden Statistics

	Camilo Cienfuegos	Pogoloti-Finlay	**Total**
Sales (% yes)	27	58	**40**
Activity type (% respondents):			
- Only activity	38	47	**42**
- Second job	11	32	**19**
- Hobby	51	21	**39**
Gardening experience (% yes)	56	59	**57**
Quality (scale 1 to 5)	3	3	**3**
Want to use chemicals (% no)	57	65	**61**
How long more (% unlimited)	70	94	**81**
UA after Special Period? (% that agreed)	72	96	**82**

Two multi-faceted questions asked respondents about the benefits (question 2.5) and the problems (question 2.7) related to the garden (tables 4.5, 4.6). Question 2.5 used a scale of 1 to 5 to elicit the importance of a series of potential UA benefits[15], and further asked which two benefits were most important to them, in order of importance. Respondents could choose from the previous list or state other benefits not found in the list. Table 4.5 shows that the most important benefit was "increased household and community food security" for 38% of respondents, and to "save money" was the second benefit most widely stated (22% of respondents). There is an interesting "distribution" of benefits in the sample, in the sense that some non-market benefits such as "hobby" or "environmental enhancement" were also chosen as two of the most important benefits.

[14] Standard deviations are in parenthesis

[15] The scale results were not compiled due to the fact that respondents did not seem to understand the exercise very well.

Table 4.5

Benefits of Urban Agriculture

	Most important benefit (% of respondents)	Second most important benefit (% of respondents)
Increased household and community food security	38	18
Hobby	12	16
Save money	10	22
Community solidarity	9	4
Generate income	8	6
Feeling of usefulness	8	6
Urban environment enhancement	6	11
Other	9	17

In question 2.7 (table 4.6), respondents were asked to choose the two most important problems affecting the garden, but no list of potential problems was presented. As expected, lack of water was the most important problem (67% of respondents for most important problem and 21% for second most important problem), but the "lack of fertilizers and pesticides" seemed to be more important than theft, which was not the case in the pre-test. Other important problems were lack of tools and machinery and lack of or bad quality of seeds.

Table 4.6

Problems Affecting Urban Agriculture

	Most important problem (% of respondents)	Second most important problem (% of respondents)
Lack of water	67	21
Lack of tools/machinery	12	10
Lack of fertilizers/pesticides	8	29
Theft	7	19
Lack of/bad quality of seeds	2	10
Other	4	11

4.3. Willingness to Pay for Urban Agriculture Land

4.3.1. Mean and Median Willingness to Pay

Table 4.7 shows the statistics on the mean, median and standard deviation for WTP for both "without improvement" (WTP1) and "with improvement" (WTP2) scenarios. Mean WTP1 is 23.5MN/month/1000m^2, while the median is 20MN. Mean WTP2 is 34.4MN/month/1000m^2, while the median is 30MN. As expected with CV data, mean values are higher than median values, suggesting a positively skewed distribution. This was confirmed by a skewness-kurtosis test (Hamilton, 1998) that rejected the null of normality at the 1% level. However, there was no statistically significant difference in median or mean for both measures of WTP: the null hypothesis of equal mean and median was not rejected at 7% for WTP1 and at 13% for WTP2.

Table 4.7

Mean and Median Willingness to Pay for Urban Agriculture

	Camilo Cienfuegos	Pogoloti-Finlay	**Total**
WTP1 (pesos/month/1000m^2)			
Mean	19.0	29.8	**23.5**
	(22.27)	(19.57)	**(21.77)**
Median	16	30	**20**
WTP2 (pesos/month/1000m^2)			
Mean	25.0	45.8	**34.4**
	(15.82)	(39.06)	**(30.43)**
Median	20	40	**30**

A t-test rejected the null of equal variances of WTP1 across regions and rejected the null of equal variances of WTP2 across regions, at the 1% level. The effect of the region is also analyzed below

with the use of regression models. A t-test rejected strongly the null of equal means between WTP1 and WTP2.

4.3.2. Regression Analysis for Willingness to Pay

This section pertains to the estimated bid functions of WTP1 and WTP2, using OLS and the previously described explanatory variables. When indicated, transforms of the dependent variable and the explanatory variables were needed to correct for heteroskedasticity. Natural log transforms or Box-Cox[16] transformations were used. This was expected as a skewness-kurtosis test (Hamilton,1998) rejected normality for all the continuous variables. The models are tested for first-order auto-correlation, using a Durbin-Watson test, multicollinearity, and heteroskedasticity, using Cook and Weisberg's test (Cook and Weisberg, 1982). This is followed by tests for starting point bias, interviewer bias and a test for regional differences. Finally a discussion of the results are presented.

4.3.2.1. Regression Analysis for Willingness to Pay "Without Improvements" (Model 1)

The estimated bid function for WTP1 using Model 1 used a Box-Cox transformation of WTP1 (λ = 0.3367) to correct for heteroskedasticity. There was an acceptable adj. R^2 value of 0.24, meaning that 24% of WTP's behavior could be explained by this model. However, the model did not perform well in terms of a number of explanatory variables, with only area significant, at the 1% level. Also, because of a low number of responses for income, the regression was performed on

[16] The Box-Cox procedure finds a λ value that will most efficiently correct for skewness and kurtosis of a variable distribution, by using the following transform:
$variable_{Box\text{-}Cox} = (variable^{\lambda\text{-}1}) / \lambda$.

only 71 observations.

This justified the step of making some adjustments to the model. INC was taken out so the degrees of freedom would increase; DEPEND was taken out and the three dummies ACT1-3. In this case, Box-Cox transforms of AREAM2 (λ = -0.1359), and PY1 (λ = 0.2056) were necessary to correct for heteroskedasticity. The revised model is presented in table 4.8.

Table 4.8

Estimated Bid Function, Model 1 (revised)

Variable	Coefficient	t statistic	P value
areab	-1.90	-1.767	0.080
py1b	.69	2.683	0.009
ed2	2.31	2.681	0.009
ed3	2.33	2.417	0.018
ed4	2.56	2.408	0.018
q2	2.40	1.567	0.121
q3	2.03	1.827	0.071
q4	2.87	2.377	0.019
q5	.37	0.240	0.811
sales	1.03	1.587	0.116
_cons	8.16	1.681	0.096
Adj. R^2			0.34
N			106
chi2(1)			2.55

There are significant coefficients[17] on all variables except sales, and the quality dummies for level 2 and 5. With respect to the interpretation of the coefficients, these need to be untransformed from their Box-Cox transforms. When using this type of transform, the change in the (untransformed)

[17] For the purpose of this study, all coefficients with a level of significance of 10% and less will be considered significant.

dependent variable varies according to the magnitude of the independent variable. Thus to have an indication of the impact of a change of one unit of the independent variable on the dependent variable, variations around the mean of the independent variable can be used.

Area is significant at the 10% level and has an expected negative impact on WTP, but the magnitude is very low. Using variations around the mean (mean = 2213m^2), an increase of one square meter of land holding (from 2213 to 2214m^2) decreases WTP by 0.001MN/month/1000m^2. The impact of area is also smaller the more area increases. For example, an increase in land holding of one square meter, from 5000 to 5001 m^2, decreases WTP by a lower amount, i.e. by 0.0006MN.

Production value is significant at the 1% level and is positively correlated to WTP, as expected. Around the mean production value per square meter, for an increase of 1MN/y/m^2, WTP increases by 0.46MN/y/1000m^2, and the impact lessens with increasing production value amounts. It can be inferred from this that production value is important to the respondent's valuation process, but it does not account for the whole WTP amount. This would suggest that direct use value, which can be derived from production value estimates by the respondent, is part - but not all - of the respondent's value for the good.

