British Columbia Real Estate's Place in an Investment Portfolio

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Introduction

The strong growth in the British Columbia (BC) real estate market since 2000 has sparked great interest in investing in the local real estate market. Recent performance, however, may not be the best determinant of an asset's future place in an investor's portfolio. This is both because this performance may be at odds with historic performance and because return alone fails to address both risk and the diversification benefits that result from a mix of assets in a portfolio. This report uses modern portfolio theory to examine the position of BC real estate in a diversified investment portfolio. We find that for many investors, BC real estate should have an important place in their investment portfolio and that the best results come from having a geographically diverse set of properties.

Our findings are sensitive to the assumptions we must use in the analysis, the period under study, and investor type. Three factors in particular are important in determining how much BC real estate an investor should hold: how long they intend to hold the real estate, their tolerance for risk, and the size of the premium real estate must pay to offset its lower liquidity relative to financial assets. Except for those investors who place a great premium on the liquidity offered by stocks and bonds or have a very low tolerance for risk, BC real estate should make up at least 50 percent of an investment portfolio that also includes Canadian equities and bonds.

The basis of modern portfolio theory is the selection of assets to minimize the volatility or variance of returns for any given targeted return. An efficient portfolio allocation is one for which it is impossible to lower the variance of the returns without also lowering the expected return. Different combinations and amounts of assets yield different efficient portfolios where a greater return comes at the price of greater volatility. No one efficient portfolio is better than another as they reflect different combinations of risk and return. An individual investor's choice of a portfolio allocation among the efficient set depends on his or her relative tolerance for risk. Those with a greater tolerance for risk will choose portfolios that yield greater returns, but come with a higher variance in their returns. The shares (weights) of assets in an efficient portfolio is a function of their average return, the volatility of these returns, and the correlation of changes in returns with those of other assets in the investor's set of potential investments.

This study identifies a range of efficient combinations for investment portfolios consisting of four BC real estate assets and two more general financial assets. The BC assets are a Lower Mainland house and Lower Mainland, Whistler, and Okanagan/Kelowna condominium units. The two financial assets are the TSE composite total return (stocks) and the Scotia Capital Canadian Bond Universe index (bonds), a comprehensive portfolio of Canadian government and corporate bonds. All returns are total returns, including both capital appreciation and net cash flow or dividends, and are adjusted for inflation. In this paper, real estate is considered solely as an investment asset. A house in the Lower Mainland, for example, is assumed to be rented out at all points of the year. The individual must therefore pay the "market rate" for the use of his own house, eliminating the consumption benefit derived from owning that asset. For completeness, it would be desirable to include some type of non-residential BC real estate in the set of assets. Unfortunately, there is not sufficient data on historic returns for this asset class to be able to compare it with the others.

The remainder of the paper is structured as follows. First we review the existing research on the role of residential real estate in an investment portfolio to understand the important recent findings in the relevant academic research. We follow that with a discussion of the data and the research methodology, highlighting the strengths and weaknesses of the approach used here. The final section presents the results of the analysis, which are further supported by a data appendix.

Existing Research

The common premise in the academic literature is that individuals hold too much of their wealth in real estate. There are a number of factors that explain this view. First, housing is both an investment and consumption good. With their principal residence, individuals may buy more house than is optimal for their investment portfolio in order to enjoy the consumption and ownership benefits of the house.[2] Second, how an investment portfolio is defined also plays a role. Economists take a very broad view of what defines a portfolio, including both the returns to financial and human capital. The former is what one typically thinks of as investment, the latter are the wages one can earn in the labour market. Not surprisingly, house prices are highly correlated with incomes in a city over time, rising and falling together with the local economy.[3] Taking the return to human capital (wage income) as a required part of the portfolio reduces the optimal allocation to local real estate. This general belief is based on nation data for housing returns and need not be true in all markets.

Given the consumption motivation to buy a house, there is a question of whether owner-occupied housing should even be considered in the same framework as other investments. Research suggests it should because it can behave like an investment asset. Two studies of local markets find that housing displays the same risk-return tradeoffs as other assets, consistent with treating it as an asset in the portfolio. Gat (1994) studied neighbourhoods in Tel Aviv, Israel and finds that mean returns are higher for units with a greater variance in the monthly rents and prices. Crone and Voith (1999) study the same issue with better data on US census tracts using a repeat sales index to measure price changes. They find returns are higher for individual houses in riskier markets. Studies of real estate's "optimal" share find quite varied results.[4]

Part of the difficulty with real estate in a portfolio is that it is constrained. A house is owned or not, fractional ownership is not possible, and there are not yet fully developed markets for real estate futures.[5] Englund, Hwang, and Quigley (2002) examine whether a portfolio of housing,

[2] The first paper examining this is Brueckner (1997)

[3] For instance quarterly total employment and real house prices have a correlation of 0.50 for Vancouver. Cocco (2004) finds a correlation between unforecast changes in house prices and income of 0.55

[4] Goodman (2003) examines a related issue, finding that there is a place for real estate investment trusts (REITs) even in portfolios where home equity is two thirds of total wealth. Jud, Wingler, and Winkler (2006) use data from US cities and find for a ten year holding period median risk portfolio, housing's share of a portfolio runs from 22-37 percent uses city specific measures of house price appreciation. However, they use national rather than city specific averages for the imputed rent flow to an owner-occupier, property taxes, and maintenance.

[5] Trading has begun recently in London and Chicago for different types of real estate futures. The Chicago mercantile exchange is trading futures contracts based on repeat sales price indexes for ten US cities http://www.cme.com/about/press/cn/05-129HousingIndexAgreement15738.html . In London, contracts are based

stocks, and bonds, would benefit from the ability to hedge housing risk. They find that the ability to sell a house price index short delivers benefits to households who have their owner occupied house as part of their portfolio, increasing the median portfolio return by 200 basis points (two percentage points). Cauley, Pavlov, and Schwartz (2005) examine the effect of allowing homeowners to sell a fractional ownership in their home. Simulation analysis finds that wealth would be 2 - 25 percent higher, depending on assumptions, if there was not a requirement to keep assets equal to the value of a home in residential real estate.

One of the more recent approaches taken in the literature is rather than to question owner-occupied real estate place in a portfolio to take it as a given.[6] Flavin and Yamashita (2002) study how the need to own a large enough house to satisfy a household's consumption demand for housing affects their optimal portfolio. They demonstrate that the apparent portfolio anomaly where the share of stocks in an investment portfolio rises with a person's age, as opposed to converting to fixed income instruments that are lower risk and deliver higher cash flow, makes sense when one requires them to have their own house as a part of their portfolio. Younger households with high ratios of house value to net worth will optimally use non-housing wealth for non-risky assets like bonds instead of riskier stocks.[7] For older households, housing wealth is a smaller part of their total portfolio, so they increase their allocation (relative to bonds) to the other risky assets, stocks. Consequently, the ratio of stocks to bonds in a portfolio rises with age.

Synthesizing all of the research in this area is difficult, but a number of themes appear that are relevant for British Columbia. First, because real estate performance varies so dramatically across markets, the optimal share is very city specific. As well, being invested in real estate in one local market need not preclude the desirability of investing in residential real estate in another region. Finally, the optimal allocations are quite sensitive to risk preference and the amount of the investment portfolio constrained to be in owner occupied real estate. Regarding this last point, there remains the matter of whether owner occupied real estate need be fully considered an investment. Clearly it behaves as an investment and owners benefit from an increase in wealth when house prices rise, wealth they can access through a sale or a second mortgage. However, a certain part of this wealth is just the pre-payment of rent, and as such not be viewed as part of an investment portfolio. As well, many people are reluctant to sell their home or may be adverse to increased debt. This report will not attempt to resolve this question; we just look at the efficient portfolio allocations.

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on the IPD non-residential price indexes. Currently the real estate derivative market is dominated by swaps among large institutions.

[6] This is not unreasonable given that the vast majority of Canadians own a house at some point over their lives, homeownership delivers important non-monetary benefits, and compared with renting, owner-occupancy allows for a more complete return to any investments made in renovations, security of tenure, and depending on the choice of financing instrument, stability of payments.

[7] Cocco (2004) finds a similar result, that homeownership affects other investment decisions and that this effect changes with total wealth and with age. The key element of Cocco's work is that because there is a fixed cost to participating in the stock market, for instance acquiring sufficient market knowledge, younger households with relatively less wealth and a greater percentage of their income in housing will invest less in risky equities.

Data and Methodology

To generate optimal portfolio allocations, this report uses estimated quarterly annualized returns to four types of real estate and two financial assets for the years 1985-2005. In both cases we use total returns, capital appreciation and cash flow (rent, interest, or dividend income). We present the real (inflation-adjusted) annual total returns for all asset types in Appendix Table A-1.

Returns for the financial assets are straight forward and easily calculated. We use the TSX total return index, which adds market capitalization weighted percentage changes in equity prices with dividend payments yields. For bonds, we use the Scotia Capital Overall Universe price index for Canadian fixed income instruments for both capital appreciation and the yield for the interest payments.

