A Framework for Constructing a Housing Price Index-A Progress Report

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ABSTRACT

As evident from the 2007/2008 housing crash in the United States of America, the fortunes of the real estate market not only aid as a guide for where overall economic activity and credit may be going, but also have implications for the overall health of a financial system. However, despite the initial efforts of Browne et al (2008), there exists no real estate price index for Barbados to date. The lack of an official and published index has spurred the authors' efforts to develop a real estate price index for Barbados. Employing data provided by the Land Registry Department, the analysis will ultimately evaluate a number of models proposed in the literature for constructing real estate price indices, identify those factors most important for determining property prices in Barbados, and build a practical real estate index for the island. The study furthers the initial efforts by Browne et al (2008) by using a more comprehensive and applicable dataset including the actual prices of houses sold and additional variables which may be important in determining property prices on the island.

1. Introduction

The 2007/2008 housing market crash in the United States of America and other developed economies highlighted the increasingly connected relationship between the real estate sector, the financial system and the real economy. For many financial institutions, mortgages and other property related lines of credit have traditionally represented major exposures and sources of income, while other non-real estate loans are backed by properties offered as collateral in the transaction. In addition, with the advent of securitization, particularly with reference to mortgage backed securities, this ongoing relationship between the real and financial sectors has become even more complex.

In the case of Barbados, mortgages alone accounted for 42 percent of total loans and advances of commercial banks at the end of 2013, and about 44 percent of the credit unions' portfolio. Simultaneously, non-performing loans to real estate, renting and other business activities accounted for 17 percent of gross classified debt, with loans to individuals and individual trusts making up another 42 percent, much of which is attributed to residential mortgages. At the same time, some finance and trust companies and some insurance companies provide mortgages to their customers, and at times these make up more than half of those institutions' credit portfolios. On the external side, capital inflows for various real estate projects go a long way to financing

Barbados' persistent current account deficit. Griffith and Moore (2011) estimated that "the sale of…condominiums accumulated foreign exchange earnings in excess of US$ 400 million in 2007, attracted capital in the form of foreign direct investment, expanded the tourism product as it relates to accommodation capacity, and created sources of employment opportunities that increased incomes earned, consumption, and capital expenditure on goods and services."

The fortunes of the real estate market therefore not only aid as a guide for the direction of overall economic activity and credit, but also have implications for the overall health of the financial system. However, despite the initial efforts of Browne et al. (2008), there exists no official real estate price index for Barbados to date. The authors used online list prices of 4,584 properties in Barbados spanning just 12 months to construct both median and hedonic house price indices for the island. However, the authors cited the small time series, and the exclusion of factors such as age, proximity to schools, shopping areas and the beach – in the case of the hedonic model – as challenges in carrying out their research. Potentially more problematic, was that the use of listed prices rather than actual transaction prices after negotiations are completed and fees have been paid may not represent the true values of properties on the island.

The lack of an official index prompted the International Monetary Fund, as part of their 2013 Financial Sector Assessment Programme, to suggest that the Central Bank of Barbados develop a real estate price index in order to measure the adequacy of banks' valuations of collateral used in financial transactions. This would ultimately be useful in determining whether there is a need for haircuts to the value of this collateral, as well as to augment the current macro prudential toolkit in order to assess where excessive buildup of risks may be occurring.

As such, this study furthers the initial efforts of Browne et al. (2008) by using a more comprehensive dataset of actual transactions provided by Barbados' Land Registry Department. The paper seeks to create a real estate price index for Barbados using the actual prices of properties sold while determining those variables that may be important in explaining property prices on the island. The analysis will evaluate a number of models proposed by the literature for constructing real estate price indices as well as define those factors most important for determining property prices in Barbados. Ultimately, the constructed index will be incorporated into the Central Bank of Barbados' Financial Stability Unit's macro prudential and surveillance toolkit.