An increase in the level of education increases WTP, which is consistent with the assumption presented above that more educated respondents may have more income, increasing their ability to pay; it is also possible that the more educated respondents better understood the valuation

exercise and were able to value a wider range of benefits they got from their UA activity, thus increasing WTP. However, a close look at the coefficients on ED2, ED3 and ED4 shows that these are not significantly different, and thus any higher education level increases WTP *compared* to ED1, but having completed level 2 or level 3 make little difference to WTP. An increase in the perceived quality of the last two harvests increases WTP, although there seems to be a problem with Q5, the highest level of quality: the coefficient on Q5 is insignificant. Nevertheless, Q3 and Q4 are significant and show that better quality harvests makes the respondent value their production more, thus stating higher WTP values.

Adj. R^2 is reasonably high showing that 34% of WTP's behavior can be explained by the explanatory variables. Cook and Weisberg's test for heteroskedasticity results in a chi2 value of 2.55, so we cannot reject the null hypothesis of constant variance at the 10% level. The Durbin-Watson test rejects first-order auto-correlation (Durbin-Watson statistic= 1.63).

Tables 4.9 through 4.11 show the regression results for tests of starting point bias, interviewer bias testing and for differences between regions. The results in tables 4.9 and 4.10 indicate that there is no presence of starting point bias or interviewer bias when accounting for the other predictors in the model. The corresponding variables are clearly not significant. According to table 4.11, there is also no influence of the region in which the gardens were located, but the P value is only at 12%. The impact of location of the garden may possibly be diminished by other regional factors in the model such as production value and size. The distributions of these variables are significantly different from one region to the other, and their significance in the model could be canceling out the impact of the location. On the other hand, REG has the expected negative impact on WTP,

i.e. a decreasing impact on WTP when the gardens are located in Camilo Cienfuegos. This is expected because land sizes are bigger and production values lower in that area.

Table 4.9

Starting Point Bias Test

Variable	Coefficient	t statistic	P value
Areab	-2.56	-2.104	0.038
py1b	.516	1.860	0.066
ed2	2.26	2.498	0.014
ed3	2.20	2.174	0.032
ed4	2.38	1.955	0.054
q2	2.34	1.463	0.147
q3	2.12	1.751	0.084
q4	2.77	2.059	0.043
q5	.38	0.230	0.819
Sales	.94	1.407	0.163
sp1	**-.0009**	**-0.036**	**0.971**
_cons	11.38	2.068	0.042
Adj. R^2			0.30
N			99

Table 4.10

Interviewer Bias Test

a) Individual Interviewer Bias

Variable	Coefficient	t statistic	P value
Areab	-1.86	-1.695	0.093
py1b	.61	2.050	0.043
ed2	2.35	2.680	0.009
ed3	2.25	2.275	0.025
ed4	2.62	2.395	0.019
q2	2.58	1.602	0.113
q3	2.02	1.763	0.081
q4	2.87	2.327	0.022
q5	.39	0.252	0.802
Sales	1.04	1.583	0.117
int2	**-.22**	**-0.218**	**0.828**
int3	**.51**	**0.545**	**0.587**
_cons	7.88	1.594	0.114
Adj. R^2			0.33
N			106

b) Local vs. Foreign Interviewer Bias

Variable	Coefficient	t statistic	P value
Areab	-1.92	-1.773	0.080
py1b	.67	2.413	0.018
ed2	2.29	2.638	0.010
ed3	2.30	2.333	0.022
ed4	2.61	2.398	0.018
q2	2.34	1.498	0.137
q3	1.97	1.726	0.088
q4	2.83	2.306	0.023
q5	.39	0.253	0.801
Sales	1.03	1.576	0.118
Lint	**.188**	**0.240**	**0.811**
_cons	8.26	1.687	0.095
Adj. R^2			0.33
N			106

Table 4.11

Regional Differences Test

Variable	Coefficient	t statistic	P value
areab	-1.69	-1.569	0.120
py1b	.52	1.876	0.064
ed2	2.40	2.800	0.006
ed3	2.22	2.305	0.023
ed4	2.91	2.698	0.008
q2	2.61	1.714	0.090
q3	2.13	1.935	0.056
q4	2.90	2.420	0.017
q5	.63	0.406	0.685
sales	.84	1.273	0.206
reg	**-1.23**	**-1.587**	**0.116**
_cons	7.90	1.640	0.104
Adj. R^2			0.35
N			106

Since there is no evidence of effects related to starting bids, interviewers or location of garden, model 1 presented in table 4.8 remains the best model among all the models presented in this section. A correlation matrix for the regressors is presented in Appendix III. There is no strong correlation between the independent variables, suggesting that the model is not affected by multicollinearity.

The results are valid, as the coefficients have the expected signs and some of the magnitudes are high. The coefficient on the size of land is negative and significant, consistent with the assumption of decreasing marginal value of land, but its magnitude is low. In the initial model 1, which was later revised and presented in table 4.8, the impact of household income level was not significant, which was unexpected. However, it could be argued that production value might be a better

indicator of income for the respondents, as some were not employed but informally sold produce and generated income, not represented in the INC variable. There is confidence gained by the fact that the coefficient on PY1 is significant and positive. According to this model, the fact that increases in production value do not increase WTP by large amounts suggests that other values than direct use value influence the valuation process of the respondent. It could be the case that the respondents value urban agriculture for the indirect use they get from it, not just direct use value from the production value. This can be seen in table 4.5 where a vast array of benefits are reported as first and second most important benefits. Therefore, WTP would be a function of the value placed on the recreational and health benefits of the activity, along with the value placed on the feeling of being useful.

Moreover, it can also be argued that non-use value may also be a determinant of WTP, given the fact that "contributing to the environmental enhancement of the city" was stated as one of the most important benefits; the benefit of "preserving UA for future generations", which relates to bequest value (a non-use value), was also chosen as one of the two most important benefits, but only in a few interviews. Nevertheless, these data provide some indication that not only use value, but also non-use value, may have determined WTP.

Another reason why WTP is not strongly correlated to production value may relate to the risk involved in the UA activity. Many respondents made it clear that lack of resources and variable climate affected the performance of their garden and the insurance of constant yields year after year. The respondents considered the WTP questions seriously, and maybe did not want to state an amount that could be hard to pay in the event of shortages in inputs or bad climate conditions.

It is very plausible that these risks influenced WTP values and lessened the importance of production value.

4.3.2.2. Willingness to Pay "With Improvements" (Model 2)

Because the respondents are responding to a possible improvement, current characteristics of the garden, such as quality levels, production value or sales, are not expected to influence WTP2. These would be subject to change once the hypothetical improvements would be in place, since problems such as water and theft in Havana seem to have significant influence on production and utility that the gardeners can extract from their activity, including indirect use value like relaxation and having a hobby.

The initial model 2 used a natural log transform of the dependent variable WTP2 and Box-Cox transformations of AREA (λ = -0.1359), PY1 (λ = 0.2056), DEPEND (λ = 0.5327) and INC (λ = -0.513). These transformations resolved problems of heteroskedasticity. However the model did not perform well in terms of significant explanatory variables, which justified the use of a revised model 2, presented in table 4.12.

The revised model has a better fit to the data, with an adj. R^2 4% higher than in the initial model 2, and is constructed without PROB and ACT1-ACT3. It is also more confident in not rejecting homoskedasticity, with a lower chi2 value of 1.36, compared to 1.82 in the previous model. The Durbin-Watson test rejected first order auto-correlation with a statistic of 1.48.

Table 4.12

Estimated Bid Function, Model 2 (revised)

Variable	Coefficient	t statistic	P value
areab	-1.86	-6.428	0.000
dependb	.10	2.032	0.046
ed2	.27	1.145	0.256
ed3	.39	1.537	0.129
ed4	-.28	-0.627	0.533
incb	.59	2.572	0.012
_cons	8.34	4.591	0.000
Adj. R^2			0.44
N			77
chi2(1)			0.24

According to the results, the size of the garden, the number of dependents and income are all significant and have the expected impact on WTP2. The model enjoys a favorable adj. R^2 of 0.44, a very acceptable ratio for cross-sectional data. Education levels do not seem to have an influence on WTP2, an unexpected result given the assumption that better educated respondents should find it easier to evaluate hypothetical scenarios.