Real estate returns are based on an estimated price for a standardized house or condo. Capital appreciation is calculated using the percentage changes in a housing price index specific to each location and unit type. We estimate rent and expenses for each unit type and location, and then use Statistics Canada consumer price index (CPI) component sub-indexes to vary rental income and expenses over time. For each period, dividing the estimated net rent by the appropriate period‘s estimated price for the same type of unit gives us the rental or cash flow return. Details on the methodology for the house price index and for estimating rents are in the appendix.

In Figure 1 we show the real (inflation adjusted) movement in house prices over our analysis period. All regions experienced the post-Expo price boom between 1986 and 1990, with a subsequent downturn in 1990-91. While most areas saw real housing prices fall between 1995 and 2001, Whistler stands out because of the tremendous run-up in prices over this period. The falling Canadian dollar and economic prosperity in the US is a likely explanation for this difference as foreign ownership of real estate is higher in Whistler than elsewhere in the province. Over the same period, the market price for Lower Mainland strata units fell more than did house prices in the same area. One likely contributing factor is the problems with water damage in strata units, as many units suffered damage and buyers were more hesitant to purchase these units.

Prices in Whistler peaked at the end of 2003 and have been falling since then. Over the recent period of price increases, 2000-2005, prices for Kelowna and the Lower Mainland have moved almost in lock step, flat until 2002 and then increasing at over 10 percent per year through 2005. The decline in Whistler prices at the end of the period means that the total increase in prices for 2000-2005 for Whistler has been about the same as for the other areas. The differences in the figures does highlight how sensitive time period is in doing portfolio analysis: relative to the Lower Mainland, price increases for real estate were lower in Whistler over 1985-94, higher for 1994-2004, and lower there after. Consequently, optimal portfolio allocations would vary with the time period.

Figure 1
Real (Inflation Adjusted) BC Real Estate Prices 1985-2005

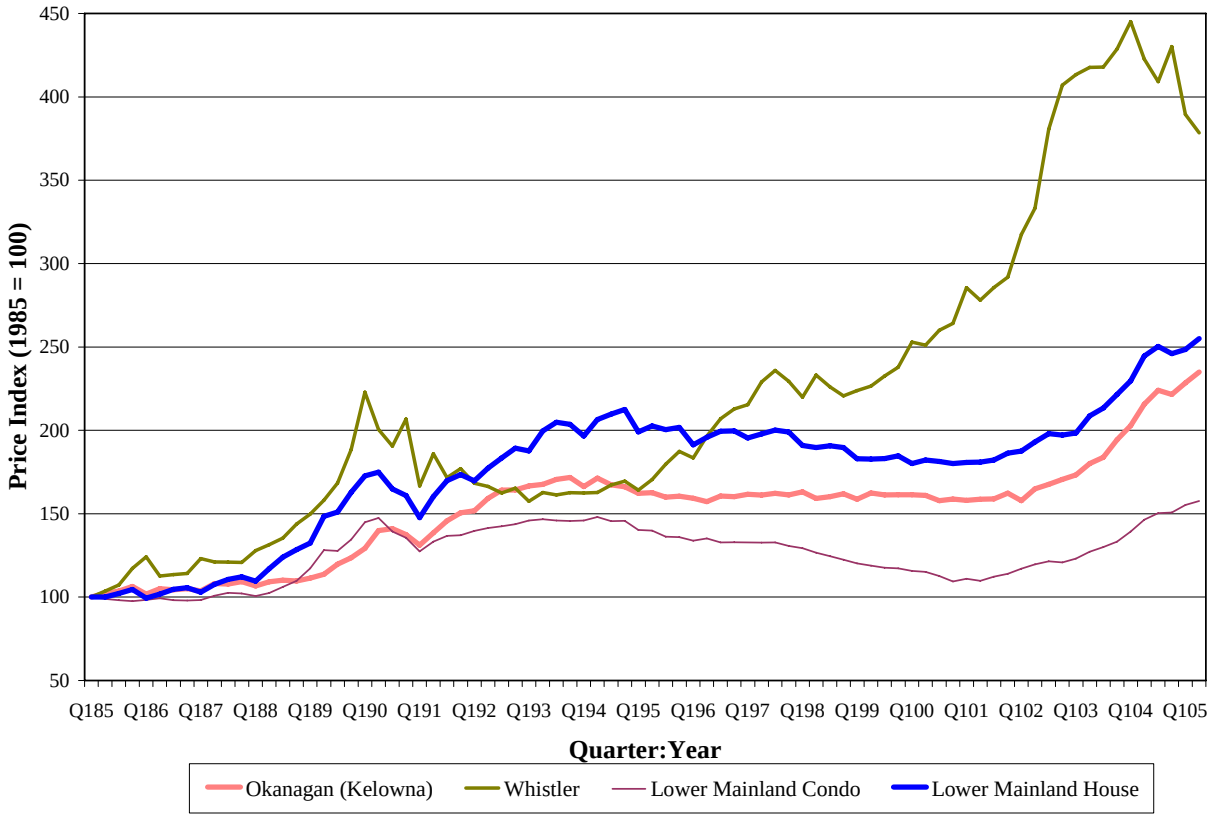


Table 1 below summarizes the asset returns. Consistent with Figure 1, Whistler has the highest return among the real estate options, but at the cost of the highest variance (risk) in returns among these asset choices. The gap between the returns for Lower Mainland houses and condos is quite striking; as the latter's average return is 2.53 percentage points or 253 basis points (bp) lower, with only a modest reduction in risk. [8] In comparison, the mean return for bonds is 107 basis points higher than that of the Lower Mainland condos, but with a lower variance. Stocks would appear to be a poor choice. Relative to real estate they deliver a return slightly lower than that of Lower Mainland houses, but it comes at the cost of the highest variance among the assets studied here.

[8] 100 basis points equals one percentage point. We use basis points to avoid the common tendency to confuse percentage points with percent. As an example, a return of 5.38 percent is 9 basis points lower than a 5.47 percent return. It is not 0.09 percent lower, but 0.09 percentage points lower.

Table 1 – Annual Total Real Asset Returns

Area	Annual Real Return	Standard Deviation
Lower Mainland House	5.38%	8.24%
Lower Mainland Condo	2.86%	7.75%
Whistler	7.16%	13.50%
Okanagan (Kelowna)	6.12%	6.34%
Stocks	5.47%	16.57%
Bonds	3.93%	5.92%

Notes: Based on quarterly annualized returns 1985-2005, adjusted for inflation using the BC all items CPI. Stocks are TSE total return. Bonds are Scotia Capital Overall Universe Index for Canadian bonds, appreciation and dividend yield. There is no adjustment for management expense ratio, transactions costs, charges, and taxes, or liquidity premiums.

The mean returns in Table 1 do not identify the portfolio benefits from diversification. In Table 2 we present the correlations between the returns for these assets, which are suggestive of the potential benefits from portfolio diversification. Correlations above 0.80 suggest little portfolio diversification benefits from combining the two assets, while those below 0.20 indicate high potential. The actual benefits depend on each asset's mean return, its variance, and the correlation with the other assets.

Table 2 – Total Return Correlations

Area	Lower Mainland House	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Stocks	Bonds
Lower Mainland House	1.00					
Lower Mainland Condo	0.95	1.00				
Whistler	0.40	0.42	1.00			
Okanagan (Kelowna)	0.72	0.76	0.15	1.00		
Stocks	0.01	-0.02	-0.07	-0.09	1.00	
Bonds	-0.07	-0.14	-0.14	-0.07	0.20	1.00

Notes: Correlations are of total real returns, which include cash flow and capital appreciation using quarterly annualized returns 1985-2005. Stocks are TSE total return. Bonds are Scotia Capital Overall Universe Index for Canadian bonds, appreciation and dividend yield. There is no adjustment for management expense ratio, transactions costs, charges, and taxes, or liquidity premiums.

There is unlikely to be any portfolio benefit for an owner of a Lower Mainland house to add a condo unit in the same market. The correlation between the two is close to perfect and the condo has a substantially lower return. Consequently, the higher return, lower variance of returns Lower Mainland house will almost always be preferred to a Lower Mainland condo in any

portfolio.[9] The extremely low correlation of stocks and bonds with the real estate asset choices suggests that there is a clear margin for improved portfolio performance by combining them in a portfolio, despite the high variance in returns on stocks. The correlations between real estate in different areas of BC are quite intriguing. For instance, Whistler's correlations with the Lower Mainland options are below 0.45 and 0.15 with Kelowna. It is likely that many investors will benefit from having a portfolio that includes a mix of different BC real estate assets.

This report follows the conventional risk-return optimal portfolio methodology. For each possible return, we identify the combination of assets that minimizes the total portfolio variance. This approach generates a range of possible allocations that range from 100 percent investment in the lowest return asset to 100 percent in the highest. Calculating the minimum variance portfolios for each return generates a 'frontier" of minimum variance asset allocations. In Figure 2 we display this set of minimum variance allocations for a portfolio of a Lower Mainland house, stocks, and bonds.