The rest of the paper is structured as follows: section 2 reviews the methodologies used in the literature for the construction of real estate price indices, section 3 gives a brief synopsis of the data available for Barbados and presents a preliminary data analysis, section 4 details the methodology, section 5 analyses the results given the various measures, and finally, section 6 summarizes the findings and concludes.

2. Existing Literature (Review of Methodological Approaches)

The uses of real estate price indices are myriad. These include the measurement of price bubbles in the housing market, an input in the measurement of consumer price inflation, as a key measure of real household wealth and as part of the analysis of a mortgage lender's exposure to default risk. Indeed, there has been increasing appreciation among policy makers that central banks should monitor asset prices as well as goods' prices (Blanchard et al., 2010).

However, the construction of aggregate measures of housing prices is not a straightforward exercise and involves a number of conceptual and practical issues. Ultimately, a real estate price index should represent the price change experienced by a typical house within the geographical area covered by the index. An accurate starting point for constructing any price index between two time periods is to collect prices on exactly the same product or item for two time periods under consideration - the standard matched-model methodology. However, Diewert (2007) notes that the fundamental problem with real estate price indices is that the exact matching of properties over time is impossible because:

1) properties depreciate over time (the depreciation problem)
2) properties are renovated over time (the renovation problem), and
3) except in very large markets, property turnover rates tend to be low[1] (infrequency of transactions).

Furthermore, properties vary immensely along several dimensions, many of which are extremely difficult to quantify. While the segmentation of the market in terms of location, size or age of property might be straightforward, controlling for quality of construction, customer appeal or level of comfort is less obvious. Nevertheless, the Bank for International Settlements (2014) reported that fifty-five countries produced property price indices in 2014.

A few methodologies have been developed in the literature for constructing real estate price indices. Each measure has its unique benefits and shortcomings, and varies in terms of the relative degree of simplicity of implementation and data intensity.

Simple and Stratified Median Price Indices

Given its heterogeneous nature and the fact that only a relatively small fraction of the housing stock is traded in any period, a sample of housing transactions at any point of time may not be representative of the entire housing stock. Changes in the simple median or mean price measures of traded properties may not provide good estimates of the pure price changes as they could quite possibly also reflect compositional changes in houses sold between periods (Assil, 2012).

[1] Prasad and Richards (2006) report that about six percent annual rate of turnover in any year in Australia and argue that the turnover rate in other countries is often lower.

The simplest approach to address the compositional problem in the construction of a real estate price index is to stratify the market into homogenous property types (Eurostat, 2011). Strata are defined by considering the balance of homogeneity of housing characteristics, and the number of observations required for producing a reliable median unit price. Defining housing strata based on geography captures the notion that dwellings in a given area share amenities linked to the property's location[2]. Notwithstanding the stratification method used, the median price for all properties in a base period and subsequent periods is calculated and these ratios are used to generate sub-indices. The median unit price for each stratum is then weighted to reach the overall price index.

The following limitations in the literature have been summarized by Diewert (2007): if there are too many cells in the stratification, there may not be a sufficient number of transactions in any given period in order to form an accurate average cell price, but if they are too few cells in the stratification, the resulting cell averages will suffer from unit value bias i.e., the mix of properties sold in each period within each cell may change dramatically from period to period, so that the stratified indices may not hold quality constant.

Nevertheless, depending on the limitation of the quality of the database the median price index has been used in many instances. Since the distribution of unit prices in a stratum is positively skewed, the median price produces a more robust indictor than the mean value (EUROSTAT, RPPI Handbook, 2011). For example, the Real Estate Institute of Australia, the U.S. national Association of Realtors, the Canadian Real Estate Organization and the Real Estate Institute of New Zealand all publish house price data with simple median or mean data. The concern that compositional changes impact the construction of the median index is not unfounded. However, Prasad and Richards (2006) further show that the median prices can be made considerably more useful if taken from a stratified data sample compared to a single unstratified median taken from the entire data sample. Indeed, these authors note that the price-clustering technique they employed- clustering by price rather than geography - produced a measure of price growth that is highly correlated with a more sophisticated - but more computationally intensive - hedonic model with locational explanatory variables. Similarly, Hansen (2006) argued that it is possible to generate good estimates of short term price movements from median prices, if the medians are taken from an appropriately stratified data sample that is designed to address the key problem of compositional change.