Starting point bias was evaluated by running the model with starting point (sp2) as an additional regressor. The results in table 4.13 show that starting point bias is present. The coefficient on sp2 is significant at the 1% level, and increased adj. R^2 by 17%. However the null hypothesis of homoskedasticity is strongly rejected at the 1% level, indicating that the model's t statistics may be flawed.

Table 4.13

Starting Point Bias Test

Variable	Coefficient	t statistic	P value
area2b	-1.81	-6.866	0.000
dependb	.049	1.127	0.264
ed2	-.04	-0.187	0.852
ed3	-.05	-0.204	0.839
ed4	-.23	-0.637	0.526
incb	.41	2.110	0.039
sp2	**.02**	**5.270**	**0.000**
_cons	8.52	5.214	0.000
Adj. R^2			0.61
N			75
chi2(1)			**15.47**

The source of heteroskedasticity seemed to come from a few outliers that were observed in a plot of residuals versus predicted values of the dependent variable WTP2. Dropping these four outliers corrected for the problem. It also simplified the model by reverting back to untransformed distributions of AREA, DEPEND and INC instead of their Box-Cox transformations. This semi-log model uses a natural log transformation on the dependent variable WTP2.. Results from table 4.14 demonstrate that the coefficient on SP2 is still significant at the 1% level, and the low chi-square statistic (1.02) indicates evidence of heteroskedasticity. Adj. R^2 is very high with an estimate of 0.68. Thus, there appears to be a strong case for starting point bias.

Table 4.14

Starting Point Bias Test, Corrected for Heteroskedasticity

Variable	Coefficient	t statistic	P value
area	-.0003	-6.860	0.000
depend	.031	1.572	0.121
ed2	.02	0.095	0.924
ed3	-.13	-0.746	0.458
ed4	-.20	-0.698	0.488
inc	.0005	2.206	0.031
sp2	**.02**	**7.577**	**0.000**
_cons	2.51	12.979	0.000
Adj. R^2			0.68
N			71
chi2(1)			**0.09**

Interviewer bias was tested by introducing two dummy variables (INT2, INT3) to distinguish between the three interviewers. The effect of the local interviewers versus the author was tested by introducing the dummy variable LINT.

Table 4.15a shows that there also seems to be interviewer bias for interviewer 2, as the coefficient on INT2 is significant (P=0.03); the coefficient on INT3 is not significant at the 10% level (P=0.18). Both local interviewers had a downward effect on the WTP amounts, suggesting that interviewer 1 had an upward effect on the bids. This is confirmed in the model presented in table 4.15b where the coefficient on the local interviewer dummy is negative and significant (P = 0.04).

Table 4.15

Interviewer Bias Tests

a) Interviewer bias test

Variable	Coefficients	t statistic	P value
area	-.0003	-6.895	0.000
depend	.05	2.146	0.036
ed2	.06	0.408	0.685
ed3	-.07	-0.435	0.665
ed4	-.25	-0.871	0.387
inc	.0005	2.189	0.032
sp2	.02	6.918	0.000
int2	**-.37**	**-2.254**	**0.028**
int3	**-.20**	**-1.367**	**0.177**
_cons	2.54	13.305	0.000
Adj. R^2			0.69
N			71
chi2(1)			0.31

b) Local Interviewer Bias

Variable	Coefficients	t statistic	P value
area	-.0003	-7.365	0.000
depend	.04	1.931	0.058
ed2	.05	0.306	0.760
ed3	-.08	-0.467	0.642
ed4	-.21	-0.745	0.459
inc	.0004	2.076	0.042
sp2	.02	8.029	0.000
lint	**-.28**	**-2.135**	**0.037**
_cons	2.56	13.498	0.000
Adj. R^2			0.69
N			71
chi2(1)			0.32

There is no evidence that region had an influence on WTP bids. The regressor REG was introduced and was not significant (table 4.16). This is a similar result to WTP1, although the t-statistic on REG in model 2 is much lower and the null is not rejected at a more comfortable level (P=0.80) than in model 1 (P = 0.12). As in model 1, significant differences between the two areas of study would suggest a significant coefficient on REG, but the impact of AREA and PY1 may be offsetting that expected influence. The negative sign on the REG coefficient is also consistent with the result from model 1.

Table 4.16

Regional Differences Test

Variable	Coefficient	t statistic	P value
area	-.0003	-6.889	0.000
depend	.04	1.934	0.058
ed2	.05	0.325	0.746
ed3	-.08	-0.448	0.656
ed4	-.22	-0.761	0.449
inc	.0005	2.036	0.046
sp2	.02	7.365	0.000
lint	**-.27**	**-2.091**	**0.041**
reg	-.03	-0.261	0.795
_cons	2.57	13.329	0.000
Adj. R^2			0.69
N			71
chi2(1)			0.42

Because of the high significance of the starting bid and the local interviewer dummy, these should be an inherent part of model 2. Thus the estimated bid function for WTP2 is better represented in table 4.15b, with the size of the land and the starting bid significant at the 1% level, income and the coefficient on local interviewer are significant at the 5% level and the coefficient on the number dependents is significant at the 10% level. The adj. R^2 is unexpectedly high for cross sectional

data, showing that the model explains 69% of WTP2's behavior.

A correlation matrix for the regressors is presented in Appendix III. The model does not seem to be affected by multicollinearity as the correlation values are low between regressors of model 2.

The coefficients in a semi-log model such as in model 2 express the relative change in the dependent variable from a unit change in the independent variable. As in model 1, the size of land is negatively correlated to WTP2, and its impact is negligible. WTP2 decreases by 0.03% for each increase in one square meter of land.

Income and the number of dependents are positively correlated to WTP2, but the coefficient on income is negligible. An increase in one dependent increases WTP by 4%, which is a significant impact. Starting bid does also seem to have had an influence on WTP results. An increase of 1MN in the starting bid increases WTP2 by 2%. This means that using a starting bid of 40 compared to a starting bid of 10 pesos would increase the WTP amount by 21MN (30 x 2% x 34.4MN) compared to the mean of 34 pesos. As discussed earlier, starting point bias is an important problem in CV studies, and the results of this study are affected by it.

Starting point bias did not affect WTP in the first scenario, which could mean that in the presence of a scenario well understood by the respondent, the individual valuation process is not influenced by starting bids. But when the concept of the good is more vague, such as improvements in water and anti-theft services, the respondent may take the starting bid as an indication of the value of the good. This is consistent with what is reported in the literature on the impact of starting bids. The

vagueness of the second scenario probably came from the anti-theft aspect of the scenario, as this service could have been provided through many different channels. It could have meant resources to build a fence, install a night light or provide nights watchmen, but no specifications were given.

Finally, the author's interviews yielded higher WTP values than the local interviewers. The coefficient on the dummy for local interviewer is -0.28, meaning that when the UA delegates administered interviews, the WTP amounts were 28% lower than the WTP amounts elicited by the foreign interviewer (author). There can be many reasons for this. One possible explanation can be the fact that some wanted to promote UA in the presence of a foreigner, which is a form of interviewer bias. Another possible explanation is that the scenario was very realistic, and some respondents may have thought there was a possibility that the state would start charging a fee in exchange for better services. Thus the respondents may have bid lower in the presence of the local interviewer, fearing an actual fee to keep access to the land. In the case of the foreign interviewer, perhaps the scenario was not taken as seriously.

