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An Application to Barbados

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A Retrospective Stated Preference Approach to Assessment of Coastal Infrastructure Investments: An Application to Barbados

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Abstract

Ex-post economic impact evaluations are standard requirements for loans and grants from multilateral international development institutions. In many cases, however, lack of sufficient baseline or historical data, or the very nature of the investment itself renders orthodox economic impact evaluation approaches unviable. Nonetheless, evaluations are required to provide an indication of the benefits generated by the investment and insights for future program design. Addressing this challenge, this paper develops an ecosystem service, retrospective stated preferences approach to assess the benefits of a coastal infrastructure investment in Barbados. Results show that the investment generated cultural and aesthetic ecosystem service benefits for tourists and residents, and that local businesses derived value and avoided some damage costs from the enhancement of regulatory ecosystem services. The approach is versatile facing data constraints and generates policy-relevant information to support decisions to scale up interventions, catalyze additional investment, and provide data on user preferences that can be incorporated in the design of future interventions.

JEL Codes: Q51 (valuation of environmental effects); Q57 (Ecological economics); C51 (Model construction and estimation); F21 (International investment).

Keywords: ex-post analysis; impact evaluation; ecosystem services; stated preferences; contingent valuation; tourism; coastal infrastructure.

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Contents

1.0. Introduction

Economic impact evaluations are standard requirements of loans and grants from multilateral international development institutions. Evaluating development investments is important to: assess if the intervention has led to the desired outcomes; learn and improve the design of future interventions; ensure value for money and accountability; support evidence-based policy making, and; inform the scaling up successful programs (Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2011). In The Paris Declaration on Aid Effectiveness (2005) and the Accra Agenda for Action (2008), monitoring and evaluation are critical to understanding how aid effectiveness contributes to meeting development objectives. Furthermore, these agreements stress managing for results and mutual accountability between donor and partner countries (OECD, 2015).

Ex-post economic impact evaluations are designed to assess the changes in individuals' wellbeing that are attributable to a development intervention. The key challenge of an evaluation is to demonstrate causation between the intervention and outcome. Ideally, an impact evaluation is prospective, where it is designed and integrated into the development intervention itself. This enables the beneficiaries or treatment group and the counterfactual or comparison group to be defined and baseline data collected. Of the experimental methods, the gold standard of impact evaluation is the randomized control trial which involves the randomized assignment of treatment and control groups to avoid the confounding effects of selection bias (Gertler et al., 2011).

In practice, there are a number of reasons why prospective economic impact evaluations and experimental methods, specifically, randomized control trials, are not feasible. Concerning prospective evaluations, first, there is a backlog of development interventions that now or in the near future will require an impact evaluation, but did not include the evaluation in the intervention design. Second, the need to evaluate in some cases is due to a movement toward greater accountability in international development, and in other cases, as the result of a decision to evaluate made after the program was implemented. Third, where an impact evaluation was built into program design, due to implementation challenges, the collection of baseline data was delayed years into program execution, rendering it an inaccurate representation of the before program condition. Fourth, institutions often require impact evaluations immediately following execution of a program; some interventions require time for outcomes to materialize and a

program that is evaluated as unsuccessful upon completion may prove to generate significant medium-run impacts that go unmeasured and unattributed to the program.

Concerning experimental methods, while these methods may be appropriate for evaluating some types of interventions, they are not suitable for interventions where: (i) it is not possible or desirable to select and separate a treatment and control group, and/or; (ii) treatment and control outcomes are not easily defined. The restrictions imposed by experimental methods are loosened in some respects with quasi-experimental methods (e.g. a difference-in-difference approach) which may be appropriate in some cases. While with quasi-experimental methods the selection of treatment and control groups may be non-random, these groups and the indicator outcomes must still be clearly defined which can be problematic (Winters, Salazar, & Maffioli, 2010), particularly when individuals in the group are mobile.

Investments in the tourism sector provide a good example of interventions where it is not desirable and generally not possible to prevent individuals from benefiting from an intervention (Banerjee, Gachot, Lemay, & Jacquet, 2014). In addition, public investments in the tourism sector are often broad in scope, involving multiple sectors such as public infrastructure, water, sanitation, and transportation which makes the selection of outcome indicators and attribution complex (Henderson & Corral, 2013; Taylor, 2010). Investments in coastal infrastructure and coastal resilience[1] share similar characteristics with tourism investments when it comes to impact evaluation with the difficulties inherent in separating treatment and control groups, the broad nature of the investments and multiplicity of outcome indicators.

Clearly, there are practical challenges to the implementation of orthodox experimental and quasi-experimental methods in economic impact evaluations with many interventions presenting characteristics that do not meet the basic criteria that these methods require for their application to be considered rigorous and credible. The Inter-American Development Bank (IDB) confronted this challenge in the evaluation of the Coastal Infrastructure Program (CIP) in the Caribbean island of Barbados. CIP is a US$30.3 million investment supported by the IDB with the dual

[1] While definitions of coastal resilience vary, what is consistent is that coastal resilience has ecological, morphological, and socioeconomic dimensions; each of these dimensions represent an aspect of a coastal system's capacity to adapt to disturbance (McCarthy, Canziani, Leary, Dokken, & White, 2001).

goal of enhancing coastal resilience and the amenity values of key beaches on Barbados' south coast. The investment began in 2002 with the final disbursement in 2009 and works concluding in 2010. After over six years since completion, an interest in evaluating CIP arose with the aim of demonstrating the socioeconomic benefits of the program and to catalyze both public and private investment in coastal infrastructure works in Barbados and in the Caribbean region. With the challenges inherent in the CIP evaluation, the IDB employed two distinct methods to the evaluation. The first approach involved using remotely-sensed luminosity data as a proxy for economic growth (Corral, Schling and Rogers, in review). The second approach and the subject of this paper was an ecosystem service-based, retrospective stated preference approach to estimating the value of CIP to beneficiary groups.