Kaya et al (2012) compiled and developed a stratified median price for Turkey using appraisal data sourced from commercial banks and real estate companies. The use of appraisal data was driven by the absence of actual transaction data and efforts were expended in standardising appraisal reporting forms. The choice of the median price method was arrived at after

[2] However, Prasad and Richards (2006) have argued purely geographical stratification is unlikely to divide houses into strata with the maximal feasible similarity in prices within strata.

considering the repeated sales method, hedonic regression and sales price appraisal methods due to data availability and statistical applicability.

Repeat Sales Method

One popular alternative to the stratified median method is the repeat sales approach developed by Bailey et al (1963). In this methodology, housing quality is controlled for by comparing sales of the same house across time. By utilizing information on "identical" properties that trade in more than one period, the repeat sales method attempts to hold the quality of the properties constant over time. Thus, the price change considered is that of the same house over multiple instances.

Diewert (2007) noted that the main advantages of the repeat sales model are that results are reproducible and the availability of source data from administrative records on the resale of the original property means that no imputations are involved. However, the author also noted that this method does not use all the available information on property sales, but only those sold more than once during the period. Additionally, it cannot deal adequately with depreciation of the dwelling unit or structure, or with units that undergo major repairs or renovations. The method may also fail due to lack of market sales for smaller categories of property. In principle, estimates for past price changes obtained by the repeat sales method should be updated as new transactions information becomes available. Thus the repeat sales method is subject to never ending revisions, with the most recent index releases being revised the most.

Silverstein (2014) also agreed that despite its popularity the repeat sales method also contains a number of other pitfalls. Firstly, sales prices are not entered into the index until they are paired with a subsequent sale. Furthermore, repeat sales do not occur very often, so most of the transaction data are not used. In addition, houses with paired sales may not be representative of the housing market as a whole as cheaper "starter" homes tend to sell more often. Furthermore, it is possible that the difference in composition for the new sales pairs is systematic across time, potentially leading to a bias in the index.

Nagaraja et al. (2010) also examined various repeat sales methodologies, considering their predictive ability and index structure. In addition to the four repeat sales methods, they also consider an auto regressive index which makes use of the repeat sales idea but also included single sales as well. They ultimately favoured a hybrid repeat sales/hedonic method compared with a number of pure repeat-sales methodologies.

Hedonic Method

The hedonic method rests upon the formulation of a regression model in which the dependent variable is the price of houses and the explanatory variables are those representing the quality of the dwellings that have a significant impact on price. In order to gauge the impact of a property's

characteristics on its price, property values are regressed on various attributes (for example, the age, size, number of rooms, location, etc). The coefficients of the attributes are estimates of implicit prices or hedonic prices (Can, 1990), so that the approach permits the separation between price changes and quality changes (Browne et al 2008). Of course, hedonic regressions are only as good as the data on housing characteristics that are available. This method was employed by Meese and Wallace (1997), Hill and Melser (2007), and Kaya et al (2012) among others. However, Gourieroux and Laferrere (2009) noted that despite the theoretical advantages, the hedonic method is not commonly used by statistical agencies or real estate professionals, mainly because of the required detailed data on properties' characteristics over time. Browne et al (2008) summarized some of the other short comings of this method, regarding the choice of housing characteristics to be used, the correct functional form of the hedonic equations, the existence of spacial dependence in the sample selected and model specification issues.