4.3.3. Aggregate WTP for Urban Agriculture in Havana

According to the latest estimates by the Urban Agriculture Department of Havana, 2 438.7 hectares of land are cultivated by 17 900 individual gardeners (Gonzalez, 1999), which suggests an average land holding of 1362.4 m^2 per gardener. This value is different than the sample mean (2 213m^2), but is relatively close to the sample median of 1 250 m^2. This difference in means may be caused by the few larger units found in Camilo Cienfuegos that strongly influence the mean,

suggesting that the frequency of larger units is higher in the sample than in the population and that the sample may not be representative of the population. In other words, the sample probably under-represents the very small gardeners. In spite of these limitations, aggregate values of WTP are estimated from the sample in order to provide an indication of the importance of UA in Havana for individual gardeners.

Aggregate WTP is estimated by multiplying the mean WTP values by the number of 1000m^2 in Havana (table 4.17). Based on the latest 1999 estimate of a total of 2 438.7 hectares of land in usufruct leased to individual gardeners in Havana, the total user value of land in UA in Havana is estimated to be 6.88 million pesos a year. The user value of the proposed improvements in water and anti-theft services adds another 3.19 million pesos a year, to bring the aggregate WTP to 10.07 million pesos.

Table 4.17

Aggregate WTP for Land in UA in Havana

	User Value of Land (in millions of Cuban pesos)	User Value of Land ($US)
Value for land in current conditions	**6.88**	**344 000**
Value for land with improvements	**10.07**	**503 500**
Difference	**3.19**	**159 500**

These amounts can be interpreted on two different levels. On one hand, for most Cubans, the value of the gardens seems to be high. According to mean WTP values, respondents are willing to contribute 11% of their monthly household income to the garden fee, and 14% with the proposed improvements. The production values are also high, suggesting that the monetary value

of the harvests in one year adds up to 4 416 pesos per gardener. If we consider the fact that Cubans earn 200 to 300 pesos a month, the benefits in terms of saving food costs is quite large. These results suggest that UA is profitable and may even generate more income than state employment opportunities. This is consistent with the fact that some make a living out of UA and even earn twice or three times the salary of a professional.

On the other hand, aggregate user value interpreted as rent that could be extracted by the state is not considered very high. Havana has a well developed tourism sector that draws investors and foreign currency to the country, increasing real estate value for land. It is safe to assume that the state would generate more income by allocating the land for tourism rather than for UA.

4.4. Assessment of Validity

There are many reasons to believe that this study has produced interesting and valid results to help illuminate the preferences for UA in Havana among users who have been granted use rights on state-owned land.

Firstly, the summary statistics of the survey's quantitative and qualitative data seem to be consistent with other studies of UA in Havana. This pertains to, for example, the strong majority of retired men that practice the activity and the stated benefits and the problems of the gardens. The respondents of this study, as the ones in Moskow (1999) and Murphy (1999), were also very enthusiastic about their gardens and planned to pursue their activity for as long as possible.

Secondly, the survey seemed to have filled the requirements of the content validity criteria as described in section 2. According to field observations, the majority of the respondents found the contingent valuation scenarios realistic and were able to put themselves in the hypothetical situations. The questions were taken seriously and there were no illogical responses or protest bids. It is believed that the fact that the good was very well known had an important influence on content validity. Also, the idea of paying a fee to the state for the use of these units of land was considered realistic and even possible in the near future. In fact, cooperatives that have used land in usufruct without charge are now paying a monthly fee per square meter for the same land. This is part of the transition that has taken place in the agricultural sector since 1994.

What is perhaps more controversial was the decision to use the bidding game to elicit WTP. Widely criticized for the potential of the starting bids to influence individual WTP, the bidding game has been basically forgotten in the last decade. In this study, respondents needed a starting point to "get started", and the projected small sample size at the beginning of the project justified the use of this technique. Also, as argued earlier, when respondents are well informed about the good, such as for UA, starting bids should not be a problem. This was shown to be true from the results of this study, with respect to WTP for land in its current condition. There was no starting point bias found in the first WTP scenario, but there was a significant and important effect in the second scenario.

However, these results are not fully reliable. The starting bids were not far apart from each other (10, 20 and 40) and the small sample size limited the number of starting bids. It would have been interesting to use a higher amount for the highest starting bid, such as 100 pesos, in order to see if starting bids clearly influenced the valuation process of the respondent. It should also be noted

that there were some execution errors by interviewers. For example, the bids should have been increased or decreased by 10 pesos, which was not always respected. Also, the bidding game for WTP "with improvements" was set to start at 20 pesos over the stated WTP "without improvements", but some bidding games started at 30 pesos over. The author acknowledges that these inconsistencies may have influenced the validity of the WTP responses.

Thirdly, the results seem to respect the criteria of theoretical convergent construct validity. All coefficients had the expected signs but some magnitudes were quite small compared to what was expected. For example, in model 2, the impact of the size of land was negative, suggesting theoretically accurate decreasing marginal utility of land, but its magnitude was small and in practical terms, insignificant. Production value also was statistically significant but did not have a strong practical impact on WTP1. Education was positively correlated to WTP1, but a closer look at the dummies on levels 2, 3 and 4 showed that WTP1 increased only from a respondent with level 1 education compared to levels 2, 3 or 4, but did not increase with the increase in the level of education from 2, to 3 and to 4. Overall the explanatory power of the models 1 and 2 were satisfactory, which is another point for the validity of this study. Adj. R^2 was high in both cases, i.e. 0.34 in model 1 and .69 in model 2. It should be noted however that the starting bid in model 2 was responsible for about 15% of the Adj. R^2.

On the other hand, the fact that a random sampling process was not done is also a point against the validity of this study. This is mostly true for the use of Camilo Cienfuegos as one of the areas of study, which enjoys a low population density compared to the rest of Havana's urban areas, making the sample's mean size of land higher than the population mean. Production values and

WTP values were also lower in that area, compared to Pogoloti-Finlay, thus possibly making the mean WTP of this study a lower bound to the true mean WTP of UA in Havana. Moreover, the fact that area has a negative impact on WTP means that the estimates of this study are under-estimates of aggregate WTP.

Thus, Pogoloti-Finlay may be a more representative district. The statistic on mean size of land (1325 m^2) compared favorably to the estimated population mean size of land from Gonzalez (1999) of 1365 m^2, but that was the only comparison possible because of lack of data on the population.

5. Conclusion

"…It seems that urban agriculture makes sense on ecological, social, and economic grounds virtually everywhere on Earth. Governments should see it as an idea whose time has come" (Rees, 1997).

When Cubans spontaneously created gardens throughout the city of Havana, they probably thought, and even hoped, that it would be temporary, just as the harsh Special Period they had just plunged into. The urban agriculture system came from the necessity of feeding the local population and providing basic medicine for a country in crisis. Ten years later, these gardens, now occupying 3.4% of urban land and tended by 18 000 individuals, seem to be much more than a means to cope: they are becoming part of the landscape, part of the way of life. But just as this is happening, Cuba is slowly but surely recovering from the fall of the Berlin Wall. The Cubans have developed joint ventures with foreign businesses, more trade agreements, and there has been some easing of the embargo from the United States. While these can be beneficial to the Cuban people, some are concerned that it will bring Cuba back to a state of dependence on foreign products and inputs. This is especially true for the urban food supply. Will Cuba revert to foreign imports in order to feed its urban centers?

Opportunities for Cuba to develop within the global market may take a toll on the support for urban agriculture in Havana. For example, tourism is very important in this city, and using more urban land to serve that industry is already part of the management plan for land presently used for UA. If the city can have access to foreign food supplies, urban land used for agriculture may be used for hotels and shops for tourists. This is a policy issue where economic valuation can contribute by

estimating the welfare impacts of such transitions and make the most socially efficient choice. What would be, for example, the impact of taking one hectare of land in usufruct in Havana and using it for a hotel complex? According to environmental cost-benefit frameworks, the impacts of such a change are economic, social and environmental. It is also an issue directly linked to the concept of sustainability in urban systems.