This paper describes the ecosystem service-based, retrospective stated preferences approach to assessing investments where orthodox experimental and quasi-experimental methods are not feasible, and applies it to the evaluation of CIP. This retrospective stated preference approach captures tourist and resident valuations of an intervention after implementation while the ecosystem services framework facilitates the cataloguing and prioritizing of benefits. This paper is structured as follows. Section two provides an overview of CIP and its key components. Section three presents the study methodology and its implementation. Section four discusses the key findings of the study and section five concludes the paper with a discussion of the capability and versatility of the ecosystem service-based retrospective stated preference approach for assessing coastal infrastructure investments.

2.0. Barbados' Coastal Infrastructure Program

Since the 1980s, the Government of Barbados has been active in integrated coastal zone management (ICZM) to increase coastal resilience and safeguard the island's tourism industry, which in 2014 was directly responsible for 11.3% of employment and 10.8% of gross domestic product (WTTC, 2015). In 1996, the Coastal Zone Management Unit (CZMU) was established as the country's permanent provider of coastal zone management services, and fully integrated into the public administration. Since then, the CZMU has been monitoring and managing complex physical processes that shape Barbados' shoreline and contribute to the country's cultural and aesthetic values. As a result of these efforts, Barbados has pioneered the most

comprehensive coastal and marine management programs in the Caribbean and is a recognized best practice model and regional leader.

Between 2002 and 2010, the Government of Barbados implemented CIP. The principle goal of CIP is to ensure a healthy environment and the economic development of Barbados through improved management and conservation of the coastal zone. CIP has four specific objectives: (i) to enhance the amenity value of beaches for the use of locals and tourists through the implementation of shoreline stabilization and erosion control projects; (ii) to restore and protect affected ecosystems through the implementation of coastal infrastructure recovery projects; (iii) to encourage safe and increased access to the waterfront through coastal access improvement projects, and; (iv) to upgrade capabilities and support the process of innovation in coastal zone management, through the implementation of institutional strengthening of the CZMU.

CIP is comprised of three core infrastructure projects which are the focus of this analysis, namely: (i) the Rockley to Coconut Court Waterfront Improvement Project; (ii) the Holetown Beach Improvement Project, and; (iii) the Welches Beach Improvement Project. The Rockley to Coconut Court Project included the construction of five landscaped headlands, 1.2 km of boardwalk, revetment and steps, 10,677 m^3 of beach sand recharging and 38 meters of breakwater. The Holetown Beach Improvement Project comprised the construction of two headlands, a new walkway protected by boulder revetment and 2,698 m^3 of beach sand recharge. The Welches Beach Improvement Project included the construction of a retaining wall with a walkway along the seaward edge; access steps to the beach; construction of a revetment along the seaward edge of the roadway; construction of three new groynes, and; 12,000 m^3 of sand recharging. In this paper, these three beach improvement projects are referred to as CIP beaches.

The CIP beach infrastructure projects were designed to enhance coastal resilience through improved protection against erosion and storm damage, generate higher amenity values, and create safer conditions, all of which were aimed to promote economic growth and development. While monitoring and ongoing evaluation of CIP activities were built into its design, a formal economic impact evaluation strategy was not and therefore, limited baseline information is available. Given the recent directive to conduct an impact evaluation of CIP, the lack of baseline information, the multi-sectoral nature of the investment, the multiplicity of outcome indicators, and the impossibility of establishing ex-post control and treatment groups of tourist beneficiaries,

an alternative approach to experimental and quasi-experimental economic impact evaluation methods was developed and is described below.

3.0. Methodology

An ecosystem services approach provides a comprehensive organizational framework for cataloguing, prioritizing and estimating ecosystem service supply (Banerjee, Bark, Connor, & Crossman, 2013) and is the approach taken in this evaluation. Ecosystem services contribute to human well-being and are classified as provisioning, regulating, cultural and aesthetic and supporting services (Banerjee, Crossman, & de Groot, 2013; Daily, 1997; Haines-Young & Potschin, 2010; Millennium Ecosystem Assessment, 2003; Perrings, 2006; TEEB, 2010).

The starting point for the quantification of CIP benefits is the prioritization and selection of the critical ecosystem services to be quantified (Crossman et al., 2013; Raymond et al., 2009). The selection of ecosystem services was undertaken in collaboration with the CZMU, government officials and local experts through a deliberative process. Given the importance of the tourism sector to Barbados' economy, the quantification of cultural and aesthetic ecosystem services was given the highest priority. Next, in light of the country's vulnerability to extreme weather events and climate change, storm surge and flooding were considered a high priority. These two ecosystem services were found to rank considerably higher than other ecosystem services and therefore were selected as the subject of the evaluation. Beneficiaries of ecosystem service flows were then logically grouped as tourists, residents and local business owners.

To understand how beneficiary groups perceived changes in the flow of cultural and aesthetic ecosystem service benefits, a stated preference, contingent valuation (CV) approach is used to capture total value which is composed of use and non-use value (Champ, Boyle, & Brown, 2003; Pearce, Atkinson, & Mourato, 2006). A stated preference methodology is the only method that captures non-use values (Flores, 2003). Since the evaluation was to be undertaken ex-post, a willingness to accept (WTA) contingent valuation question seemed to be most appropriate, assessing the willingness of beneficiaries to accept compensation for a loss, for example, of access to the CIP beaches. A WTA approach, however, raised a number of issues, particularly in the framing of a WTA question to tourists and obtaining a reliable response. Furthermore, from a methodological standpoint, depending on the good or service, WTA often results in higher value estimates (Hanemann, 1991; Shogren, Shin, Hayes, & Kliebenstein, 1994).

A willingness to pay (WTP) approach was used in this study to estimate respondents WTP to maintain the beaches in their current condition. While most WTP studies are hypothetical, this study takes a retrospective approach to estimating ecosystem service benefits for a change that has already occurred. One of the most well-known retrospective WTP studies was the Exxon Valdez oil spill study (Carson et al., 2003). Retrospective CV studies face the 'time traveler' challenge, where respondents cannot be reasonably expected to behave or respond as though an event has not occurred and be asked to provide a prospective value for that change. To overcome this challenge, a scenario is developed to simulate the same change that would have been valued in an ex ante setting. In the Exxon Valdez application, the ex-ante scenario was the development of a program to prevent a future oil spill from occurring. In this study, the scenario is a program to maintain the improvements and flow of ecosystem service benefits that were generated through CIP.

