Volatility: A Statistical Comparison Between the Secondary and Primary Home Markets

The Lower Cape's Volatility and Average Return Compared to Three Boston Area Primary Markets.

By
Craig Knight
B.A., Economics, 1993
Northwestern University

Submitted to the Department of Urban Studies and Planning
in Partial Fulfillment of the Requirements for the
Degree of Master of Science in Real Estate Development
at the
Massachusetts Institute of Technology
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Signature of Author:_____
Department of Urban Studies and Planning
August 4, 2003

Certified by:_____
Dr. Henry O. Pollakowski
Visiting Scholar, Center for Real Estate
Thesis Advisor

Accepted by:_____
Professor David Geltner, Chairman
Interdepartmental Degree Program in Real Estate Development

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ABSTRACT

This thesis attempts to analyze the long-standing perception that the secondary home market, homes built in and around vacation areas, is more volatile than the primary home market. For the first time, this study measures the volatility of a secondary home market, the Lower Cape. This markets volatility and average return are then compared with three primary housing markets in Boston's Metropolitan Statistical Area.

In order to compare the volatilities and average returns among the markets, a price index for Lower Cape Cod was estimated by applying the repeat sales regression technique to sales transaction data from the Warren Group. The Case, Shiller, Weiss zip code price indexes for the Boston area were used for the comparison primary markets.

The results from the study suggest that the secondary market is not more volatile than all primary markets. In fact, from these findings it appears that secondary markets have very similar volatilities and average returns to primary markets within 10 miles of the economic center of the region. This study finds that the Lower Cape was less volatile and had lower average returns than the market region within five miles of downtown Boston. The study also demonstrates that the Lower Cape's housing market is highly correlated with Boston's market and appears to lag behind Boston's market by one year.

Thesis Supervisor: Dr. Henry O. Pollakowski
Title: Visiting Scholar, Center for Real Estate

ACKNOWLEDGEMENTS

I would especially like to thank Dr. Henry Pollakowski and Professor David Geltner. I would not have been able to complete this study with out both of their invaluable help. I would also like to thank Karl Case for providing the Boston MSA Zip Code indexes. Without the primary market indexes, the comparison study could not have been possible.

In addition, I would like to thank my wife Jody who now knows more about price indexes and repeat sales regressions than she ever wanted to.

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INTRODUCTION

Recent Trends in The Secondary Home Market

Since the mid 1990's, development in and around resort areas has become a thriving niche in the real estate industry. According to the National Association of Realtors, the secondary home market makes up nearly 6% of the annual single-family homes sales throughout the United States.[1] Last year's median price appreciation in the secondary home market was nearly 27%. "Make no mistake, the second home market is extremely hot and will be for some time to come," said the National Association of Realtors (NAR) president Martin Edwards Jr. in 2002.[2] In addition, Broderick Perkins of Realty Times believes that "With 77 million baby boomers set to retire in the next three decades and [with] the increased desire by high net worth individuals to acquire a place to get away, it appears that the demand for second homes and the recent price appreciation will only increase for the foreseeable future."[3]

Hypothesis

The historical perception of the secondary home market is that price levels heat up during periods of strong economic growth, only to bust during impending recessions. Due to the recent increase in second home demand and the unprecedented price appreciation, the overwhelming perception is that the secondary home market is experiencing another one of its highly volatile boom-bust market swings.[4]

Although these perceptions of the secondary home market may be accurate, the lack of data has made thorough statistical analysis impossible. Without complete statistical analysis, markets tend to suffer from pricing inefficiencies and misinformed investors, which leads to higher levels of market volatility.[5] The intent of this paper is to take the first careful statistical look at one

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[1] Sichelman, Lew, *Second Home Market, Older and Larger than Thought,* Realty Times, 2002.
[2] Perkins, Broderick, *Second Homes Remain a Sound Investment,* Realty Times, 2002.
[3] Ibid.
[4] The author interviewed a sample of 12-second homeowners to compare the volatilities between the secondary home market and the primary home market. In each case all of the subjects questioned, perceived the secondary home market as a "riskier" investment than the primary market.
[5] Gatzlaff, Geltner, *A transaction Based Index of Commercial Property and its Comparison to the NCREIF Index,* 1998

secondary home market, and create a repeat sales price index in order to better understand the secondary home market's price level trends, average returns, and market volatility. In addition, this paper will attempt to compare the secondary market index to three primary home market indexes. To date, no one has created a price index for a secondary home market in order to chart its historical price level trends and compare its average return and volatility to a primary home market.

The comparison between the secondary home market index and the three primary home market indexes will answer three central questions about the secondary home market in the hope of increasing its market efficiency and accurately informing investors about its risk levels. Until this study, these three questions could not be answered with any statistical significance.

1. Is the secondary home market more volatile than the primary home market?
2. Is the secondary market's average return commensurate with the level of risk as compared to the primary market?
3. Is the secondary market correlated with the primary market?

For this study, Lower Cape Cod was chosen as the market area to create the secondary home market index. The Lower Cape is comprised of four Cape Cod towns, Harwich, Brewster, Chatham, and Orleans. Each town's repeat sales observations from 1989-2002 were aggregated to create the Lower Cape Index. The Lower Cape Index (LCI) was compared to three primary market regions in the Boston area. The primary market data was obtained from Case, Shiller, and Weiss's Boston Metropolitan Statistical Area zip code price indexes. Zip code indexes were aggregated to create three distinct primary market regions, one 0-5 miles from downtown Boston, one 0-10 miles from downtown Boston, and one 10-25 miles from downtown Boston.[6]

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[6] The Author would like to thank Karl Case for offering the Boston MSA Zip Code Indexes to be used as the primary home market data.

Pre-Analysis Expectations

Due to the lack of prior serious analysis on the secondary home market, there are no prevailing statistical expectations. However, the simple economic expectation exists that the second home market demand is driven by a strong economy when people have higher than normal discretionary income. During these times of high prosperity, individuals and families purchase second homes in resort communities, driving up home prices in the market. But, during economic slow downs, demand falls sharply, and more secondary homeowners place their vacation properties on the market, due to a decrease in discretionary income and spending. The compounded effect of the decrease in demand and increase in "for sale" supply forces market prices down even further. This cycle creates the perception that the secondary home market is highly volatile. With higher volatility, one might reasonably predict that average annual returns in the secondary market should be commensurate with the risk. Therefore the pre-analysis hypothesis is that the secondary home market should have a higher volatility than primary home markets and therefore higher average annual returns.[1]

Framework of the paper

After the Introduction, the first chapter of this thesis gives the reader a brief history of Cape Cod and explains how the area became a secondary home market, in relationship to Boston. The second chapter, the methodology section, compares three different methodologies for estimating a price index and explains how the repeat sales methodology was implemented to estimate the Lower Cape Price Index. The third chapter describes the repeat sales transaction data used to estimate the Lower Cape Index. The fourth chapter, the quantitative analysis section, shows the results of the repeat sales estimation for Lower Cape Cod. The fifth chapter summarizes the results of the Lower Cape Index and compares them to three Boston area indexes in order to assess the differences between the volatilities and average returns of the two markets. Finally, conclusions are drawn from the statistical results, and the author suggests further areas of study.

[1] This follows basic portfolio theory that higher risk investments should have higher ex-post returns.

A Brief History of Cape Cod
Establishing itself as a resort community

Early History

In November 1620, the Pilgrims set anchor off the tip of Cape Cod, named in 1602 by a Royal British scout for the abundance of fish spotted off its shores. Although the Pilgrims moved to Plymouth later that year to form a more permanent settlement, their first landing sight would later become Provincetown, a Royal Naval base during the Revolutionary war and a center for the shipbuilding enterprises of Boston's merchants during the first days of independence. With the aid of the Wampanoag Indians, Cape Cod's earliest settlers subsisted on farming and raising livestock on the sandy soil, which proved less than ideal for agriculture. By the late 1700's to mid 1800's, the substantial amount of finfish and shellfish in the area kept most of the seacoast towns thriving.[8] During this period, settlers harvested cranberries and started a whaling industry, which was ultimately surpassed by Nantucket and New Bedford. Ports along the bay continued to trade with ships carrying goods to and from Boston, and Cape seamen were in great demand in deep water ports such as Boston and New York.[9] By the turn of the 19th century, a saltworks industry attempted, but ultimately failed, to take hold in the area.[10] It was during this period that President Grover Cleveland made the Cape his "summer White House," and artists and writers began flocking to the area, Provincetown in particular. But, it wasn't until the onset of a new rail line (which is now defunct and has been converted into a bicycle trail) and the construction of the mid-cape highway (formerly known as the King's highway, now known as Route 6) in the mid-twentieth century that Cape Cod became more accessible to Boston's primary residents and took a firm stance as a secondary home community. Currently, Cape Cod towns have an average population of 2,500 year round residents. During the summer, these population statistics typically grow fivefold.[11]

The Creation of Cape Cod National Seashore Establishes the Cape as a "Summer Resort."

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[8] Foster, C. *The Cape Cod National Seashore A Landmark Alliance,* 1985.

[9] NY Times Fodors Website

[10] Foster, C. *The Cape Cod National Seashore A Landmark Alliance,* 1985.

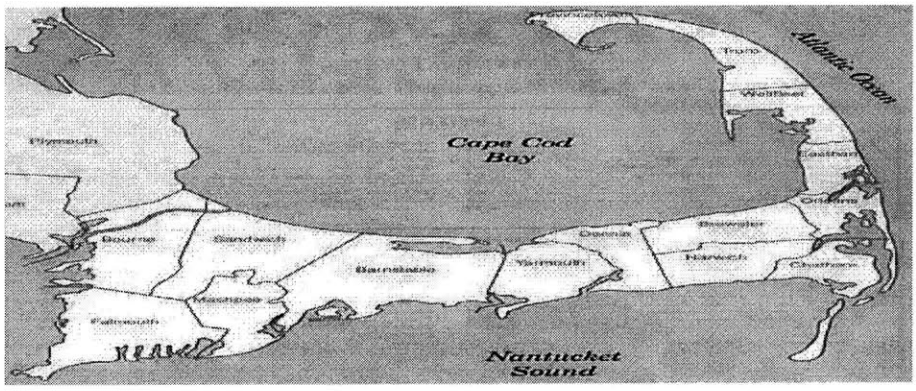
[11] Ibid.

The creation of the Cape Cod National Seashore in 1961 truly converted the Cape into a destination location for summer vacationers and second homeowners. In August of 1961, President John F. Kennedy, who spent many summers vacationing on the Cape, signed the legislation establishing the Cape Cod National Seashore. He said, "I hope that this will be one of a whole series of great seashore parks which will be for the inspiration and enjoyment of people all over the United States." From that point forward, the Cape firmly established itself as a destination location. The Cape's native wildlife, open beaches and countryside, and multiple outdoor activities made it an ideal spot for the secondary homebuyer.[12]

Cape Cod's Geography

The Cape Cod peninsula extends into the Atlantic Ocean for close to 70 miles off the Massachusetts coastline. The Cape Cod National Seashore, managed by the National Park Service, extends for 40 miles along the Cape's outer arm between Chatham and Provincetown. Generally, the part of the arm closest to the mainland is called the Upper Cape, and the end farthest from the mainland is referred to as the Lower Cape. More specifically, The Upper Cape towns include Bourne, Falmouth, Mashpee, and Sandwich. The Mid Cape towns include Barnstable, Dennis, Hyannis, and Yarmouth. The Lower Cape towns include Chatham, Brewster, Orleans, and Harwich. The Outer Cape towns include Provincetown, Truro, Wellfleet, and Eastham.[13]

Figure 1: Map of Cape Cod



Source: Internet Maps

[12] Foster, C. *The Cape Cod National Seashore A Landmark Alliance,* 1985.
[13] Ibid.