Cities have often been accused of developing in an "open loop" format (UNDP, 1996), consuming large amounts of inputs and products while producing large amounts of waste to be disposed of in the surrounding environment. This problem, along with social disparity, is being exacerbated by the fast rise in urban population. In this context, UA can contribute to the sustainability of a city by providing an array of economic, social and environmental benefits: increasing local food security, waste recycling, reducing food transportation costs, abating pollution, creating employment and providing green space for city dwellers. Urban agriculture cannot be expected to compete, in terms of cash flow, with other types of development, such as hotels that bring in foreign currency. However, there are many other benefits to UA that are not translated into income generation. This study represents an attempt to measure some of these potential non-market benefits, derived from the user value of land in UA in Havana.

The contingent valuation method was used to estimate user value of UA land in Havana, for individual producers granted a unit of state land in usufruct. It was estimated that the producers were willing to pay an average of 23.5 pesos per month per 1000 m^2 for their land, and an average of 34.4 pesos per month per 1000 m^2 for their land with improvements in water and anti-theft services. The data suggest that direct use value, indirect use value and also non-use value were

determinants of WTP. Using the estimates above, the aggregate user value of land in UA in Havana, analogous to a rent that could be collected by the state, is 6.88 million pesos a year (344 000 $US), and 10.07 million pesos a year (503 500 $US) with improvements. In fact, the individual WTP values show that an average of 11% of total household income would be contributed to paying the fee, or 14% with the proposed improvements.

However, this is only part of the *total economic value* of urban agriculture in Havana. In addition to the user value estimated in this study, other non-market benefits of urban agriculture that affect non-users and the general ecosystem also need to be assessed in order to estimate total economic value. There is also the value to another type of user of these gardens, i.e. the local consumers of the produce that comes from the gardens. There are therefore potential social and economic benefits to these consumers of the presence of UA in their neighborhood, environmental benefits to the general city population that enjoy these gardens as open and green space, and environmental benefits in the form of air pollution abatement that comes from the sequestering of pollutants by the plants themselves. Finally, the urban food system in Havana practices semi-organic and organic agriculture that greatly reduce soil, air and water contamination from synthetic pesticides and fertilizers. These benefits put together provide a more general picture of the total economic value, which can be summarized as all the benefits that have a positive impact on the welfare of the society.

This study was therefore a first attempt at quantifying the benefits of UA. It can be concluded that CVM can be applied to this type of quasi-public good and yield interesting results. However, this study is limited by the fact that some inconsistencies in survey execution and an inadequate

sampling procedure may have affected the outcome. As pointed out by many CV researchers (Mitchell and Carson (1989) and Arrow et al. (1993)), the accuracy of CVM comes from well designed, well executed surveys, and methodologically rigorous analysis. This research would have clearly benefited from better survey execution and an adequate random sampling procedure.

It can also be concluded that CVM is adaptable to the Cuban context. Similar to Mourato's (1998) concern of how environmental valuation can work in Hungary, a country in economic transition, there was concern in this application of CVM that Cubans would not understand very well the contingent market and the valuation questions, given the fact that individuals are given very few property rights. As for the CV study in Hungary, this was shown to be wrong, possibly because Cuba can also be considered in transition, especially with regards to the agriculture sector.

These results indicate that urban agriculture in Havana has economic value and that users are willing to pay at least some amount to avoid a loss of access in the good and pay for some improvements. The contingent valuation method was able to be adaptable to the contexts of Cuba and urban agriculture.

It is believed that the information provided in CVM studies could contribute to cost-benefit analysis of UA, such as through the framework developed by Nugent (1999b), by providing monetary measures to be included in the analysis. Future research topics related to UA could include more non-market valuation studies that would aim at assessing other non-market benefits of UA, such as environmental benefits and the benefits to city dwellers that are provided with food from the UA system. A similar study to this one would also be pertinent, building on the information provided in

this study and aiming at a more representative sample of the Havana urban gardeners. Given the importance of non-market benefits, a non-market valuation technique such as the contingent valuation method can be useful in order to fully assess the role of urban agriculture in the development of sustainable urban systems.

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Appendix I

Main Food Crops Grown in Havana and Some Market Prices

Crop	Spanish name	Latin name	Market price[18]
Vegetables			
Beets	remolacha	*Beta vulgaris*	
Cabbage	col	*Brassica oleracea*	
Celery	apio	*Apium gravolens*	
Chard	acelga	*Beta vulgaris*	
Chives	cebollino	*Allium ascalonicum*	2MN/bunch
Corn	maiz	*Zea mays L.*	
Cucumber	pepino	*Cucumis sativus*	3MN/lbs
Eggplant	berenjena	*Solanum melongena*	
Garlic	ajo	*Allium sativum L.*	
Green bean	habichuela	*Phaseolus vulgaris*	
Lettuce	lechuga	*Lactuca sativa*	4MN/each
Okra	quingombo	*Hibiscus esculentus*	
Onion	cebolla	*Allium cepa*	10MN/lbs
Peanut	maní	*Arachis hypogeae*	
Pepper	ají	*Capsicum frutescens*	5MN/100gr.
Radish	rábano	*Raphanus sativus*	
Spinach	espinaca	*Spinacia oleracea*	
Squash	calabaza	*Cucurbita maxima*	3MN/lbs
Fruit crops			
Avocado	aguacate	*Persea auericana*	
Banana	plátano fruta	*Musa paradisiaca*	1MN/each
Chirimoya	chirimoya	*Annona chirimola*	
Coconut	coco	*Coco nucifera*	
Grapefruit	toronja	*Citrus paradisi*	
Grapes	uvas	*Vitis spp.*	
Guava	guayaba	*Psidium guajava*	4MN/lbs
Sour orange	naranja ágria	*Citrus aurantium*	0.50MN/each
Soursop	anón	*Annona squamosa*	
Lime	limón	*Citrus aurantifolia*	
Mandarin	mandarina	*Citrus nobilis*	
Mango	mango	*Mangifera indica*	
Mamey	maney	*Calocarpum sapota*	
Cantaloupe	melón	*Citrullus vulgaris*	
Orange	naranja	*Citrus aurantium*	.50MN/each
Papaya	fruta bomba	*Carica papaya*	3MN/lbs
Pineapple	piña	*Ananas comosus*	10MN/each

[18] Prices collected by Patrick Henn at state and private markets in December 1999. The abbreviation MN (for *moneda nacional)* is used to designate Cuban pesos.

Passion Fruit	maracuya	*Passiflora spp.*	
Tamarind	tamarindo	*Tamarindus indica*	
Tomato	tomate	*Lycopersicon esculentum*	
Tuber Crops			
Cassava	yucca	*Manihot esculenta*	1MN/lbs
Plantain	plátano macho	*Musa balbisiana*	1MN/each
Sweet Potato	boniato	*Ipomoes tuberosum*	3MN/lbs
Taro	malanga	*Alocasa spp.*	3MN/lbs
Legumes			
Pigeon Pea	frijol gandúl	*Cajanus cajan*	
Black beans	frijol negro	*Phaseolus spp.*	6MN/lbs
Red beans	frijol colorado	*Phaseolus spp.*	
Soy beans	soya	*Glysine maxima*	
Garbanzos	garbanzo	*Cicer arietinum*	
Other			
Rice	arroz	*Oryza sativa*	6MN/lbs
Sugarcane	caña de azúcar	*Saccharum officinarum*	

(Source: Murphy, 1999)

Appendix II - Survey Questionnaire

Introductory Statement Intended for the Respondents of the Study

(To be read by the interviewer before the start of the survey)

This interview is part of a research project on urban agriculture in Havana. It aims at collecting information on the activity and assessing the costs and benefits for the producers in usufruct. You have been selected at random from the group of producers in your municipality to answer questions related to your urban agriculture activity.

This study is for academic purposes only, and is part of the Masters thesis of Patrick Henn, McGill University, Canada. Please be informed that all your answers will remain private and anonymous, and you will not be associated personally to your answers. Your are free to end this interview whenever you wish and to not answer any questions you do not want to.