It is true that respondents may have a determined WTP to prevent the beaches from reverting to their previous state which may diverge somewhat from their WTP for a program that transforms beaches from an original degraded state to the conditions present at the CIP sites. This is a challenge since most CV studies are experimental and not linked to specific policies or investments which have been undertaken. This potential divergence was considered in the study design, though it was not plausible to ask respondents to assume that CIP had not occurred; experts on the team also did not feel there were three similar unimproved beaches where the study could be conducted in order to simulate the CIP improvements[2]. Nonetheless, it is important to consider how this may have affected the results.

A single-bounded dichotomous choice format was used since it is an incentive-compatible elicitation format (Carson and Groves, 2007) and is the approach recommended by the NOAA Blue Ribbon Panel (Arrow et al, 1993). The bid values were chosen based on observed values in the literature, consultation with local leaders and the survey expert, and results from the pilot study.

In addition to the questions formulated to estimate economic values, auxiliary questions are included in the survey instrument to understand which characteristics of the CIP beaches

[2] For a discussion on the WTP and WTA disparity, see Kim et al. (2015).

beneficiaries derive value from. This information is important to help inform the design of future coastal infrastructure investments.

In assessing regulatory ecosystem service benefits, a survey-based avoided cost methodology is used. The avoided cost questions aim to estimate changes in business expenses related to mitigating or recovering from storm surge and flooding. In addition, the business survey was designed to investigate income, investment and employment impacts of CIP through a difference in difference approach. A difference in difference approach cannot be applied with tourists since it is not possible or desirable to restrict tourist mobility to artificially create treatment and control groups. Since businesses are generally fixed in situ, however, creation of treatment and control groups is possible and thus the difference in difference approach may be applied. To apply the difference in difference approach, control beaches where businesses operated were identified based on their similarity to the treatment beaches in terms of beach morphology and patterns of use. Advice on control beach selection was provided by the CZMU and local experts based on their intimate knowledge of the beaches and surrounding area.

3.1. Surveys

Both tourists and residents were to be surveyed at the three CIP sites: the Welches Beach Improvement Project, the Rockley to Coconut Court Waterfront Improvement Project, and the Holetown Beach Improvement Project[3]. During July and August of 2015, the time of survey implementation, however, Welches Beach exhibited a heavy loading of sargassum seaweed. It was determined that this unfavorable temporary feature would adversely affect respondents' view of the beaches and as a consequence, tourist and resident surveys were not conducted at Welches beach. For tourist and resident surveys, given budget constraints, a minimum of 200 observations each were sought. An on-site interview protocol which involved random interception of beach users at different times of the day and different days of the week was adhered to at each (Cumberbatch and Boyle, 2015).

In the case of business surveys, all businesses within proximity of the three CIP beaches were surveyed. Since it was anticipated that business owners have a longer term perspective of the beach, the sargassum outbreak at Welches Beach was less likely to have an adverse impact on

[3] See CZMU (2016) for detailed site descriptions.

their responses. In addition to the three CIP beaches, three control beaches were surveyed, namely: Paynes Bay, St. Lawerence Gap, and Worthing Beach. Due to the limited number of businesses situated at individual CIP and control beach sites, results are analyzed for the aggregate of CIP (75 businesses) and control (18) beaches.

3.2. Tourist and Resident Survey Design

The design of tourist and resident surveys was undertaken in accordance with the principles outlined in Champ et al. (2003). Four versions of the surveys were administered. First, separate surveys were designed for tourists and residents to allow for differences in these two beneficiary groups. Second, separate surveys were designed for Holetown Beach and Rockley Beach so that the surveys could refer to these beaches by name and the CV question could be customized to each beach. Respondents were first informed about the beach resilience projects (figure 1) and the survey narrative was accompanied by images showing the beach before and after the CIP intervention (figure 2). Tourists and residents were presented the same information and images of the before and after conditions of the beaches, and; both tourist and resident surveys contained a CV question and questions designed to elicit information on respondent beach use, preferences for beach features and respondent personal characteristics.

The issue of consequentiality was placed front and center in the survey design process. A well-designed CV study ensures that respondents believe their decisions are consequential and that policy makers will make decisions in a way that is consistent with respondents' stated preferences (Carson et al., 2014; Vossler et al., 2012). To emphasize consequentiality of a payment being made, subjects were told:

- "Your answers are very important and will help to make decisions about beach improvement projects."
- They were subsequently told: "The Barbados Coastal Zone Management Unit has invested in projects to improve the quality of Holetown/Rockley Beach and other Barbados beaches and the stability of the coast in general." (Wording varied by survey beach version.)
- Just before the CV question, subjects were told: "To make decisions about maintaining beach improvements the Barbados Coastal Zone Management Unit would like to know how important these improvements are to beach users like you."

- And it was subsequently stated: “If the fee to be paid as you pass through Customs is approved, it will maintain Rockley Beach in the After Improvement conditions shown in the photographs.”

Figure 1. Description of CIP interventions

The Barbados Coastal Zone Management Unit has invested in projects to improve the quality of Rockley (Hastings) Beach and other Barbados beaches and the stability of the coast in general.

Rockley (Hastings) is the beach you are on today.

Please look at the photos of Rockley (Hastings) Beach in the handout.

These photos show the beach **before** and **after** the improvements.

The improvements include:

- maintaining a wide sand beach
- providing connectivity so people can walk from one beach to another
- planting vegetation along the beach
- placing steps from roadway to improve access
- building a sidewalk and benches for sitting

The project also protects the shoreline and properties near the shore from beach erosion and damage from storms.