The Repeat Sales Regression Methodology
Estimating The Lower Cape Price Index

The Importance of House Price Indexes

A price index tracks changes in the value of an asset or asset class over a period of time.[14] For example, the Dow Jones Industrial Average (DJIA) is an index of the weighted average of 30 stocks. The DJIA index allows investors to track changes in the stock market and assess how it has performed on both a daily and historic basis. An index that tracks how the stock market performs over time allows investors to calculate stock market volatility and its average return and measure its correlations with broader markets. The information provided by the DJIA index allows investors to make more informed investment decisions and allows them to develop better price expectations. [15]

While it is easy to track changes in stock prices and create market indexes from these price changes, this is not always the case for real estate assets. The lack of asset homogeneity and infrequent trading makes the real estate market informationally inefficient. Lack of market information can causes high levels of volatility due to the inability to determine a "market value (price)" for a particular real estate asset. [16]

Even though it is difficult to track price changes in real estate assets, it is important to determine price indexes for these assets in order to increase market efficiency and allow investors to make informed investment decisions. The most commonly used index for commercial real estate assets is the NCREIF Property Index (NPI). This index is created based on the appraised values of commercial property. In addition to the NPI, other firms have created indexes for single-family homes in and around large cities, or Metropolitan Statistical Areas (MSA's). The Office of Federal Housing Enterprise Oversight (OFHEO)[17] created price indexes by MSA for detached single family homes based on repeat sales transactions from mortgage data obtained from

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[14] Another definition of a Price Index is a measure of periodic "wealth" changes.
[15] Gatzlaff, Geltner, *A transaction Based Index of Commercial Property and its Comparison to the NCREIF Index,* 1998
[16] Ibid.
[17] website: www.ofheo.gov

Freddie Mac and Fannie Mae. This type of index is a useful resource for investors and homebuyers of single-family homes.

Price Indexes for Single Family Homes: A Comparison of Three Different Methodologies, the Repeat Sales Regression, the Hedonic Regression, and the Hybrid Model.

Repeat Sales Regression (RSR)[18]

A repeat sales regression estimates the period-by-period capital return of a real estate asset by measuring repeat sales transactions of individually traded properties. Case, Pollakowski, and Wachter (1991) aptly describe a repeat sales price index as "[An index that focuses] solely on individual properties that transacted at least twice during the study period and for which no attributes changed between transactions. Thus the difference between the transaction prices is solely a function of the study's time period."[19]

For example, a repeat sales regression can estimate the annual capital return for a town's single family homes by measuring homes that sold more than once during a given time period.[20] Bailey, Muth, and Nourse (1963) proposed the first RSR methodology. Advancements in the RSR technique have been made over the past 15 years.[21] Today, RSR methodology is widely used by government housing agencies and private consulting firms to track periodic percent changes in asset values for single family homes.[22]

There are some drawbacks to the RSR however. An RSR can lead to biased measurements of price appreciation.[23] For example, in a particular market there may be some frequently transacting properties which are not representative of the larger population. Additionally, an

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[18] For a detailed statistical review of estimating price levels with the Repeat Sales Regression Methodology, see Statistical Methodolgy Appendix A. Additionally, the author assumes that a repeat sales regression is interchangeable with a repeat sales index.

[19] Case, Pollakowski, and Wachter, *On choosing among house price index methodologies (1991)*

[20] It is necessary to have at least one observation per time period in order to create a repeat sales index. In addition this example assumes that no attributes or capital improvements were made to the individual properties during the study's time period.

[21] Case and Shiller, *The Efficiency of the Market for Single-Family Homes (1989)*, Goetzman, *The accuracy of Real Estate Indices* (1992).

[22] Case, Shiller,Weiss consulting firm, and OFHEO a government agency are two examples of firms the use the repeat sales methodology to create single family home price indexes.

[23] Case, Pollakowski, and Wachter, *On choosing among house price index methodologies, (1991)*

appreciation bias may occur when small home improvements (over time) increase the sales price of a home, but are not significant enough improvements to be "noticed" and removed from data.[24] Aging of properties is a changing factor that cannot be "accounted for" in the RSR methodology and may contribute to appreciation bias. An even more subtle bias can occur if attribute prices vary over time.[25]

Another area of concern with the RSR methodology is inefficient sample size and index "noise"[26]. Noise is apparent in an estimated index by the presence of a "spiky" or "sawtooth" appearance in the return or the index level graphs. Noise occurs when the RSR technique estimates the periodic capital returns for a small number of observations (or small sample size) over the study's time period. Since the RSR methodology is restricted to repeat sales transactions with no changes in property attributes, the RSR technique is particularly prone to small sample sizes since most observations are removed from the data set.[27] Small sample sizes and the resulting index "noise" are particularly prevalent with commercial and industrial real estate repeat sales indexes where transactions tend to be quite infrequent and acquiring sales data can be difficult. However, since noise is noticeable in resulting indexes, it is possible to judge whether the index has successfully filtered out most of the noise. In any case, the more transaction observations per time period, the better the regression estimation can filter out the transaction noise.[28]

Hedonic Regression (HR)

Another methodology, the hedonic regression procedure, uses property characteristics to estimate transaction based price indexes for different real estate markets. Unlike the RSR technique, the HR methodology can account for property attributes such as property age and changes in attribute prices over time.

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[24] Since the RSR methodology requires that no attribute has changed between the transaction periods, it is necessary to remove (clean) any repeat sales transactions for properties that have had capital improvements.
[25] The HR approach can account for time-varying attributes as well as the impact of age.
[26] If the resulting index has excess noise then there are statistical smoothing methods. The "Ridge Regression Technique" will be discussed briefly later in this chapter. For a statistically summary of the procedure see, Statistical Methodology Appendix B.
[27] Case and Shiller, *The Efficiency of the Market for Single-Family Homes (1989).*
[28] Gatzlaff, Geltner, *A transaction Based Index of Commercial Property and its Comparison to the NCREIF Index,* (1998)

However, the HR methodology is also subject to bias and inefficiencies. The main bias with the HR technique is knowing which characteristic variables influence (and by how much) the transaction price of property. Difficulty obtaining or omitting explanatory variables can cause significant bias in the price estimates. According to Case, Pollakoski, and Wachter (1991), "Because of the difficulty of correctly specifying a hedonic price model, several economists have advocated a repeat sales method both as a means of avoiding the bias introduced by an incorrectly specified hedonic model and as a means of taking advantage of the "controls" inherent in repeat sales transaction."[29]

Hybrid Approach

The Hybrid approach jointly estimates the hedonic and repeat sales regression equations in an attempt to eliminate the bias and inefficiencies of each of these two methods. Case and Quigley (1991), were the first to propose the hybrid approach and found that by combining the two equations they increased the efficiency of the price index estimation. However, according to Case, Pollakowski, and Wachter (1991), "Even though it was found to increase the efficiency of the estimation, [there are difficulties] combining the repeat sales and hedonic regression methodologies [since it assumes] homogeneity between the two markets represented by both data sets."[30]

LOWER CAPE INDEX (LCI): Choice of Estimation Technique

The repeat sales regression methodology was implemented to estimate the Lower Cape Index. As is with most price indexes, the availability of data limited the choice of methodologies that could have been used to estimate the LCI.[31] In this case, there were very few property characteristics contained within the data set that could have been used to estimate price changes over time. The lack of characteristic attributes eliminated the ability to estimate the price index with either the HR or Hybrid methodologies. In addition, the intent behind this study was to compare a secondary market index to a primary market index. In this case, the primary index

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[29] Case, Pollakowski, and Wachter, *On choosing among house price index methodologies (1991)*

[30] Ibid

[31] Ibid

chosen for comparison, the Boston Area zip code price index(es) were estimated using the RSR methodology.

The Repeat Sales Regression Equation: Estimating the Lower Cape Index

The repeat sales equation used to estimate the LCI can be expressed as follows[32]:

$$Y = D\beta + \varepsilon$$

Y is the left hand side (the dependent variable) of the regression equation. The LHS is a column vector of the log price relative observations, for example; $Y_1 \equiv LN(P_2/P_1)$. The right hand side of the regression equation consists of D, which is a dummy variable matrix whose rows correspond to the observations and columns correspond to the years in the regression, in this case 1989-2002. In this procedure, the dummy variable is 1 between the sale pair transaction and 0 otherwise.[33] β is the regression results coefficients, a column vector of period-by-period compounded capital returns. ε is a column vector of the regression "error" term.[34]

Mitigating Bias and Sample Inefficiencies in the LCI

In an attempt to eliminate appreciation bias caused by capital improvements (home renovations), sale pairs that had greater than 100% return in less than 1.5 years were eliminated from the data set. An additional measure to eliminate bias in the LCI was taken by deleting any transaction for less than $100,000 from the sample set. There were two reasons for this: 1. From a close inspection of the data, many transactions for less than $100,000 appeared to be non-arms length transactions. For example, a home would sell for $25,000 from one person to another; however, they both had the same surname. 2. There was an inability in the data set to determine if an address was originally a land only parcel. For example, a land only parcel of property would sell for $45,000 in 1990 and be sold two years later in 1992 for $250,000 with a newly built home on it.[35] Finally, any sale pair transaction that occurred in the same year was deleted from the data

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[32] Gatzlaff, Geltner, *A transaction Based Index of Commercial Property and its Comparison to the NCREIF Index,* (1998).

[33] It is important to note that the first sale transaction is 0, not 1.

[34] Gatzlaff, Geltner, *A transaction Based Index of Commercial Property and its Comparison to the NCREIF Index,* (1998).

[35] This was observed on a parcel of property in the data set for known transactions.

set. The reason for this was that there was no way for the repeat sales regression to "observe" a sale of this type since the LCI is an annual index, not semi-annual or quarterly.

Filtering Excessive "Noise" from the LCI[36]

After running the first repeat sales regression estimation on the Lower Cape it was apparent from the spiky appearance in the index that excessive noise was present in the resulting price estimates. In order to eliminate the noise from the price estimates, the "ridge regression technique" was implemented.[37] The ridge regression procedure is essentially the Bayesian/Method of Moments estimation technique developed by Goetzmann,(1992) which filters excessive noise in data sets with relatively small sample sizes using *a priori* expectations.[38]

[36] For a the entire "ridge regression" statistical procedure, see Statistical Methodology Appendix B.
[37] I thank David Geltner for his assistance with this step.
[38]Goetzmann, *The Accuracy of Real Estate Indices: Repeat Sales Estimators.(1992)*

A Description of The Data
Summary Statistics of the Lower Cape Repeat Sales Transaction Data

Why Study the Lower Cape? Some Market Demographics

The Lower Cape, which is comprised of the four towns of Harwich, Brewster, Orleans, and Chatham, was chosen because it is a well-established secondary home market. The Lower Cape has been a summer destination for vacationers for well over 40 years, and the market is dominated by second homes. Between 55-70% of homes in the area are considered to be second homes and between 10-15% of the primary homes are in fact homes occupied by retirees and non-working members of the community.[39] Finally the Lower Cape was chosen in an attempt to isolate regional economic influences. Boston, the primary home market, was used as the comparison market because it is only 90 miles from the Lower Cape.[40]

In comparison to the rest of Cape Cod, the Lower Cape has the highest concentration of secondary single-family homes. The Upper and Mid Cape are comprised of eight towns, two of which Hyannis and Falmouth, are considered thriving year round communities (more than 60% of the homes in these towns are primary homes). The Outer Cape does not have a large enough sample size to build a statistically large data set to compare with the primary market.[41]

The Lower Cape Data

The transaction data used for this study was obtained from The Warren Groups Record Service. The data was compiled by each town of the Lower Cape and aggregated by year. All sales transactions from 1989-2002 were available, but only repeat sales transactions were included in the data set.

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[39] For each town in the Lower Cape the town assessor was asked to provide the number of second homes in the area. Some towns were not as accurate as others, but for the most part their response was given by counting the number of mailing addresses.

[40] In addition, the availability of the Boston MSA Zip Code Price Indexes from Case, Schiller, and Weiss made the Lower Cape the natural secondary home market to analyze.

[41] Data was obtained for the towns of Wellfleet and Truro and it was determined that the sample size was too small. In addition, the data was not collected before 1992. It was found that the Provincetown market was mostly comprised of condos.

Descriptive summary statistics are reported for the repeat-sale data in Exhibit 2. This exhibit indicates that the data represent a wide range of property values from $100,000 to $4,500,000. It is interesting to note that from the years of 1990-1997 there were no repeat sales transactions that were for more than $1,000,000. The average home price for these transactions ranged from $130,000 in 1989 to $ 281,792 in 2002. The lowest mean occurred in 1990, $177,902, and the highest mean in 2001, $208,350. It is also interesting to note that the standard deviations remained relatively constant in the low-mid $100,000 range in the early 90's, but began spiking in 1998-2002, with the highest standard deviation year occurring in 2000, $469,924. Finally, the year with the least number of sale transactions, 77 occurred in 1991, and the most sale transactions 228, occurred in 2000.