Results of this study will be made available to you through the Fundación Antonio Nuñez Jimenez de la Naturaleza y el Hombre.

Do you have any questions?

We thank you for your collaboration.

Interview #: _____

Interview Administered to Urban Agricultural Producers of Havana, Cuba.

1. General Data on the Unit

1.1. Location of garden:
Street (or square # in grid):
District

1.2.Creation date of garden (Year):

1.3. Production strategy:
1) Organopónico
2) Directly in soil

1.4. Garden size: _____ hectares (IF DOESN'T KNOW, USE FOLLOWING SCALE):
1) small (0-1/4 hectare)
2) medium (1/4-1/2 hectare)
3) large (1/2-1 hectare)

1.5. What do you grow in your garden (what and how much do you plant in a year)?

1.6. With respect to your production, in one year, for example this last year, what was the yield of your crops (kgs, lbs, regimes of banana, etc.)

1.7a) Is your UA activity your only activity, a second job or a hobby?

1.7b) Did you have experience in agriculture before starting UA?

1.8a) How many hours weekly do you dedicate to your garden (including sales, meetings, transportation, etc.):

1.8b) Who works with you (friends, family, workers, age and gender) and how many hours weekly do they work in the garden?

1.9a) Regardless of access constraints, how many more years would you like to continue your UA activity?
1) One more year
2) Two more years
3) Three more years
4) As long as I can

5) Until I find another job
6) other_____

1.9b) Until when are you guaranteed access to your UA unit in usufruct?
Date_____

1.10 I will read you a series of statements that are related to UA. Indicate if you disagree (1), agree (3) or partially agree (2) with the following statements:

	Disagree		Agree
a) UA is good for the urban environment	1	2	3
b) UA creates solidarity links in the community	1	2	3
c) UA helps Cuba in its search for food security	1	2	3
d) I practice UA only because I do not have other possibilities to feed my family	1	2	3
e) UA pollutes the urban environment	1	2	3
f) UA occupies space that would be better used to build houses, factories or create parks	1	2	3
g) Even if Cuba was out of its food crisis, agricultural production sites should remain in the city.	1	2	3

2. Economic Data of the Unit

2.1a) For what purpose do you produce?

a) Family food supply
b) Community food supply
c) Sales (on site, at the market, in farmers' shops)

2.1b) What is the proportion of your production that goes to each of the mentioned purposes? (ASK FOR FRACTIONS SUCH AS ¼, ½. IF DOESN'T KNOW, ASK WHERE THE MAJORITY GOES)

2.2a) How many families benefit from your garden (from direct consumption and not sales)?

2.2b) How many persons in all?

2.3 Could you calculate the total value of your production (per month or per year)?
(IF NECESSARY, REPEAT ANSWER TO 1.6)
(I F NECESSARY, HELP RESPONDENT WITH AMOUNTS LIKE 100 PESOS, 1000 PESOS, ETC.)

(IF DOESN'T KNOW, USE THE FOLLOWING QUESTION):

If you wouldn't have the garden anymore and you would need to buy the same products at the market, how much would it cost you?

2.4 Only with respect to your family:

a) What you produce in your garden covers how much of the food needs of your family?

1) 0 - ¼
2) ¼ - ½
3) ½ - ¾
4) ¾ - all

b) How much money do you save in food costs with your garden (monthly or yearly)?

2.5a) I will read you a series of statements that represent potential benefits of UA for you. Say, with a scale of 1 to 5, 5 being the highest, the importance for you of each of these benefits. By benefits, we mean all tangible and non-tangible aspects of the activity that gives you personal satisfaction.

		Not important				Very Important
1	Interact with others in community	1	2	3	4	5
2	Generate income	1	2	3	4	5
3	Contributing to environmental improvement of the city	1	2	3	4	5
4	Contribute to my family and to the neighborhood's food security	1	2	3	4	5
5	Feel useful	1	2	3	4	5
6	Preserve UA land for future generations	1	2	3	4	5
7	Recreation and hobby	1	2	3	4	5
8	Independence, because I have my own production	1	2	3	4	5
9	Save money	1	2	3	4	5

2.5b) Now choose from the previous list the two most important benefits for you (RESPONDENT CAN ALSO STATE SOMETHING NOT IN LIST)

2.6 I will read you 2 phrases on the quality aspects of the garden. Indicate for each the level between 1 and 5, 5 being the highest level of appreciation.

Aspect	Level of appreciation
Quality of the last 2 harvests	1 2 3 4 5
Overall performance of garden in the last 2 harvests.	1 2 3 4 5

2.7 What would be the two most important problems associated to your garden?

2.8 What inputs do you use and if the use of synthetic chemicals would not be prohibited, would you consider using them?

3. Contingent Valuation

In this last part of the interview, we would like to measure the value that you put on your urban agriculture activity. In order to do this, we will put you in 2 hypothetical situations and we want you to think of the benefits of UA for yourself. We ask you to consider these situations seriously and think of what you would really do in these situations. We also remind you that your answers are completely confidential and will remain anonymous.

3.1a) You are presently not paying for the land you cultivate. You have ___ m^2 of land and the production value of your garden is ___ pesos/month or year. Suppose that the state would charge a monthly fee to all urban farmers (for each 1000m^2) , and that you personally would need to pay this fee to keep access to your plot, or would be asked to leave. Note that the garden conditions stay the same as right now.

BIDDING GAME (USING 10, 20 OR 40 PESOS/MONTH/1000 M^2):

If the State would charge a fee of ____ pesos/month/1000 m^2, would you be willing to pay this amount or would you decide to leave the land?

(IF THE ANSWER IS A POSITIVE AMOUNT, GO TO 3.3)
(IF THE ANSWER IS "0", "DON´T KNOW" OR "REFUSAL", GO TO 3.2)

3.2. You answered 0MN, don't know or refused. Why?

(GO TO 3.3)

3.3. Now suppose that the problems related to water and theft are resolved in the community for all the gardeners, such that these problems do not affect your production anymore. In this case,

If the State would charge a fee of ____ pesos/month/1000 m^2, would you be willing to pay this amount or would you decide to leave the land?

(IF ANSWER IS A POSITIVE AMOUNT, GO TO 3.5)
(IF THE ANSWER IS "0", "DON´T KNOW" OR "REFUSAL", GO TO 3.4)

3.4 You answered 0MN, don't know or refusal. Why?

(GO TO 3.5)

3.5 Now suppose a different situation in which to maintain access to the land, you would need to donate a part of your production to a kindergarten, a school or another state establishment. In the

present conditions of the garden, up to what fraction of your production would you be willing to give away?

4- General Household Data

4.1.Age of respondent
4.2. a) Number of economically dependent persons
b) Monthly household income
4.3.Completed level of education
Primary
High School
Pre-University
University
4.4.Are you part of a horticultural club?
4.5. Gender

Interviewer Evaluation

(COMPLETE THIS RIGHT AFTER THE INTERVIEW)

This is related to questions 3.1 to 3.5 of the questionnaire. Irrespective of whether or not the respondent answered these questions, in your judgment, how well did the respondent understand what he or she was asked to do in these questions?

- Understood completely
- Understood very well
- Understood somewhat
- Understood a little
- Did not understand very much
- Did not understand at all
- Other (specify):

Which of the following descriptions best describe the degree of effort the respondent made to arrive at a value for the 2 contingent valuation questions:

- Gave the questions prolonged consideration in an effort to arrive tat the best possible value
- Gave the questions careful consideration, but the effort was not prolonged
- Gave the questions some consideration
- Gave the questions very little consideration
- Other (specify):

Please mention any other relevant comment that could help the analysis of the data.