Figure 2. Before and after images of the Rockley Beach Improvement Project

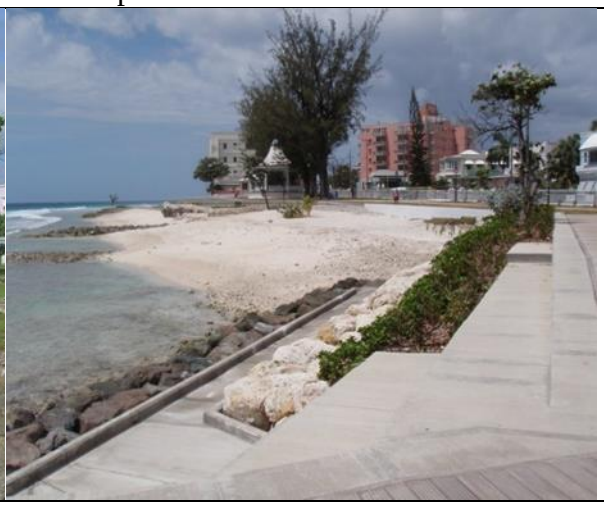
BEACH WIDTH PROVIDES WIDE SAND BEACHES	
Before Improvement	After Improvement
	
BEACH CONNECTIVITY **PROVIDES CONNECTED BEACH SEGMENTS FOR USERS TO WALK ALONG**	
Before Improvement	After Improvement
	

Figure 2. Before and after images of the Rockley Beach Improvement Project (cont.)

BOARDWALK AND VEGETATION PROVIDES SAFE WALKWAYS

Before Improvement	**After Improvement**
	

ROCKLEY BEACH PROJECT AFTER IMPROVEMENTS

BEACH EROSION IS REDUCED AND COASTAL PROPERTIES ARE PROTECTED FROM STORM DAMAGE

Source: Coastal Zone Management Unit, Barbados.

A CV study requires that survey respondents are informed of the mechanism by which a hypothetical change would occur, and the payment vehicle for that change. In this study, the change had already occurred so respondents were asked about their willingness to maintain the current post-CIP improved condition. Respondents were informed of the need to actively maintain the beaches in their improved conditions and that without maintenance, the site would degrade and eventually revert to their pre-improvement conditions.

The payment vehicle differed for tourists and residents. Tourists were asked if they would pay a beach fee each time they arrived to Barbados at customs. The beach fee for tourists ties the payment to the CIP beaches and the payment at customs ensures all legal visitors pay the fee.

Such a fee is not feasible for residents and any question that discussed raising taxes on residents was likely to engender significant protest responses. Thus, the payment was posed as a reallocation of a portion of taxes residents already pay to the government toward a special fund for beach maintenance and resilience projects. This payment is an annual, reoccurring payment.

The next step in the survey is to ask the CV question to tourists (figure 3a) and residents (figure 3b). The only difference in the CV questions between the tourist and resident surveys is the payment vehicle. The CV questions were the same for Holetown Beach and Rockley Beach. The CV questions in Figures 3a and 3b include a space to enter a Barbadian dollar amount, where the amounts entered were $12, $24, $39, $64 or $82BBD[4] for both tourist and resident surveys. One of these dollar amounts was randomly assigned to each survey. If respondents answer yes to the CV question, they are revealing a value to maintain the current improved conditions so that they do not revert to the pre-CIP conditions. Thus, the average value computed is the value of the Holetown Beach and Rockley Beach CIP intervention to tourists and residents.

Figure 3a. Contingent valuation question- tourist survey

VOTING ON A TOURIST ENTRANCE FEE TO SUPPORT BEACH MAINTENANCE

To make decisions about maintaining beach improvements the Barbados Coastal Zone Management Unit would like to know how important these improvements are to beach users like you.

If the fee to be paid as you pass through Customs is approved, it will maintain Rockley Beach in the **After Improvement** conditions shown in the photographs.

We are conducting surveys like this on other beaches in Barbados and these surveys will be used to decide how much money to allocate to each beach.

Since you are being surveyed on Rockley Beach, **your vote will be used to allocate funds to Rockley Beach**.

Do you vote <u>for</u> or <u>against</u> a fee of $____BBD where your payment would be used to maintain the Rockley Beach improvements shown in the photographs? (Please circle one number)

1 FOR

2 AGAINST

[4] 1 USD is equivalent to 2 BBD.

Figure 3b. Contingent valuation question- resident survey

VOTING ON A FUND TO SUPPORT BEACH MAINTENANCE

To make decisions about beach maintenance the Barbados Coastal Zone Management Unit would like to know how important maintaining beach improvements are to beach users like you.

If the fund is approved, it will maintain Rockley (Hastings) Beach in the **After Improvement** conditions shown in the photographs.

We are conducting surveys like this on all of the improved beaches in Barbados.

Since you are being surveyed on Rockley (Hastings) Beach, **your vote will be used to allocate funds only to Rockley (Hastings)**.

This means, when you vote, you should assume your entire tax amount you approve for the fund will be allocated to Rockley (Hastings) Beach.

Do you vote for or against creating a fund where $____BBD from the taxes you already pay would be used to maintain the Rockley (Hastings) Beach improvements shown in the photographs? (Please circle one number)

1 FOR

2 AGAINST

3.3. Business Survey Design

A survey was administered to businesses located at and around CIP beaches and control beaches. Standard survey design and implementation procedures were followed (Dillman, 2000; Gubrium & Holstein, 2002). To investigate if the CIP interventions have a positive impact on nearby businesses, survey participants were asked to respond to three groups of questions: (i) before and after questions; (ii) simultaneous questions, and; (iii) simultaneous before and after questions. Specifically:

- Before and after analysis: did businesses near CIP beaches experience more damage from Hurricane Ivan[5] in 2004 (before CIP) than Hurricane Tomas[6] in 2010 (after CIP)? The events of Hurricane Ivan and Tomas were used in the analysis to provide an unambiguous and identifiable event among respondents to elicit information on how CIP may have

[5] Hurricane Ivan was a Category 5 Cape Verde-type hurricane reaching a maximum wind speed of 165 mph, 120 mph sustained winds and storm surge of up to 16 m on Grand Cayman (NOAA, National Weather Service Weather Forecast Office: http://www.srh.noaa.gov/mob/?n=ivan).