Exhibit 2: Descriptive Statistics of the Transaction Data, Listed by Year of Sale, 1989-2002

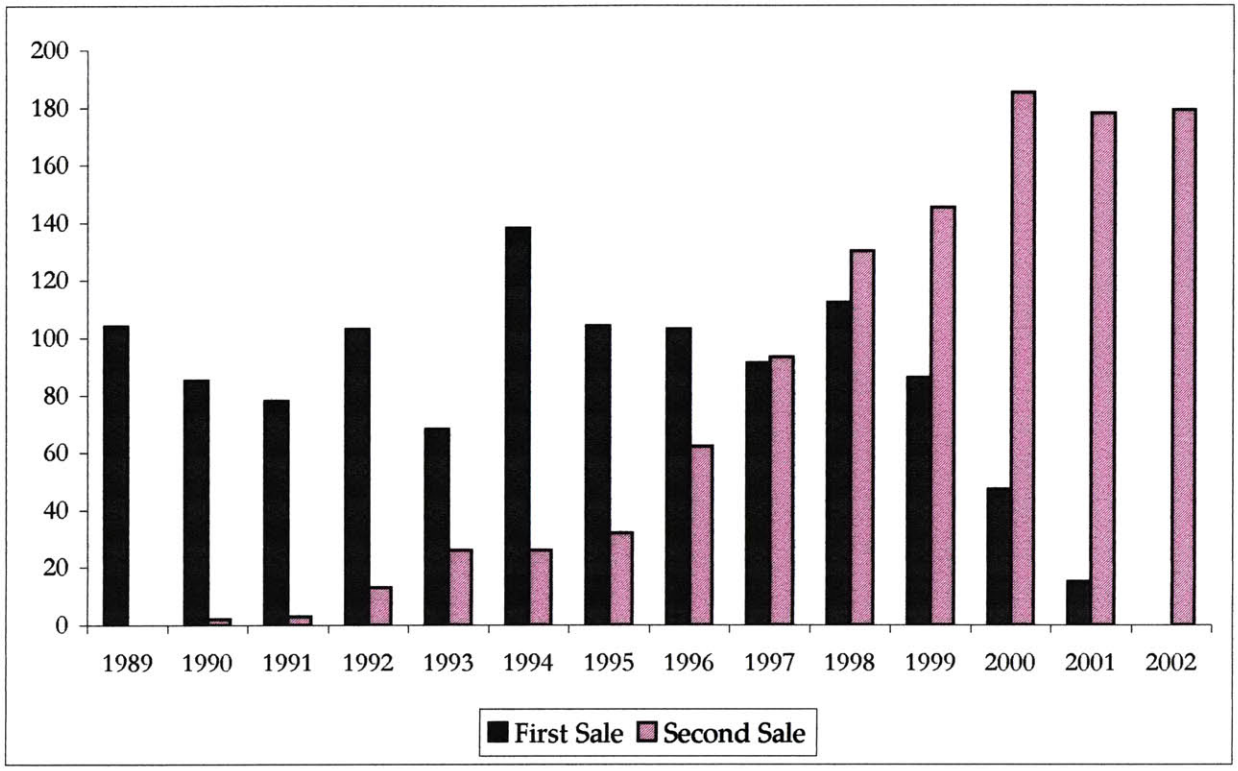
Year	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Mean	$ 221,456	$ 177,902	$ 193,532	$ 192,543	$ 186,783	$ 193,805	$ 191,831
Median	$ 171,500	$ 138,600	$ 150,000	$ 144,425	$ 151,000	$ 152,750	$ 147,250
Mode	$ 130,000	$ 160,000	$ 100,000	$ 107,000	$ 110,000	$ 100,000	$ 135,000
Std. Dev.	$ 149,193	$ 108,711	$ 121,125	$ 127,747	$ 103,192	$ 125,364	$ 111,004
Min	$ 105,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Max	$ 1,075,000	$ 815,000	$ 725,000	$ 770,000	$ 600,000	$ 975,000	$ 810,000
No Obs.	100	81	77	106	84	156	128
Year	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Mean	$ 221,763	$ 221,079	$ 241,877	$ 281,975	$ 389,955	$ 408,350	$ 381,792
Median	$ 159,200	$ 167,000	$ 170,000	$ 210,000	$ 250,000	$ 289,000	$ 320,000
Mode	$ 110,000	$ 125,000	$ 125,000	$ 250,000	$ 185,000	$ 275,000	$ 270,000
Std. Dev	$ 158,843	$ 186,826	$ 197,189	$ 266,599	$ 469,924	$ 431,416	$ 253,569
Min	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 108,750	$ 142,000	$ 120,000
Max	$ 895,000	$ 2,200,000	$ 1,600,000	$ 2,800,000	$ 3,750,000	$ 4,500,000	$ 2,350,000
No Obs.	153	175	240	227	228	187	177

Note: The statistics above are calculated from both the first and second sales of the 2,119 repeat-sale pairs.

Exhibit 3 details when each transaction occurred in a sale pair. For example, if one address was sold in 1993 and again in 2000, the chart would record the first sale in 1993 and the second sale in 2000. From viewing the chart, 1994 had the highest level of first sale transactions. In the year

2000, the most second sale transactions were recorded. The average sale time between sale pair was approximately 3.5 years.

Exhibit 3: Lower Cape Cod's Repeat Sale Transactions, by Year 1989-2002



Note: The statistics above are calculated from both the first and second sales of the 2,119 repeat-sale pairs. The Y-axis is the number of transactions in each year by sale pair.

The Lower Cape Index
Results from the Repeat Sales Regression Estimation

Results from the RSR estimation

Exhibit 4 shows the results of the RSR price index estimation for the Lower Cape from the 2119 repeat sale pairs.[42] The resulting index levels are set to an arbitrary level of 100 as of 1989. Exhibit 5 charts the LCI from 1989-2002.[43]

Exhibit 4: The RSR Estimated Index for Lower Cape Cod

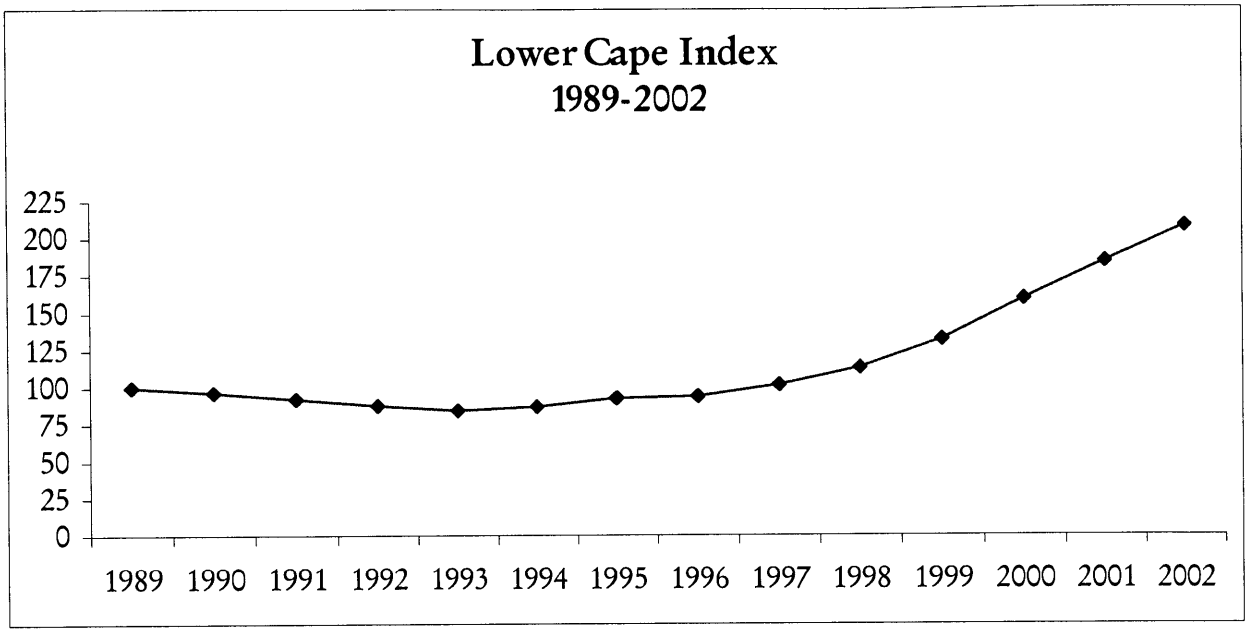
LCI Annual Summary Statistics		
GMEAN	5.79%	
MEAN	6.13%	
STDEV	8.80%	
MIN	-4.62%	
MAX	20.45%	
Year	**Index Level***	**Capital Return**
1989	100.00	
1990	96.52	-3.48%
1991	92.28	-4.39%
1992	88.01	-4.62%
1993	84.47	-4.03%
1994	87.35	3.41%
1995	92.55	5.96%
1996	94.21	1.79%
1997	101.87	8.13%
1998	113.44	11.36%
1999	132.32	16.64%
2000	159.38	20.45%
2001	184.31	15.64%
2002	207.92	12.81%

*Note: Price Index Levels are in Nominal Dollars

[42] The price estimation results listed here are the results after the ridge regression smoothing procedure was applied to the first price index estimation results. The Appendix shows the difference between the smoothed and non-smoothed results.

[43] The RSR estimation technique used here results are in geometric values. They have been converted to Arithmetic Values in order to compare the LCI with the primary market indexes. For the statistical methodology of this procedure, see Appendix A

Exhibit 5: Lower Cape Index (Charted)



The first conclusion that can be drawn from this RSR estimation is the price history revealed from the index. For five years, from 1989-1993, there was a general loss of property prices on the Lower Cape. It is not until 1994 that this property price loss reverses itself. It is also interesting to note that it is not until 1997 that the price index level recovers back to the 1989 price levels. This indicates that some buyers in 1989 may have waited 8 years for property prices to return to their 1989 price level. Finally, the price index shows a strong appreciation in property prices from 1997-2002.

The second conclusion that can be drawn from the RSR estimation is the overall annual volatility and annual average return for the Lower Cape. It was found that the Lower Cape's annual average return was 6.13% with a volatility of 8.8%. Again, this is the first time a careful statistical study has attempted to measure the annual returns and annual volatility for a secondary home market. The pre-analysis perception is that the volatility in the secondary market is quite high. From these results, it does not appear that the annual volatility is excessive; in fact this level of volatility is well below the annual volatility observed in the stock market.[44]

[44] The aggregate annual volatility in the stock market is approximately 20%. For an index of large cap stocks the annual volatility is approximately 15%, while the annual volatility of an individual large cap stocks is typically as much as 30%. (Geltner email)

The Lower Cape Index Compared to Three Primary Markets
The LCI vs. the BAI, the 128 Index, and the SI

In order to gain some comparative insight between the secondary home market and the primary market, the Lower Cape Price index was compared to three primary market indexes. The three primary indexes were created from the Boston Metropolitan Statistical Area Zip Code Index provided by Case, Shiller and Weiss. The zip code indexes were aggregated to form three primary market areas from 1989-2002.[45] The first primary market index region is within 5 miles from downtown Boston, the second index area is within 10 miles of downtown Boston, and the third area index is from 10-25 miles from downtown Boston (more specifically the area between Rt. 128 and Rt. 495).[46] For purposes of this study the index from 0-5 miles from Boston will be called the Boston Area Index (BAI), the index from 0-10 miles from Boston will be called the Rt. 128 Index (128 Index), and finally, the area between 10-25 miles from Boston will be called the Suburban Index (SI).

[45] The data from the Boston Zip Code Indexes was only until June of 2002, while the Lower Cape Data contained sales transactions from the entire year.
[46] Measured from the corner of Franklin and Congress st. in Downtown Boston. Distances were taken from Mapquest's driving distances in miles.