Appendix III - Correlation Matrix for Regressors of Models 1 and 2

Model 1

	areab	py1b	ed2	ed3	ed4	q2	q3
areab	1.0000						
py1b	0.4520	1.0000					
ed2	-0.0802	-0.1920	1.0000				
ed3	-0.0328	-0.1971	0.6355	1.0000			
ed4	-0.1729	-0.1028	0.5431	0.4843	1.0000		
q2	-0.1573	-0.2747	-0.1349	-0.2232	-0.0521	1.0000	
q3	-0.1369	-0.2492	-0.1507	-0.2257	-0.1558	0.6564	1.0000
q4	-0.0933	-0.3245	-0.0816	-0.1548	-0.1446	0.6087	0.7914
q5	-0.2545	-0.1453	-0.2167	-0.1970	-0.1757	0.4678	0.6161
sales	-0.1989	-0.2487	-0.0160	-0.0205	0.1053	0.2321	0.0896
_cons	-0.9758	-0.3977	0.0010	-0.0221	0.1102	0.0302	-0.0223

	q4	q5	sales	_cons
q4	1.0000			
q5	0.5543	1.0000		
sales	0.0492	0.0459	1.0000	
_cons	-0.0575	0.1524	0.1317	1.0000

Model 2

	area	depend	ed2	ed3	ed4	inc	sp2
area	1.0000						
depend	0.0774	1.0000					
ed2	-0.1254	-0.0302	1.0000				
ed3	-0.0393	-0.0386	0.7208	1.0000			
ed4	-0.0742	-0.1410	0.4183	0.3942	1.0000		
inc	0.1134	0.0589	-0.1251	-0.1404	-0.4605	1.0000	
sp2	-0.0319	-0.1233	-0.2036	-0.2529	0.0036	-0.0403	1.0000
lint	0.3111	-0.1570	-0.0979	-0.1372	0.0129	0.0858	-0.3659
_cons	-0.4263	-0.2986	-0.3216	-0.2630	-0.0678	-0.3926	-0.3420

	lint	_cons
lint	1.0000	
_cons	-0.1157	1.0000

Parcelero **Respond**	entrev **interv**	Reg **Reg** 1=CC	aream2 **aream2** (squ. m.)	venta **sales** (1=yes)	val prod/a **prod val/y** (MN)	pa1 **py1** (MN)	pp1 **sp1** (MN)	dap1r **wtp1r** (MN)	pp2 **sp2** (MN)	dap2r **wtp2r** (MN)	trabajo **actype** 1=(job)	cali. **qua**	prob1 **prob1** (1= water or theft)	prob2 **prob2**	dependen **depend** (# pers.)	suel **inc** (MN	edu **edu** (level	Sexo **Gender** (masc=1)
1	1	**1**	4000	1	4500	1.13		1.25	20	25	1	3	1		5		1	1
2	1	**1**	6000	1	12000	2.00		0		11.67	1		1	0	3		4	1
3	1	**1**	2400	0	1080	0.45					2	3			8		1	1
4	1	**1**	6000	0	1250	0.21		18.33			1	3	1		4		4	1
5	1	**1**	1250	0			200	40			1	3	1	1	6		1	1
6	1	**1**	5000	1	2400	0.48	15	3			2		0	0	6		4	1
7	1	**1**	1250	0	10000	8.00	20	40			3				3		4	1
8	1	**1**	6500	1	17500	2.69		38.46			3	4			4		4	1
10	1	**1**	6400	0	1000	0.16		0			1	3	1		4		2	1
11	1	**1**	800	0	300	0.38	10	0			1	1	1	1	2		2	1
13	1	**1**	8100	0						2.47	3		1	1	5		1	1
14	1	**1**	525	0	1000	1.90	25	30			1	4	1	1	6		2	1
15	1	**1**	7000	1	**1000**	0.14	50	4.28		10	1	5	1	0	4		2	1
16	1	**1**	4500	0	**200**	0.04	10	2.22			3	4	1	0			1	1
17	1	**1**	5000	0	**3000**	0.60		6	50	14	2	3	1	0	6		4	1
18	1	**1**	200	0	**3000**	15.00	10	30	50	50	3	3	1	0	6		4	1
20	1	**1**	4000	1	**240**	0.06	50	0	50	12.5	2	3	0	1	5		4	1
21	1	**1**	1500	0			25	16.67	50	33.33	3	1.5	1	0	1		2	1
22	1	**1**	1000		1000	1.00	20	40		40					5		3	1
23	1	**1**	2000	1	17500	8.75	50	150			3	4	0	1	4		4	1
24	1	**1**	300	0	**480**	1.60	30	50	70	50	3	2	1	0	5		2	1
25	1	**1**	2500	0	1000	0.40	20	0		0	3	5	1	0	**6**		3	1
26	1	**1**	3600	0	4000	1.11	20	0	20	40	3	3	0	1	**8**		1	1
27	1	**1**	9000	1	5500	0.61	10	10	20	20	1	3	1	0	8		2	1
30	1	**1**	8000	0	11000	1.38	20	0	20	40	3	5	1	0	4		4	1
31	1	**1**	4000	1	**1800**	0.45	20	30	40	40	3	2.5	1	0	0		4	1
32	1	**1**	4000	0			20	5	30	5	3	1	1	0	8		1	1
33	1	**1**	1600	0	1000	0.63	20	20	40	30	3	5	1	0	6		2	1
34	1	**1**	8000	0	5500	0.69	20	30	50	30	3	5	1	0	5		4	1
35	1	**1**	2500	1	4500	1.80	20	0	20	0	3	4.5	0	0	3		2	1
36	1	**1**	1400	0	2000	1.43	10	10	20	20	3	4	1	0	1		4	1
37	1	**1**	720	0	550	0.76	80	30	50	50	3	3.5	0		2		4	0
38	1	**1**	400	0	**600**	1.50	20	20	40	20	2	3	0	1	0		1	0
39	1	**1**	1000	0	0	0.00	20	0	20	0	3	1	1	0	1		1	1
40	1	**1**	4400	0	4500	1.02	10	20	30	20	3	2.5	0		5		2	1
41	1	**1**	300	1	**300**	1.00	10	0	10	10	3	1	1	0	2		1	1
42	1	**1**	1000	0	**140**	0.14		0	40	60	3	1	1	0	2		4	0