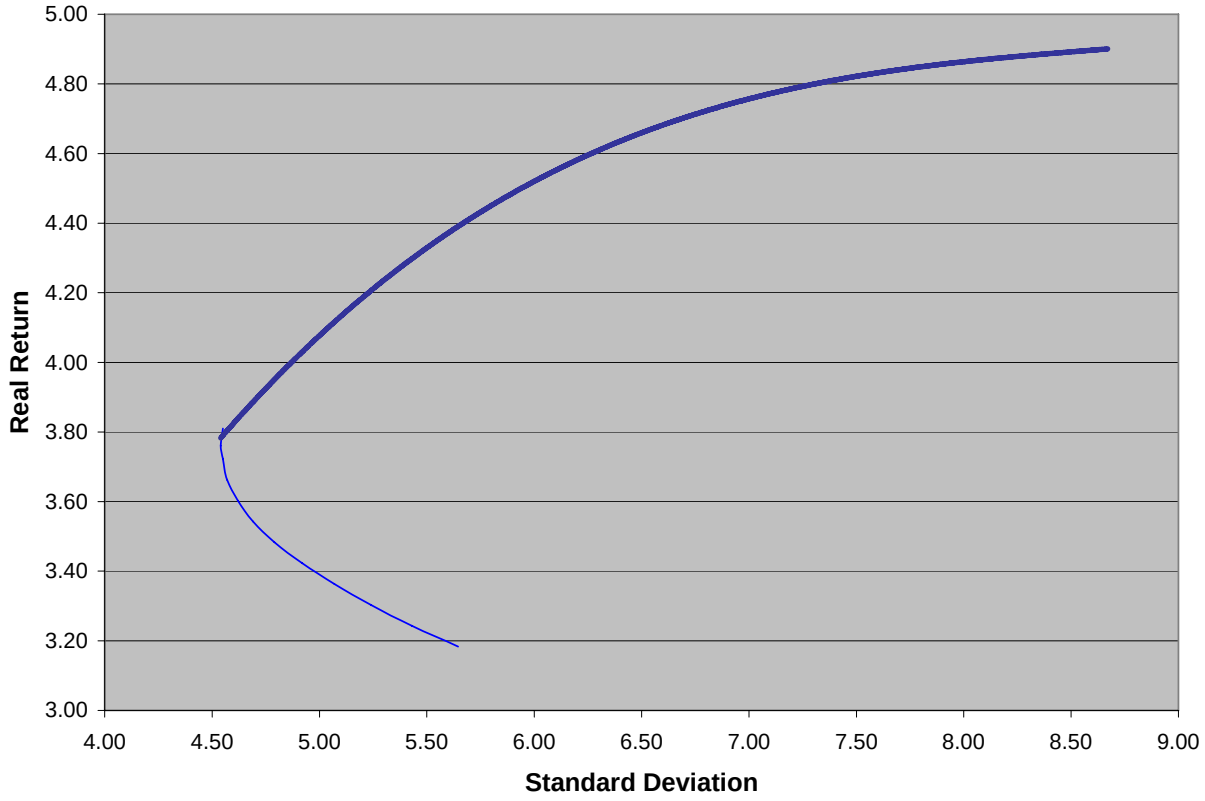
Not all minimum variance portfolios are efficient. For some it is possible to raise the return without changing the risk, i.e. without increasing the standard deviation of the returns in the portfolio. With efficient portfolios the only way the expected portfolio return can be increased is by also increasing the portfolio variance (its risk). In Figure 2 we identify these two different portfolio types. Among the set of minimum variance portfolio allocations, the light segment identifies the set of inefficient portfolios, while the bold segment highlights the set of efficient portfolio allocations.

Among the efficient allocations, which risk-return combination, and thus portfolio, is best or optimal for a given investor depends on the investor's appetite for risk. Those with a low tolerance will select a portfolio at the left end of the set of efficient portfolios (bold segment), with a lower mean return and lower variance of returns. The more risk loving investor will be towards the right end. In the results below we order portfolios as a percentile of the riskiest choice, with 0 describing the lowest risk efficient portfolio, 100 the highest, and 50 the median risk portfolio. One final aspect of note is that by definition the highest return portfolios will have a larger allocation to the highest return, and typically riskiest asset. And in the extreme this weighting will be 100 percent. Consequently, at the right tail of the frontier, portfolio benefits tend to be minor as the weight is allocated disproportionately to the one highest yielding asset. Consequently, the frontier is quite flat as small gains in returns come at the expense of large increases in risk.

The model as used in this paper relies on a number of simplifying, if somewhat unrealistic, assumptions. First, we assume there is no minimum amount needed to invest in real estate, so that any value amount of real estate may be acquired. For example, if the investor has only ten thousand dollars to invest, and the model solves for an optimal portfolio at the preferred level

[9] This analysis ignores the realities of actually purchasing a unit. Investors who own a house in the Lower Mainland, have a limited amount of equity, and are concerned about managing a distant property might well prefer to purchase a Lower Mainland condo unit. Increasing the value of their home by purchasing and moving to a more valuable Lower Mainland house would generate a more favourable return, but there are many financial and non-financial transactions costs to this approach to portfolio balancing that are beyond the scope of this report.

Figure 2 - Minimum Variance Portfolio Combinations



of risk with a 40% weighting in a Lower Mainland house, we assume the investor is able to enter the market and acquire four thousand dollars worth of a Lower Mainland house. For direct ownership this assumption is problematic as a four thousand dollar direct investment in real estate is improbable. Purchasing shares in a real estate investment trust (REIT) would eliminate this problem; however REITs do not have the regional specificity or sufficient performance history in Canada for this study. Second, we assume that financing options are not asset-specific, so the financing terms are the same for all assets. This assumption simplifies the analysis by allowing us to avoid dealing with leverage and the wide range of different financing options available to individuals. However, as mortgages offer favourable terms relative to financing options for the acquisition of financial assets, it is likely to be the case that it is optimal to use a mortgage to free equity to invest in stocks and bonds.[10]

One of the ways that wholly owned privately held real estate differs from equities and bonds traded in public markets is in liquidity, how quickly and easily assets can be bought and sold. Trades of equities can be done almost instantly on-line and for bonds, same day transactions are equally possible. Real estate cannot be traded nearly as quickly. Also, liquidity in real estate varies dramatically over the market cycle, so that in down markets, units can be very hard to sell.

[10] Flavin and Yamashita (2002) and LeBlanc and Lagarenne (2004) demonstrate how including mortgage debt as an asset, one with a negative return, allows individuals to hold more housing and stocks combined than they would otherwise.

Consequently, real estate must earn a higher return than equities and bonds just to be comparable, i.e. to offset the "liquidity premium" of the financial assets. As well, there are differences among real estate markets in liquidity. Generally, real estate assets in larger markets and those with more standardized characteristics are more liquid. Liquidity also tends to be lower and more volatile in vacation markets. Unfortunately there is no clear guide as to what should be the appropriate adjustments for liquidity for the BC real estate assets studied here.[11] We make the following adjustments to reflect liquidity differences, in an attempt to address the issue in some way: Lower Mainland condo, Whistler, and Kelowna returns are lowered by 50, 100, and 150 basis points respectively, but we assume that a Lower Mainland house is sufficiently liquid.

The asset returns used in the portfolio calculations are net of management, operating, and transactions costs. The financial assets are assumed to have no transactions costs, but do have a 75 bp annual management expense cost. For real estate, we include both property transfer tax and a standard MLS realtor commission. The cumulative cost of these transactions charges vary from 4.9 to 5.75 percent of the property value for our assets in 2005, falling in percentage terms with the price of the real estate asset. These are amortized over the holding period, with the real estate return reduced by the annual amortized amount. The longer the holding period, the smaller the effect of the transactions costs on the annual return. In Appendix table A-2 we compare the real returns with and without the liquidity and straight-line amortization of the transaction cost adjustments for the real estate assets. The effects are substantial and important. For instance, they lower the effective real return for Kelowna/Okanagan condominiums from 6.12 to 4.27 percent. Without this adjustment, Kelowna condominiums deliver a higher return at a lower variance than does the Lower Mainland house. With the adjustments, their return is lower.

Results

We provide efficient portfolio weightings for a large number of different portfolios, varying by the set of assets included in the calculation. Weights all total 100 percent. Figure 3 shows the first portfolio, consisting of a Lower Mainland house and the two financial assets. Here, as in all cases we show the 10^{th}, 25^{th}, median, 75^{th}, and 90^{th} percentiles of the risk-return distribution among the efficient portfolios. We find that a Lower Mainland house is part of the efficient portfolios across the range of risk exposure highlighted here. Its share, along with that of equities, increases at the expense of bonds as the investor's tolerance for risk, the uncertainty of returns, increases. In Table 3 we provide the numerical weights. What is striking about these results is just how large the share is for a Lower Mainland house when compared with findings in other research: it has a greater than 50 percent weight for the 60 percent of portfolios with the greatest tolerance for risk. Part of this reflects our more detailed and precise treatment of real estate cash flows as well as an approach that somewhat downplays volatility in real estate. Of greatest effect, though, is that when compared with national data from the US and Canada, and with most cities in North America, Vancouver has experienced rather high and consistent growth over our analysis period.