[6] Hurricane Tomas was a Category 2 hurricane with a maximum wind speed of 100 mph.

affected ecosystem regulating services and how businesses may have benefited from CIP investments.

- Simultaneous analysis: did businesses near CIP beaches experience less damage from Hurricane Tomas in 2010 (after CIP) than businesses near control beaches? Did businesses near CIP beaches invest more in their business than businesses near control beaches? Did businesses near CIP beaches hire more new employees than businesses near control beaches?
- Simultaneous before and after analysis: did businesses' revenue increase more at CIP beaches from before 2006 (before CIP) to after 2009 (after CIP) than businesses near control beaches?

The surveys administered to businesses near CIP beaches differed from surveys administered near control beaches in one dimension. The CIP beach surveys included questions related to the specific beach resilience projects; these questions were not appropriate for the control beaches and were not included in these surveys.

3.4. Survey Implementation

Draft tourist, resident and business surveys were pretested in June 2015. Nineteen enumerators and two supervisors were trained following standard survey research protocols for training enumerators to administer on-site surveys. The survey pretesting yielded 58 usable responses, 27 for the tourist survey and 31 for the resident survey. The enumerator training and pretesting of the surveys provided important inputs to refining the survey instruments. The comments about the contents of the survey were typical of what would be expected for a draft survey and suggested that the surveys were working well. The pilot did not generate any evidence to suggest that respondents had any issue related to the credibility of the scenario (Cumberbatch and Boyle, 2015). The responses to the valuation questions in the tourist and resident surveys provided confidence that these surveys would successfully produce data to estimate the values that tourists and residents place on the CIP investments.

The small number of business pre-test surveys revealed that the business survey was working well, but did not show whether the survey would successfully produce data to detect the impact of CIP on businesses. The limited number of pre-test interviews is due to the limited number of businesses located at CIP beaches and a desire to retain as many businesses as possible for the

final survey implementation. For a further discussion of the survey pretesting see Cumberbatch & Boyle (2015).

3.4.1. Tourist and Resident Surveys

The tourist and resident surveys were conducted by enumerators walking along Holetown Beach and Rockley Beach. The enumerators covered the extent of these beaches associated with the CIP intervention and the extent of the beaches south and north of the CIP areas up to an impediment that precluded beach users from easily walking any further along the beaches. All individuals who were on the beach, but not in the water were eligible for inclusion in the sample; enumerators attempted to interview beach users before or after they entered the water. The enumerators conducted surveys between 6 am to 5 pm on survey dates. The Holetown Beach surveys were administered from July 19 to 25, 2015 and August 7 to 9, 2015. Two hundred tourist surveys and 200 resident surveys were completed. The Rockley Beach surveys were administered from July 22 to 28, 2015. Rockley is one of the more popular beaches on the island and therefore there was no difficulty obtaining a minimum 200 completed surveys for the tourist and resident surveys (Cumberbatch, 2015). The number of completed surveys is documented in table 1.

Table 1. Number of survey respondents.

	Tourist Survey	Resident Survey	Totals
Holetown Beach	210	203	413
Rockley Beach	415	406	821
Totals	625	609	1,234

Source: Authors' own elaboration.

Beach users that were approached could either agree or decline to participate in the survey. Some respondents declined to reveal whether they were tourists or residents, which is an implicit refusal since the enumerator would not know which survey to administer. Overall, 47% of the beach users approached agreed to participate in the survey; 51% for Holetown Beach and 46% for Rockley Beach (Cumberbatch, 2015).

3.4.2. Business Survey

The business surveys were conducted with businesses that were adjacent to CIP and control beaches and businesses south and north of the beaches within easy walking distance from the CIP beaches and control beaches. The sampling strategy consisted of surveying businesses between the beach and the street running along the beaches, and businesses located across the

street from the beaches. Due to the small number of businesses, all eligible businesses were contacted to participate in the survey. The business survey was administered throughout July and August, 2015. The survey completion rate for the business survey was 40% (75 surveys) for the CIP beaches and 28% (18 surveys) for the control beaches. These completion rates are not unexpected for a survey of businesses where they are not obliged to complete the survey.

3.4.3. Representativeness of Survey Data

Due to the short time period over which the surveys were administered, and based on the available information, it is not possible to confirm with certainty that the data collected are representative of tourist and resident beach goers in Barbados, though there is no compelling case suggesting that it does not. Tourism data shows that Barbados has a high volume of monthly tourist visits throughout the year rather than the large peaks and dips characteristic of seasonal tourism destinations (Caribbean Tourism Organization, 2015). Therefore, the period over which the surveys were implemented is relatively average in terms of arrivals[7]. As another check of representativeness, with regard to country of origin, the largest number of respondents was from the United Kingdom, followed by the United States and then Canada. This is consistent with tourist arrivals data for Barbados (BBS, 2014). The business surveys were a census of businesses located near control and project beaches and therefore the data generated are representative of local businesses. However, the insights drawn from the business survey data should be interpreted with caution due to the limited number of businesses located in proximity to the beaches, the fact that not all businesses cater to beach users, and that some of the businesses surveyed (%) had only been operating for a short period at their current locations and therefore lacked a before and after perspective.

3.5. Approach to Survey Analysis

To test for difference in means in survey results, the Pearson chi-square test and the F-test were used. Estimates of WTP are reported as nonparametric, lower-bound estimates (Haab and McConnell, 1997). The step-wise regression of beach and respondent characteristics' contribution to WTP is a linear probability model where variables are added until there are no additional significant regressors at the 10% level (Wooldridge, 2015).

[7] Follow-up tourist and resident surveys are planned for the 2016 high season to consolidate findings.