43	1	**1**	1500	1	15600	10.40	20	30	50	30	2	3	0	1	10	109	3	1
44	1	**1**	5000	0			10	0	10		3	3	1	1	2		3	1
45	1	**1**	**1250**	0	**1000**	0.80	10	0	10	30	3	1	1		0	424	1	0
46	1	**1**	1250	0	1000	0.80	20	32	50	40	2	4	1		0	553	1	0
47	1	**1**	1250	0	1000	0.80	20	16	50	40	2	1	1		3	340	2	1
48	1	**1**	4500	0	8200	1.82	10	3.33	20	6.67	3	3	1	0	2	340	2	1
49	1	**1**	1500	0	300	0.20	10	10	20	30	3		1	0	4	200	2	1
50	1	**1**	1800	0	5500	3.06	10	10	20	20	3	3	1		6	###	4	1
52	1	**1**	6000	0	**300**	0.05	10	0	10	20	3	3	1	0	6	246	1	1
53	1	**1**	1250	0	800	0.64	40	32	60	32	3	4	0	1	3	250	2	1
54	1	**1**	2000	1	900	0.45	10	10	40	20	3	1	1	0	1	460	2	1
55	1	**1**	750	0	300	0.40	10	10	20	10	3	3	1	0	3	300	3	1
56	1	**1**	250	0	30	0.12		0		10	3	3	1	0	1	140	1	1
57	1	**1**	1250	0	3000	2.40	40	40	60	64	3	3	1	0	0	###	3	1
58	1	**1**	300	0	550	1.83	40	15	20	20	3	3	1	0	1	900	4	0
59	1	**1**	6250	0	10000	1.60	10	0	10	3.2	3	4	1	0	0	495	1	1
60	1	**1**	10000	1	1800	0.18	40	6	80	10	3	5	1	0	1	248	2	1
61	2	**1**	2500	1	5000	2.00	40	16	60	16	1	3	0	0	4	450	3	1
62	2	**1**	1500	0	**850**	0.57	40	20	40	20	1	3	1	1	8	400	3	1
63	2	**1**	1250	1	800	0.64	40	40	70	40	1	3	1		4	300	1	1
64	2	**1**	2500	0	1000	0.40	40	20	30	20	1	4	1	0		200	1	1
65	2	**1**	1250	1	4800	3.84	40	32	60	32	3	3	1	1	7	450	2	0
66	2	**1**	6250	1	1500	0.24	40	1.6	30	1.6	1	3	1	1	6	350	2	1
67	2	**1**	1250	0	2800	2.24	40	0	40	8	1	2	1	1	12	450	2	1
68	2	**1**	1250	1	4000	3.20	40	16	40	16	1	3	0	1	5	370	2	1
69	2	**1**	1250	0	1250	1.00	40	0	40	8	1	3	1	1	7	340	2	1
70	2	**1**	1200	1	3500	2.92	40	0	40	20	1	4	0	1	5	400	3	1
71	2	**1**	1600	0	2700	1.69	20	30	30	30	1	3	0	1	6	250	2	1
72	2	**1**	1900	0	3500	1.84	20	20	40	20	1	2	1	0	8	500	2	1
73	2	**1**	2500	0	3500	1.40	20	30	40	20	1	2	1	1	4	350	3	1
74	2	**1**	1020	0	3850	3.77	20	40	40	40	1	2	1	0	14	500	3	1
75	2	**1**	2000	0	2000	1.00	20	50	70	50	1	1	1	0	8	450	3	1
76	2	**1**	1200	0	5000	4.17	20	40	50	40	1	3	1	1	12	600	3	1
77	2	**1**	2400	0	2000	0.83	20	30	40	30	1	3	1	1	3	400	4	1
78	2	**1**	1600	0	4000	2.50	20	50	60	50	1	3	1	1	7	480	2	1
79	2	**1**	2400	0	5500	2.29	20	30	50	30	1	2	1	1	6	500	3	1
80	2	**1**	1800	0	4500	2.50	20	40	50	40	1	2	1	0	10	400	2	1
81	1	**0**	500	1	1500	3.00	10	40	60	200	3	3	1		9	###	2	1
82	1	**0**	560	1	9000	16.07	20	60	80		1	5	0	0	3	500	2	1
83	1	**0**	2000	1	4500	2.25	20	20	20	30	2		1	0	2	367	2	1

84	1	**0**	4000	0	**2000**	0.50	20		20	10	3	1	1	0	7	175	2	1
85	1	**0**	10000	0	2000	0.20	20	1	40	1	1	1	1	0	4	100	1	1
86	1	**0**	1600	1	12000	7.50	20	15.63	40	18.75	1		1	1	3		2	1
87	1	**0**	3500	1	5750	1.64	10	7.14	40	7.14		1	0	0	1	158	2	1
88	1	**0**	500	1	1080	2.16	10	10	20	10	3	4	0	0	1	221	1	1
89	1	**0**	600	1	1000	1.67	40	60	80	200	3	4	1	1	4	250	3	1
90	1	**0**	300	1	450	1.50	40	40	60		3	4	1	0	1	600	2	1
91	1	**0**	1000	1	300	0.30	10	20	20	20	3	3	1		1	183	1	1
92	1	**0**	3000	1	28500	9.50	20	10	50	10	2	2	0		2	360	3	1
93	1	**0**	1000	0	2000	2.00	20	50	70	50	2	3	1	0	1	700	2	1
95	1	**0**	400		2000	5.00	20	20	40	30		3	1	1	2		3	0
97	1	**0**	800	1	2000	2.50	20	30	40	50	1	1	1	0	12	80	1	1
99	1	**0**	1500	0	2000	1.33	10	6.67	30	10	2	2	1		3	250	3	1
100	1	**0**	3500	1	2000	0.57	10	2.86	30	8.57	1	4	0		1	160	1	1
101	1	**0**	4000	1	2000	0.50	10	12.5	70	20	3	3	0	1	8	221	4	1
103	1	**0**	700	1	2000	2.86	10	10	30	30	2	1	1	0	9	230	1	1
104	1	**0**	400	0	2000	5.00	10	20	40	20	3	3	1		1	200	2	1
105	1	**0**	4000	0	2000	0.50	10	2.5	30	7.5		3	1	0	4	500	2	1
106	1	**0**	300	0	2000	6.67	40	30		100	3	4	1		3	800	3	1
107	1	**0**	500	0	1200	2.40	40	30	50	60	2	4	0		3	225	2	1
108	3	**0**	850	0	6450	7.59	40	40	40	40	1	4	1	0	5	510	4	1
109	3	**0**	1000	1	12500	12.50	40	40	40	40	3	4	0	1	4	300	3	1
110	3	**0**	500	0	6800	13.60	40	0	40	40	1	3	1	0	6		1	1
111	3	**0**	700	1	1050	1.50	40	20	40	20	1	3	0	0	4	200	3	1
112	3	**0**	746	1	6700	8.98	40	10	30	10	1	4	1	0	2	200	1	1
113	3	**0**	1000	1	4400	4.40	40	40	70	40		4	0		3	400	3	1
114	3	**0**	756	0	8400	11.11	40	20	50	30	2	4	1	0	2	380	3	1
115	3	**0**	750	0	12900	17.20	40	40	70	40	1	4	1	1	3	480	2	1
116	3	**0**	900	1	6000	6.67	40	30	50	30		3	1	0	0	300	2	1
117	3	**0**	940	1	1900	2.02	40	100	130	100	1	3	0	1	11	480	3	1
118	3	**0**	1000	1	9200	9.20	10	50	80	50	1	3	1	0	4	380	2	1
119	3	**0**	1300	1	7700	5.92	10	23.08	80	38.46		3	1	1	4	300	3	1
120	3	**0**	800	0	7100	8.88	10	20	50	30	2	3	1	1	3	310	2	1
121	3	**0**	1100	1	6600	6.00	10	45.45	90	45.45	1	4	0	0	3	300	2	0
122	3	**0**	840	0	1220	1.45	10	20	60	40	1	3	0	1	3	250	3	1
123	3	**0**	900	1	8000	8.89	10	50	90	60	1	3	0	1	5	360	2	1
124	3	**0**	700	0	3500	5.00	10	20	50	50	2	3	1	1	3	408	3	0
125	3	**0**	1200	1	15380	12.82	10	25	70	41.67	1	4	0	1	5	540	2	1
126	3	**0**	800	1	4670	5.84	10	30	60	50	2	3	1	1	4	380	3	1
127	3	**0**	900	1	4000	4.44	10	40	70	40	2	3	0	0	5	450	3	1

128	3	**0**	700	1	3900	5.57	20	30	70	50	1	4	1	0	4	300	2	1
129	3	**0**	840	1	6200	7.38	20	30	60	50	1	3	0	0	2	400	2	1
130	3	**0**	700	0	3100	4.43	20	50	80	70	1	3	1	1	5	400	2	1
131	3	**0**	800	0	3300	4.13	20	60	100	80	2	2	1	0	4	300	3	1
132	3	**0**	750	0	3300	4.40	20	20	60	50	2	3	1	0	8	480	3	1
133	3	**0**	730	0	1600	2.19	20	30	60	60	2	3			6		3	1
134	3	**0**	600	0	3800	6.33	20	20	50	40	1	2	1		7	550	1	1
135	3	**0**	676	1	2000	2.96	20	40	70	80	1	4			5	400	2	1
136	3	**0**	600	0	3700	6.17	20	40	70	50	1	3	0		4	200	1	1
137	3	**0**	1500	0	4550	3.03	20	70	110	80	2	4	0		5	500	3	1