[11] Fisher, et. al. (2003) estimate a constant liquidity index based on transaction volume for commercial real estate and find that it can have a substantial effect on portfolio allocations.

Figure 3 - Efficient Portfolio Allocations
Portfolio of Lower Mainland House, Stocks, and Bonds

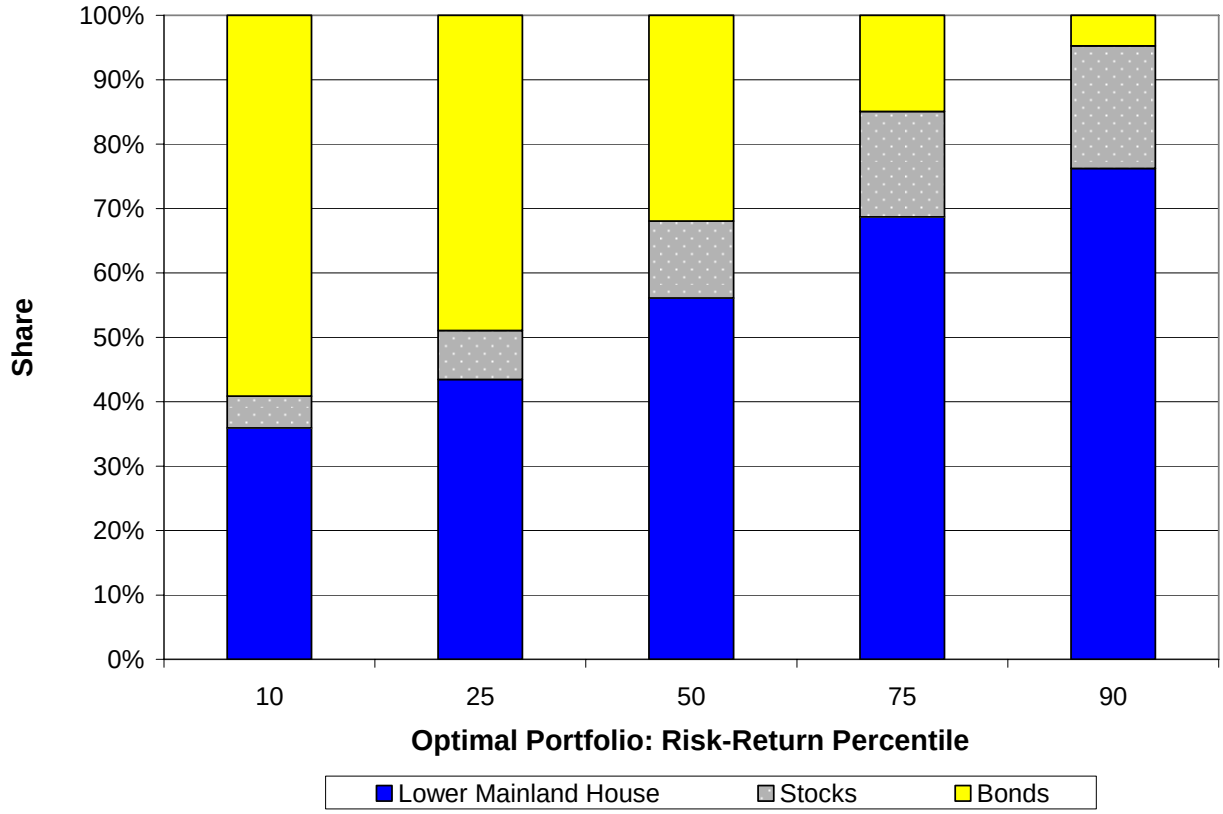


Table 3 - Efficient Portfolio Allocations
Portfolio of Lower Mainland House, Stocks, and Bonds

Percentile	Lower Mainland House	Stocks	Bonds	Annual Real Return	Standard Deviation
10	35.9%	5.0%	59.1%	3.87	4.59
25	43.5%	7.6%	48.9%	4.04	4.82
50	56.1%	12.0%	31.9%	4.33	5.56
75	68.7%	16.4%	15.0%	4.61	6.61
90	76.2%	19.0%	4.8%	4.78	7.33

Notes: Based on quarterly annualized returns 1985-2005, adjusted for inflation using the BC all items CPI. Stocks are TSE total return. Bonds are Scotia Capital Overall Universe Index for Canadian bonds, appreciation and dividend yield. Both assume a 75 basis point management expense ratio. All real estate returns are reduced to account for the holding period average of the broker sales cost at sale and transfer tax. There is no discount for the lower liquidity of the Lower Mainland house.

The portfolio calculations shown in Table 3 are sensitive to our assumptions. Chief among them is whether there is a cost to the lower liquidity of a Lower Mainland house relative to stocks and bonds, and if so, how much. The calculations above assume that the return for a Lower Mainland house is not reduced to reflect their lower liquidity. To demonstrate the importance of this assumption, we re-calculate these allocations, but with the assumption that we need to reduce the return to Lower Mainland houses by 100 basis points per year (one percentage point) to reflect their lower relative liquidity. These new portfolio allocations are shown below in Table 4. The share for the Lower Mainland house is essentially unchanged for the lower risk and median risk allocations, but the portfolio allocations have a slightly lower average return and higher risk. The effects are most dramatic for the higher return - higher risk portfolios, where equities replace housing. This is because with the adjustment, the real return for real estate net of transaction costs declines from 4.9 to 3.9 percent, making it lower than the 4.7 percent it is for stocks. Consequently, stocks make up a much larger share of the high return portfolios. For the 90th percentile portfolio, the share for stocks rises from 19 to 85 percent the return, almost entirely at the expense of the share for Lower Mainland houses. This reallocation and decline in the real estate return slightly lowers the overall portfolio real return for this allocation, from 4.8 to 4.6 percent, and nearly doubles the risk (the standard deviation in returns increases from 7.3 to 13.9 percent). For the remainder of this paper we retain the original assumption that the real returns for Lower Mainland houses do not need to be discounted to account for their lower liquidity, but we will discount the other less liquid types of real estate.

Table 4 - Efficient Portfolios - With Vancouver House Illiquidity Discount
Portfolio of Vancouver House, Stocks, and Bonds

Percentile	Lower Mainland House	Stocks	Bonds	Annual Real Return	Standard Deviation
10	36.6%	9.4%	54.1%	3.58	4.71
25	44.7%	17.9%	37.3%	3.78	5.42
50	58.4%	32.2%	32.2%	4.09	7.37
75	37.9%	62.1%	0.0%	4.40	10.64
90	15.2%	84.8%	0.0%	4.60	13.87

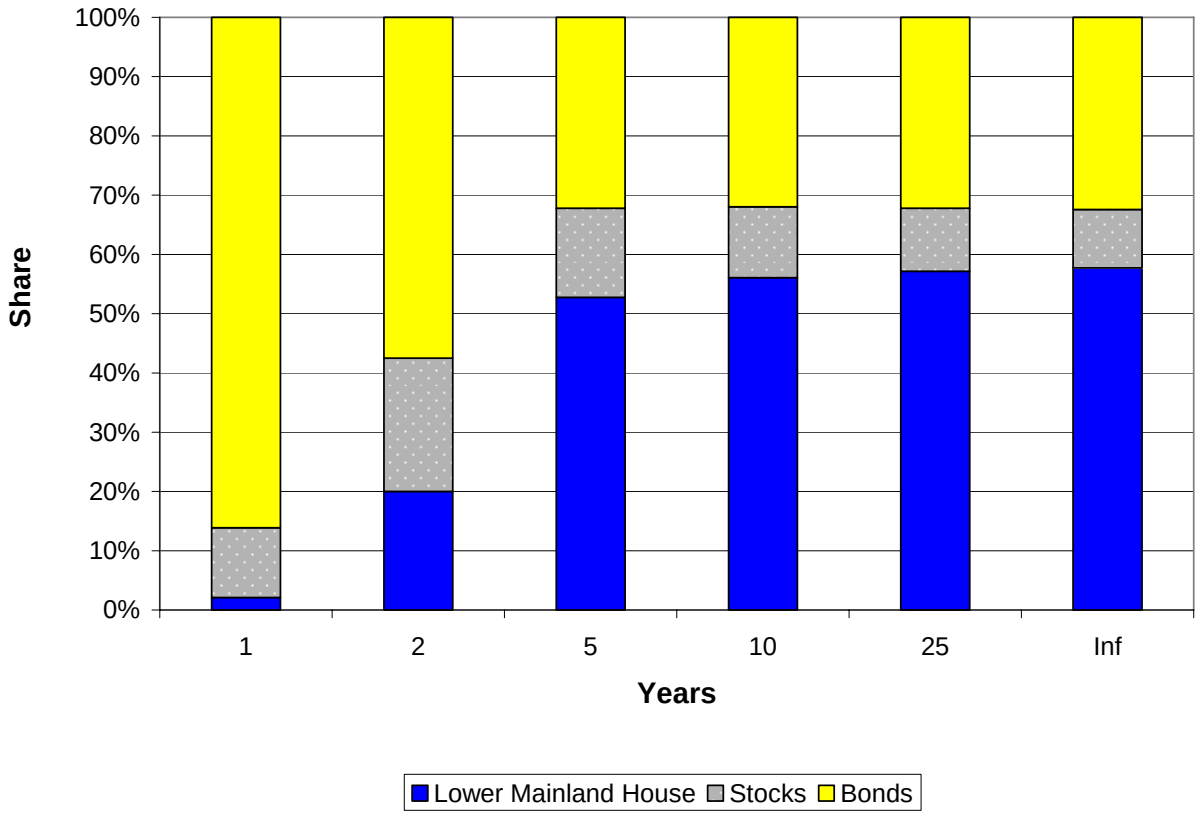
Notes: Based on quarterly annualized returns 1985-2005, adjusted for inflation using the BC all items CPI. Stocks are TSE total return. Bonds are Scotia Capital Overall Universe Index for Canadian bonds, appreciation and dividend yield. Both assume a 75 basis point management expense ratio. All real estate returns are reduced to account for the holding period average of the broker sales cost at sale and transfer tax. We reduce the annual return for the Lower Mainland house by 100 bp to account for its lower liquidity.