Browne et al (2008) represents a previous attempt at constructing a house price index for Barbados. The authors utilised a regression model on list prices in Barbados to derive regression hedonic coefficients and their results find support for size, location and number of bedrooms in deriving a house price index in Barbados. These authors also compared the results of the hedonic regression with those of an unstratified median index, and while they argued that the potential problems associated with the (unstratified) median index were substantial, the two techniques delivered similar considerations as to the evolution of the housing prices. One possible weakness of this study was the use of the parish variable as the control for spatial orientation, as arguably greater granularity was needed to capture housing clusters.

3. Preliminary Data Analysis

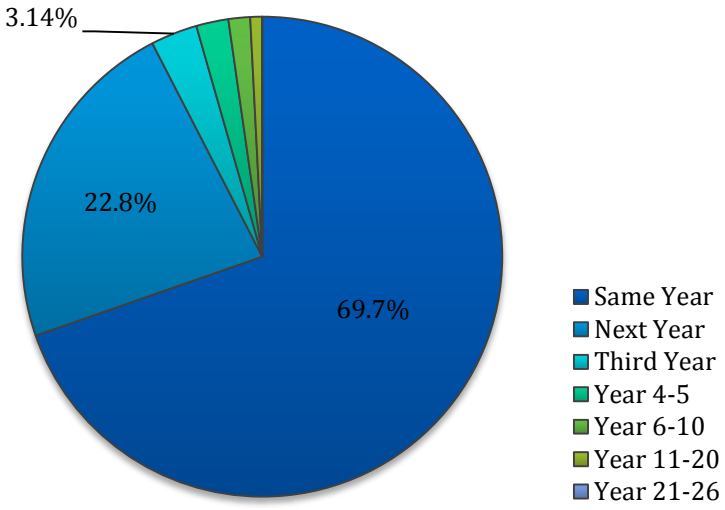
The data employed in the study thus far was obtained from the Government of Barbados' Land Registry Department (LRD) and covers each transaction or property transfer that is filed with the LRD between 1988 and 2013. Included in the dataset are the respective transaction date, the file date, the transaction price, and the location of each property transfer that is filed with the LRD. Each property is also tagged with a land tax number which should identify it across other departments in the island that capture data relating to it; more specifically these codes could be utilized to track the characteristics of the properties in question, through the Land Tax Division of the Barbados Revenue Authority or the Town and Country Planning Department.

An accurate measure of price in a given market should ideally be linked to the actual sale or transfer of a property at an agreed price between the parties involved, at the date on which the agreement was made. However, given the function of the LRD, their data capture is naturally organised by the date in which property transactions are filed (signed). A comparison of the dates on which conveyances are signed versus those on which they are filed with the LRD reveals that

while the majority of property transactions are filed within the year in question, some lag does exist for some transfers. Figure 1 illustrates this relationship over the sample period.

Figure 1: File Date vs. Transaction Date

(Average Time in which Property Transfers are filed over the Sample Period)



Source: Land Registry Department

On average, 70 percent of transactions signed are filed within the same year, 23 percent the following year, and another 3 percent two years after. The remainder is filed many years after in some instances, where for example some transactions from 1989 were only filed in 2006. There is no existing legislation which details the time period within which property should be filed with the LRD.

For the purpose of this study, the data was reorganized by sign date. As a result, all transactions filed within the sample period, but transacted before the sample start date were discarded. An additional implication is that the data relating to transactions not yet filed will always be missing from the dataset, more significantly so for the most recent year(s) available.