4.0. Results

4.1. Tourist Survey Results

About two thirds of the respondents at Rockley and Holetown beaches had visited Barbados previously and slightly more than 50% of those had visited the island more than five times. About two thirds of respondents were on visits of two weeks or less and were typically traveling with their family for recreation. The largest percentages of respondents at both beaches were staying at hotels or rental houses on the beach (39% for Holetown and 47% for Rockley) with the rest saying in hotels or rental houses not on the beach or in other forms of accommodations. Nearly two-thirds of all respondents were visiting Holetown Beach or Rockley beach because these beaches were near where they were staying. In addition, 23% of Holetown Beach respondents and 30% of Rockley Beach respondents said they chose these beaches due to the improved conditions attributable to the CIP investments. This finding suggests that as additional beach resilience projects are completed, tourists that stay at or near beaches will benefit, as should businesses also located in proximity to these intervention sites.

For all tourist respondents, a sandy beach was the most important characteristic informing their choice of beach to visit. This was followed by the presence of nearby restaurants and bars, and then by the number of beach amenities. When asked if they would continue to visit the beaches if they were not maintained and returned to pre-improvement conditions, 60% of Holetown and 63% of Rockley resident visitors said they were “much less likely” or “somewhat less likely” to visit these beaches. These results indicate that the CIP interventions are important and valuable to visitors and that interventions that restore and maintain sand on the beaches are particularly important, the impacts of which will have positive spill-overs to nearby businesses catering to tourists.

Table 2 shows the percentage of respondent votes for and against payment of the fee. As the fee increases, tourist respondents’ WTP tends to decline for both Holetown and Rockley Beaches as may be expected.

Table 2. Votes for and against payment of fee for maintenance of beach improvement.

Fee			**Holetown**		**Rockley**			
BB$	For	Against	No response	Don't know	For	Against	No response	Don't know
12	81%	17%	0%	2%	64%	34%	2%	0%
24	71%	24%	6%	0%	59%	39%	3%	0%
39	79%	21%	0%	0%	48%	48%	3%	0%
64	56%	41%	0%	3%	47%	47%	5%	2%
82	36%	62%	2%	0%	46%	50%	4%	0%

Source: Authors' own elaboration.

Based on responses to the CV question, the estimated value for Holetown Beach is $51 BBD per visitor with a range of $45 to $56 BBD per visitor (95% confidence). The comparable result for Rockley Beach is $43 BBD per visitor with a range of $38 to $46 BBD per visitor (95% confidence). The per visitor value for Holetown Beach is $8 BBD higher, and these two estimates are statistically different at the 5% level.

A step-wise regression equation was estimated to evaluate how a tourist's desired beach characteristics and their personal characteristics influence their response to the CV question (table 3). The results show that as the tourist fee increases, tourists are less likely to answer "yes" to the CV question which is the expected relationship. The significant, negative coefficient for the Rockley Beach variable confirms that tourists place a higher value on Holetown Beach compared with Rockley Beach. Respondents who said that a sandy beach or a boardwalk was not important to them were less likely to answer "yes" to the CV question and this same relationship holds for respondents who said that parking is important. Respondents who were less likely to visit the beach if it returned to its pre-CIP condition were more likely to answer "yes" to the CV question.

Table 3. Stepwise regression of beach characteristics and tourist characteristics influencing CV responses (n=585)[8].

Explanatory Variable Names (Coding)	**Coefficient Estimates (p-values)[9]**
Contingent-Valuation Question Dollar Amount ($ BBD)	-0.003
	(0.00)
Rockley Beach (1/0)	-0.114
	(0.01)
Sandy Beach Not Important (1/0)	-0.240
	(0.138)
Boardwalk Not Important (1/0)	-0.141
	(0.01)
Not Return if Before Improvement Conditions (1/0)	0.127
	(0.00)
Parking Important (1/0)	-0.102
	(0.01)
Education (Years)	-0.037
	(0.04)
Constant	0.969
	(0.00)

Source: Authors' own elaboration.

When tourists were asked why they would pay to maintain the beaches in the post-CIP state, the primary reasons were to maintain current beach conditions or to preserve the greater benefits that the improved beaches provide (table 4). The top reasons to oppose payment for maintaining the post-CIP improved conditions is that the fee was too high and the sentiment that well maintained beaches should be free.

[8] The dependent variable is 1/0, answered for/against to the CV question. The sample size is smaller than reported in table 1 due to item nonresponse for some of the variables included in the equation.

[9] The significance of coefficient estimates is shown by p-values less than or equal to 0.10.

Table 4. Motivation for voting for or against paying to maintain beaches.

	Holetown	Rockley
Why pay to maintain beaches		
Maintain current beach conditions	25%	21%
Preserve beauty/economy/wildlife of island/beach	13%	12%
Small price for large benefit	12%	9%
Encourage tourism	8%	6%
Good cause	3%	3%
Why not pay to maintain beaches		
Too much money	14%	21%
Beaches should be free	8%	6%
Get money from elsewhere	3%	5%
Will hurt tourism	2%	3%
Don't use beach	1%	2%

Source: Authors' own elaboration

4.2. Resident Survey Results

Fifty four percent of resident respondents visit the beaches daily or weekly. At Holetown Beach, the primary reason for visiting the beach is proximity to the respondent's home, while appealing beach conditions are the primary reason at Rockley Beach. At least two-thirds of all respondents also visit other beaches regularly. Approximately three out of four respondents had visited the beaches before 2008, which is before the completion of CIP (table 5). Of those who had visited the beaches prior to 2008, over 80% think that CIP resulted in a substantial improvement in beach quality. Respondents think reduced beach erosion is the main impact of CIP and over half of all respondents think that CIP resulted in reduced property damage.

Table 5. Resident perceptions of CIP interventions.

	Holetown Beach	Rockley Beach
Visited before 2008?	74%	74%
Rating of beach quality change since 2008		
Substantial Improvement in Quality	81%	84%
Small Improvement in Quality	15%	10%
No Effect	2%	4%
Small Decrease in Quality	1%	1%
Effects of beach resilience projects		
Reduced beach erosion	74%	66%
Reduced risk of storm damage to properties	58%	49%
No effect	10%	16%

Source: Authors' own elaboration.