The other important assumption we make is in regards to the holding period for the asset. This matters for the statistical properties of the data and for assumptions about transactions costs.[12]

[12] Stock and bond returns are well approximated as a random walk. For a random walk, the variance for a holding period is the quarterly variance multiplied by the holding period. Thus the solution (estimated weights) to the optimal portfolio problem will be unchanged as holding period varies. In contrast, housing returns estimated from price indexes have strong positive autocorrelation. As the holding period lengthens, the annualized or periodic variance in returns will tend to increase. Working against this is that the idiosyncratic variance in the sales price for

As noted above, transaction costs for real estate, property transfer taxes and agent's commission are quite large, with an aggregate cost of approximately 5 percent of property value. This cost has to be amortized over the holding period of the asset, so that the effect on returns depends on this period, reducing the return by approximately 5 percent if the asset is held for one year and by less than 0.1 percent if the asset is held for over twenty years. For stocks and bonds there is no transaction cost, just an ongoing annual management fee, so the annual return is not affected by the holding period. Below in Figure 4 we show how the assumption about holding period effects asset allocations (the numerical allocations can be found in Appendix Table A-3). The allocations are for the median risk portfolio for the three assets used above.[13] For a one year holding period, transaction costs make it unwise to hold real estate, as the allocation is below 3 percent. For a holding period of 5 years the allocation to real estate rises above 50 percent. Once the holding period is 10 years, the effect of holding period is statistically insignificant, as it approaches the 58 percent that would be optimal even if there were no transactions costs.

Figure 4 - Effects of Holding Period - Median Risk Efficient Portfolio Allocation Portfolio of Lower Mainland House, Stocks, and Bonds

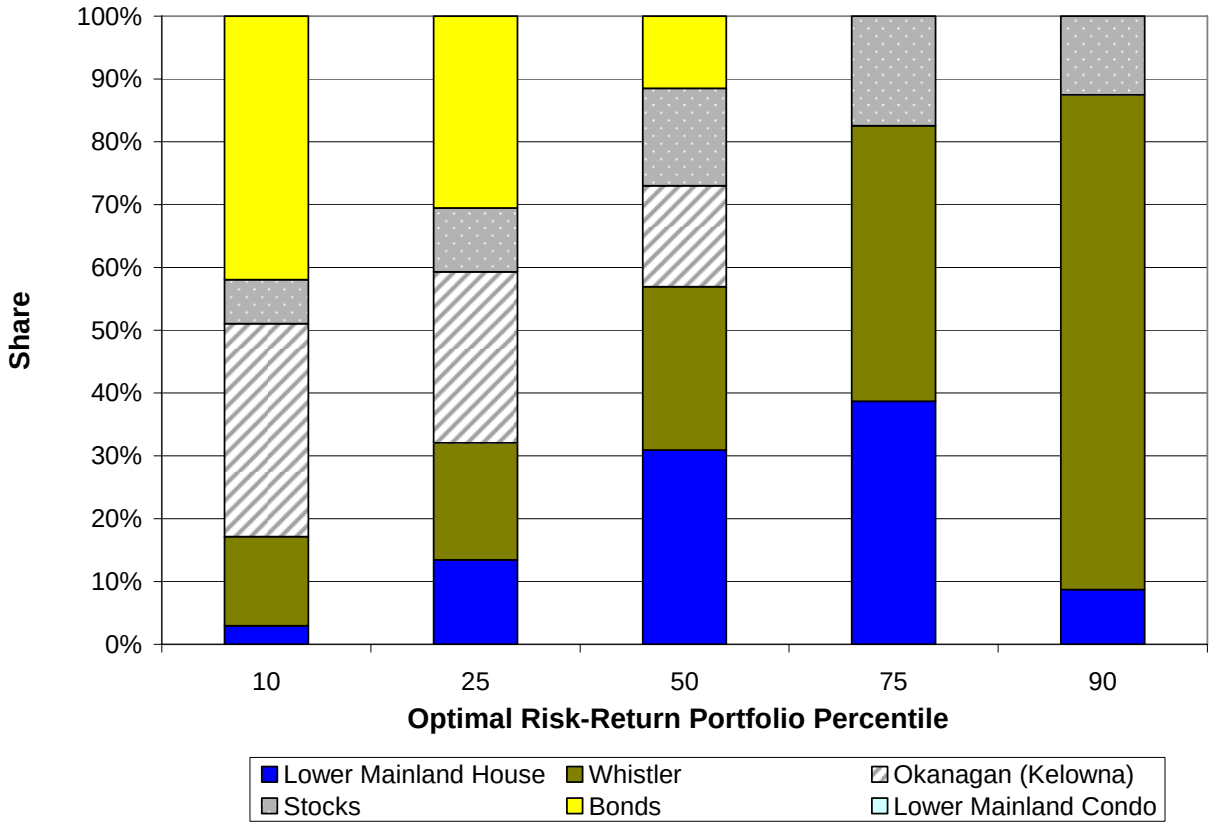


an individual house will be reduced on an annualized basis as the number of years over which this variation is amortized. Goetzmann (1993) finds that there are two effects of holding period on the optimal portfolio allocation that includes housing that tend to offset one another

[13] The risk and return for each of these portfolios differ across holding periods because of the effect on the return to real estate of the amortized transaction costs.

For the next portfolio, we expand the set of BC real estate assets to include Lower Mainland, Whistler, and Kelowna condominium units. The efficient allocations are presented below in Figure 5 and Table 5. As the descriptive statistics in Tables 1 and 2 suggest, once a Lower Mainland house is in the portfolio, it is not efficient to add a Lower Mainland condo to the portfolio.[14] However, adding in other BC real estate assets to the universe of potential investments leads to a substantial increase in BC real estate's share of the portfolio: the BC share is 73 percent of the median risk portfolio. Kelowna/Okanagan and Whistler condominium units form an important part of an optimal portfolio, with the Okanagan more important for lower risk tolerance investors and Whistler for those with more appetite for risk.

Figure 5 - Efficient Portfolio Allocations
Portfolio of BC Real Estate, Stocks, and Bonds



The inclusion of the other BC real estate options does not come equally at the expense of all of the other assets. Comparing Tables 3 and 5, the share allocated to bonds for the two lowest risk

[14] This comes with a number of important caveats that relate to the methodological approach used here. If an investor's capital is limited, real estate must be purchased in whole units, and there is a need to take a direct role in the property, then a local condo may be the only way effectively to invest in real estate beyond one's principal residence.

preferences declines by approximately 18 percentage points. In contrast, the effect on stocks is smaller and varied. The allocation actually rises by 1 to 3 percentage points for all but the highest risk allocation, and declines 6.4 percentage points for the high risk allocation. Not surprisingly, the largest effect is on the share allocated to the Lower Mainland house, as the correlations among BC real estate asset returns are higher than they are between any of them and the financial assets. For the highest risk category, the share allocated to the Lower Mainland house declines from 76 to 9 percent, as the Whistler's higher return, albeit at a much higher risk, is preferred by those with a very high tolerance for risk. For the other risk categories, the decline in the share allocated to the Lower Mainland house remains large, but smaller, ranging in magnitude between 25 and 33 percentage points. The clear message is that there is a very important place for BC real estate in a diversified portfolio. Ideally, this would comprise of real estate in different local markets within the province, with the relative shares depending on investor preferences.[15]

Table 5 - Efficient Portfolio Allocations
Portfolio of British Columbia Real Estate, Stocks, and Bonds

Percentile	Lower Mainland House	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Stocks	Bonds	Annual Real Return	Standard Deviation
10	3.0%	0.0%	14.2%	33.9%	7.0%	41.9%	3.99	4.08
25	13.4%	0.0%	18.6%	27.2%	10.2%	30.5%	4.27	4.66
50	30.9%	0.0%	26.0%	16.1%	15.5%	11.5%	4.74	6.19
75	38.7%	0.0%	43.9%	0.0%	17.4%	0.0%	5.21	8.23
90	8.7%	0.0%	78.7%	0.0%	12.6%	0.0%	5.49	10.96