Before conducting our initial analysis, a few further adjustments were made to the data:

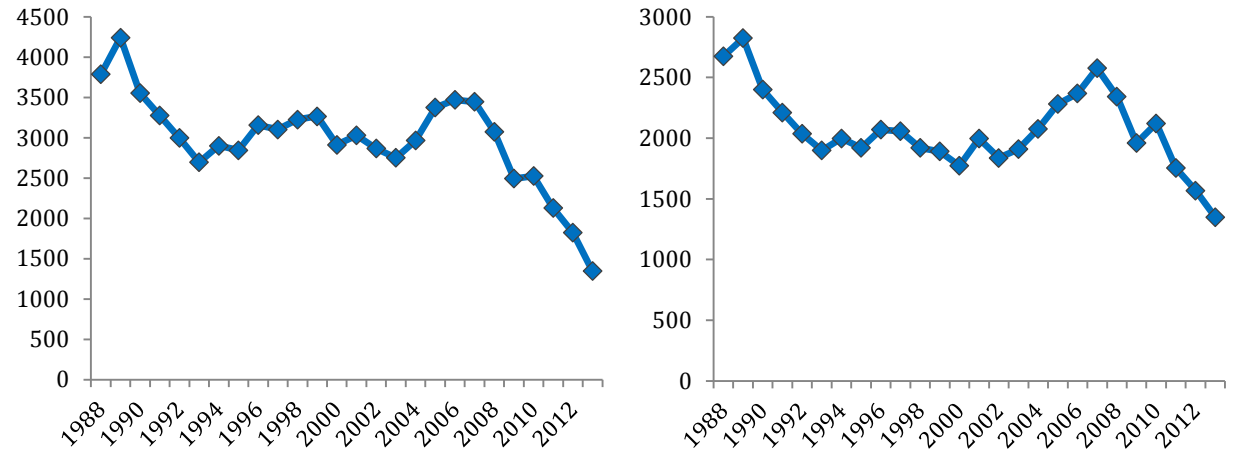
- In order to retrieve the data, LRD built a query which pulled the requested fields; however, the data are housed across more than one database and consequently, the data was populated with several duplicates. These entries were identified (as all equal fields (columns) across a particular row) and removed.

- There were numerous zero-valued transactions for drainage, road reserves and open areas or shared spaces that were allotted by developers to owners who purchased property in their development. For example, if there were 324 properties in a particular development, $1/324^{th}$ part of an open area would be allotted to each owner, separate and apart from the property sold. All such entries were also discarded from the database.

Figure 2 illustrates number of properties which changed ownership over the period. Given that the latter years may be biased due to missing data, Panel B depicts the number of property transfers filed within the current year, and indicates a similar overall pattern.

During 1988, approximately 3,700 property transfers were filed with LRD; by 1992, this amount had declined significantly, and remained close to this level until 2003, after which property transactions began to pick up again at an annual average growth rate of 8 percent. However, since 2007, there have been substantial declines in the number of transactions being filed, with a notable exception in 2010. Notwithstanding this uptick in 2010, which resulted from transactions related to one particular development, the number of properties which changed ownership declined to 1,947 by 2013.

Figure 2: Number of properties which changed Ownership (1988-2013)



Panel A: Number of property transfers which were filed within the sample period.

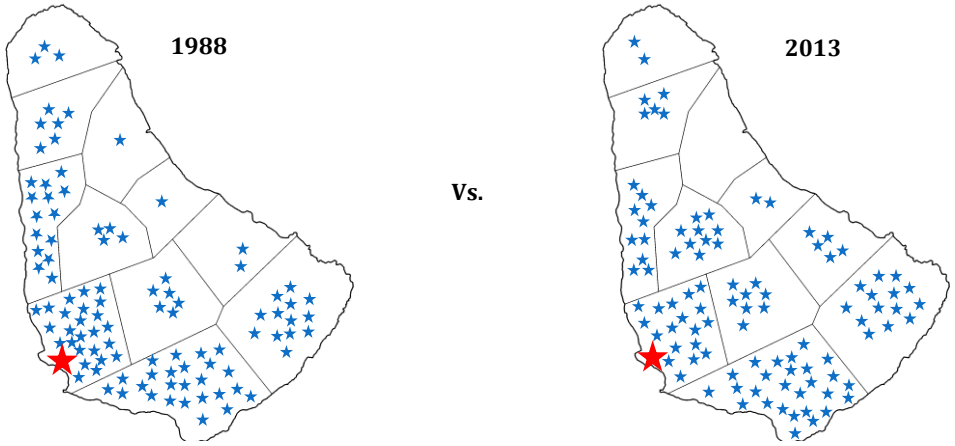
Panel B: Number of property transfers which were filed within that particular year.