When asked if they would continue to visit the beaches if they were not maintained, and eventually returned to their pre-CIP conditions, 44% of Holetown and 60% of Rockley residents said they were "much less likely" or "somewhat less likely" to visit these beaches. These results indicate that the beach improvement projects are valuable to residents. Even those who did not say they were less likely to visit may have done so because the beaches are located near where they lived and are therefore convenient to visit. Due to this convenience, although they may not reduce their visitation if the beach were to return to pre-CIP conditions, these residents still benefit from the enhanced cultural and aesthetic ecosystem services the beaches supply.

As is the case for tourists, a sandy beach is the most important beach characteristic for residents, followed by the number of amenities such as availability of parking and benches. While restaurants and bars rate lower in terms of important characteristics for residents compared with tourists, the percentages are not substantially different; tourist percentages are slightly greater than 50% and resident percentages are less than 50%. This indicates that a substantial proportion of residents are customers of the restaurants and bars located near the CIP beaches and their increased visitation should result in positive spill-overs for local businesses.

Table 6 shows the votes for and against the reallocation of taxes for maintenance of beach improvement. As the amount of tax reallocation increases, resident respondents' WTP tends to decline for both Holetown and Rockley Beaches as may be expected, though there was a relatively high proportion of respondents that indicated a WTP of BB$64 for beach improvement.

Table 6. Votes for and against reallocation of taxes for maintenance of beach improvement.

Tax allocation	Holetown			Rockley		
BB$	For	Against	No response	For	Against	No response
12	70%	20%	9%	82%	14%	4%
24	78%	17%	6%	61%	31%	9%
39	68%	25%	7%	65%	31%	4%
64	78%	19%	3%	81%	17%	1%
82	51%	42%	7%	57%	38%	5%

Source: Authors' own elaboration.

Based on responses to the CV question, the estimated value for Holetown Beach is $57 BBD per resident with a range of $51 to $62 BBD per resident (95% confidence interval). The comparable result for Rockley Beach is the same when rounded to the nearest dollar at $57 BBD per resident with a slightly narrower range of $54 to $61 BBD per resident (95% confidence). The per resident value for Holetown Beach is less than $1 BBD different from the Rockley Beach per resident value, and this difference is not statistically significant at the 5% level.

Noteworthy is that the highest fee amount of $82BBD did not elicit vote responses under 50% at either beach. The interpretation of this result is that the median values for both beaches are greater than $82BBD, and therefore, had fees higher than $82BBD been included in the survey, more positive "for" responses would have been obtained and the WTP estimates would have been higher than those presented here.

A stepwise regression equation was estimated to identify the residents' desired beach characteristics and their personal characteristics that were most important in influencing responses to the CV question (table 7). The results show that as the amount of tax reallocation increases, residents are less likely to answer "yes" to the CV question which is the expected relationship. The Rockley Beach variable was not significant in this equation, which indicates that residents place the similar value on the CIP interventions at Rockley and Holetown Beaches. Residents who responded that a long beach was not important to them were less likely to vote for the tax reallocation; it may be inferred that residents who think these features are important hold higher values for CIP interventions. This result may arise from residents using the beaches for exercise and preferring a longer beach for running and walking. Residents who indicated that nearby bars are important also hold higher values for the CIP interventions. Residents who walk to the beach hold higher values for the CIP interventions, while residents who live adjacent to the beach hold lower values. This latter result may be indicative of the people who live nearby not liking the increased beach activity and traffic associated with the improved beaches. Respondents who are familiar with beach conditions and the effects of the beach resilience projects also hold higher values for the beach improvement projects.

Table 7. Stepwise regression of beach characteristics and resident characteristics influencing CV responses (n=553)[10]

Explanatory Variable Names (Coding)	**Coefficient Estimates (p-values)[11]**
Contingent-Valuation Question Dollar Amount ($BBD)	-0.002 (0.00)
Flat Beach Not Important (1/0)	0.076 (0.11)
Long Beach Not Important (1/0)	-0.090 (0.05)
Nearby Bars Important (1/0)	0.076 (0.05)
Walk to Beach (1/0)	0.106 (0.03)
Near Where Live (1/0)	-0.089 (0.06)
Been to Beach Before (1/0)	0.243 (0.03)
Beach Recommended to Visit (1/0)	-0.137 (0.05)
Visited Beach Before Resilience Project (1/0)	0.085 (0.06)
Resilience Project Will Reduce Erosion (1/0)	0.237 (0.00)
Resilience Project Will Have Effects in Addition to Reduce Erosion and Storm Damage (1/0)	0.157 (0.07)
Return if Before Improvement Conditions (1/0)	0.133 (0.07)
Not Return if Before Improvement Conditions (1/0)	0.130 (0.00)
Age (Years)	0.004 (0.00)
Male (1/0)	-0.071 (0.08)
Constant	0.076 (0.58)

Source: Authors' own elaboration

[10] The dependent variable is 1/0, answered for/against to the CV question. Sample size is smaller than reported in table 1 due to item nonresponse for some of the variables included in the equation.

[11] The significance of coefficient estimates is shown by p-values less than or equal to 0.10.

When asked why residents would agree to the reallocation of their taxes to maintain the CIP interventions, the primary reasons were to maintain current beach conditions or to preserve the greater benefits that accrue from the improved beaches (table 8). These same reasons were also the top reasons expressed by tourists. The top reason to oppose payment is that respondents felt it was too much to pay, which is also consistent with tourist responses.

Table 8. Motivation for voting for or against paying to maintain beaches.

	Holetown	Rockley
Why Pay to Maintain Beaches		
Maintain current beach conditions	25%	25%
Preserve beauty/economy/wildlife of island/beach	15%	16%
Small price for large benefit	12%	9%
Encourage tourism	15%	10%
Good cause	6%	5%
Why Not Pay to Maintain Beaches		
Too much money	11%	12%
Get money from elsewhere	4%	3%
Corruption	3%	3%
Taxes will eventually increase	2%	1%
Should support entire island, not just one area	1%	25

Source: Authors' own elaboration.