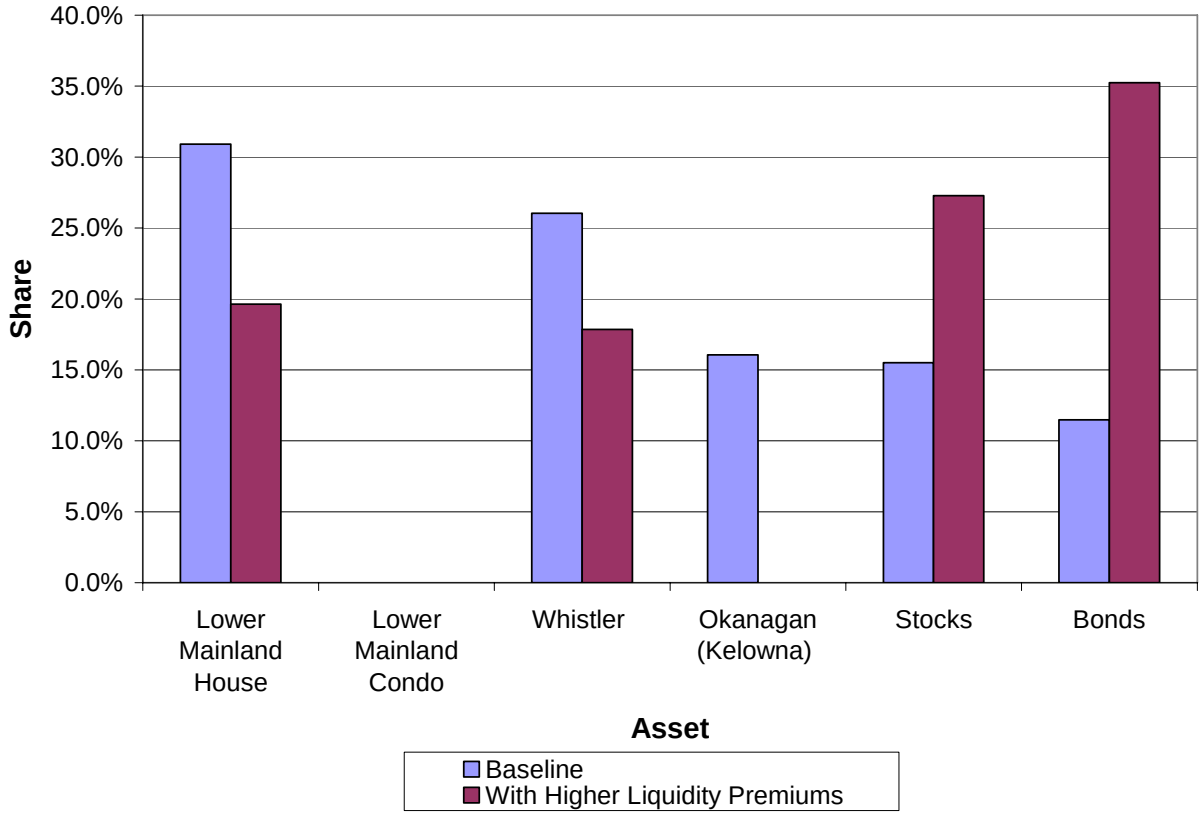
Notes: Based on quarterly annualized returns 1985-2005, adjusted for inflation using the BC all items CPI. Stocks are TSE total return. Bonds are Scotia Capital Overall Universe Index for Canadian bonds, appreciation and dividend yield. Both assume a 75 basis point management expense ratio. All real estate returns are reduced to account for the holding period average of the broker sales cost at sale and transfer tax. Lower Mainland condo, Whistler, and Kelowna returns are lowered by 50, 100, and 150 basis points respectively to account for the greater liquidity of the other assets.

Just as we did in Table 4 above, we test the sensitivity of these findings to changes in the assumption about the effect of liquidity. In Figure 5 and Table 5, we do not discount the return for the Lower Mainland house, but we lower returns for the Lower Mainland condo, Whistler, and Kelowna real estate assets by 50, 100, and 150 basis points respectively, to account for their lower relative liquidity. To determine how sensitive our findings are to these results, we re-estimate the optimal median risk portfolio with larger discounts of 150, 200, 300, and 400 basis pints for the Lower Mainland house, and the Lower Mainland, Whistler, and Kelowna condos, respectively. An advantage of doing this comparison is that will provide weightings that would be more appropriate for an investor with a strong preference for liquidity. We present the effects

[15] We have chosen larger faster growing markets. It is unlikely that real estate in those areas of BC that have experienced lower levels of economic or population growth would find a place in these portfolio allocations.

of the assumption about the liquidity premiums below in Figure 6 for the median risk portfolio (the actual allocations are shown in Appendix Table A-4).

Figure 6 - Effect of Liquidity Premiums
(Based on Median Risk-Return Portfolio)



The effects of a higher discount for the illiquidity of real estate are quite striking. The overall share allocated to BC real estate assets is halved from 73 to percent to 37 percent. The effect of the 400 basis point discount for Kelowna/Okanagan removes this real estate from the optimal median portfolio, though it does remain in the lower risk portfolios shown in Appendix Table A-4. There is a market price for illiquidity, but the absence of appropriate data makes it difficult to identify this for real estate assets. Each investor will have a different preference for liquidity and thus need to make a different adjustment to the allocations presented here. As a basic principal, the more important liquidity is to an investor the less attractive wholly owned real estate will be, and the less attractive will be real estate in smaller markets, vacation real estate, and unusual or atypical properties. The investor who wants to achieve some real estate portfolio benefits while retaining high liquidity would be best off investing in securitized real estate instruments such as REITs, though it is impossible to invest solely in BC real estate through them.

In the Appendix we provide a number of tables that examine a number of different portfolio allocations. Appendix Table A-5 presents allocations under the assumption that 50 percent of an investor's wealth is already in their own home in the Lower Mainland. In the results in this table the efficient allocations are constrained so that at least 50 percent of an investor's portfolio must be in the Lower Mainland house. Appendix Table A-6 presents the allocations where the assets are limited to BC real estate only. In Appendix Table A-7 we limit the analysis to strata or condominiums, which are more often used as a vehicle for investing in residential real estate.

Conclusions

This report highlights the valuable place BC real estate can hold in an investor's portfolio. Among the more important results is the demonstration of the benefit of having real estate investments in different areas of BC. The findings here are a function of the mix of assets we choose to use in the analysis and the time period of the study. Different assets and periods may lead to substantially different results. As well, the portfolio allocations are sensitive to the assumptions that we impose, particularly regarding the "cost" of real estate's lower liquidity, relative to stocks and bonds.

There is one final caveat about this analysis, and that relates to what investors can actually purchase. While it is possible to invest in stocks and bonds in small monetary increments, this is more difficult to do with wholly owned real estate. For an investor with limited capital, a Lower Mainland house or Whistler condo may simply not be a feasible investment. If an investor lives in the Lower Mainland and chooses to manage the portfolio themselves, a Lower Mainland condo may indeed be part of an efficient portfolio, once the set of constraints they face is factored into the analysis. However, this level of detail in the set of constraints imposed on the investor is beyond the terms of reference for this study.

References

Brueckner, Jan K., Consumption and Investment Motives and the Portfolio: Choices of Homeowners, *Journal of Real Estate Finance and Economics*, 15 (2), 1997, 159-80.

Calhoun, C., OFHEO House Price Indexes: HPI Technical Description, Washington, D.C.: OFHEO, March 1996.

Cauley, Stephen D., Pavlov, Andrey D., and Eduardo S. Schwartz, Homeownership as a Constraint on Asset Allocation, Anderson Graduate School of Management Working Paper, 2005.

Cocco, Joao F., Portfolio Choice in the Presence of Housing, *The Review of Financial Studies*, 18 (2), 2004, 535-65.

Crone, Theodore M. and Richard P. Voith, Risk and Return within the Single-Family Housing Market, *Real Estate Economics*, 27 (1), 1999, 63-78.

Englund, Peter, Hwang, Min, and John Quigley, Hedging Housing Risk, *Journal of Real Estate Finance and Economics*, 24 (1/2), 2004, 167-200.

Fisher, Jeffrey, Gatzlaff, Dean, Geltner, David and Donald Haurin, Controlling for the Impact of Variable Liquidity in Commercial Real Estate Price Indices, *Real Estate Economics*, 31 (2), 2003, 269-303.

Flavin, Marjorie and Takashi Yamashita, Owner Occupied Housing and the Consumption of Household Portfolio, *American Economic Review* 92 (1), 2002, 345-362.

Gat, Daniel, Risk and Return in Residential Spatial Markets: An Empiric and Theoretic Model, *Journal of Real Estate Finance and Economics*, 9 (1), 1994, 51-67.

Goetzmann, William N., The Single Family Home in the Investment Portfolio, *Journal of Real Estate Finance and Economics*, 6 (3), 1993, 201-222.