Source: Land Registry Department

Majority of transactions filed over the period relate to properties situated in the south-west or more urban sub-urban parts of the island[3]; on average, 72% of these properties are located in four of the eleven parishes. Figure 3 illustrates the proportion of property transfers by parish, and shows only modest variation in the geographical dispersion of transactions between 1988 and 2013.

[3] The dispersion is also quite highly correlated with the dispersion of the population as evidenced by the Barbados Census (2010). See Appendix Table A1.

Figure 3: Proportion of Properties which changed Ownership by Parish 1988 vs. 2013



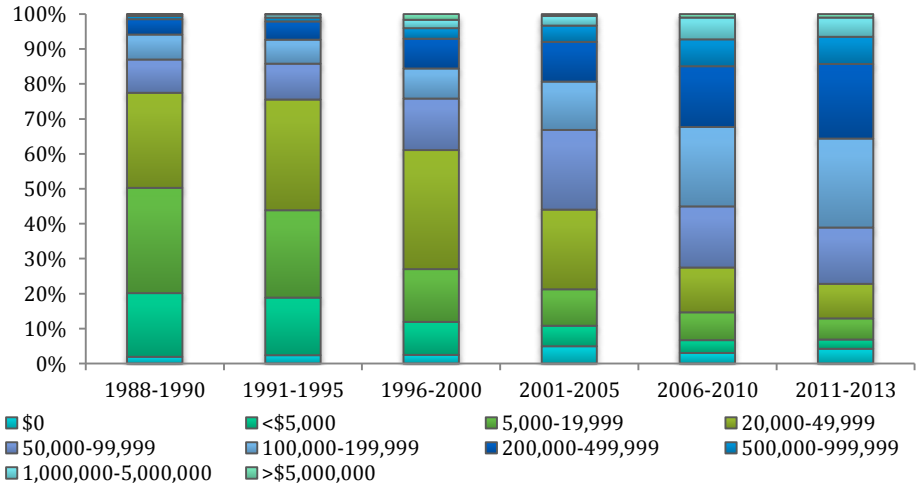
Panel A: Proportion of property transfers by parish in 1988

Panel B: Proportion of property transfers by parish in 2013

Source: Land Registry Department

Figure 4 depicts the composition of property transfers by transaction price and indicates an overall redistribution of the average price of properties filed over time. In the 1988-90 period 31 percent (the largest category) of properties were in the $5,000 to $19,000 range, followed by the $20,000-$49,000 category which captured 27 percent of transfers. Properties greater than $500,000 accounted for just 1.5 percent of all transactions. In contrast, by the 2011-13 period 47 percent of ownership changes were for properties were between $100,000 and $499,999, while properties greater than $500,000 accounted for almost 15 percent. Moreover, the over $5 million category is now being featured at 1 percent in 2013, which did not feature at all in 1988.