4.4. Business Survey Results

Due to the relatively small number of businesses interviewed at each beach, results are reported together for CIP beaches and together for the three control beaches, rather than for each of the six beaches individually. In some cases, CIP beach respondents' ability to answer the survey questions was constrained by the limited time their businesses were in operation at their current locations. Only 51% of CIP beach businesses were operating in their current location prior to CIP and therefore 49% of these businesses could not respond to the before and after condition questions.

Eighty-nine percent of control beach businesses were operating in their current locations in 2009 which is after the conclusion of the CIP works, compared to 59% for CIP beach businesses. This

30% difference is suggestive evidence that the CIP investment made the intervention areas more attractive for businesses that cater to beach users. This evidence is supported by the finding that 68% of CIP beach businesses sell to beach users compared to only 33% of control beach businesses.

CIP beach businesses, where the respondents had an opinion, were divided on whether beach use had increased or decreased since completion of CIP; 44% of CIP beach businesses felt that CIP had benefited their businesses. A common reason to explain the benefit was the increased foot traffic; those that did not perceive a benefit often mentioned that they thought the boardwalks diverted foot traffic off the streets thereby reducing contact with the businesses. The relatively small number of businesses at CIP beaches that were in operation before (38 businesses or 51%) and after CIP (44 businesses or 59%) makes a definitive answer to this question elusive.

In total, only four businesses experienced damage from Hurricane Ivan in 2004, all four of which were CIP beach businesses. Eleven businesses experienced damage from Hurricane Tomas in 2010, with all but one being a CIP beach. In total, 75% of CIP beach businesses make sales to beach users, while only 33% of control beach businesses do; this difference is statistically significant[12]. More CIP beach businesses experienced revenue increases since 2009 (46%) compared to control beach businesses (36%). Furthermore, fewer CIP beach businesses experienced revenue declines since 2009 (39%) compared to control beach businesses (43%).

For businesses that reported revenue growth, CIP beach businesses experienced significantly higher revenue growth, an 18% increase on average, compared with control beach businesses that experienced an 8% increase. For those businesses that experienced revenue losses, there was no significant difference in losses between CIP beach businesses (20% loss) and control beach businesses (21% loss). In summary, CIP beach businesses were more likely to experience revenue increases and among those businesses that experienced revenue increases, CIP beach businesses experienced greater increases in revenue. CIP beach businesses were also less likely to experience revenue losses.

[12] All statistical tests are conducted using the Pearson chi-square test or the F-test for a difference in means.

The majority of businesses at CIP and control beaches have experienced increases in the cost of conducting their businesses since 2009 (76% and 57%, respectively). Only 8% of CIP beach businesses and 21% of control beach businesses report decreases in the cost of running their businesses. Cost increases averaged 9% for CIP beach businesses and 12% for control beach businesses. Cost decreases averaged 15% for CIP beach businesses and 6% for control beach businesses. As with business revenue, the difference in costs between the CIP and control beach businesses was not statistically significant; these differences would, however, likely prove to be statistically significant if there were more businesses available to survey.

For CIP beach businesses, 43% invested in their business since 2009 compared to 56% of control beach businesses. CIP beach businesses on average made significantly larger investments, on average, $154,000 BBD versus $143,000 BBD. With regard to employment, there was no generalizable evidence to suggest that businesses increased or decreased employment since 2009. Nonetheless, CIP beach businesses that did increase employment, increased employment by more on average than control beach businesses (8 employees versus 2 employees for CIP and control beach businesses, respectively). This difference is statistically significant. The information presented in this section taken collectively indicates that CIP has indeed generated benefits for local businesses, though a more precise quantification of the benefits is hindered by the small number of businesses available to survey.

5.0. Conclusions

This paper developed an ecosystem service-based retrospective stated preference approach to evaluating coastal infrastructure investments. The ecosystem services lens facilitates the cataloging and prioritizing of ecosystem service benefit flows. While traditional CV studies focus on a hypothetical change, the retrospective analytical approach developed here proved effective in quantifying benefits ex-post. The ecosystem service-based retrospective stated preference approach is versatile, powerful and appropriate for evaluating development interventions when: experimental and quasi-experimental methods are not feasible; baseline data is unavailable; it is not possible or desirable to select and separate a treatment and control group, and; treatment and control outcomes are not easily defined.

The ecosystem-based retrospective approach was applied to CIP, a US$24.2 million investment to enhance coastal resilience and the amenity values of key beaches on Barbados' south coast. Results of this analysis show that CIP had a positive impact on enhancing cultural and aesthetic ecosystem services for both tourists and residents. Tourists value the CIP interventions at Holetown and Rockley beach at BB$51 per visitor and BB$43 per visitor, respectively, while residents valued CIP interventions at Holetown Beach and Rockley Beach similarly at BB$57 per resident. Regression results show that beach width and a sandy beach are the most important beach characteristics to tourists, while residents have more complex motivations for valuing beach improvements.

While the business survey data are limited due to the relatively low number of businesses present, the results indicate that businesses located near CIP beaches benefit from enhanced cultural and aesthetic and regulatory ecosystem services, and that CIP beach businesses are more likely to: make sales to beach-goers; experience larger revenue growth including during periods of economic decline; invest more in their businesses, and; employ more people. These findings could be further supported and consolidated through case study analysis of individual CIP beach businesses.

The approach developed here generates important findings that can be used to evaluate past development interventions and inform the design of future interventions. The retrospective CV approach generates dollar values that provide compelling evidence to policy makers and investors to scale-up successful investments and undertake new ones. The evidence presented demonstrates that tourists and residents value CIP-like interventions while positive spill-overs of the investments benefit local businesses catering to tourist and resident visitors and recreationalists.

With three beneficiary groups defined in this study, the characteristics that influenced each group's preferences were revealed through the retrospective stated preference approach. Future investments designed to catalyze private sector support should be careful, for example, not to inadvertently divert foot traffic from businesses as a result of new coastal infrastructure. In the case of investments targeting the enhancement of cultural and aesthetic ecosystem service supply for tourists, widening of sandy beaches is important. If residents are the target beneficiary group,

enhancing beach connectivity and length as well as areas that apt for resident use and congregation are important.

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