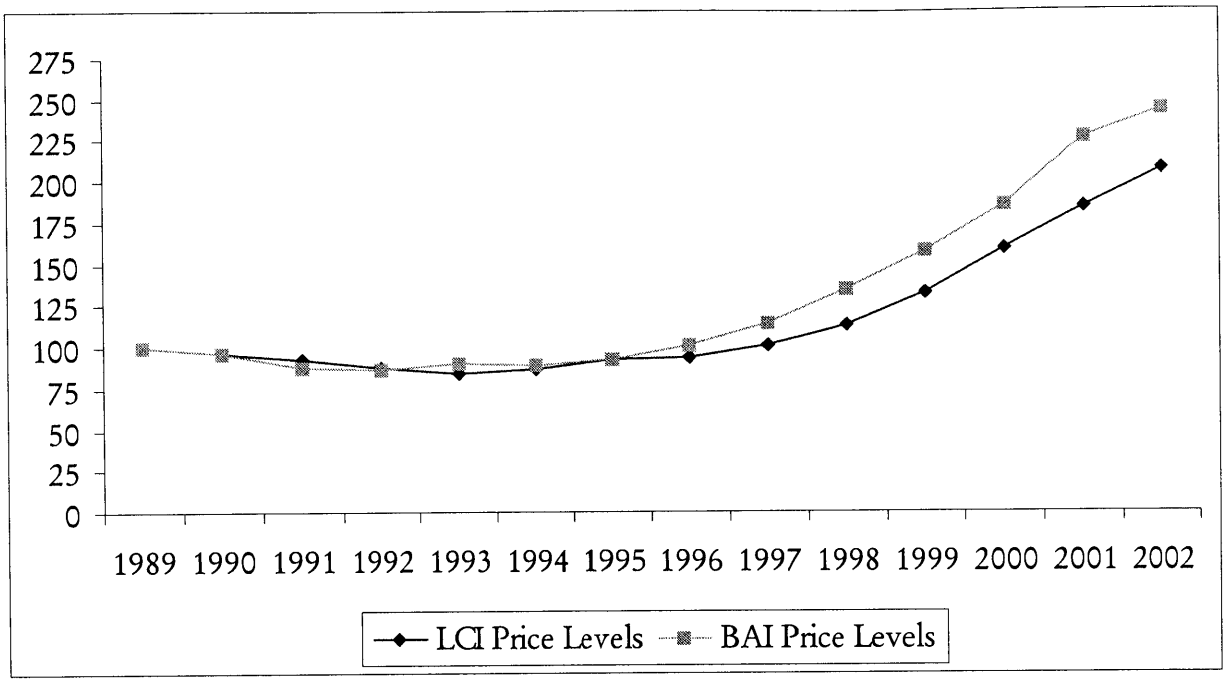
The Lower Cape Index compared to the Boston Area Index (0-5 Miles from Downtown Boston)

Exhibit 6 summarizes the statistics of both the LCI and the BAI on an annual level in order to make comparisons between the primary and secondary home markets. The estimated price levels are set to an arbitrary level of 100 as of 1989. Exhibit 7 charts both the LCI and the BAI price level indexes from 1989-2002.

Exhibit 6: The Lower Cape Index estimated results compared to the Boston Area Index

Annual Return Summary Statistics				
		BAI		LCI
	GMEAN	7.11%		5.79%
	MEAN	7.50%		6.13%
	Std. Dev.	9.55%		8.80%
	MIN	-9.28%		-4.62%
	MAX	21.41%		20.45%
	Correlation		85.95%	
	Lag Correlation		91.80%	
Year	BAI Price Levels	BAI Returns	LCI Price Levels	LCI Returns
1989	100.00		100.00	
1990	96.48	-3.52%	96.52	-3.48%
1991	87.53	-9.28%	92.28	-4.39%
1992	86.37	-1.33%	88.01	-4.62%
1993	90.30	4.55%	84.47	-4.03%
1994	89.59	-0.79%	87.35	3.41%
1995	93.28	4.12%	92.55	5.96%
1996	101.66	8.99%	94.21	1.79%
1997	115.03	13.14%	101.87	8.13%
1998	135.61	17.90%	113.44	11.36%
1999	158.48	16.86%	132.32	16.64%
2000	186.28	17.54%	159.38	20.45%
2001	226.16	21.41%	184.31	15.64%
2002	244.09	7.93%	207.92	12.81%

Exhibit 7: The LCI and BAI Estimated Price Levels (Charted)



The results summarized in Exhibit 6 and 7 are quite interesting and unexpected for the following reasons. First, the primary market (BAI) not only has a higher volatility (9.55% vs. 8.88%) than the secondary home market (LCI), but it also has a higher annual average return (7.50% vs. 6.13%). This is quite surprising as the pre-analysis expectations were that the volatility of the Lower Cape would not only be higher than comparative primary markets, but would also have higher annual average return.

Another surprising result is the correlation (+85.95%) between the two markets. This high level of correlation is strong evidence of interdependence between the markets annual returns, rather than two independent markets, which was the prevailing hypothesis. In addition, the correlation between the BAI and the LCI increases to +91.80% when lagged by one year. (It is interesting to note that both the lowest and highest returns in the BAI preceded the lowest and highest returns in the LCI.) This high degree of "lagged" correlation indicates that the Boston Area Market may be good price indicator for the Lower Cape.

When comparing the historical price trends, the result is also quite interesting. The BAI return levels appear to have fallen much lower in the early nineties as compared to the Lower Cape

market (-9.01% return vs. –4.39% return in 1991). Also, the Lower Cape Index had 5 consecutive negative years in its annual returns, followed by a 9 positive return years, while the Boston area market appears to have had a few false starts in the early nineties with a positive year in 1993 followed by a negative year in 1994, and then followed again by a positive return year in 1995.

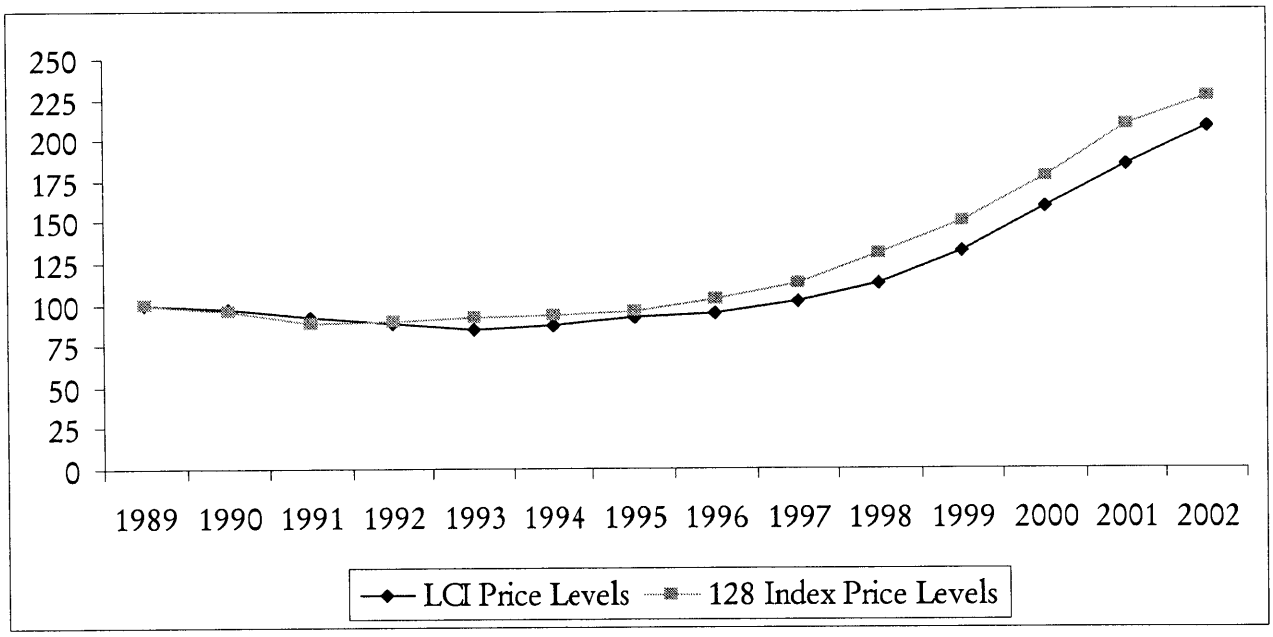
The Lower Cape Index Compared to the Rt. 128 Index (0-10 Miles from Downtown Boston)

Exhibit 7 summarizes the statistics of both the LCI and the 128 Index on an annual level in order to make comparisons between the primary and secondary home markets. The estimated price levels are set to an arbitrary level of 100 as of 1989. Exhibit 8 charts both the LCI and the 128 price level indexes from 1989-2002.

Exhibit 7: The Lower Cape Index estimated results compared to the 128 Index

Annual Return Summary Statistics				
		128 Index		LCI
	GMEAN	6.47%		5.79%
	MEAN	6.76%		6.13%
	Std. Dev.	8.20%		8.80%
	MIN	-7.54%		-4.62%
	MAX	17.93%		20.45%
	Correlation		90.18%	
	Lag Correlation		92.26%	
Year	128 Index Price Levels	128 Index Returns	LCI Price Levels	LCI Returns
1989	100.00		100.00	
1990	96.31	-3.69%	96.52	-3.48%
1991	89.06	-7.54%	92.28	-4.39%
1992	89.39	0.38%	88.01	-4.62%
1993	91.78	2.67%	84.47	-4.03%
1994	93.04	1.37%	87.35	3.41%
1995	95.99	3.18%	92.55	5.96%
1996	103.06	7.36%	94.21	1.79%
1997	113.41	10.05%	101.87	8.13%
1998	130.75	15.29%	113.44	11.36%
1999	151.01	15.49%	132.32	16.64%
2000	176.81	17.08%	159.38	20.45%
2001	208.51	17.93%	184.31	15.64%
2002	225.86	8.32%	207.92	12.81%

Exhibit 8: The LCI and the 128 Index Estimated Price Levels (Charted)



The comparative results between the Lower Cape and inside the Rt. 128 market regions are strikingly similar. Again, the pre-analysis expectation did not predict such a high degree of similarity between the markets. The volatility between the indexes is only slightly different. The 128 Index appears modestly less volatile with 8.2% annual volatility as compared to 8.8% for the LCI. Additionally, the annual average returns are quite similar between these two markets. The annual average return for the 128 Index is 6.76% as compared to 6.13% for the LCI. Finally, the two markets are highly correlated with a +90.18% correlation and a +92.26% one-year lag correlation.

As noted in the results, the difference between these two markets is only very slight, but what is not clear from these results is why the average annual return for the 128 Index is slightly higher than the LCI (6.76% vs. 6.13%). The expectation from basic portfolio theory is that the higher the volatility the higher the ex-post returns. (The LCI has a higher volatility, so the expectation is that it should have a higher average annual return.) As this result is atypical, the difference between these average annual returns is so slight they may not be statistically significant and could have been caused by random estimation error.[47] Another explanation may be due to the

[47] Particularly since two different sources of data and methodology procedures were used to estimate each index.

sample's time period. As noted in the results, the Lower Cape price levels appear to lag the primary markets price levels by one year. If this is the case, the Lower Cape will sustain an additional year, or possibly more, of higher returns at the peak of the market cycle, which would increase the annual average returns for the Lower Cape as compared to the 128-market region. However, the only conclusive way to test this theory is to continue the study for the next few years, or until the peak of the current market cycle has been reached in both the primary and secondary markets.

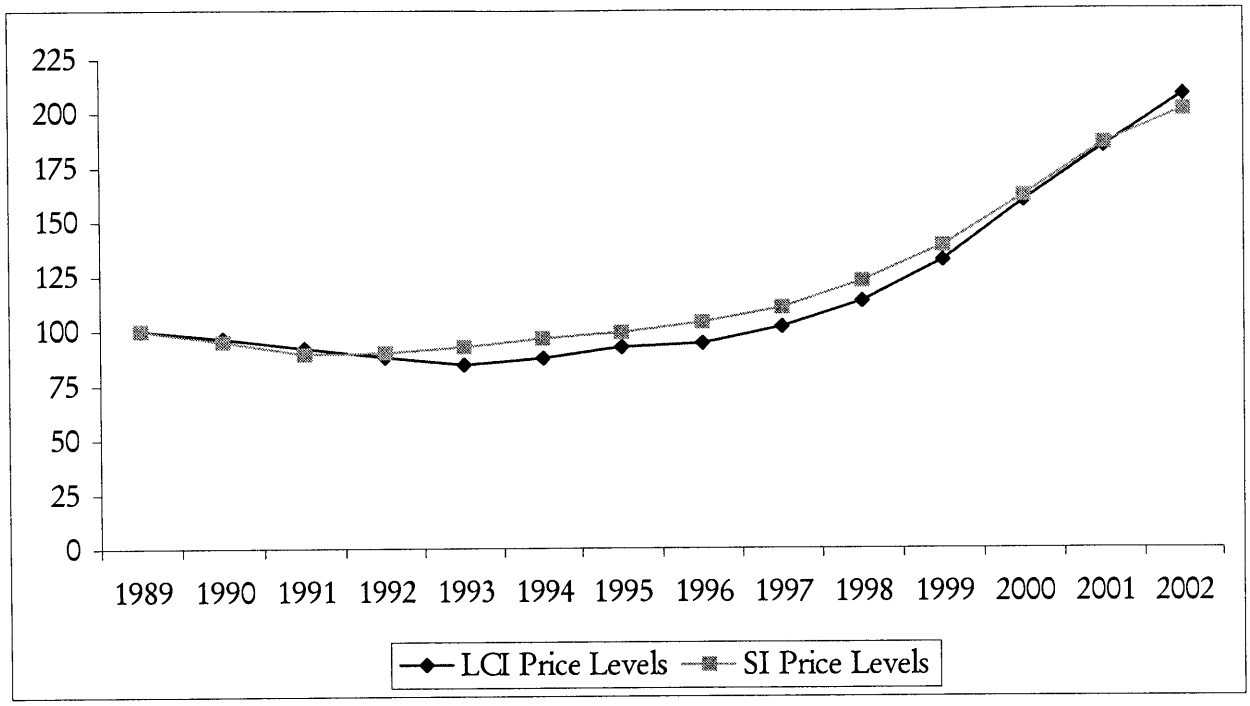
The Lower Cape Index Compared to the Suburban Index (10-25 Miles from Downtown Boston)

Exhibit 9 summarizes the statistics of both the LCI and the SI on an annual level in order to make comparisons between the primary and secondary home markets. The estimated price levels are set to an arbitrary level of 100 as of 1989. Exhibit 10 charts both the LCI and the SI from 1989-2002.