Goodman, Jack, Homeownership and Investment in Real Estate Stocks, *Journal of Real Estate Portfolio Management*, 9 (2), 2003, 93-105.

Jud, G. Donald, Wingler, Tony R., and Daniel T. Winkler, Single-Family Housing and Wealth Portfolios, *Journal of Real Estate Portfolio Management*, 12 (1), 2006, 13-22.

Appendix

House Price Index Construction

Generating house price indexes raises statistical challenges because the houses sold in any period vary dramatically in the value of their locations and their structure characteristics. At any time and over the market cycle the changes in the composition of houses sold will cause measures such as median or average house prices to deviate from a "true" measure of the market price of housing. Measures that do not suffer from "composition-bias" are referred to as constant quality price indexes. Two main approaches are used to measure the change in constant quality house prices over time: hedonic pricing and repeat sales. This paper uses the repeat sales methodology, which uses the change in house prices between two sales of the same unit to identify the changes in market prices.[16] Because the housing unit is held constant, the change in prices is interpreted as a pure effect, not contaminated by changes in the composition of housing sold, as could be the case for an average or median price. This methodology is considered to be the most likely to generate price indexes that accurately describe changes in market prices.

The accuracy of the repeat sales method depends on several strong assumptions. First, that there is no change in the house's structure characteristics between sales. We know this to be erroneous given the extent of home renovations. Second, that there are no differences in rates of house price appreciation within the geography. Since this study uses several large areas, Okanagan, Lower Mainland, this assumption is unlikely to hold. Third, because only units that sell at least twice within the study period are included, excluding other houses should not compromise the results. We recognize that these assumptions do not fully hold, but the repeat sales method remains the best choice among the alternatives. However, it does mean that the results are only as good as the estimates, and different data will yield different results, though we remain confident that different data for the same time period would generate similar results.

Our choice of data and approach does result in certain kinds of bias in the results. Using a house price index to measure returns to individual homeowners underestimates the volatility for any individual house. The repeat sales index we use is in its basic form a weighted average of the price changes of individual houses. Like any average, the variance of its changes, i.e. the variance of the market rate of house price appreciation, is less than that of changes in the return experienced by individual owners. The purchase and sales price of an individual home reflects both the micro-market supply and demand for the unique mix of timing, house structure characteristics, quality, and location at the time a unit is put up for sale and the bargaining and negotiating strengths of the parties to the sale. Analysis by Calhoun (1996) and Englund, Hwang, and Quigley (2002) suggest that using national US data, the variance of individual house returns is two percentage points above that of the aggregated price index. However, the effect on the average annual return is sensitive to the holding period. As the holding period for a real asset lengthens, the years over which this bias is amortized increases, lowering its impact on the average return to real estate.

[16] The hedonic approach requires detailed information on house characteristics that we do not have for all periods of this study.

Our data are the universe of transactions in the Lower Mainland, Whistler, and the Kelowna/Okanagan BC Assessment Authority area. To eliminate units that are flipped, and thus likely to have a renovation, we exclude units that are purchased and then re-sold within one year. For strata/condominium units, we only include units with one or two bedrooms. For houses we only include those with three or four bedrooms. We use all transactions between 1978 and 2005, but because repeat sales estimators have high variances in the first years, our actual analysis is done on results from 1985 to 2005. This has the additional benefit of allowing us to exclude the extremely unusual housing price bubble that occurred 1981-82.

Net Rental Income Calculations

The calculation of net rental income is somewhat more complicated. For Vancouver and the Okanagan we use the 2003 Canada Mortgage and Housing Corporation (CMHC) rental report to supply estimated rents for 2 bedroom condos separately for the Lower Mainland (Vancouver CMA), Downtown Vancouver (West End), and Kelowna.[17] These values are reduced each year by the CMHC estimated vacancy rate for that year. To account for unexpected turnover, we make a 2.7% deduction to rental income to allow for losing one months rent every three years from tenant replacement. Rental income is adjusted over time using the rented accommodation sub index series of the consumer price index (CPI). When ever possible, we use a Vancouver specific CPI index for the Lower Mainland and a rest of BC index for Kelowna and Whistler.[18] When a Vancouver specific index is unavailable, we use the all BC index instead for all jurisdictions. Maintenance is estimated at 10 percent of revenues based on a survey of property managers for 2005. The calculated value for 2005 is adjusted over time using the home maintenance and repairs sub-index of the CPI. The same 10 percent was recommended for property management fees, which are adjusted over time using the all items, CPI. Property tax values are based on actual mill rates (2003 for Kelowna and 2004 for the Lower Mainland) both adjusted by the CPI, property tax sub-index. For utilities, discussions with property managers suggest that $300 per month is a reasonable estimate for 2005. We then adjusted this value over time using the utilities sub-index of the CPI.

Our approach for Whistler is different because the revenue depends on tourism rather than long-term occupants. From a consulting report on Whistler, we were able to generate revenue estimates for 2001. Discussions with Whistler realtors provided estimates for management expenses at 37.5 percent of revenues. We used the same estimates for Whistler for maintenance and utilities as for Kelowna and the Lower Mainland. Costs are indexed using the same price indexes as for Kelowna. However, revenues are indexed over time using estimated revenue per available room (RevPAR) as provided by Tourism Whistler.

[17] *2003 Vancouver Rental Market Report* and *2003 Kelowna Rental Market Report*, Ottawa: Canada Mortgage and Housing Corporation.

[18] We estimate this rest of BC index by extracting the Vancouver component from the BC index values using the relative populations of the province and the Vancouver CMA as weights.

Appendix Table A-1 - Real Returns: Annual Total Inflation Adjusted Returns

Quarter:Year	Lower Mainland House	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Stocks	Bonds
Q185	-5.68%	-7.69%	-28.31%	-7.40%	4.18%	6.22%
Q285	-5.78%	-8.57%	-18.41%	-5.48%	16.38%	10.18%
Q385	-2.79%	-3.89%	-3.07%	-1.18%	16.31%	21.39%
Q485	1.30%	-2.31%	9.93%	5.37%	15.16%	12.17%
Q186	0.74%	-0.36%	25.97%	6.69%	8.75%	11.80%
Q286	3.28%	1.86%	10.63%	7.71%	12.06%	15.86%
Q386	3.53%	1.06%	6.46%	4.84%	4.79%	8.28%
Q486	2.43%	1.88%	-1.77%	3.43%	4.80%	9.00%
Q187	4.91%	1.18%	-0.66%	6.19%	17.62%	4.42%
Q287	7.23%	2.96%	7.32%	6.31%	15.78%	3.77%
Q387	7.03%	5.87%	7.05%	7.19%	29.70%	0.73%
Q487	7.03%	5.06%	4.90%	6.39%	-4.75%	-5.95%
Q188	7.13%	2.99%	2.72%	5.24%	-14.82%	-4.51%
Q288	9.26%	1.91%	7.76%	3.42%	-14.89%	-3.54%
Q388	12.94%	3.93%	10.84%	4.32%	-21.59%	0.96%
Q488	15.33%	8.03%	19.07%	3.52%	6.50%	7.17%
Q189	21.50%	16.93%	16.60%	7.30%	8.16%	2.09%
Q289	27.02%	25.31%	18.53%	5.80%	5.33%	-2.97%
Q389	21.37%	19.68%	22.17%	9.87%	14.35%	2.06%
Q489	25.99%	21.50%	28.00%	12.90%	11.17%	0.67%
Q190	29.35%	22.04%	46.84%	16.40%	-4.82%	2.74%
Q290	16.00%	13.02%	24.21%	23.77%	-12.38%	-2.30%
Q390	7.41%	7.56%	10.67%	18.82%	-21.91%	-5.02%
Q490	-3.35%	-1.32%	7.10%	12.22%	-26.93%	-5.29%
Q191	-18.99%	-16.33%	-32.03%	-0.34%	-16.54%	-6.33%
Q291	-11.49%	-12.85%	-11.80%	-1.84%	-7.72%	6.23%
Q391	1.14%	-4.04%	-13.88%	2.91%	-2.46%	2.99%
Q491	7.20%	0.28%	-17.33%	10.08%	6.98%	11.52%
Q192	16.33%	10.90%	1.47%	19.22%	3.98%	15.61%
Q292	11.23%	6.61%	-10.87%	17.47%	-3.56%	7.33%
Q392	8.42%	4.55%	-5.64%	15.11%	-3.66%	12.35%
Q492	8.67%	4.15%	-7.67%	11.06%	-7.25%	6.81%
Q193	9.92%	3.50%	-8.01%	10.75%	-4.77%	2.29%
Q293	12.38%	3.21%	-2.98%	6.76%	13.60%	8.40%
Q393	11.28%	1.59%	-1.34%	4.99%	17.56%	5.05%
Q493	7.20%	0.90%	-2.33%	5.41%	26.66%	5.95%
Q194	5.20%	0.36%	4.03%	1.77%	29.38%	12.78%
Q294	4.25%	1.73%	1.31%	4.46%	9.24%	5.17%
Q394	3.28%	0.54%	4.85%	0.06%	6.93%	-2.39%
Q494	5.35%	0.96%	5.59%	-1.31%	-0.95%	-0.74%
Q195	1.79%	-3.50%	2.62%	-0.27%	-8.61%	-7.91%
Q295	-1.70%	-5.58%	6.07%	-3.43%	2.19%	0.14%
Q395	-4.17%	-6.12%	9.31%	-2.12%	3.95%	10.55%
Q495	-4.08%	-5.76%	13.09%	-0.16%	8.91%	8.85%