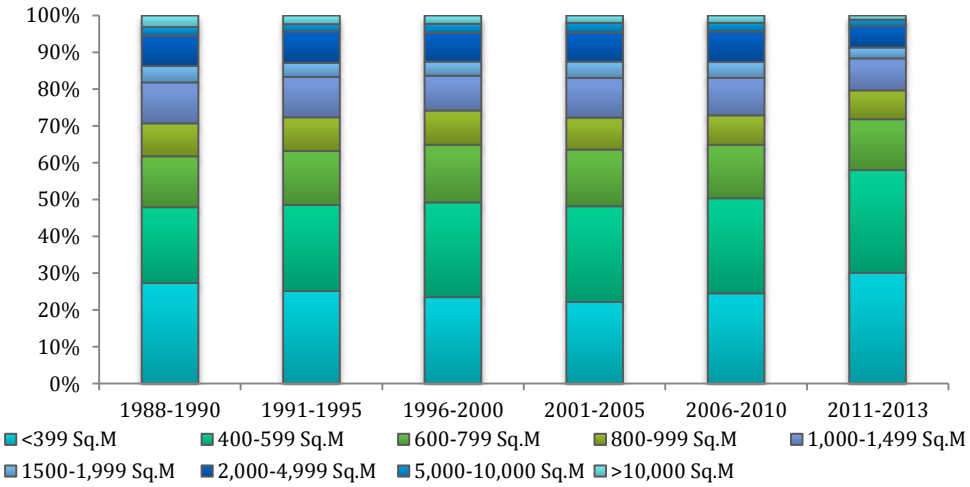
Figure 4: Proportion of Properties which changed Ownership by Transaction Price



Source: Land Registry Department

This shift in the distribution of transaction prices observed indicates to some extent the degree of increase of property prices over time. However, constructing a true measure of property prices is quite challenging due to the sporadic nature in which these transactions occur, and more importantly, is dependent on the characteristics of the properties under consideration (for example size of property), and how these have changed over time. Figure 5 indicates that the relative proportions of transactions with a particular size[4] remained quite stable over time, with majority of the properties being characterized by the smaller sized bands. On average, 25 percent of transfers were for properties less than 400 square metres (4,306 square feet), while another 25 percent represented those between 400 and 600 square metres (6,458 square feet).

Figure 5: Proportion of Properties which changed Ownership by Size



Source: Land Registry Department

The relatively stable size-proportions combined with the growing shift towards higher priced properties once again points towards an overall increase of prices over the period. However, other characteristics of the property should also be considered, such as whether it has structure, and the size and relative quality of the structures over time, including the number of rooms. In the following section and the next, the authors will seek to develop various measures of constructing a real estate price index to determine the exact nature of these price changes over time.

[4] Size here refers to the land area of the property, and does not take into account any structure that may exist on the property.

4. Challenges and the Way Forward

A number of challenges still remain that continues to hamper our development of an appropriate retail price index for Barbados:

- The current dataset does not distinguish whether there is structure on the property (or any of its characteristics) or whether it is land alone.
- There is currently no distinction between residential and commercial real estate.
- Condominiums are listed as having zero size/area in the database.
- Legislation detailing the information that should be included when filing property transfers took effect from 1980. However a few entries are still reported without a land tax number.
- There still appears to be a small level of duplication, where repeats of blocks of data, with varying land numbers, or transactions with the same price, date, address and land tax number but with substantially different sizes.
- In a sub-division of a development, the individual properties are assigned the land tax number of the original property. A unique land tax number is only assigned after the individual properties have been filed, and only shows up in the filing system if/when the property is subsequently sold.

Guided by the above challenges, the project will therefore proceed with the following:

- Have further discussions with LRD to tease out some of the nuances observed in the data
- Attempt an estimation the simple/stratified median price index
- Determine whether there is a unique code that may be used to track individual properties through the system, so as to enable the use of the repeat sales method
- Follow-up with the Land Tax Department and/or Town and Country Planning to determine whether it is possible to obtain the characteristics associated with the properties, so as to conduct the hedonic approach.

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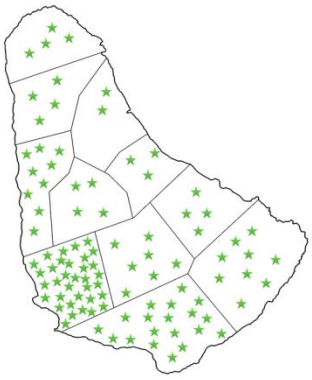
Appendix

Figure A1: Distribution of the Population by Parish (2010)



Source: Barbados Statistical Service