Exhibit 9: The Lower Cape Index estimated results compared to the Suburban Index

Annual Return Summary Statistics				
		SI		LCI
	GMEAN	5.52%		5.79%
	MEAN	5.73%		6.13%
	Std. Dev.	6.94%		8.80%
	MIN	-5.68%		-4.62%
	MAX	16.29%		20.45%
	Correlation		92.53%	
	Lag Correlation		92.48%	
Year	SI Price Levels	SI Returns	LCI Price Levels	LCI Returns
1989	100.00		100.00	
1990	95.06	-4.94%	96.52	-3.48%
1991	89.66	-5.68%	92.28	-4.39%
1992	90.11	0.50%	88.01	-4.62%
1993	92.70	2.87%	84.47	-4.03%
1994	96.66	4.27%	87.35	3.41%
1995	99.20	2.63%	92.55	5.96%
1996	103.86	4.70%	94.21	1.79%
1997	110.71	6.59%	101.87	8.13%
1998	123.02	11.12%	113.44	11.36%
1999	139.04	13.02%	132.32	16.64%
2000	161.69	16.29%	159.38	20.45%
2001	185.92	14.99%	184.31	15.64%
2002	200.97	8.09%	207.92	12.81%

Exhibit 10: The LCI and the Suburban Index Estimated Price Levels (Charted)



When comparing the LCI to the Suburban Index, the results become typical of what was expected from the pre-analysis expectations. The LCI has a higher volatility (8.88%) and average annual return (6.13%) compared to the SI that has a modestly lower volatility (6.94%) and lower average annual return (5.73%). Again, the correlations between the markets are remarkably high with +92.53% correlation. However, unlike the other two primary market indexes, this index does not have an increased correlation after a one-year lag.

The trends between the two markets are clearly shown in Exhibit 10. The SI does not experience the extreme low price levels in the early 1990's as compared to the Lower Cape, but the SI also does not have as steep of a price level increase from 1997-2002. In addition, it appears that the price levels have fallen off in the Suburban Index since 2001, while the LCI appears to have sustained price level increases during these years.

SUMMARY OF THE RESULTS

Exhibit 11: Summary of the Average Annual Return Vs. Volatility, 1989-2002

The LCI and the Three Primary Markets Risk (Charted)

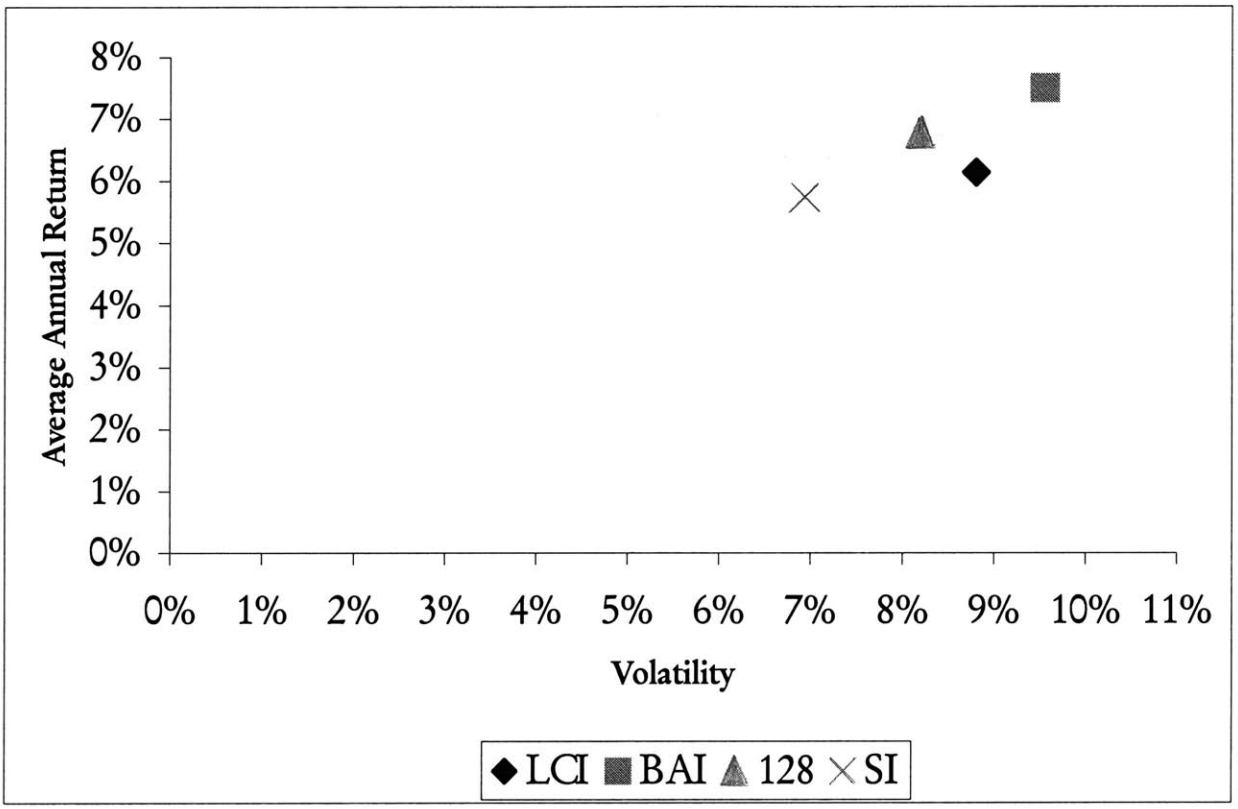


Exhibit 11 summarizes the estimated results between the four indexes. The Chart shows the Lower Cape Index volatility and returns are below the BAI. Also, as one can see, there is a very close relationship between the LCI and the 128 Index. As expected, the LCI had both a higher volatility and return than the SI. One important thing to note here, however, is how closely the secondary market's volatility and average return is with the primary markets. In addition, it is interesting that all of these volatility levels are well below general stock market volatility averages.

Exhibit 12: Correlation Matrix of LCI's Annual Returns with the Three Boston Markets 1989-2002

Correlation Matrix	*LCI*	*BAI*	*128*	*SI*
LCI	100%			
BAI	86%	100%		
128	90%	99%	100%	
SI	93%	94%	99%	100%

Exhibit 12 summarizes the correlations between the markets. It is remarkable how correlated the Lower Cape's annual returns are with each of the three Boston markets. As mentioned earlier, the correlations between both the BAI and 128 Index increase if the annual returns are lagged one year. From the results of the straight annual return correlation, the Suburban Area Index has the highest correlation to the Lower Cape Market.

CONCLUSION

The intent of this study was to increase investor knowledge about the secondary home market and to try and evaluate some of the preconceived market perceptions with thorough statistical analysis. This study estimated the first secondary home market price index, the Lower Cape Index, in order to chart the historical price levels, estimate its volatility, and analyze its average return.

From the results, it was possible to compare the Lower Cape Index to three primary market indexes. It was found that the Lower Cape was, in fact, less volatile than one of the primary market areas and marginally more volatile than two of the primary areas. The average return for the Lower Cape was right in line with all of the markets, which indicates that the returns are fairly commensurate with the risk. Finally and probably most surprisingly, the Lower Cape was highly correlated with all three primary markets.

FUTURE STUDY

Estimating the Lower Cape Price Index will hopefully inform investors and homebuyers of the risks and returns associated with investing in the Lower Cape's market. However, the secondary market is a rapidly growing sector in the real estate industry and to date is one of the least understood and analyzed. There are many other secondary markets that have close proximity to primary markets like the Lower Cape and Boston; for example, Vail and Denver, The Hamptons and New York City, Lake Tahoe and San Francisco, and Mammoth Lake and Los Angeles. These are all market areas that would benefit from a price index estimation and further statistical study.

APPENDIX A
STATISTICAL METHODOLOGY

Estimating the Lower Cape Index

The intent of the statistical methodology appendix is to use a simple numerical example of the Repeat Sales Regression Methodology to help explain how the procedure estimates the Lower Cape Price Index. The following detailed statistical explanation describes the exact methodology and procedures used in this study. The detailed explanation of this technique will give readers a better understanding of this price estimation technique and allow future readers to duplicate these results and procedures to analyze other primary and secondary home markets.

The Repeat Sales Regression Equation

Before delving into the specifics of the right and left hand side of the regression equation, it is first important to understand the regression equation as a whole. The Repeat Sales Regression equation to estimate the LCI can be expressed as follows: [1]

$$Y = D\beta + \varepsilon$$

Y is the left hand side (LHS) or the dependent variable of the regression equation. It is the log price relative of the sale pair observations. The right hand side of the regression equation consists entirely of dummy variables D, which consist of a matrix of 0's and 1's, β is the regression results coefficients, or the estimated annual capital returns, and ε is the regression "error" term.[2]

Solving for β (the equations coefficients), the Annual Capital Returns.

In an attempt to explain the repeat sales regression methodology, one repeat sale transaction taken from the Lower Cape data set will be analyzed. This example is one

[1] Gatzlaff, Geltner, *A transaction Based Index of Commercial Property and its Comparison to the NCREIF Index,* (1998).
[2] Ibid

address that had three sales (two repeat sales transactions) during the estimation's time period from 1989-2002 and is summarized in Exhibit 1.a

Exhibit 1.a

Street Address	Date of Sale	Sale Price	LHS (Y)
1 Parallel St	1995	$ 134,178 (p1)	.37985 ln(p2/p1)
1 Parallel St	1998	$ 196,000 (p2)	.40886 ln(p3/p2)
1 Parallel St	2002	$ 295,000 (p3)	

Step 1. Solve for the Left Hand Side (Y) of the Repeat Sale Regression equation from the Repeat Sales Transaction Data.

To solve for the left-hand side (Y) of the regression equation, take the natural log (ln) of each sale pair: $LN(P_2/P_1)$. P_1 is the property's sale price of the first sale of the sale pair transaction, and P_2 is the sale price for the second sale of the pair. (See Exhibit 1a.)

It is necessary to take the natural log of the sale price difference in order to linearize the regression. Linearizing the regression allows the resulting estimates to be log levels of price appreciation rather than changes in actual value of home prices.

Step 2. Building the Right Hand Side (RHS) of the Regression Equation

The RHS variables of the regression consist purely of dummy variables. Each dummy variable corresponds to a period of time, in this case a year. D95, D96, etc, correspond to years 1995, 1996, etc. The dummy variable is 1 during the time between sales and 0 otherwise.[3]

[3] Dummy variables are 1 between two sales transactions but do not including the first sale date which is a 0.

Exhibit 2.a

			1995	1996	1997	1998	1999	2000	2001	2002
Address	**Sale Date**	**Sale Price**	**D95**	**D96**	**D97**	**D98**	**D99**	**D00**	**D01**	**D02**
1 Parallel St	1995	$ 134,178	0	1	1	1	0	0	0	0
1 Parallel St	1998	$ 196,000	0	0	0	0	1	1	1	1
1 Parallel St	2002	$ 295,000	0	0	0	0	0	0	0	0

Exhibit 2a. (using the sale transaction from Exhibit 1.a) summarizes how the dummy variables are created for the RHS of the repeat sale regression equation. [4]

Step 3. Using the RHS and LHS of the repeat sales equation to estimate the coefficients (β).