Appendix Table A-1 - Real Returns: Continued

Quarter:Year	Lower Mainland House	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Stocks	Bonds
Q196	-2.24%	-2.96%	14.36%	1.39%	19.55%	15.52%
Q296	-1.60%	-1.57%	17.51%	-0.15%	16.55%	9.84%
Q396	2.07%	-0.06%	16.87%	3.35%	12.95%	6.61%
Q496	1.22%	0.00%	14.99%	2.55%	26.61%	6.75%
Q197	4.31%	1.42%	18.69%	3.98%	21.51%	6.89%
Q297	3.18%	0.29%	17.44%	4.92%	21.62%	7.47%
Q397	2.37%	2.10%	14.97%	3.71%	33.52%	9.12%
Q497	2.19%	0.78%	9.43%	4.04%	15.04%	9.99%
Q198	0.59%	0.26%	4.56%	5.11%	18.79%	6.65%
Q298	-1.35%	-1.75%	4.63%	3.34%	20.97%	10.04%
Q398	-1.98%	-3.48%	-1.04%	3.22%	-11.61%	8.21%
Q498	-1.77%	-3.35%	-0.61%	4.51%	-4.80%	5.77%
Q199	-1.36%	-4.27%	4.33%	0.67%	-7.92%	6.08%
Q299	-1.34%	-3.91%	-0.77%	4.66%	-8.72%	3.04%
Q399	-2.33%	-3.96%	4.45%	2.55%	14.00%	-0.97%
Q499	-0.97%	-2.66%	9.94%	1.93%	19.55%	-3.01%
Q100	0.25%	-1.86%	16.20%	4.95%	35.46%	-6.08%
Q200	1.56%	-1.32%	14.37%	2.60%	35.57%	-3.64%
Q300	0.32%	-2.85%	15.52%	1.52%	49.74%	-1.47%
Q400	-1.67%	-5.97%	13.77%	1.00%	13.78%	-0.66%
Q101	2.26%	-2.32%	16.35%	1.65%	-10.63%	4.70%
Q201	0.20%	-3.82%	12.41%	0.45%	-21.99%	1.14%
Q301	1.97%	1.04%	11.60%	2.91%	-35.10%	0.09%
Q401	6.19%	6.96%	13.52%	5.84%	-19.77%	5.53%
Q102	4.86%	6.54%	11.87%	1.41%	-9.99%	2.30%
Q202	7.78%	10.13%	21.04%	5.95%	-7.56%	0.83%
Q302	9.84%	9.40%	33.79%	7.10%	-14.31%	3.08%
Q402	5.81%	5.95%	39.46%	5.74%	-17.16%	-0.75%
Q103	5.75%	4.98%	29.36%	9.97%	-21.83%	-0.39%
Q203	9.16%	7.44%	24.97%	10.21%	-11.80%	2.54%
Q303	8.84%	8.05%	9.31%	10.93%	12.68%	5.42%
Q403	13.56%	11.55%	4.95%	15.36%	21.51%	3.26%
Q104	17.24%	14.81%	7.60%	18.78%	33.55%	2.84%
Q204	17.64%	15.48%	0.28%	20.70%	20.77%	4.46%
Q304	17.90%	16.23%	-2.61%	23.07%	13.06%	-1.92%
Q404	11.33%	13.48%	-0.73%	14.51%	11.38%	-1.27%
Q105	8.46%	11.75%	-13.25%	13.58%	7.54%	-0.51%
Q205	4.91%	8.25%	-11.02%	9.75%	13.47%	0.44%
Mean	5.38%	2.86%	7.16%	6.12%	5.47%	3.93%
Std Dev	8.21%	7.71%	13.50%	6.34%	16.69%	5.86%

Appendix Table A-2– Liquidity Discounts, Transfer Tax, and Realtor Fees

Area	Unadjusted Real Return	Liquidity Discount (percentage points)	Amortized Transfer Tax	Amortized Realtor Fee	Total Net Real Return
Lower Mainland House	5.38%	0.00%	0.16%	0.33%	4.89%
Lower Mainland Condo	2.86%	0.50%	0.14%	0.39%	1.83%
Whistler	7.16%	1.00%	0.17%	0.32%	5.67%
Okanagan (Kelowna)	6.12%	1.50%	0.10%	0.25%	4.27%

Appendix Table A-3 – Effect of Holding Period
Portfolio of Lower Mainland House, TSE & Bonds

Holding Period (years)	Lower Mainland House	Stocks	Bonds	Real Return	Std Dev
1	2.1%	11.8%	86.1%	3.22	5.56
2	20.0%	22.5%	57.5%	3.39	5.56
5	52.8%	15.0%	32.2%	3.96	5.56
10	56.1%	12.0%	31.9%	4.24	5.56
25	57.2%	10.6%	32.2%	4.40	5.56
Infinite	57.7%	9.9%	32.4%	4.52	5.56

Notes: Maximizes return for the standard deviation of the optimal 50th percentile portfolio for the 10 year holding period as holding periods are allowed to change.

Appendix Table A-4 – Efficient Portfolio Allocations with Higher Liquidity Premiums
Portfolio of British Columbia Real Estate, Stocks & Bonds

Percentile	Lower Mainland House	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Stocks	Bonds	Annual Real Return	Std Dev
10	5.6%	0.0%	10.3%	23.7%	5.3%	55.1%	2.94	4.00
25	17.1%	0.0%	10.2%	7.9%	6.3%	58.5%	3.24	4.26
50	19.6%	0.0%	17.8%	0.0%	27.3%	35.2%	3.73	5.99
75	14.4%	0.0%	28.9%	0.0%	56.6%	0.0%	4.23	10.04
90	0.0%	0.0%	18.9%	0.0%	81.1%	0.0%	4.53	13.26

Notes: Lower Mainland house, condo, Whistler, and Kelowna returns are lowered by 150, 200, 300, and 400 basis points, respectively, to account for the greater liquidity of the financial assets.

Appendix Table A-5 - Constrained Efficient Portfolio Allocations
Minimum 50% in Lower Mainland House
Portfolio of British Columbia Real Estate, Stocks & Bonds

Percentile	Lower Mainland House	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Stocks	Bonds	Annual Real Return	Std Dev
10	50.0%	0.0%	3.6%	0.0%	4.1%	42.3%	4.18	5.06
25	50.0%	0.0%	9.4%	0.6%	6.7%	33.4%	4.37	5.34
50	50.0%	0.0%	16.9%	6.8%	10.5%	15.8%	4.67	6.14
75	50.0%	0.0%	25.9%	10.2%	13.9%	0.0%	4.98	7.23
90	50.0%	0.0%	39.8%	0.0%	10.2%	0.0%	7.72	8.22

Appendix Table A-6 - Efficient Portfolio Allocations
Portfolio of British Columbia Real Estate Only

Percentile	Lower Mainland House	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Annual Real Return	Std Dev
10	7.9%	0.0%	21.6%	70.5%	4.46	6.50
25	23.8%	0.0%	25.7%	50.5%	4.67	6.88
50	50.2%	0.0%	32.7%	17.2%	5.00	7.97
75	42.9%	0.0%	57.1%	0.0%	5.34	9.77
90	17.2%	0.0%	82.8%	0.0%	5.54	11.80

Appendix Table A-7 - Efficient Portfolio Allocations
Portfolio of "Investment" BC Real Estate Only, Stocks & Bonds

Percentile	Lower Mainland Condo	Whistler	Okanagan (Kelowna)	Stocks	Bonds	Annual Real Return	Std Dev
10	0.0%	12.9%	35.8%	6.1%	45.3%	3.91	3.99
25	0.0%	21.0%	38.4%	10.7%	30.0%	4.20	4.53
50	0.0%	34.4%	42.6%	18.4%	4.5%	4.69	6.27
75	0.0%	59.9%	16.3%	23.8%	0.0%	5.18	8.87
90	0.0%	79.3%	0.0%	20.7%	0.0%	5.48	10.96

Notes for all Appendix tables.
Based on quarterly annualized returns 1985-2005, adjusted for inflation using the BC all items CPI. Stocks are TSE total return. Bonds are Scotia Capital Overall Universe Index for Canadian bonds, appreciation and dividend yield. Both assume a 75 basis point management expense ratio. All real estate returns are reduced to account for the 10 year holding period average of the broker sales cost at sale and transfer tax. In Tables A-4, A-5, and A-6Lower Mainland condo, Whistler, and Kelowna returns are lowered by 50, 100, and 150 basis points respectively to account for the greater liquidity of the financial assets.