(Building the Column Vector Matrix)

Exhibit 3.a

Left Hand Side (Y)	Right Hand Side (D)							
	D95	**D96**	**D97**	**D98**	**D99**	**D00**	**D01**	**D02**
.37985	0	1	1	1	0	0	0	0
.40886	0	0	0	0	1	1	1	1

At this point, both the left and right hand side of the repeat sales equation are complete and the equation is ready to be estimated. Exhibit 3.a summarizes the RHS and LHS of the regression equation. [5] A statistical program such as SAS or STATA can be used to estimate the coefficients once the column vector matrix is built.[6]

[4] According to Gatlzaff and Geltner (1998), "To eliminate temporal aggregation in the estimated returns index, one can define the dummy variable to equal the fraction of the time period which falls between the two sales in chronological time. Thus, for example, suppose that for a certain observation the first sale occurred at the end of September 1995 and the second sale occurred at the end of September 1997. Then for an annual return index the dummy variable values for that observation would be 0.25 for 1995, 1.0 for 1996, and 0.75 for 1997." The Regression equation that estimated the Lower Cape's coefficients used only 1's and 0's, for the RHS dummy variable time periods. Since this is the case, the results in this study may be affected by temporal aggregation.

[5] For this simple example, the RSR equation cannot estimate the coefficients since there are more time periods (dummy variables) than sales pair observations.

[6] It is important to note that there is no constant (alpha) in the estimation equation and results.

Step 4. From the Regression Results Capital Returns (β), Estimate the Index.

Exhibit 4.a Example Statistics, Summarizing the Price Level Estimates

Year	Capital Returns (β)	Sum of the Returns (SOR)	(e) * (SOR)	Price Level Index
1989	-0.026	-0.026	0.974	100.000
1990	-0.035	-0.061	0.940	96.515
1991	-0.045	-0.106	0.899	92.278

A Price level index can now be estimated from regression estimates capital returns (β).[7]

Using the estimated capital returns (β) from Exhibit 4.

First, sum the capital returns (β): (SOR)

1989 = -.026

1990 = -.035 + (-.026) = -.061

1991 = -.045 + (-.061) = -.106

Next, take the anti-log (e) of the (SOR)

1989 = exp(-.026) = .974

1990 = exp(-.061) = .940

1991 = exp(-.106) = .899

Finally, to create a base year for the index (in this case 1989) divide all the anti-logs of the SOR's by the ((e) * SOR) in 1989. [8]

1989 = (.974/.974)*100 = 100

1990 = (.940/.974)*100 = 96.515

1991 = (.899/.974)*100 = 92.27

[7] It is important to note that this estimation procedure produces geometric capital returns. Most price level indexes (according to Professor Geltner) are arithmetic price levels. Goetzmann (1992) suggested a simple conversion of geometric to arithmetic coefficients by using an estimated variance level of .05. The Lower Cape Index utilizes this simple conversion procedure to convert the estimated geometric capital returns to arithmetic capital returns before comparing the LCI to the Boston Area Price Indexes. The equation for the conversion is AR (arithmetic capital returns) = GR (geometric estimated capital returns)+ ((.05^2)/2)

[8] It is important to note that the anti logs will give the index a base of one. In order to more effectively graph the index and see the annual changes the LCI has been multiplied arbitrarily by a factor of 100. This is fairly common practice. The Boston Area Zip Code Price Indexes were multiplied by a factor of 100.

APPENDIX B
STATISTICAL METHODOLOGY

The Ridge Regression Smoothing Technique

Appendix B covers the statistical methodology of the "ridge regression", the technique used to smooth the Lower Cape Indexes price levels. In addition, this section will chart both the "smoothed vs. unsmoothed" capital returns in order to show the effect of the ridge regression procedure on the estimated returns.

What is the "ridge regression smoothing technique"?

The ridge regression technique effectively mitigates random noise in price level indexes. The technique is a Bayesian/Method of Moments" procedure based on *a priori* information about what the 1st-order autocorrelation is perceived to be in a noise-free index. In other words, the noise filter should assume *a priori* results from an index based on a data set with a very large sample size.[9]

The presence of "Noise" in the Lower Cape's Capital Returns Estimates[10]

As previously discussed in Chapter 2, "noise" is apparent in an estimated index by the presence of a "spiky" or "sawtooth" appearance in the return or the index level graphs. Noise occurs when the RSR technique estimates the periodic capital returns for a small number of observations (or small sample size) over the study's time period.

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[9] Gatzlaff, Geltner, *A transaction Based Index of Commercial Property and its Comparison to the NCREIF Index,* (1998)

[10] For the regression estimation results and resulting price index from Lower Cape's first run regression estimates, see Appendix IX

Exhibit 1.b The Lower Cape's Estimated Capital Returns, 1989-2002 (Charted)

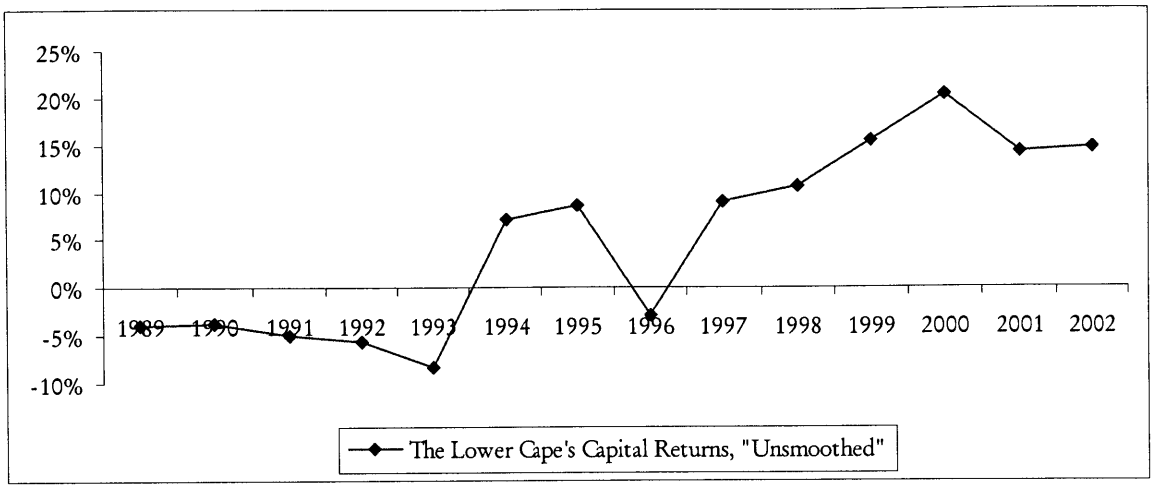


Exhibit 1.b charts the results of Lower Cape's first run regression results. From the chart one can clearly see the "sawtooth" like appearance in the return levels. The areas that show the most "noise" appear to be between 1992-1996. Since the Lower Cape data set was relatively small as compared to the Boston Housing Zip Code Indexes and due to the appearance of the noise in the capital returns, the "ridge regression procedure" was implemented in an attempt to filter the random noise.

The Ridge Regression Methodology

In order to implement the "ridge regression" procedure it is necessary to add "synthetic data" from *a priori* expectations to both the right and left hand side of the repeat sales regression equation.[11]

[11] Geltner, D, and Miller (2000). Chapter 25, page 658 footnote. For the complete statistical methodology of the Repeat Sales Regression methodology, see Statistical Methodology, Appendix A

Exhibit 2.b: The Synthetic Data Matrix from *A Priori* Expectations

D89	D90	D91	D92	D93	D94	D95	D96	D97	D98	D99	D00	D01	D02	Annual Returns
10	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.0385313
0	10	0	0	0	0	0	0	0	0	0	0	0	0	-0.0375971
0	0	10	0	0	0	0	0	0	0	0	0	0	0	-0.0498135
0	0	0	10	0	0	0	0	0	0	0	0	0	0	-0.0560631
0	0	0	0	10	0	0	0	0	0	0	0	0	0	-0.0823944
0	0	0	0	0	10	0	0	0	0	0	0	0	0	0.0714416
0	0	0	0	0	0	10	0	0	0	0	0	0	0	0.0870836
0	0	0	0	0	0	0	10	0	0	0	0	0	0	0.0893066
0	0	0	0	0	0	0	0	10	0	0	0	0	0	0.0912516
0	0	0	0	0	0	0	0	0	10	0	0	0	0	0.1074497
0	0	0	0	0	0	0	0	0	0	10	0	0	0	0.1555722
0	0	0	0	0	0	0	0	0	0	0	10	0	0	0.2036947
0	0	0	0	0	0	0	0	0	0	0	0	10	0	0.142872
0	0	0	0	0	0	0	0	0	0	0	0	0	10	0.1479445

Exhibit 2.b summarizes the synthetic data matrix that was added to both the right and left hand sides of the repeat sales regression column vector matrix.[12] The right hand side of the synthetic matrix is equal to the time dummy variables, called the ridge parameters (k). The LHS of the equation is the *a priori* expectation in the annual return for each of the time dummy variables. In this case, the first run regression coefficients were used as the *a priori* expected returns. In 1996, due to the extreme levels of noise (as apparent in Exhibit 1.b) the annual *a priori* return was made to reflect the average of the returns from 1994-1998.[13] The ridge parameter (k) was set to 10 after a series of "trial and error" (k's) estimated the capital returns for the Lower Cape. When k=10, the years with the highest levels of noise (1992-1996) were the most effected by the smoothing technique.[14]

[12] See Statistical Methods Appendix A step 3 for an explanation of the repeat sales regression estimation column vector matrix.

[13] These results were given to Professor David Geltner the guru in the Ridge Regression technique. He thought that the use of the first run regression estimated coefficients were reasonable *a priori* expectations for the LHS of the synthetic matrix. In addition, the author would like to thank Professor Geltner for taking the time to explain this smoothing procedure.

[14] To determine the proper level to set k, the ridge parameter, regression estimations were run for k = 1,2,3,4,5,10,15,20,25,100.

Exhibit 3.b The Comparison Between the Lower Cape's Smoothed and Unsmoothed Capital Returns.

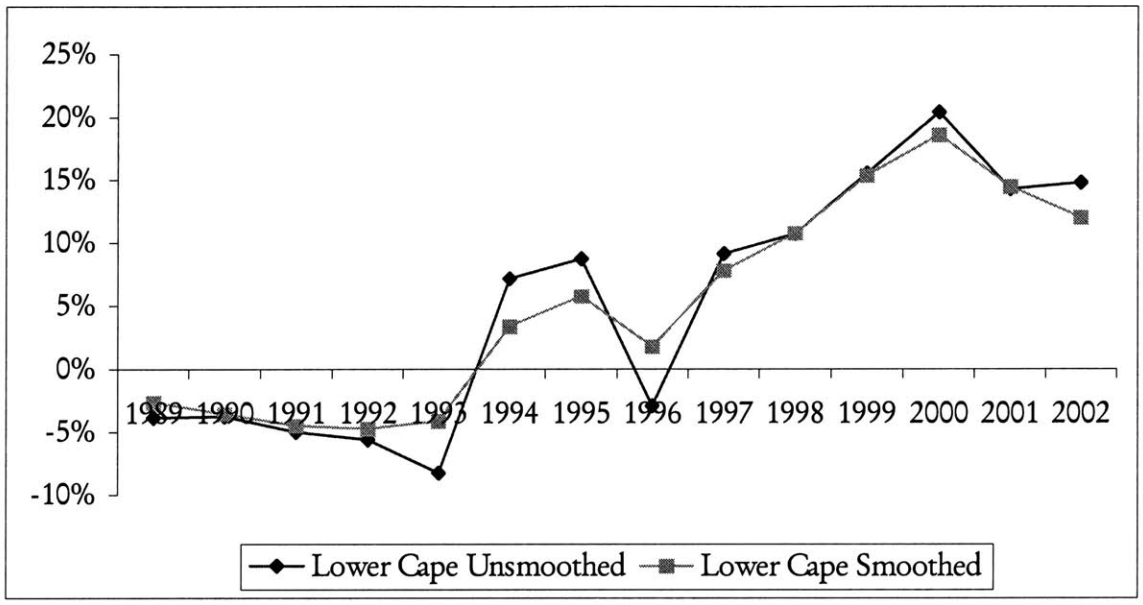


Exhibit 3.b charts the Lower Cape's first run regression capital return estimates (unsmoothed) along side the Lower Cape's capital return estimates after the ridge regression procedure was preformed. It is interesting to note that the procedure essentially "forces" each year's capital return estimates closer the overall mean. As can be seen with from the chart, with k=10 the most significant changes in the returns occurred during the years with the highest levels of noise, 1992-1996. It is interesting to note that in 2002, the smoothed capital returns actually fall, while the unsmoothed returns show an increase.

APPENDIX I

Town of Harwich Repeat Sales Transaction Descriptive Statistics, 1989-2002

Year	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Mean	$199,198	$152,208	$ 176,228	$ 183,684	$ 180,129	$ 163,131	$149,089
Median	$158,000	$127,000	$ 137,250	$ 140,000	$ 133,250	$ 144,375	$130,000
Std. Dev.	$120,813	$115,887	$ 131,541	$ 127,215	$ 136,848	$ 78,222	$ 58,633
Minimum	$105,000	$100,000	$ 100,000	$ 100,000	$ 102,200	$ 100,000	$100,000
Maximum	$655,000	$815,000	$ 725,000	$ 770,000	$ 582,617	$ 547,500	$425,000
No. Obs	47	40	39	49	12	68	51
Year	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Mean	$180,603	$175,247	$ 242,523	$ 215,952	$ 283,320	$ 332,386	$334,816
Median	$135,000	$142,000	$ 157,000	$ 168,500	$ 193,000	$ 246,950	$291,000
Std. Dev.	$117,136	$ 79,208	$ 230,468	$ 168,850	$ 386,607	$ 498,878	$150,374
Minimum	$100,000	$100,000	$ 100,000	$ 104,000	$ 108,750	$ 130,000	$120,000
Maximum	$690,000	$460,000	$ 1,600,000	$ 1,475,000	$ 2,900,000	$ 4,500,000	$869,000
No. Obs	48	84	109	96	93	76	97

APPENDIX II

Harwich Repeat Sales Regression Estimations and Price Index (Charted)

Harwich 1989-2002

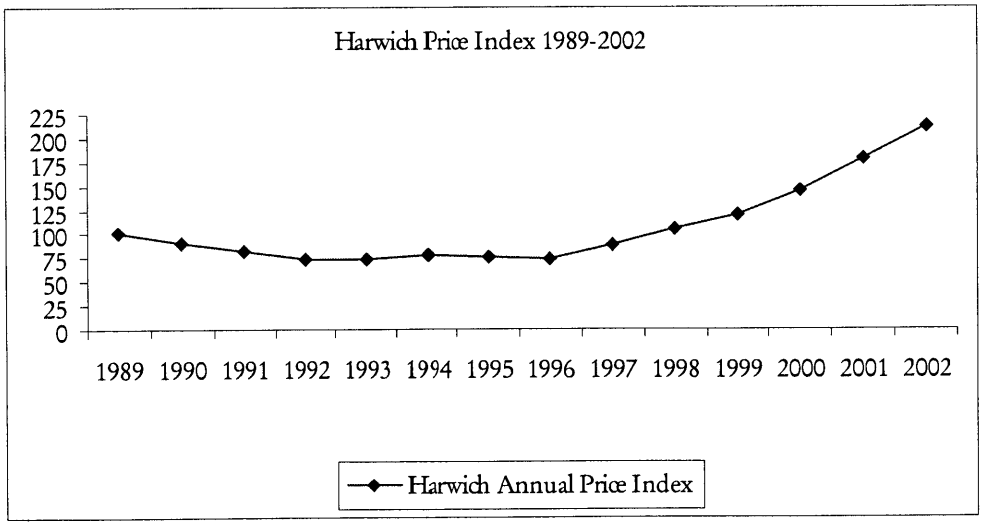
Source	SS	df	MS		
				STDEV	0.103082
				MEAN	0.047902
Model	86.2341315	5.74	894201	**MIN**	-0.1017
Residual	50.673297509	.099	554612	**MAX**	0.173548
Total	136.90743524	.261	273717		

Year	**Coef.**	**Std. Err.**
1989	0.027	0.066
1990	-0.092	0.067
1991	-0.079	0.065
1992	-0.102	0.064
1993	0.012	0.078
1994	0.047	0.076
1995	-0.015	0.052
1996	-0.036	0.055
1997	0.162	0.051
1998	0.143	0.044
1999	0.111	0.041
2000	0.174	0.041
2001	0.170	0.046
2002	0.150	0.047

Number of obs	524
F(15, 509)	57.75
Prob >F	0
R-squared	0.6299
Adj R-squared	0.619

Price Index Calculations

1989	0.447	1.685	100.000
1990	0.355	1.513	89.786
1991	0.276	1.379	81.869
1992	0.174	1.225	72.713
1993	0.186	1.242	73.733
1994	0.233	1.312	77.848
1995	0.217	1.289	76.488
1996	0.181	1.236	73.345
1997	0.343	1.493	88.593
1998	0.486	1.763	104.668
1999	0.598	2.008	119.203
2000	0.771	2.459	145.946
2001	0.942	2.999	177.980
2002	1.091	3.571	211.932



APPENDIX III

Town of Brewster Repeat Sales Transaction Descriptive Statistics, 1989-2002

Year	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Mean	$ 190,331	$ 155,667	$ 153,569	$ 169,307	$ 147,603	$ 153,325	$ 151,213
Median	$ 154,000	$ 148,000	$ 124,000	$ 134,950	$ 128,500	$ 135,000	$ 135,250
Std. Dev.	$ 99,873	$ 42,580	$ 65,790	$ 125,179	$ 86,771	$ 64,503	$ 50,436
Minimum	$ 115,000	$ 107,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Maximum	$ 520,000	$ 250,000	$ 343,350	$ 725,000	$ 530,000	$ 400,000	$ 345,000
No. Obs.	25	21	18	35	32	34	33
Year	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Mean	$ 163,526	$ 191,204	$ 172,465	$ 199,643	$ 302,649	$ 341,380	$ 349,619
Median	$ 145,000	$ 154,500	$ 155,000	$ 189,900	$ 214,000	$ 290,000	$ 320,000
Std. Dev.	$ 104,822	$ 120,995	$ 64,059	$ 61,606	$ 264,135	$ 161,286	$ 130,161
Minimum	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 114,000	$ 142,000	$ 135,000
Maximum	$ 760,000	$ 640,000	$ 390,000	$ 365,000	$ 1,600,000	$ 1,050,000	$ 735,000
No. Obs.	49	39	58	55	50	50	51

APPENDIX IV

Brewster Repeat Sales Regression Estimations and Price Index (Charted)

Brewster 1989-2000

Source |	SS	df	MS
Model |	59.1739614	4.2	2671164
Residual |	30.67263305	.10	566008
Total |	89.8466319	.28	1650769

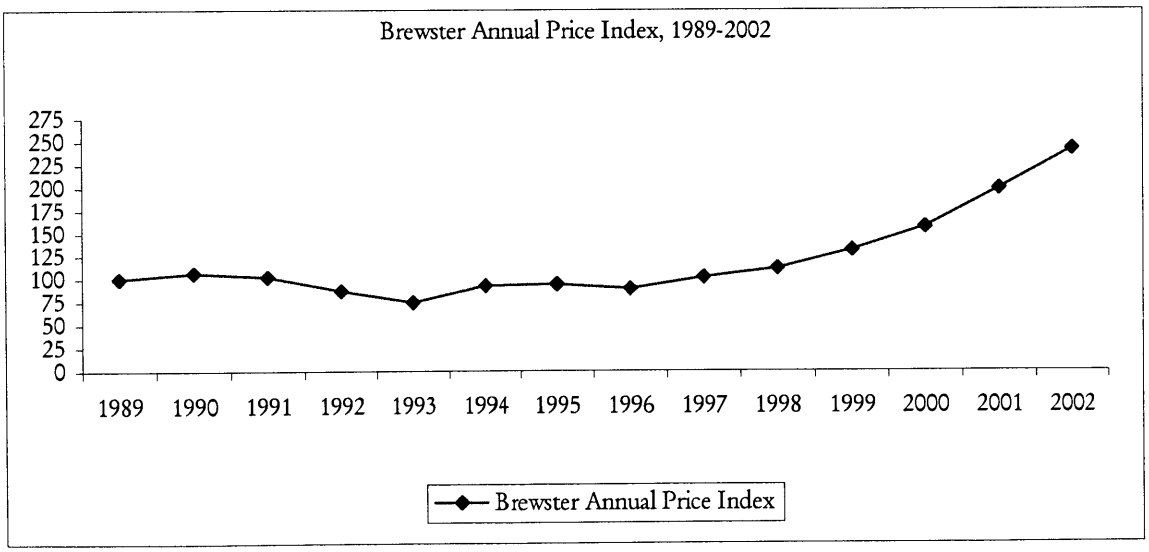
STDEV	0.128992
MEAN	0.036396
Min	-0.14202
Max	0.208988

Year	**Coef.**	**Std. Err.**
1989	-0.137	0.080
1990	0.055	0.095
1991	-0.037	0.099
1992	-0.142	0.088
1993	-0.142	0.071
1994	0.196	0.077
1995	0.016	0.074
1996	-0.051	0.066
1997	0.116	0.062
1998	0.083	0.065
1999	0.151	0.058
2000	0.155	0.057
2001	0.209	0.059
2002	0.176	0.057

Number of obs	319
F(14, 305)	42.03
Prob >F	0
R-squared	0.6586
Adj R-squared	0.6429
Root MSE	0.31712

Price Index Calculations

1989	-0.13691	0.85764	100
1990	-0.08158	0.912558	106.4034
1991	-0.11836	0.875672	102.1025
1992	-0.26005	0.747001	87.09965
1993	-0.40206	0.637001	74.2737
1994	-0.20588	0.793791	92.55526
1995	-0.18942	0.808582	94.27985
1996	-0.24018	0.763834	89.06233
1997	-0.12396	0.870192	101.4636
1998	-0.04122	0.954812	111.3302
1999	0.109322	1.13046	131.8105
2000	0.264161	1.344879	156.8116
2001	0.473149	1.700158	198.2368
2002	0.649255	2.071463	241.5306



APPENDIX V
Town of Chatham Repeat Sales Transaction Descriptive Statistics, 1989-2002

Year	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Mean	$ 269,775	$225,503	$ 210,731	$ 147,807	$ 205,906	$ 287,670	$239,472
Median	$ 215,000	$180,000	$ 200,000	$ 138,643	$ 189,500	$ 222,125	$184,500
Std. Dev.	$ 230,908	$109,299	$ 67,844	$ 63,205	$ 82,778	$ 213,903	$151,638
Minimum	$ 100,000	$118,000	$ 107,500	$ 100,000	$ 102,000	$ 106,000	$ 100,000
Maximum	$ 1,075,000	$425,000	$ 340,000	$ 242,500	$ 400,000	$ 975,000	$810,000
No. Obs.	19	17	13	7	16	28	22
Year	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Mean	$ 298,324	$246,221	$ 272,702	$ 460,948	$ 575,667	$ 593,101	$ -
Median	$ 225,000	$235,000	$ 210,000	$ 313,000	$ 382,500	$ 393,750	$ -
Std. Dev.	$ 206,537	$ 95,483	$ 182,656	$ 440,330	$ 629,915	$ 542,549	$ -
Minimum	$ 103,500	$117,900	$ 104,900	$ 100,000	$ 149,000	$ 100,000	$ -
Maximum	$ 895,000	$415,000	$ 1,000,000	$ 2,800,000	$ 3,750,000	$ 2,850,000	$ -
No. Obs.	35	19	42	52	52	41	0

APPENDIX VI
Chatham Repeat Sales Regression Estimations and Price Index (Charted)

Chatham 1989-2002

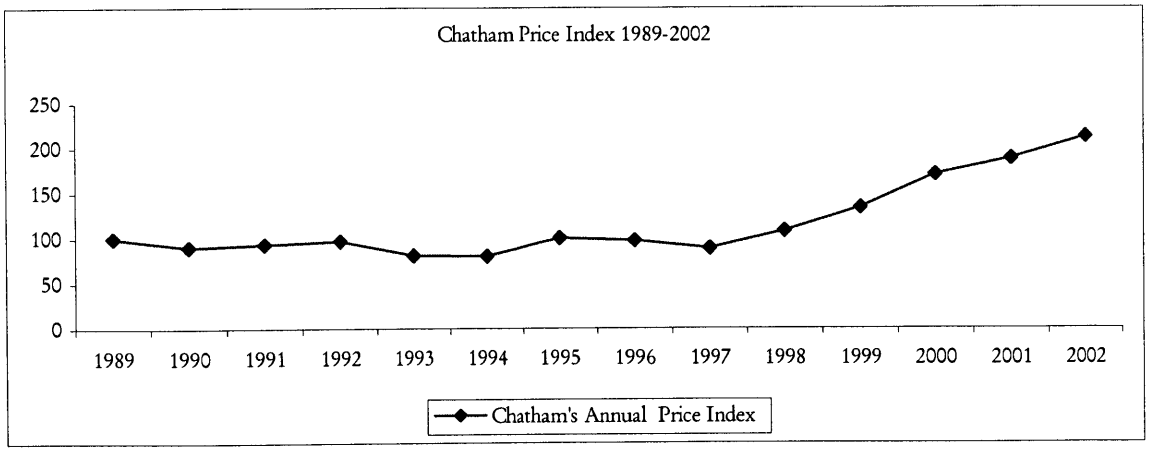
Source |	SS	df	MS	STDEV	0.138052
				MEAN	0.049084
Model |	73.6456115	4.9	970763	MIN	-0.17957
Residual |	71.38353366	.19	5036961	MAX	0.242217
Total |	145.0291381	.38	653917		

Year	Coef.	Std. Err.
1989	0.007	0.104
1990	-0.109	0.107
1991	0.036	0.118
1992	0.034	0.126
1993	-0.180	0.120
1994	-0.007	0.100
1995	0.229	0.083
1996	-0.033	0.077
1997	-0.089	0.086
1998	0.194	0.084
1999	0.213	0.066
2000	0.242	0.070
2001	0.102	0.071
2002	0.120	0.078

Price Index Calculations

1989	0.131484	1.140519	100
1990	0.022903	1.023167	89.71069
1991	0.05866	1.060415	92.9765
1992	0.092826	1.09727	96.20799
1993	-0.08674	0.916914	80.39445
1994	-0.09395	0.910329	79.81704
1995	0.134703	1.144196	100.3224
1996	0.101217	1.106516	97.01867
1997	0.011799	1.011869	88.72
1998	0.205503	1.228142	107.6827
1999	0.418652	1.519911	133.2648
2000	0.660869	1.936475	169.7889
2001	0.762955	2.144603	188.0375
2002	0.88286	2.417804	211.9915

Number of obs	381
F(15, 366)	25.17
Prob >F	0
R-squared	0.5078
Adj R-squared	0.4876
Root MSE	0.44163



APPENDIX VII

Town of Orleans Repeat Sales Transaction Descriptive Statistics, 1989-2002

Year	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
Mean	$220,676	$ 237,188	$ 259,708	$246,750	$ 200,815	$204,031	$ 271,039
Median	$190,000	$ 198,750	$ 197,500	$201,250	$ 177,500	$175,000	$ 250,000
Std. Dev.	$138,125	$ 122,061	$ 152,143	$134,296	$ 106,925	$103,661	$ 133,851
Minimum	$100,000	$ 155,000	$ 105,000	$107,000	$ 100,000	$100,000	$ 100,000
Maximum	$695,000	$ 525,000	$ 550,000	$545,000	$ 600,000	$568,000	$ 600,000
No. Obs.	16	8	12	22	32	32	27
Year	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
Mean	$261,421	$ 314,269	$ 297,353	$300,197	$ 480,433	$424,016	$ 563,044
Median	$189,500	$ 232,500	$ 227,500	$250,000	$ 313,750	$393,500	$ 432,500
Std. Dev.	$174,177	$ 333,841	$ 207,917	$158,188	$ 505,757	$176,770	$ 458,993
Minimum	$118,000	$ 114,000	$ 127,000	$106,000	$ 155,000	$145,000	$ 280,000
Maximum	$747,500	$ 2,200,000	$ 1,060,000	$675,000	$ 2,599,500	$775,000	$ 2,350,000
No. Obs.	29	40	38	29	38	25	34

APPENDIX VIII
Orleans Repeat Sales Regression Estimations and Price Index (Charted)

Orleans 1989-2002

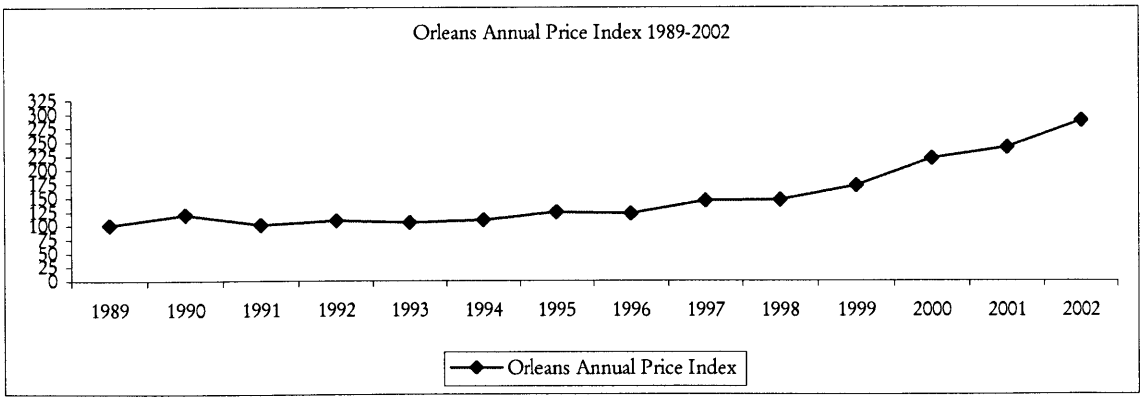
Source	SS	df	MS		
				STDEV	0.150719
				MEAN	0.057996
Model	45.434315	15	3.0289538	**MIN**	-0.33276
Residual	27.516552	198	.138972	**MAX**	0.249083
Total	72.950867	213	.342488		

Year	Coef.	Std. Err.
1988	0.147	0.271
1989	-0.333	0.136
1990	0.167	0.162
1991	-0.160	0.171
1992	0.071	0.130
1993	-0.034	0.094
1994	0.043	0.088
1995	0.122	0.090
1996	-0.015	0.094
1997	0.172	0.089
1998	0.008	0.080
1999	0.162	0.085
2000	0.249	0.085
2001	0.083	0.090
2002	0.187	0.094

Price Index Calculations

1989	-0.18533	0.830832	100
1990	-0.01866	0.981515	118.1364
1991	-0.17822	0.836755	100.7128
1992	-0.10743	0.898141	108.1013
1993	-0.14127	0.868256	104.5043
1994	-0.09803	0.906618	109.1217
1995	0.024135	1.024428	123.3014
1996	0.009557	1.009603	121.517
1997	0.181431	1.198931	144.3048
1998	0.189096	1.208157	145.4152
1999	0.350706	1.420069	170.9212
2000	0.599789	1.821734	219.2661
2001	0.683064	1.979936	238.3075
2002	0.869938	2.386762	287.2735

Number of obs = 213
F(15, 19 8) = 21.80
Prob >F 0
R-squared 0.6228
Adj R-squar ed = 0.5942
Root MSE 0.37279



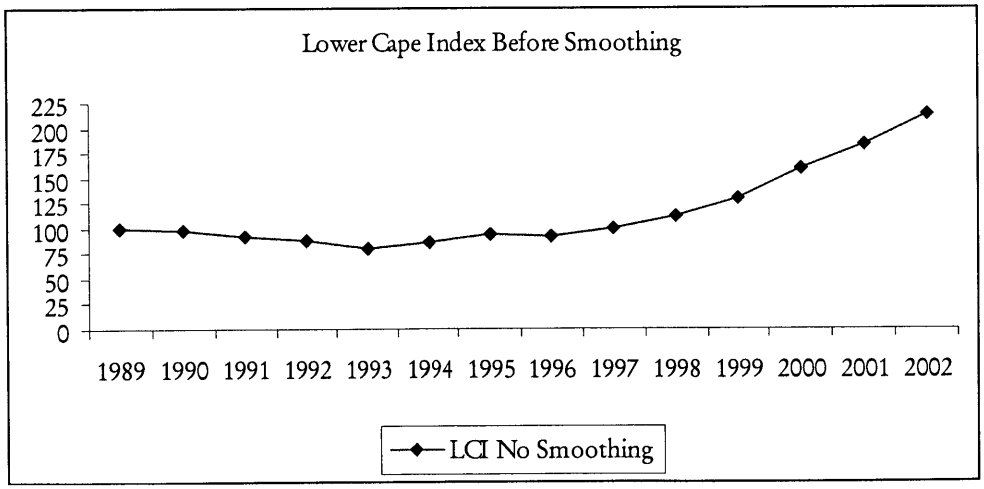
APPENDIX IX
Lower Cape Index Repeat Sales Regression First Estimation Results (Before Smoothing)

Lower Cape Cod First Repeat Sales Estimates (No Smoothing)

Source	SS	df	MS		
Model	256.219715	17.	813104	STDEV	0.095847
Residual	188.51441422	.13	2569877	MEAN	0.058186
Total	444.7341437	.30	9487836	MIN	-0.079645
				MAX	0.284081

Year	Coef.	Std. Err.	Price Index Calculations				
1989	-0.062	0.045	1989	0.222	1.249	124.884	100.000
1990	-0.033	0.048	1990	0.189	1.208	120.775	96.710
1991	-0.050	0.050	1991	0.139	1.149	114.874	91.985
1992	-0.058	0.047	1992	0.080	1.083	108.347	86.758
1993	-0.080	0.043	1993	0.001	1.001	100.052	80.116
1994	0.070	0.041	1994	0.070	1.073	107.257	85.886
1995	0.085	0.036	1995	0.155	1.168	116.763	93.497
1996	-0.027	0.035	1996	0.128	1.137	113.681	91.030
1997	0.093	0.034	1997	0.221	1.247	124.746	99.889
1998	0.108	0.032	1998	0.329	1.389	138.940	111.255
1999	0.155	0.029	1999	0.484	1.623	162.301	129.961
2000	0.203	0.030	2000	0.688	1.989	198.894	159.264
2001	0.143	0.032	2001	0.830	2.294	229.384	183.678
2002	0.148407	0.032485	2002	0.979	2.661	266.082	213.064

Number of obs	1437
F(15, 1422)	128.85
Prob >F	0
R-squared	0.5761
Adj R-squared	0.5716
Root MSE	0.3641



APPENDIX X
Lower Cape Index Repeat Sales Regression Estimation Results
(After Smoothing)

The Lower Cape 1989-2002

Source	SS	df	MS
Model	244.72714	17.	4805035
Residual	200.17081437	.13	9297712
Total	444.89791451	.30	6614653

Year	Coef.	Std. Err.		Price Index Calculations		
1989	-0.028	0.028		-0.028	97.274	100.00
1990	-0.037	0.027		-0.064	93.767	96.39
1991	-0.046	0.027		-0.111	89.538	92.05
1992	-0.049	0.027		-0.159	85.293	87.68
1993	-0.042	0.026		-0.201	81.755	84.05
1994	0.032	0.026		-0.169	84.440	86.81
1995	0.057	0.024		-0.113	89.357	91.86
1996	0.017	0.024		-0.096	90.847	93.39
1997	0.077	0.023		-0.019	98.107	100.86
1998	0.106	0.023		0.087	109.117	112.17
1999	0.153	0.022		0.240	127.118	130.68
2000	0.185	0.022		0.425	152.920	157.21
2001	0.144	0.023		0.569	176.620	181.57
2002	0.119	0.024		0.688	198.991	204.57

	Arithmetic Return	Sum of the Returns (SOR)	e^ (SOR)		
1989	-0.02639	-0.02639	0.973957	1989	100.00
1990	-0.03547	-0.06186	0.940017	1990	96.52
1991	-0.0449	-0.10675	0.898747	1991	92.28
1992	-0.04733	-0.15408	0.857202	1992	88.01
1993	-0.04112	-0.1952	0.822672	1993	84.47
1994	0.03357	-0.16163	0.850758	1994	87.35
1995	0.057848	-0.10378	0.901423	1995	92.55
1996	0.017791	-0.08599	0.917604	1996	94.21
1997	0.078131	-0.00786	0.992172	1997	101.87
1998	0.107609	0.09975	1.104895	1998	113.44
1999	0.153943	0.253693	1.288776	1999	132.32
2000	0.18605	0.439744	1.552309	2000	159.38
2001	0.145339	0.585082	1.795139	2001	184.31
2002	0.120506	0.705588	2.025038	2002	207.92

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